Conceptual and Semantic Knowledge in Language Production

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Volume II

FORMAL-CONCEPTUAL AND LEXICO-SEMANTIC REPRESENTATIONS: DIFFERENCES AND TRANSITION PROCESSES

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Abstract

This paper is motivated by the insight that automated natural language generation is facing serious problems due to discrepancies that typically exist between formal-conceptual representations originating databases or knowledge bases, and lexico-semantic representations, from which natural language surface expressions can be produced conveniently. First, the principal differences between formal-conceptual and lexico-semantic representations are elaborated, which manifest themselves in terms of granularity, distribution of information content and degree of explicitness. The main part of this paper is devoted to an overview of a two-staged transition process to express formal-conceptual representations in lexical terms. This method comprises a terminological transformation process and pattern-oriented mapping schemata. Application of these devices enables a system to generate natural language expressions from conceptual specifications in a larger variety and in structurally different ways, in comparison to similar methods.

1. Representation purposes for natural language processing

In the design of most integrated natural language systems there seems to be a crucial gap, which has yet attracted serious attention very rarely: the natural ontological differences between the predicates found in formal representations of natural language expressions and the predicates used to denote elements of a knowledge base or database. A closer examination makes it clear that the representation of information content is often organized in a fundamentally different way in the paradigms compared, i. e., in conceptual information processing and in natural language processing. There are structural and terminological discrepancies between predicate formulas easily derivable from a syntactic analysis or suitable for syntactic generation (which are oriented on lexical representations) and predicate formulas needed for manipulating a knowledge base or accessing a database (which are oriented on conceptual representations).

On the lexical representation level, items are organized according to their syntactic function, and the representations are structured rather simply (although complex nestings are built to represent comparably long utterances). Typically, representation structures are recursively composed of attribute-value pairs, which describe various syntactic properties, grammatical functions, and lexical predicates. The associated meanings, however, may appear in a rich variety of forms. The degree of detail and explicitness used to express certain facts may differ quite significantly among alternative expressions. The potential for this variety is based on numerous facets of default expectations, social conventions and contexts, which a speaker can exploit by incompletely expressing the information he/she wants to convey, thereby confidentally trusting in the hearer's capability to understand the message completely. Tense and modality features, for instance, usually bear quite complex meanings despite the fact that they can only take a few distinct values. Consequently, their correct interpretation is only possible by exploiting the knowledge about defaults and conventions associated with their use.

In contrast to that, the distribution of the information content may be organized quite differently for storage and reasoning purposes. All instances of language elements belonging to a given representation formalism express the same amount of formally accessible meaning, which should also be the case for the associated information content that one wants to model. Moreover, the information content should not only be distributed evenly, but it should also be made totally explicit. Organizing knowledge in such a way is perfectly suited to represent a model of a database or a model of some domain, for instance, in terms of states and events as a prerequisite for inferences and planning processes. However, these characteristics describe an ideal state which can only be approximated in practice to meet the purpose of a particular system.

In order to mediate between these representation levels, a way of representing knowledge must be found that enables expressing the knowledge relevant for conceptual information processing in the addressed domain or application as well as expressing the knowledge relevant for referring to these pieces of information by natural language. Such a multi-purpose domain model could serve as an intermediate representation level between conceptual information processing and natural language processing. The table in Figure 1 indicates the major differences between properties of conceptual and lexical representations and requirements of representation that can serve both purposes in principle.

Moreover, experiments carried out with humans to simulate communication with computers demonstrate several things that provide another piece of evidence for representational differences between natural language and the things language refers to:

- Humans typically make use of a variety of linguistic and communicative resources to express themselves even for comparably simple technical tasks, without dominant variants being recognizable.
- The terms humans are using in giving descriptions occasionally overlap in scope, so that contextual factors are required for a sensible interpretation of these terms.
- When giving indirect descriptions, humans typically make use of generalizations, specializations, analogies, and examples, thereby relying on the addressee's general world knowledge.

representation properties	knowledge base/database	combined representation	natural language referen
distribution of information content	evenly distributed, in the degree of precision needed	available in several degrees of precision, related to each other	intermixed degrees, accordin to the communicative purpo
attitude towards redundancy	avoid redundancies if possible, simplifies reasoning and update	redundancies expressed, to support varieties of reference	rare in natural expressions - due to gapping, pronouns, e
granularities present in representations	a single representation, with intermixed granularities	several levels simultaneously, explicitly related to each other	freely built combinations suiting the intention pursue
degree of explicitness exhibited	totally explicit, but just to the extent that is needed	totally explicit, with details beyond the application purpose	gaps left due to the exploitati of situative contexts

Figure 1: Properties of different representation levels

In order to produce natural language automatically and with a high degree of coverage, a natural language generation system must be able to bridge these representational differences in a systematic way and to exploit this knowledge in a reasonably efficient process. Our contribution to this issue lies in providing a two-staged transition process that enables expressing formal-conceptual representations in lexical terms, which may involve considerable restructuring measurements. We illustrate how an appropriate intermediate representation level for mediating between conceptual and lexical representations can be designed. The transition process itself comprises a terminological transformation process and pattern-oriented mapping schemata, which we describe from the generation perspective.

2. The design of an intermediate representation level

What we ultimately envision is a model that contains *explicit* definitions of all those pieces of knowledge that are necessary for the functionality of the system – they are expressed exclusively by means of the epistemological primitives supplied by the knowledge representation formalism. In such a model, the denominations used should ideally not require any further explanation, even for a novice, and the associated entities and relations should be sufficiently described by formal definitions. We call those parts to which this criterion applies *simple relations (Roles)* or *simple entities (Concepts)*. The other parts are called *complex relations* or *compound entities*. This way, the machine's knowledge deficit is reduced so that the gap between the human view and the machine's view is narrowed. But how can the design of such a model be achieved? In our view, this task can be most sensibly approached by pursuing three subtasks:

- Carefully identifying pieces of domain knowledge relevant for the task at hand, and reducing the meaning attributed to individual pieces of knowledge to those aspects substantially required for the functionality of the system, by making contextual dependencies *explicit* (the *knowledge identification* subtask).

- Explicitly expressing the internal relations attributed to such a piece of knowledge in terms of a coherent construct composed of epistemological primitives – eventually, this approach may produce more detailed definitions than the mere functionality of the back-end system requires; in particular, this process includes an explicit identification of functional relations, clearly separating them from entities among which the relations hold (the *formalization* subtask).

- Expressing the meaning attributed to a complex relation or to a compound entity in more explicit terms, by relating it to a construct consisting of simple relations or entities only, so that this construct and the compound entity bear identical meanings (the *refinement* subtask).

These tasks are creative and intuitive issues, and, if pursued seriously, they require a careful analysis of the domain to examine. The formalization and the refinement subtasks are much intertwined. When relevant pieces of knowledge are selected, a model designer has to choose among several possible formalizations facing restricted expressive power of the knowledge representation formalism, so that some portions of the model need to be refined. Not unexpectedly, the quality of the model also depends to a good deal on the accuracy exhibited in the knowledge identification subtask. However, it also seems to be difficult to find appropriate formalizations, since mistakes in this respect are observed frequently: e. g., failing to express some important aspects explicitly – which then become implicit assumptions, or using a certain primitive in a

superficially consistent, but in fact different, thus ambiguous way ([Brachman 1983, Woods 1975]). As a guideline, the formalization should be oriented on some principles (see [Horacek 1989]):

The principle of *conciseness*: The knowledge should be expressed as concisely as possible in the given formalism. When a compact representation is achieved, there is no room for undisclosed redundancies. In some domain models, similar or identical denominations for *Roles* and for their fillers can frequently be observed. For instance, associating the denomination Term to a *Role* and TERM to its filler may be proposed to represent the term of an asset in the domain of financial investment. However, this proposal should be rejected because the distribution of information content between the *Role* and its filler is not specified. This principle aims at the *avoidance of ontological overlaps.*

The principle of *explicitness*: The intended meaning associated with the relations and entities in a domain model should be expressed as explicitly as necessary for those aspects that are relevant for the functionality of the system. In particular, this requirement means that the reference to a certain domain object must not address different subsets of its features in distinct occurrences in the model. For instance, the distinction between a quantity of money and an asset measured by this quantity in terms of its value is crucial in a formal representation, whereas the same natural language expression, e.g., the phrase "40000 DM", may refer to either of them. If this distinction is not taken into account, the definition would be incomplete and would lead to an implicit ambiguity. This principle aims at the *avoidance of ontological gaps.*

The principle of *uniformity*: The application relevant aspects of knowledge should be expressed at a comparable level of abstraction. This attitude significantly supports achieving a model design that favors tight connections between those parts of the model that refer to closely related aspects of the 'real world'. In the domain of financial investment, it may be desirable to express investments and measures quantifying their properties (e.g., 'term', 'interest rate') in a closely connected way. Hence, a *'Concept-Role-Filler'* pattern seems to be well suited as the underlying basic structure. However, this strategy may lead to the creation of several *Roles* that can not be considered to be *simple* ('liquidity', for instance), so that the resulting definitions must become subject to refinements. This principle aims at the *attainment of ontological continuity.*

According to the principal differences sketched out above, several goals have to be fulfilled for bridging the gap between conceptual and lexical representations:

- Mediating between the degree of granularity and the portion of the information content necessary for the application at hand in relation to the needs for building lexical descriptions.
- Balancing the degree of detail and the amount of the attached information content present in the syntactic functional representation according to the level chosen in the conceptual representation.
- Making explicit the information which is only implicitly available in the syntactic functional representation.

The first of these goals will be addressed by terminological transformations to be presented in section 3. The other two goals will be addressed by pattern-based mapping schemata to be presented in section 4, namely

by *ZOOM* schemata (addressing the second goal), and by *SUBSTITUTION* schemata (addressing the third goal).

3. Transformations based on terminological equivalence

In the previous section, terminological definitions have been introduced that constitute means to reexpress the meaning associated with individual representation elements (*Concepts* and *Roles*, according to the representation language KL-ONE [Brachman, Schmolze 1985]) in more explicit terms. By building hierarchically organized *Concept* definitions, such alternatives are available for *Concepts*. For *Roles*, special definitions must be introduced to provide for these alternatives, based on the refinement task (see subsection 3.2). These terminological definitions present us with the prerequisites for mediating between alternative expressions that bear strictly equivalent meanings. Mediating between alternative, terminologically equivalent expressions essentially enables presenting the results obtained by a database access or by the inference component of a knowledge-based system to the user of that system in a way most suitable to that user. In many cases, adapting the terminology used to the particuliarities indicated by a user profile may increase the ease with which the user can interpret what that system has to offer. A special task in this presentation issue lies in explaining specific terms which might be unknown to the user, or whose precise meaning in the context of the domain and in view of the system's command of domain knowledge the user might be unaware of.

Terminologically equivalent expressions can be obtained by applying some kind of elementary operations to individual representation elements, which can be repeated in a recursive way. For generation purposes, mainly *expanding* a conceptual description is of interest, which is obtained by replacing subexpressions according to terminological definitions, which express explicit definitions for certain aspects of the terms to replace. This operation may be applied to *Concepts* and to *Roles*, which we illustrate in the two following subsections.

3.1. Operations on concept definitions

The purpose of expanding *Concept* definitions is to replace selected *Concept* predications in a conceptual description by other *Concept* predications that constitute generalizations of the *Concepts* appearing in the original description. In order to maintain terminological equivalence, the more specific meaning attributed to the *Concepts* to replace must be reexpressed explicitly by adding appropriate descriptions to the newly introduced *Concept* predications. These descriptions comprise *Role* definitions attached to the specialized *Concepts*, but not to those *Concepts* replacing them, and more specific *Role* fillers which express value or cardinality restrictions that contribute only to the meaning of the *Concepts* to replace.

We demonstrate the application of *Concept* expansions to obtain alternative, more detailed descriptions for the predication 'instance (FEMALE-STUDENT,x)'. As Figure 2 indicates, FEMALE-STUDENT is defined as a specialization of two *superConcepts*: WOMAN and STUDENT. These *Concepts*, in turn, are specializations of the *primitive Concept* HUMAN. In addition, WOMAN is also a *subConcept* of FEMALE-LIVING-BEING. HUMAN and FEMALE-LIVING-BEING are *subConcepts* of the *primitive Concept* LIVING-BEING. All other *Concepts* except to HUMAN and LIVING-BEING are *defined Concepts*. In Figure 2, the *Roles* relevant for terminological expansion are

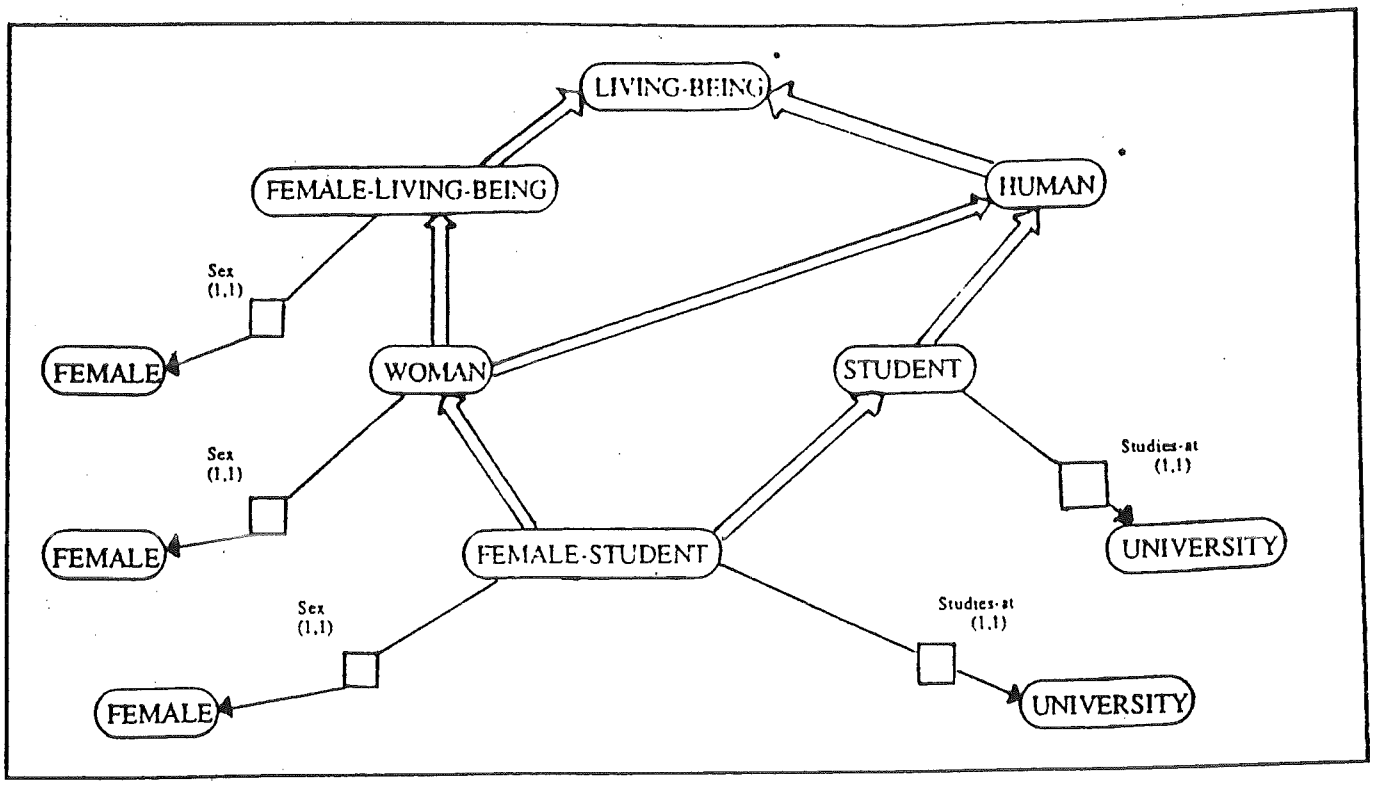

Figure 2: Taxonomic definitions used for performing terminological expansions of *Concept* definitions

attached to *all Concepts* for which they are defined, including those *Concepts* where these *Role* definitions appear through *inheritance*, for purposes of illustration. When expansions of the *Concept* predication 'instance (FEMALE-STUDENT, x)' are generated, alternative descriptions are created as indicated in Figure 3. The *Concepts* whose predications get expanded are attached to the links of the search tree, and the partially expanded descriptions are attached to the nodes corresponding to their position in the search tree (neglecting *Number Restrictions).*We demonstrate the application of *Concept* expansions to obtain alternative, more detailed descriptions for the predication 'instance (FEMALE-STUDENT,x)'. As Figure 2 indicates, FEMALE-STUDENT is defined as a specialization of two *superConcepts*: WOMAN and STUDENT. These *Concepts*, in turn, are specializations of the *primitive Concept* HUMAN. In addition, WOMAN is also a *subConcept* of FEMALE-LIVING-BEING. HUMAN and FEMALE-LIVING-BEING are *subConcepts* of the *primitive Concept* LIVING-BEING. All other *Concepts* except to HUMAN and LIVING-BEING are *defined Concepts*. In Figure 2, the *Roles* relevant for terminological expansion are attached to *all Concepts* for which they are defined, including those *Concepts* where these *Role* definitions appear through *inheritance*, for purposes of illustration. When expansions of the *Concept* predication 'instance (FEMALE-STUDENT, x)' are generated, alternative descriptions are created as indicated in Figure 3. The *Concepts* whose predications get expanded are attached to the links of the search tree, and the partially expanded descriptions are attached to the nodes corresponding to their position in the search tree (neglecting *Number Restrictions).*

For illustration purposes, we express the information carried by the alternative variants of terminological descriptions resulting from the expansion process in Figure 3 by natural language sentences:

1 A woman who is a student.

2 A female living being who is a student.

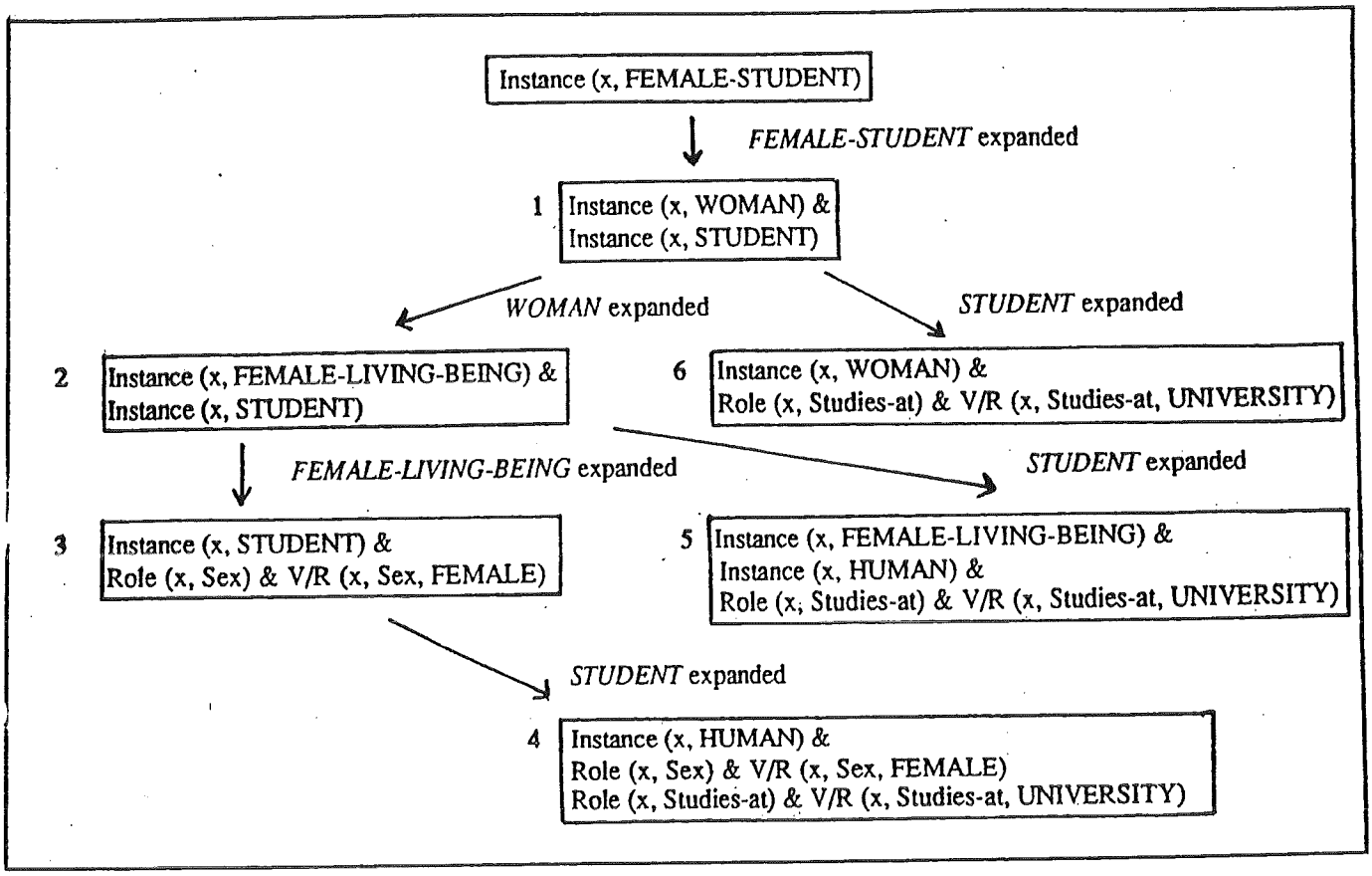

Figure 3: Alternative expansions of the conceptual description Instance (x, FEMALE-STUDENT)

3 A female student.
4 A female human who is studying at a university.
5 A female living being who is a human studying at a university.
6 A woman who is studying at a university.

3.2. Operations on role definitions

As for *Concepts*, it is also possible to replace the appearances of certain *Roles* in logical formulas. This is the case for *Roles* which are associated with a complex meaning and can be defined more explicitly in terms of possibly rather complex conceptual structures consisting of *Concepts* and *Roles* associated with less complex meanings. The terminological equivalence is expressed by transformation rules, which have the same expressive power as *Structural Descriptions* – except to the fact, that they are not interpreted as mere restrictions, but as equivalences.

In KL-ONE [Brachman, Schmolze 1985], a *Structural Description* allows one to express how *Roles* of a *Concept* interrelate in terms of other *Concepts*. *Structural Descriptions* are usually applied to express the meaning attributed to a specialized *Concept* with respect (one of) its generalizations. Our application deviates from this usage insofar as we consider only cases where the meaning of the specialization manifests itself merely in an additional *Role* or in a *Role* restriction – hence, the specialized *Concept* must not be marked as *primitive*. Consequently, the meaning associated with this *Role* (or with the restriction) can alternatively be expressed by the *Structural Description*, which is exactly what we want.

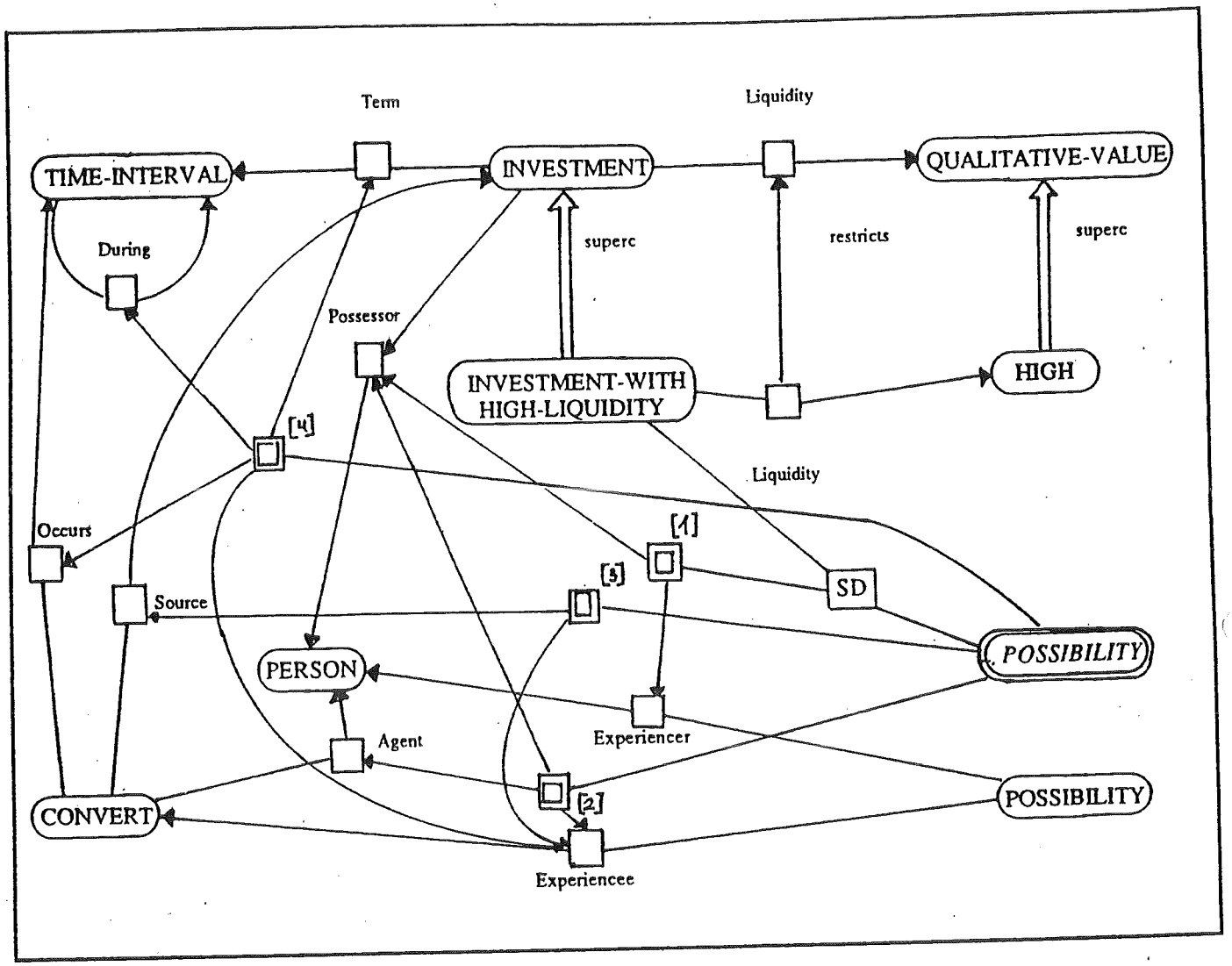

Figure 4: A Structural Description attached to the *Concept* INVESTMENT-WITH-HIGH-LIQUIDITY

To get access to the *Concepts* involved in a *Structural Description* without changing their meaning, we need an embedded 'call' to each of these *Concepts* and to bind the formal parameters of the called *Concept* to the actual arguments to be used in the context of this call. We illustrate this construct by the definition of the meaning associated with a *Role* named 'High-Liquidity' – associated with an investment, as displayed in Figure 4. The *Structural Description* (the diamond in Figure 4) has associated with it a version of another *Concept*. The structure of this internal version is isomorphic to the regular generic version. The interrelations between the *Roles* are expressed by a set of pairs of *Role Chains* (the double circled squares in Figure 4). In each pair of *Role Chains* the paths obtained by following these *Chains* must lead to the same *Concept*. Occasionally, a filler may be restricted to a certain subtype of the *Value Restriction* (via restricts, *Value Restriction Difference)*. The empty path is also feasible, which is represented by the predicate SELF. In our mechanism, a pair of *Role Chains* is expressed by an equation which operates on the two *Role Chains*.

In Figure 5, the terminological definition of a *Structural Description* is expressed in (1). It is reexpressed in the transformation rule format in (2). In (2), High-Liquidity is assumed to denote a specialization of Liquidity, where the value is restricted to be HIGH – this way, the *Structural Description*, which is copied from the terminological definition, is related precisely to a particular *Role* whose meaning is to be expressed in more explicit

```
(1)  INVESTMENT-WITH-HIGH-LIQUIDITY =
       (and
         (ROLE Liquidity HIGH)
         (SD POSSIBILITY
           (and (equal     Experiencer    Possessor)                          [1]
                (equal     (restricts Experiencee Convert) • Agent  Possessor) [2]
                (equal     Experiencee • Source    SELF)                       [3]
                (superset  Experiencee • Occurs • During   Term)))             [4]

(2)                                  (SD POSSIBILITY
                                       (and  (equal     Experiencer    Possessor)                  [1]
(ROLE High-Liquidity)   <===>                (equal     (restricts Experiencee Convert) • Agent
                                                        Possessor)                                 [2]
                                             (equal     Experiencee • Source    SELF)              [3]
                                             (superset  Experiencee • Occurs • During   Term)))    [4]
```

Figure 5: Terminological definitions and transformation rules for *Structural Description* and for *Role Value Map*

terms. Furthermore, the terminological definition of a (simple) *Role Value Map* and the corresponding rule format are illustrated in (3) and in (4), respectively. The paths defined by a *Role Value Map* are 'normalized' in some sense, so that the role to be defined appears alone on one side of the equality relation. In (3), this goal is achieved by following the *Role* Manifests-In in inverse direction, which yields the required definitions for the *Roles* Interest-Rate and Term.

In (1) and (2), the meaning of the *Role* called Liquidity – to be more precise, High-Liquidity – is defined more explicitly. An investment is considered to be associated with high liquidity, if there is a possibility for the owner of the investment to convert that investment into money during its term. This is expressed by a POSSIBILITY which refers to this investment, its owner (reached via Possessor), and the term of the investment (the time interval reached via Term). By means of the associated *Role Chains* (in (1), (2), and in the graphical equivalent in Figure 4), some relations are defined that express:

- The possibility is at the disposal of the owner of the investment (equation [1]): the Experiencer of the POSSIBILITY must be the same as the Possessor of the INVESTMENT.
- Its owner is also the agent of the conversion action (equation [2]): the Experiencee of the POSSIBILITY must be a CONVERT action due to a value restriction; its Agent must be the Possessor of the INVESTMENT.
- The object which suffers the conversion is the investment itself (equation [3]): the Experiencee of the POSSIBILITY must also have a Source which is required to be the INVESTMENT itself.
- The possibility of conversion occurs during the term of the investment (equation [4]): the Experiencee of the POSSIBILITY (CONVERT) takes place (Occurs) at a certain TIME-INTERVAL which holds During the TIME-INTERVAL that is associated with the Term of the INVESTMENT.

Thus, "high liquidity associated with an investment" can be paraphrased by "the possibility of its owner to have access to the money during the term of investment". The relevance of applying this rule depends on the discourse situation, and on other factors. For instance, if the user is assumed to be unfamiliar with the meaning of a certain term appearing in a specification generated by some back-end system (here, the 'liquidity' of an investment, represented by the *Role* Liquidity), expansion of that *Role* seems to be beneficial, which can be done by replacing its occurrence(s) in that specification by the definition from the transformation rule.

Replacing the occurrence of a *Role* by the definition from the transformation rule is slightly different for *Role Value Maps* and for *Structural Descriptions*. In each occurrence, a *Role* to replace is substituted by a logic formula which contains the *Role* predications as specified by the right side of the transformation rule. This formula is augmented by introducing quantifiers in the right places, which follows a rather regular pattern.

Intuitively, applying a transformation rule derived from a *Structural Description* for substituting occurrences of a *Role* in a logic formula works as follows: an occurrence of this *Role* is first replaced by a subformula denoting the *Concept* copy attached to the *Structural Description*. If the *Role* predication to expand occurs in the special form of a state, which is the case in the formula on the left side of (5), the occurrence of this state in the logic formula must be replaced instead of the *Role* predication itself. Thereafter, the content of the equations appearing in the *Structural Description* is transduced into logic formulas and appended to the newly inserted subformula. Variables and the semantic restrictors that denote the *Concepts* they are instances of, are inserted for each *Concept* which occurs on a path of any of the *Role Chains*. Moreover, *Role* predications are generated for each part of the *Role Cahins* – excluding multiple occurrences, and they are inserted in a suitable place in the formula according to the scope of the variables referred to in the *Role* predications.

The result after applying transformation rule (2) to the formula on the left side of (5), paraphrased by "Do you want to have an investment with high liquidity?" is given in the formula on the right side of (5), which can be paraphrased by "Do you want to be able to convert your money during the term of the investment", provided that the constant USER is substituted for the individual p – by accessing the dialog memory.

```
(5)
((EXISTS w (WANT w))
   ((EXISTS s
      (STATE s
         ((EXISTS x (INVESTMENT x))
            (Liquidity x HIGH))))
    (and (Experiencee w s)
         (Experiencer w USER))))

--->

((EXISTS w (WANT w))
   ((EXISTS y (POSSIBILITY y))
      ((EXISTS f (CONVERT f))
         (and ((EXISTS ti1 (and (TIME-INTERVAL ti1)
                                (Occurs f ti1)))
               ((EXISTS x (INVESTMENT x))
                  (and (EXISTS p (and (PERSON p)
                                      (Possessor x p)
                                      (Agent f p)
                                      (Experiencer y p)))
                       ((EXISTS ti2 (and (TIME-INTERVAL ti2)
                                         (Term x ti2)))
                          (During ti1 ti2))
                       (Source f x))))
          (Experiencee y f))
          (and (Experiencee w y)
               (Experiencer w USER)))))
```

Figure 6: Applying the transformation rule (2) to expand a *Role* definition

4. Mapping between conceptual and lexical representations

When a conceptual representation is to be expressed in natural language terms, the terminological transformations described in the previous section contribute to this aim by producing a variant on the conceptual representation level that is suitable as a starting point for natural language production. However, the selection of a conceptual variant considered suitable to the production of natural language does not mean that the generation task becomes simple this way. When mapping between intermediate and natural language representation levels, essentially two kinds of differences must be bridged, each of which comprises a variety of natural language phenomena:

- Bridging between different degrees of granularity – other than those captured by terminological transformation operations on conceptual descriptions exclusively; these differences manifest themselves in the variety of ways in which content word and features can be used to express elements on the conceptual representation level. Moreover, connections to function words and grammatical functions have to be dealt with adequately. These variations are based on the meaning attributed to elements of the domain model and implement research results originating from lexical semantics and lexicography.

- Bridging between different degrees of explicitness – these may vary significantly among some set of natural language expressions that all refer to the same conceptual representations. These variations comprise reference to an object by some characteristic property which, in particular, includes referring expressions with unexpressed metonymic relations.

A methodological requirement for the design of the transition between these representation levels lies in the necessity that not only local transitions should be treatable, but the meaning of complete structures taken from one level of representation should be successfully expressed by re-building adequate structures on the other level. This means that the elementary mapping operations must result in coherent structures in a composible way without leaving any gaps or overlaps in newly created representations. In this section, we introduce definitions of schemata which enables one to bridge gaps in granularity and in degrees of explicitness, that may hold between conceptual and lexical representation levels, devoting a sucsection to each of these issues.

We have identified some (typical) schemata where one lexeme or one grammatical function expresses the meaning associated with a certain chunk of elements in the conceptual representation (this is, in particular, a chain of nodes and links in the KL-ONE formalism). According to the two main purposes, which correspondence definitions are devoted to, extensions with respect to the standard schema are made in the following directions:

- The original structures are rebuilt in the KL-ONE representation in a form which is either contracted or expanded compared to a structure which would have been obtained by applying the standard schema. The content bearing parts, however, can be immediately identified in the resulting structure. Because of the variable size of the conceptual structures corresponding to approximately equivalent syntactic structures, we call this type of mapping a *'ZOOM'* schema.

- Missing information and relations only implicitly present on the syntactic functional level are made explicit by creating the adequate representations on the conceptual level. This type is usually applicable, when one phrase on the natural language side bears the role of another one, which was omitted for reasons of avoiding redundancy on the language level (thereby providing some kind of paraphrasing capabilities). Because one phrase functions as a placeholder for the other one, we call the type of mapping a *'SUBSTITUTION'* schema.

Hence, the transition between the representation levels is specified by a small set of elementary and composable schemata responsible for bridging differences in granularity (via *ZOOM* schemata) and for expressing relations explicitly represented on the conceptual representation level in a concise, implicit way on the lexical representation level (via *SUBSTITUTION* schemata). In generation, it is at the responsibility of the associated process to finding a suitable selection of predicates on the lexical level (attributed to lexemes and grammatical functions) that express appropriately the information content associated with the predicates on the conceptual level (attributed to *Concepts* and *Roles).* This task is, in fact, an inverted lexeme interpretation which is essentially new in this particular form. The transition involves considerable restructuring because th (relevant) meanings of lexemes and grammatical functions may be related unevenly to the information contents associated with the predicates used in our domain model.

We continue our presentation with elaborating the two types of schemata in more detail, which is followed by some more complex examples demonstrating the composition of individual schema mappings.

4.1. ZOOM schemata

A set of elementary schemata called *ZOOM* schemata serves the purpose of defining correspondences between the atomic elements on both representation levels: *Concept* and *Role* nodes and connecting links on the conceptual level, and lexemes and grammatical functions on the lexical level. Via *ZOOM* schemata a chain consisting of at least one atomic conceptual element (they comprise the conceptual coverage of a mapping schema) is mapped onto an atomic lexical element (a lexeme, a feature value, or a grammatical function). This includes simple one-to-one mappings expressed by *MICRO ZOOM* schemata as well as operations which involve more complex structures on the conceptual level. Also the 'empty lexeme' (a word with an uninstantiated PRED-feature) is a valid mapping result which is most suitably chosen for expressing major categories like 'person', 'object', and 'time interval' in a given context. Later, an F-structure representing an 'empty lexeme' yields a pronoun on the surface, unless the PRED-feature is instantiated as the result of another mapping operation (i.e., the 'empty lexeme' is 'overwritten'). Because the lexical level is identified as the basic and original one (as it reflects the structure of the language itself), *ZOOM* schemata always cove exactly one lexical element. In addition to the (basic) *MICRO ZOOM* schema, more complex schemata may cover any of the following (connected) structures on the conceptual level.

There are four subclasses of *ZOOM* schemata: *MICRO*, *STANDARD*, *MIX*, and *MACRO ZOOM* schemata. Th *MICRO ZOOM* schema maps any type of node (*Concept* or *Role* nodes) onto a noun, a verb, an adjective, o onto a feature value (e.g., PRESENT as a tense feature value). Grammatical functions and auxiliary verbs ar possible mapping results of the connecting links. Unlike the basic *MICRO ZOOM* schema, which describe simple one-to-one mappings, the more complex schemata comprise structures consisting of:

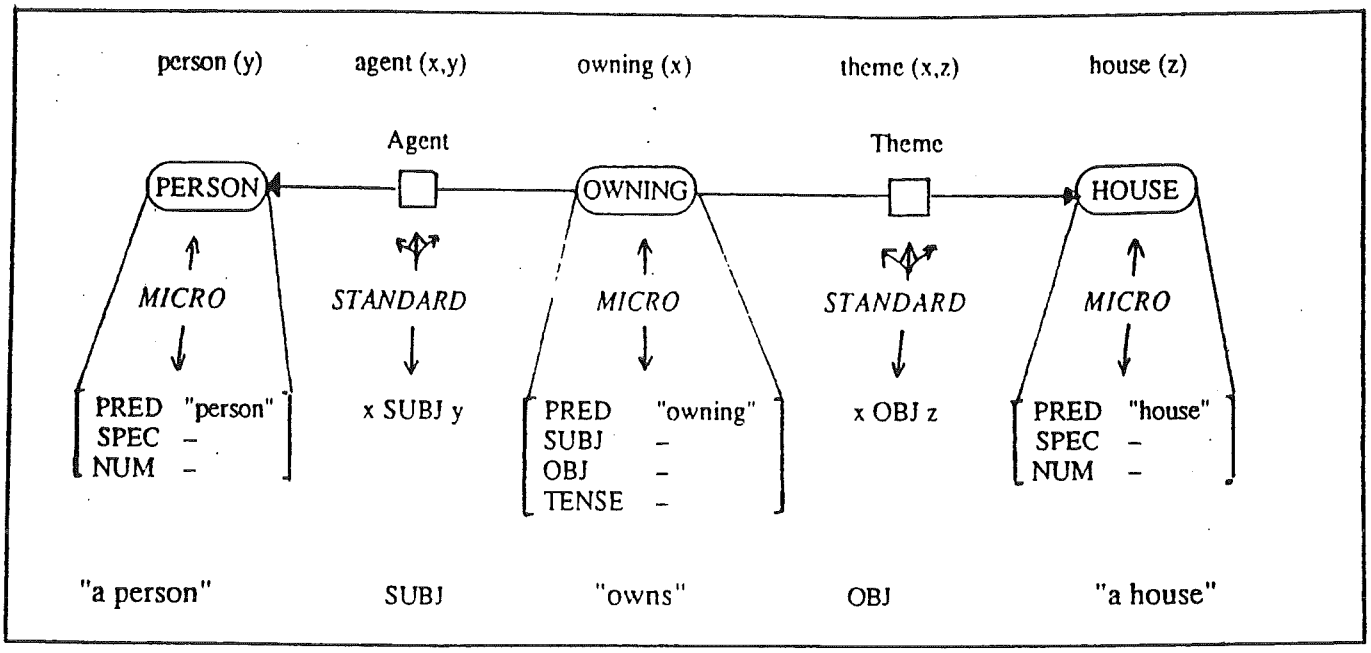

Figure 7: Expressing the *Concept* OWNING by "A person owns a house"

- a *Role* node and both its adjacent links, which are mapped onto grammatical functions via *STANDARD ZOOM* schemata (a method also found in other approaches). In Figure 7, e.g., the *Roles* Agent and Theme are mapped onto the grammatical functions SUBJ and OBJ (POSSESSIVE -'of'),

- a *Concept* node, a *Role* node, and a link connecting them, which is used for creating role nouns (nouns derived from actions) via *MIX ZOOM* schemata. In Figure 8, e.g., the chain consisting of the *Concept* OWNING, the *Role* Agent, and their connecting link is mapped onto the noun "owner",

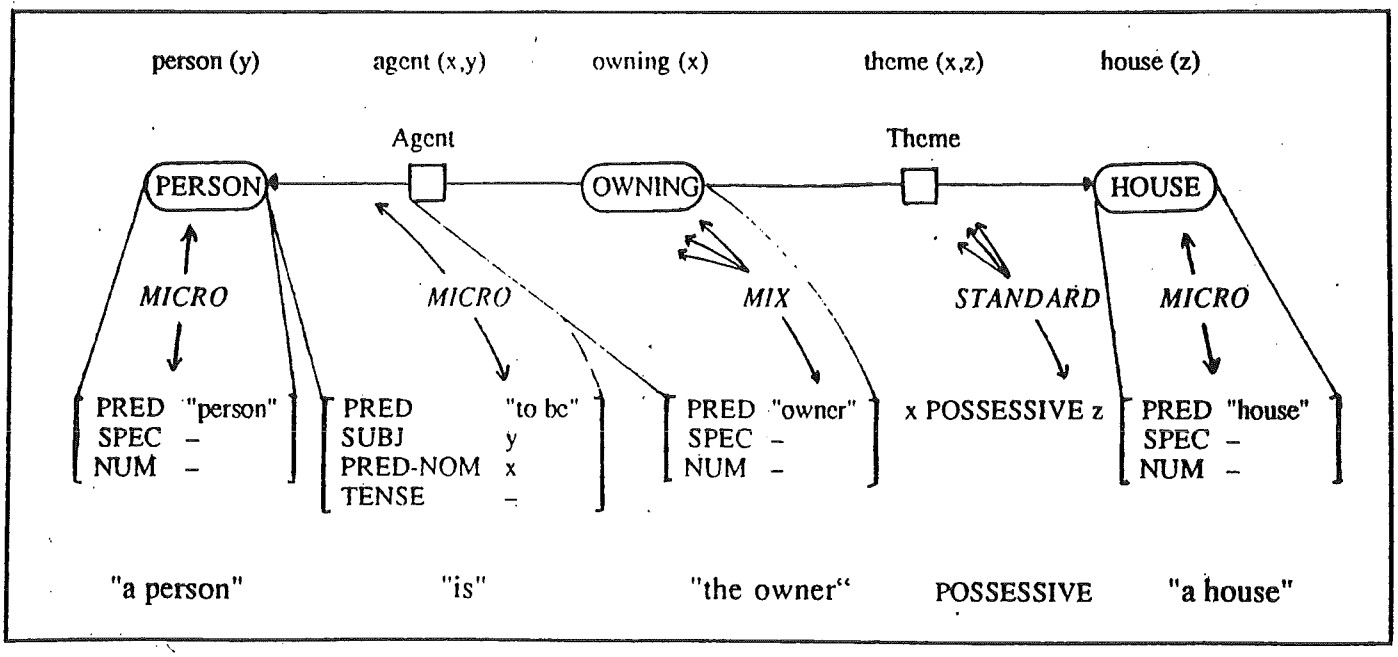

Figure 8: Expressing the *Concept* OWNING by "A person is the owner of a house"

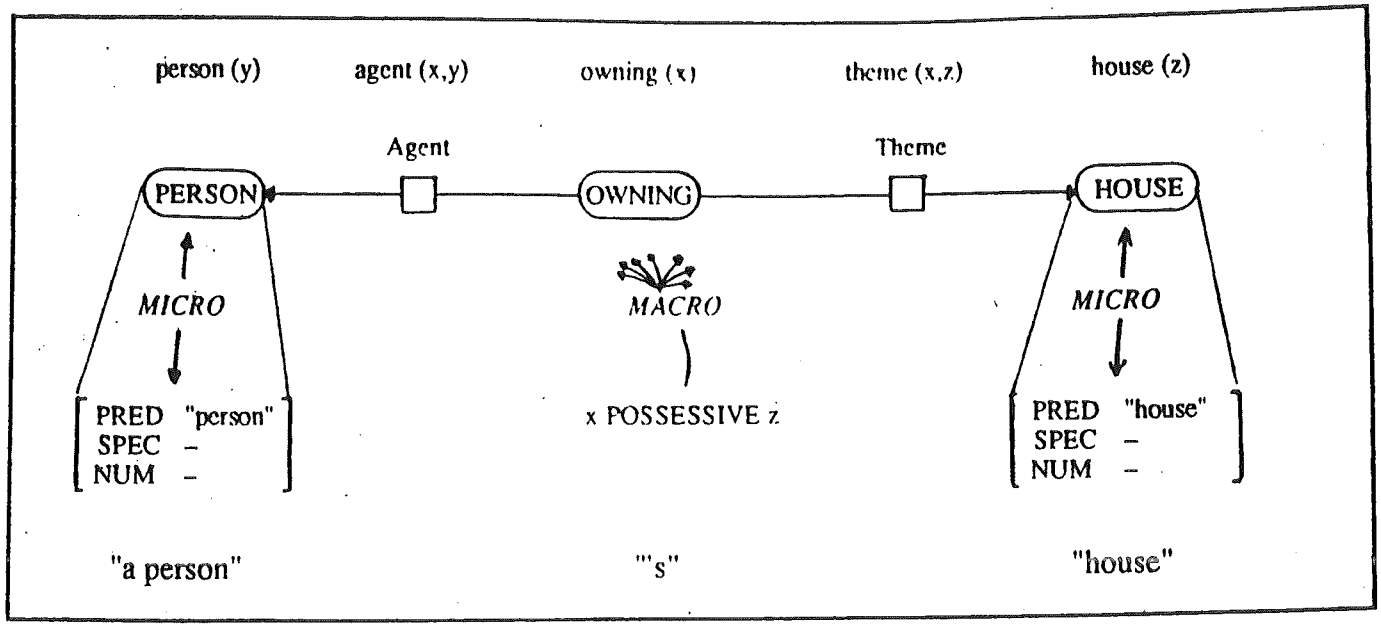

Figure 9: Expressing the *Concept* OWNING by "A person's house"

- two *Role* nodes, all their adjacent links, and a *Concept* node which establishes a connection between the *Roles* via two of these links; this construct can be expressed by a single lexical element (usually a possessive case) via *MACRO ZOOM* schemata. In Figure 9, e.g, the *Concept* OWNING, both its adjacent *Roles*, and their attached links are mapped onto a POSSESSIVE ("'s").

Examples for *ZOOM* schemata of each type are illustrated in Figures 7 to 9. They contain the resulting alternatives (for mapping the *Concept* OWNING) and their potential composability with the mapping results of the adjacent *Roles*, together with the conceptual coverage of the schemata (by means of the attached blocks).

The *MICRO ZOOM* schema maps any type of node (a *Concept* or a *Role* node) onto a noun, a verb, (or sometimes, onto an adjective). Complex noun phrases and complete sentences are built by composing nouns by the aid of suitable auxiliary verbs and grammatical functions (the possessive case, in particular) which are possible mapping results of the connecting links. By these compositions phrases like "the name of the project", "the name is WISBER", "the project has a name", "the name WISBER" are produced from a structure on the conceptual level which consists of two *Concepts*, PROJECT and STRING (its instance is WISBER in this example), and the connecting *Role* Name. These clauses can be joined adequately to yield coherent sentences. Moreover, function verbs may also be specified as correspondences instead of auxiliaries: Thus, the creation of "the project bears a name" is also possible. This kind of schema definition implement the lexical function Oper_1 from Mel'cuk's Meaning-Text Theory.

Methods that produce similar results as the *STANDARD ZOOM* schema does are also found in other approaches. These schemata map *Role* nodes (together with both their adjacent links) onto grammatical functions. The results can be combined with verbs and nouns derived by *MICRO ZOOM* schemata. For instance, a structure consisting of an OWNING state and its associated entities, the fillers of the Experiencer and Experience *Roles*, is mapped onto the verb 'besitzen' ('to own') where the SUBJ and OBJ slots bear the NPs derived.

The *MIX ZOOM* schema covers nominalizations derived from verbs denoting processes or states (referring to their agent and theme or, experiencer and experiencee, respectively). Thus, the conceptual structure corresponding to the noun 'leader' does not only comprise the *Concept* called LEADING (like the conceptual structure mapped onto the verb 'leading' would do), but it includes also the associated *Role* Agent and the link connecting them. Consequently, the link connecting the *Role* Agent and its filler may be mapped onto the auxiliary 'to be' by means of a *MICRO ZOOM*, thus contributing to the phrase "x is a leader". This kind of schema definitions is another exampe for implement lexical functions from Mel'cuk's Meaning-Text Theory. Here, it is the lexical function S_1, S_2, S_3, and so on, which yield typical nouns for the first, second, third, etc. actant of a verb – in the example, this applies to the nouns "leader" and "leadee".

By applying the *MACRO ZOOM* schema a large conceptual construct can be expressed by a single element on the lexical level (typically by a possessive case). For instance, the most concise way to express the relation between bonds and the bank issuing these bonds is by means of a possessive case. Hence, the *MACRO ZOOM* comprises a *Concept* (ISSUING), two *Roles* (Agent and Theme) and all links to form a bridge between both their *Role* fillers (the bank as the issuer and the bonds as the thing being issued).

Whereas the meaning of the relation between the bank and the bonds is still obvious in this case, ambiguities may arise in other instances due to the conciseness in which the underlying fact is expressed: in "Miller's project", the referred person may be either the leader of the project or simply a person working on it (hence, the *Concept* being in the center of the construct covered by the *MACRO ZOOM* is either LEADING or WORKING). Thus, application of a suitable combination of correspondence schemata may yield "Bill leads the project," "Bill is the leader of the project," and "Bill"s project" as alternative verbalizations for the same conceptual structure differing only in the degree of explicitness.

4.2. SUBSTITUTION schemata

Via *SUBSTITUTION* schemata a conceptual chain is mapped procedurally onto the lexical level: a unification of those functional structures is performed that have been obtained by mapping the conceptual elements adjacent to both ends of the chain. This way structures derived from different conceptual elements may collapse on the lexical level. The three types of *SUBSTITUTION* schemata are illustrated in Figure 10.

Motivated by the observation that some pieces of information typically represented in conceptual representations are frequently not expressed explicitly in surface expressions, we have developed a method that is capable of bridging between different degrees of explicitness that may hold on surface and on conceptual representation levels, which works in a bi-directional way [Horacek, Pyka 1988]. The method was essentially designed for establishing a reference to an object by the value of one of its properties in generation without explicitly expressing the property and the category of the object, and for uncovering the property and the object in interpretation, when the object is just referred to by one of its property values. Referring to an asset in terms of its associated money measure (e.g., *"100 DM"*, see Figure 11) is a typical example, as are the name of a person and the title of a book. Moreover, the method is capable of mediating between conceptual representations of temporal knowledge expressed in terms of time intervals and corresponding lexical representations, which may manifest themselves in terms of a tense feature or in terms

of a temporal adjunct. So far, applications in the systems WISBER [Horacek 1990c] and DIAMOD [Horacek 1990b] have been realized.

The method embodies an image of the conception that two separate conceptual entities (here, an object and one of its property fillers) collapse into one structure when mapped onto the lexical-functional and, ultimately, onto the surface representation level (when seen from the generation side). For unification to succeed, no clash must occur with respect to the PRED-features of the functional descriptions considered. In order to achieve this result, a functional description representing an *'empty lexeme'* (this is the term we use to denote a functional description entailing an unspecified PRED-feature) is associated with the object which is referred to by one of its properties. Such *'empty lexeme'* mappings are typically available for general *Concepts* like PERSON, PHYSICAL-OBJECT, in addition to ordinary mappings onto nouns. Furthermore, such special mappings are available for all *Conceps* in circumstances where the semantic category required in a particular situation (i.e., by means of a selectional restriction) is identical to that *Concept*.

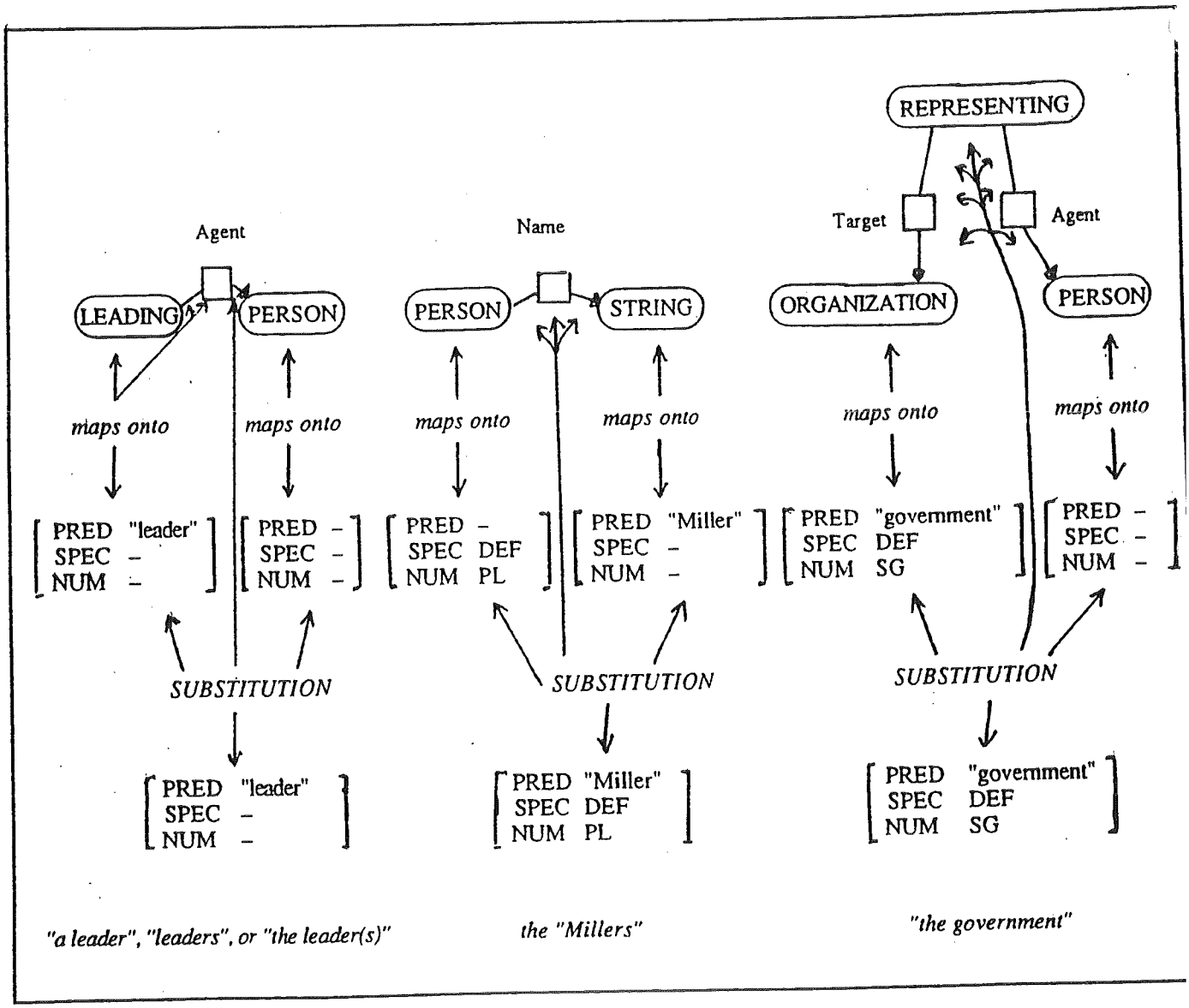

Figure 10: *SUBSTITUTION* schemata of type 1 (left side), type 2 (in the middle), and type 3 (right side)

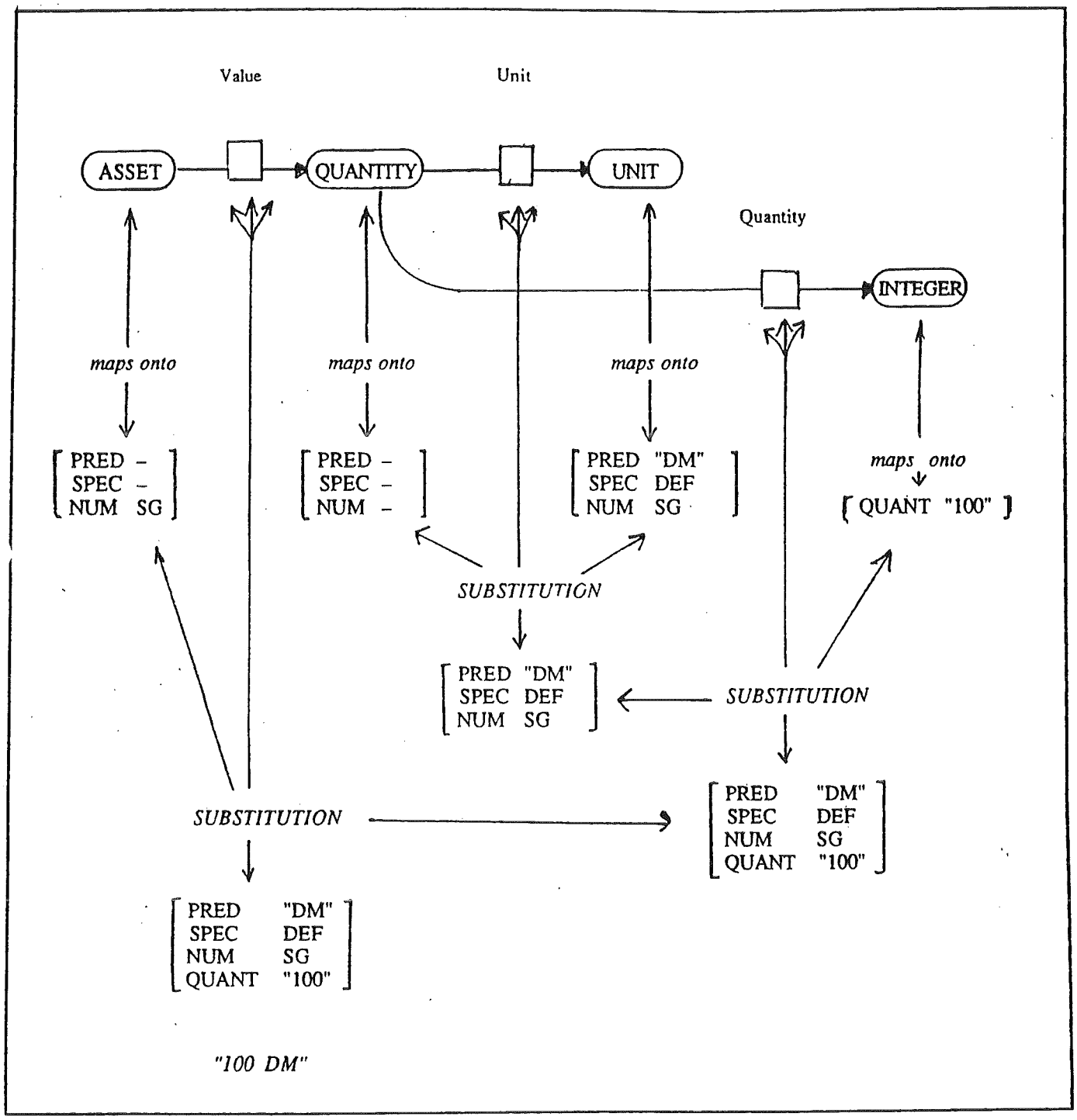

Figure 11: Multiple applications of *SUBSTITUTION* schemata (of type 2)

One remark has to be devoted to the treatment of NUM and SPEC features, which originate from the cardinality of the entities involved, their genericity, and, of course, their references in discourse. These features are partially specified according to the types of entities, which may occasionally cause unification to fail. For instance, reference to a set of assets by their shared value (e.g., *"100 DM"*) does not succeed due to a clash concerning the NUM feature (compare this to the phrase *"100 DM banknotes"*). However, generating the phrases *"Miller"* or *"the Millers"* is possible, because (unlike with units) some kind of proper names allow plural form.

SUBSTITUTION schemata frequently occur in companion with *MICRO* and *MIX ZOOM* schemata. For instance, either of the phrases "the leader", "a leader", or "(the) leaders" may be obtained when mapping the conceptual construct consisting of the *Concept* PERSON and the link by which this *Concept* is attached to the *Role* Agent, which is, together with the *Concept* LEADING and the link connecting them covered by a *MIX ZOOM* schema. In the other cases, a *SUBSTITUTION* schema refers to two *Concept* nodes, thereby covering either the joining *Role* and both its adjacent links (a *SUBSTITUTION* schema of type 2), or it may cover a *Concept* on its own, the *Roles* joining this concept with those *Concepts* it refers to, and all connecting links (a *SUBSTITUTION* schema of type 3). Typical examples are expressions referring to a person by his/her name or by an organization which the person is acting for, without expressing the category (person) explicitly. In both cases, the concepts referred to are mapped via *MICRO ZOOM* schemata, and the 'empty lexeme' is the selected mapping result for the *Concept* PERSON so that a unification with the lexeme denoting his/her name succeeds. Apparently, unification may also fail due to a feature other than PRED, e.g. SPEC or NUM may result in a clash under certain circumstances.

The *ZOOM* and *SUBSTITUTION* schemata provide excellent means to achieve significant flexibility i expressing the content of conceptual structures. This is particularly the case for referring to objects which are quantifiable by measurements. Two substitutions are usually involved to produce referring expression which are composed of a quantity (an integer, the filler of a *Role* Quantity) and a unit (a unit denomination, the filler of a *Role* Unit), thus identifying the measurement. If an object is typically identifiable by some quantifiable property, an adequate referring expression may be produced by a series of substitutions. Firstly, a measurement is referred to by means of its quantity and its unit, and the resulting expression is used again to refer to the object that is quantified by this measurement. A typical example in the domain of financial investment is the identification of an asset by the amount of money denoting its value, simply yielding, e.g., "100 DM" – see Figure 11. Furthermore, the *Role* Value may be expressed by a grammatical function (a prepositional attribute in this case): "an asset of 100 DM", which is derived by applying a *STANDARD ZOOM* schema. Finally, this relation can be expressed explicitly by "an asset at a value of 100 DM" or, in an inverse form, "100 DM in form of an asset". Both expressions are derived by *MICRO ZOOM* schemata.

The application of a suitable collection of mapping schemata to the *Concept* and *Role* predications leads to the creation of a set of functional descriptions. In generation, attempts to unify these partial results so that only those combinations of schemata are accepted which do not lead to inconsistencies on the lexical level (e.g., i an incompatibility between a feature and its value is present). Altogether, building a complete structure on th lexical level involves two necessary conditions:

- The obligatory parts[1] of the conceptual specification must be covered completely (but only once) by th mapping schemata used. This condition reflects the problems of 'untractable residues' (parts of th conceptual specification are not covered) and 'conceptual overlaps' (they are covered by more than on schema), which have been termed this way by [Mann, Moore 1981].

1 It is quite common in generation that specifications consist of 'obligatory' parts, which must be expressed at all circum stances, and 'optional' parts, which only need to be expressed if the coherence of the corresponding syntactic function expression demands that. A typical example is the (conceptual) specification of a case role and its filler, which may b ignored if the bearing concept is mapped onto a noun where this case role is optional. However, if the bearing concept mapped onto a verb, and the case role is obligarory, the it must be mapped onto the syntactic functional level.

- The resulting structure must be complete (e.g., it must not contain uninstantiated case roles) and coherent (i.e., all its parts must be connected).

It seems to us that our representation of measurements is more general, but apparently less richly elaborated than Dale's representation [Dale 1990]. Moreover, the flexibility of our verbalization mechanism enables us to produce a greater variety of surface expressions. In any case, both approaches could profit from elements of the other.

5. Summary

This paper present an approach to bridge the gap between lexical and conceptual representation levels, thereby introducing a variety of methods and techniques. Basically, an intermediate representation level is proposed from which conceptual and lexical representations can be built more systematically, and to which these representations can be transformed easier. Characteristic properties of this intermediate representation level are discussed, and guidelines for its adequate design are presented, which include principles of *conciseness*, *explicitness*, and *uniformity* .

The intermediate representation level, in fact, comprises special forms of conceptual representations. Terminological transformations serve the purpose of reexpressing terms on that representation level, in a way suitable to the particuliarities of application domain models. These transformations comprise replacement operations based on *terminological equivalence definitions* by which predicates referring to entities or relations can be *contracted* or *expanded* according to these definitions. Pattern-based operations are used in a compositional way to map lexical representations from and onto the intermediate representation level. *ZOOM* and *SUBSTITUTION* schemata are defined to bridge differences in granularity and differences in degrees of explicitness.

The primary relevance of our approach lies in significantly extending the flexibility in expressing information represented in conceptual terms by natural language.

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How to Juggle Discourse Obligations*

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Abstract

In the context of dialog, one challenge for natural language generation is that of dealing with *discourse obligations* such as those created by questions, promises, and even silences. The present paper presents new methods for (a) representing discourse obligations, (b) determining which ones are created by a given dialog move, (c) determining how the status of an existing obligation is changed by a new move, and (d) taking existing and resulting obligations into account in the generation of new moves. The task of choosing a dialog move (which may consist of a signal for the user to produce the next utterance) is conceptualized in terms of the maximization of expected utility. This quantitative approach makes it possible to do justice to observations such as the following: (a) Discourse obligations lead to tradeoffs with the system's other dialog goals. (b) Obligations differ in terms of their importance and the time within which they are to be fulfilled. (c) The severity of the consequences of nonfulfillment of an obligation depends on the relationship between the obligated speaker's moves and the total set of existing obligations.

Introduction

Issues Concerning Discourse Obligations

Traum and Allen (1994) argued convincingly that the concept of *discourse obligations* accounts for many phenomena of natural language dialog better than the more usual analyses in terms of, for example, recognition of intentions:

> The model we propose is that an agent's behavior is determined by a number of factors, including that agent's current goals in the domain, and a set of obligations that are induced by a set of social conventions. When planning, an agent considers both its goals and obligations in order to determine an action that addresses both to the extent possible. When prior intentions and obligations conflict, an agent generally will delay pursuit of its intentions in order to satisfy the obligations, although the agent may behave otherwise at the cost of violating its obligations. At any given time, an agent may have many obligations and many different goals, and planning involves a complex tradeoff between these different factors. (p. 2)

As Traum and Allen indicated, the need for the concept of *obligation* becomes especially apparent in dialog situations in which the participants do not have common goals.

Consider, for example, the following moment in a dialog, in which the user $\mathcal{U}$ is a potential used car buyer and the system $\mathcal{S}$ has the role of a used car seller:

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▷ $\mathcal{U}$: For me, safety is the most important thing.
▷ $\mathcal{S}$: [Wonders what to say about the car under discussion.]

Most likely the seller will choose to make some statement about the car's safety-related features; but why? If we assume that $\mathcal{S}$ shares $\mathcal{U}$'s goal of obtaining information about the car that is important to $\mathcal{U}$, then this question is easy to answer: $\mathcal{U}$'s utterance has revealed a way in which $\mathcal{S}$ can help $\mathcal{U}$ to achieve this goal. But what if $\mathcal{S}$ just wants to sell the car and $\mathcal{S}$ knows that the car rates poorly in terms of safety-related features? Then $\mathcal{S}$'s dialog goals would dictate avoiding this topic. Yet even such an $\mathcal{S}$ will not in general simply ignore $\mathcal{U}$'s utterance; she[1] will recognize that it creates a discourse obligation that she can flout only at her own peril. Instead of either ignoring the obligation or fulfilling it completely, she may try to find a satisfactory trade-off between her desire to obey dialog conventions and her desire to sell her car.

A similar tension can arise even if $\mathcal{S}$ is cooperatively motivated. Suppose, for example, that $\mathcal{S}$ is aware of properties of the car that are far more important to $\mathcal{U}$ than its safety-related features—for example, that it is in such poor repair that it is unlikely to go another 10 miles before collapsing. In spite of having $\mathcal{U}$'s interests at heart, $\mathcal{S}$ will be tempted to ignore $\mathcal{U}$'s previous utterance, so that she can proceed directly to the really important information; but here again, she will feel somewhat constrained by the obligation created by that utterance.

We will focus on noncooperative situations in this paper, because there the role of obligations is easier to see; but the considerations will also have relevance for cooperative dialogs.

Although Traum and Allen's (1994) conception of discourse obligations is general enough to cover the type of case just discussed, their realization of it in the context of the TRAINS system is evidently more limited (see also Allen et al., 1995). In particular, they say little about cases in which the system handles trade-offs between the desire to fulfill obligations and the desire to achieve the system's goals. As the TRAINS system has a cooperative motivation, it relatively seldom has a reason to try to avoid fulfilling discourse obligations.

The present contribution can be seen as a fuller working out of Traum and Allen's (1994) general conceptualization (although most of the work was done independently). We will address the following general issues (as well as a number of more specific ones):

1. How are discourse obligations created by dialog moves?
   The general way in which this happens has been discussed by previous researchers, but our account will add some new points.
2. How are discourse obligations fulfilled by subsequent dialog moves—or, more generally, how do dialog moves affect the status of existing obligations?
   Our account differs from previous ones in that it presents a more differentiated picture of the possible relationships between a dialog move and an existing obligation.
3. In what ways do discourse obligations constrain the generation of dialog moves?
   This issue is related to the previous one in that a speaker, when selecting a dialog move, must take into account the effect that it would have on existing obligations. But now the question must be addressed: How do these anticipated effects figure in the evaluation of a potential move? Our approach is characterized by a quantitative assessment of various factors that determine the desirability of a potential dialog move. The sort of trade-off between factors that is mentioned in the quoted passage of Traum and Allen (1994) can be handled especially naturally within such a framework.

Example Domain and System

These issues will be discussed with reference to methods that are, at the time of this writing, being integrated into the dialog system PRACMA (see, e.g., Jameson et al., 1995; Ndiaye & Jameson, 1996). They have been implemented and refined within a smaller prototype—to be called MICROPRACMA—in

[1]For clarity, we arbitrarily use feminine pronouns to refer to the seller in this dialog situation—even as simulated by the system—and masculine pronouns for the buyer.

which almost all of PRACMA's modules are replaced by simple emulators. Except where otherwise stated, all references to "the system" in the following will concern MICROPRACMA.

Both PRACMA and MICROPRACMA model dialogs in which a seller is trying to sell her used car to a potential buyer. The goals of the two dialog participants in this example domain conflict in part: The buyer wants to get the best possible information on which to base a decision about the car, whereas the seller would like to sell the car, whether or not it is really suitable for the buyer.

PRACMA and MICROPRACMA are able to take the role of either the seller or the buyer within their dialog situation. In the examples discussed in this paper, MICROPRACMA will be taking the role of the seller.

Structure of the Paper

So that not all complications have to be dealt with at the same time, the following five major sections will consider a sequence of five increasingly complex dialog situations. Each section will include the following subsections:

1. *Definition of the Situation:* a statement of the assumptions made about each situation.
2. *Theoretical Considerations:* a discussion of the considerations that need to be taken into account by the design of a system that is to act appropriately in this situation.
3. *Realization in the System:* a description of how these considerations have been taken into account in MICROPRACMA.
4. *Resulting Behavior:* a discussion, based on the performance of MICROPRACMA, of typical dialog phenomena that result if the strategies in question are applied.

Situation 1: Dialog Unconstrained by Discourse Obligations

Definition of the Situation

In this first situation, $\mathcal{U}$'s behavior is assumed to be such that it creates no discourse obligations for $\mathcal{S}$: In particular, $\mathcal{U}$ listens largely passively to what $\mathcal{S}$ has to say and answers $\mathcal{S}$'s questions directly. Although $\mathcal{S}$'s moves create obligations for $\mathcal{U}$, $\mathcal{S}$ does not yet take these obligations into account explicitly.

This situation serves as a baseline with which the later situations, which involve discourse obligations, can be compared. It allows us to explain the system's move selection criteria that do not refer to obligations; these criteria will later be applied in conjunction with criteria that do refer to obligations.

We also assume in all situations in this paper that the seller does not engage in complex dialog planning but rather performs basically reactive *dialog management* (cf. Traum & Allen, 1994). Most of the ideas introduced are also relevant in a dialog planning context, though some aspects of the move-selection strategies would have to be replaced.[2]

Finally, to postpone the discussion of turn taking issues until a more appropriate point (Situation 5), we assume for now that each dialog participant generates exactly one utterance when it's his or her turn and then surrenders the turn to the other participant.

Theoretical Considerations

In this situation, two important types of dialog move for the seller (or system) $\mathcal{S}$ are the following:

1. Moves that present information about a given car.
   Given its overall dialog goal, $\mathcal{S}$ should aim mainly to choose moves that will create a favorable evaluation of the car by $\mathcal{U}$.

[2]One example of a dialog plan in the car-selling domain is the trick whereby the seller persuades the buyer to agree to buy a given car at a reduced price, only to report subsequently that the manager has refused to authorize the price reduction.

2. Moves that elicit information from $\mathcal{U}$ concerning $\mathcal{U}$'s evaluation criteria and knowledge.
   This type of information will put $\mathcal{S}$ in a better position to choose moves of the first type. The best moves are the ones that will reduce $\mathcal{S}$'s uncertainty about $\mathcal{U}$ to the greatest extent. The utility of a move like this is in general greatest if it is made early in the dialog, because $\mathcal{S}$ will then have the most opportunity to exploit the information obtained.

The general point is that the benefits associated with each potential move should be evaluated on some sort of quantitative scale; only then is it possible for $\mathcal{S}$, for example, to judge whether it is more worthwhile to ask $\mathcal{U}$ what his profession is or how many children he has.

Realization in the System

The particular techniques that the larger system PRACMA uses to arrive at quantitative evaluations of possible dialog moves are discussed by Jameson et al. (1995).[3] For the present purposes, the only important point is that the techniques yield quantitative assessments of the expected benefits of possible dialog moves. MICROPRACMA simply uses prestored numbers that correspond to the results that would be computed dynamically in PRACMA.

For MICROPRACMA the number of possible dialog moves at any given time is finite, and the possible moves are generated with simple template-based methods. The move selection problem thus reduces in this baseline situation to the problem of choosing from a list of possible moves the move with the highest assessed benefits.

Resulting Behavior

$\mathcal{S}$ tends to ask questions of $\mathcal{U}$ that are likely to yield the most useful information, and $\mathcal{S}$ sends to generate descriptive statements that are likely to make the most favorable impressions. As the benefits of the first type of move are assigned their highest weight early in the dialog, this type of move tends to come early. In the full PRACMA system, $\mathcal{S}$'s utterances become increasingly well tailored to $\mathcal{U}$ as more and more evidence concerning $\mathcal{U}$'s evaluation standards and other characteristics becomes available.

Situation 2: Fulfilling or Rejecting Discourse Obligations

Definition of the Situation

In this situation, it is possible for $\mathcal{U}$ to make dialog moves that create discourse obligations for $\mathcal{S}$. In addition, $\mathcal{S}$ may incur obligations that are created by $\mathcal{S}$'s own moves, as when $\mathcal{S}$ promises to supply some information to $\mathcal{U}$. Cases in which two or more obligations for $\mathcal{S}$ exist simultaneously will not be considered until Situation 3; similarly, for now we only consider moves by $\mathcal{S}$ that either directly fulfill or violate its obligations. The obligations which arise for $\mathcal{U}$ are not yet taken into account explicitly by $\mathcal{S}$.

Theoretical Considerations

First it is necessary to define a concept of a *discourse obligation* as an abstract entity with the following properties, among others:

- the nature of the dialog move(s) that $\mathcal{S}$ is obligated to perform; and
- the severity of the penalty for $\mathcal{S}$ if the obligation is not fulfilled.

[3]The techniques are based on multiattribute utility theory (von Winterfeldt & Edwards, 1986) as an underlying framework, and they use Bayesian networks (Pearl, 1988) to manage the large amount of uncertainty involved and to assess the value of information that might be obtained from $\mathcal{U}$. The same Bayesian networks are used for the interpretation of evidence in $\mathcal{U}$'s dialog behavior.

The concept of a *penalty* is employed here because of the analogy with everyday situations in which a person is threatened with concrete sanctions if he or she fails to fulfill a particular obligation (e.g., the obligation to return a library book by a given date). In the context of a dialog, the negative consequences of failure to fulfill a discourse obligation are of course much less tangible and measurable; they include consequences such as irritation and negative judgments on the part of the dialog partner, as well as the unease that people themselves tend to feel when they deviate visibly from broadly accepted conventions. For simplicity of exposition we will write as if $\mathcal{S}$ had to pay some single fine whose size corresponded to the sum of all of these negative consequences.

The fact that such penalties can differ significantly in their size can be seen if we compare moves that create basically the same obligation but with a different degree of bindingness, such as the following two alternative moves:

▷ $\mathcal{U}$: I consider fuel consumption to be an important criterion.
▷ $\mathcal{U}'$: What's this car's fuel consumption?

In each of these cases, if $\mathcal{S}$ responds with a dialog move that in no way addresses the issue of fuel consumption, $\mathcal{S}$ will have violated an obligation created by $\mathcal{U}$'s move; but the violation is considerably more serious in the second case, and it will be associated with a higher penalty.

$\mathcal{S}$ has to have knowledge about the obligations created by moves of various types, and $\mathcal{S}$ must apply this knowledge after each dialog move so as to take note of any new obligations that have arisen for $\mathcal{S}$.

Equally essential for $\mathcal{S}$ is knowledge of what conditions a future dialog move has to satisfy if it is to count as fulfilling a given obligation.

Finally, obligations would have little significance if they weren't taken into account in the generation of dialog moves: When choosing a move while faced with an obligation $\mathcal{O}$, $\mathcal{S}$ should consider not only the expected benefit of each possible move $\mathcal{M}$ (as in the previous situation) but also whether each possible $\mathcal{M}$ would fulfill or violate $\mathcal{O}$. In the latter case, the violation of $\mathcal{O}$ should be viewed as a drawback of $\mathcal{M}$, one whose weight depends on the size of the penalty associated with $\mathcal{O}$.

Realization in the System

The implementation of MICROPRACMA (and of the relevant parts of PRACMA) is object-oriented (with COMMONLISP / CLOS as the language of implementation). Most of the aspects of the model to be discussed are realized through the definition of classes and associated methods.

Entities

A number of types of dialog move are distinguished, each type corresponding to a subclass of the class Move. In Figure 1 (some aspects of which will only be discussed in later sections), the left-hand and right-hand columns include examples of move classes. Most of these are domain-dependent; this fact reflects the fact that on the pragmatic level being considered here, the function of an utterance like "I'm especially concerned about safety" is partly specific to the nature of the discourse that is taking place. Each instance of such a class represents a number of properties of a move, such as the speaker, the formulation used, and the content conveyed.

The other major class of entities is Obligation. This class also subsumes a number of subclasses, some of which are shown in the middle column of Figure 1. Each subclass corresponds to a type of requirement that the obligation imposes. The following are the main properties that are associated with each instance $\mathcal{O}$ of a subclass of Obligation. (Properties and concepts that only become relevant in Situation 3 are marked with *.)

1. The dialog move that gave rise to $\mathcal{O}$;
   The content of this move largely determines the content of $\mathcal{O}$.
2. the current *status* of $\mathcal{O}$;

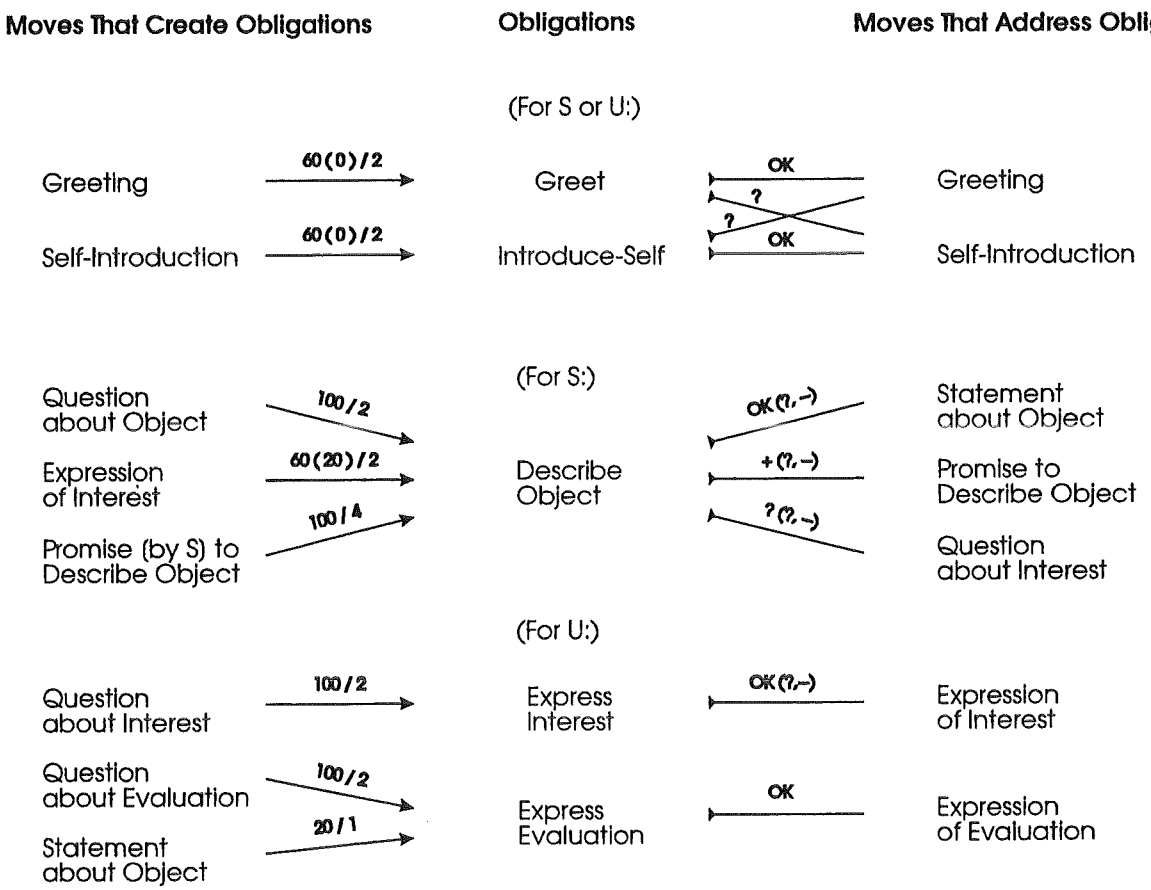

Figure 1: Summary of some methods for the creation and updating of discourse obligations.

Each arrow on the left-hand side means that a move of the type specified creates an obligation of the type specified; in the notation p/d, p refers to the total penalty associated with the obligation and e refers to the length of its expiration period (in moves); in $p_1(p_2)/e$, p_2 is the penalty that applies if the obligation-creating move is not spontaneous (cf. Situation 4). Each arrow in the right-hand side of the figure means that a move of the type specified (in the rightmost column) changes the status of the specified obligation to one of the statuses listed above the arrow (OK = Fulfilled, + = Accepted, ? = Possibly Accepted, − = Rejected). Where more than one status is specified, the first one applies if the content of the move is directly relevant to the content of the obligation; if the move is only partly relevant, or if it is irrelevant, the first or second of the statuses in parentheses apply, respectively. Any move of a type not linked to an obligation by such an arrow changes the obligation's status to Rejected (though this status may subsequently be changed to Delayed, as will be discussed in connection with Situation 3).

The possible statuses are Fresh, Fulfilled, Rejected, *Accepted, *Possibly Accepted, and *Delayed. The meaning of the first three is as follows:

- Fresh means that $\mathcal{O}$ has just been established and that $\mathcal{S}$ has not yet had a chance to address it.
- Fulfilled means that $\mathcal{S}$ has satisfied the requirement imposed by $\mathcal{O}$.
- Rejected means that $\mathcal{S}$ has made it clear that she is not going to fulfill $\mathcal{O}$.

3. the *total penalty* that will be incurred if the status of $\mathcal{O}$ is changed to Rejected;
4. * the *expiration period*, i.e. the number of dialog moves during which the obligated party can fulfill $\mathcal{O}$.

Methods for Creating and Updating Obligations

$\mathcal{S}$'s knowledge about the obligations created by particular moves essentially takes the form of rules, as is the case with Traum and Allen's (1994) model. The rules are implemented procedurally with CLOS methods, each of which is associated with a subclass of moves: For each such subclass, there is

a method that determines what obligations, if any, an instance of that subclass creates, and what penalty and expiration period are associated with the created obligation. The arrows on the left in Figure 1 give some examples of such rules. (The numbers appearing in parentheses above some of the arrows reflect the context-dependence of the corresponding rules, which will be discussed in Situation 4.) The two uppermost rules correspond to the relatively domain-independent obligations to respond to a greeting with a greeting and to a statement like "My name is X" with a similar statement of one's own. The next two rules create obligations for the seller in the used-car domain: A question about the object under discussion (e.g., "What's the car's fuel consumption?" or "What safety features does the car have?") creates a strong obligation to make some relevant descriptive statement about the object; an expression of interest like "I'm concerned about safety features" creates a weaker obligation of the same sort. The next rule illustrates how a dialog move of $\mathcal{S}$ (e.g., "I'll tell you about the car's safety features") can create an obligation for $\mathcal{S}$ herself. (The lowest third of the figure will be discussed in connection with Situation 4.)

The most straightforward way to represent knowledge about how a given obligation can be fulfilled would be with a list of one or more characterizations of possible moves that could fulfill it (cf., e.g., Traum & Allen, 1994, p. 3). A more general approach is to associate with each subclass of obligation a method that determines, for a given obligation $\mathcal{O}$ and a given dialog move $\mathcal{M}$, the effect that $\mathcal{M}$ has on the status (and other properties) of $\mathcal{O}$. (The advantages of this approach will become clearer in Situation 3, in which a larger number of possible statuses for an obligation are considered.) Each arrow on the right-hand side of Figure 1 with the label "OK" corresponds to a method which specifies that a move of a given class changes the status of an obligation of a particular class to Fulfilled. This change can be subject to particular conditions; for example, a move of the class Statement About Object only fulfills an obligation of the class Describe Object if the move is directly relevant to the topic of the move that gave rise to the obligation. In the following exchange, for example, $\mathcal{S}$'s move changes the status of the Describe Object obligation to Rejected:

▷ $\mathcal{U}$: `Does the car have white-walled tires?`
▷ $\mathcal{S}$: `The car has air conditioning.`

Taking Obligations into Account in Move Selection

In this simplified situation, it is straightforward for $\mathcal{S}$ to take any obligation it faces into account when deciding what to say: The evaluation of a possible move $\mathcal{M}$ considers not only its expected benefits (as in the previous situation) but also—if $\mathcal{M}$ is a move that would change the status of an obligation to Rejected—the penalty that $\mathcal{S}$ would have to pay.

Resulting Behavior

In this situation, the system behavior that results from our conceptualization of obligations is still largely unremarkable: When $\mathcal{S}$ faces an obligation, she is inclined to fulfill it, because otherwise she has to pay the penalty. But there is one nontrivial consequence, which results from the quantitative distinction of different penalties for obligations and different benefits of moves: $\mathcal{S}$ will sometimes flout an obligation if the penalty is relatively low and/or the desirability for $\mathcal{S}$ of making some move that is inconsistent with the obligation is especially high. In such cases $\mathcal{S}$ acts like a person who chooses to pay the fine for keeping a library book past its due date so as to be able to use the book for an important purpose.

Situation 3: More Complex Effects of Moves on Obligations

Definition of the Situation

We now take into account the fact that not all discourse obligations are necessarily fulfilled or rejected immediately after their creation. If $\mathcal{S}$ has some time during which she can address the obligation, her moves during that period can have other, intermediate effects on the status of the obligation.

Theoretical Considerations

Expiration Periods for Obligations

As was suggested earlier, some discourse obligations must be viewed as specifying a relatively long time during which they can be fulfilled (cf. the example expiration periods specified by the obligation-creation arrows in the left-hand side of Figure 1).

The conventions that determine these expiration periods depend on the type of dialog involved. For example, in the context of a courtroom cross-examination, a question presumably obligates the witness to answer without any intervening dialog move, whereas in a casual conversation a question may unobjectionably be answered several moves after it was asked.

One issue that arises is that of why discourse obligations in conversation tend to be seen as having a limited expiration period at all, rather than simply being added without deadline to a general to-do list for the obligated party. There appear to be two general reasons (which will be discussed for concreteness with reference to the roles $\mathcal{S}$ and $\mathcal{U}$):

1. $\mathcal{S}$'s fulfillment of an obligation is often of use to $\mathcal{U}$ only if it occurs within a certain period of time. For example, if $\mathcal{U}$ has asked a question, he may need to use the answer as the basis for his selection of further dialog moves.
2. Less obviously, the resource limitations that typify everyday dialog—in particular, the inability to use external storage—generally make it difficult for dialog participants to maintain large to-do lists of obligations.[4]

   The convention that discourse obligations expire sooner or later ensures in two ways that the number of obligations faced by $\mathcal{S}$ will not get very large:
   - Even if $\mathcal{U}$ insists on piling obligations onto $\mathcal{S}$ faster than $\mathcal{S}$ can fulfill them, some of these obligations will expire unfulfilled, so that the number that $\mathcal{S}$ has to deal with will remain small.
   - Recognition of this fact encourages $\mathcal{U}$ not to overload $\mathcal{S}$ with obligations in the first place, as this practice is counterproductive for $\mathcal{U}$.

     This second consideration becomes especially relevant in Situation 5, in which the number of dialog moves per turn is variable; it will be discussed further in connection with that situation.

Intermediate Statuses for Obligations

Before the expiration period has elapsed, a move $\mathcal{M}$ by $\mathcal{S}$ can have one of the following three additional relationships to the obligation in question (cf. the examples in the right-hand side of Figure 1):

1. $\mathcal{M}$ may indicate to $\mathcal{U}$ that $\mathcal{S}$ intends to fulfill $\mathcal{O}$, even though $\mathcal{S}$ has not yet done so.

   A clear example of such a case is one where $\mathcal{S}$ announces the intention to fulfill $\mathcal{O}$.

   This case should not be handled in the same way as a direct fulfillment of $\mathcal{O}$; after all, $\mathcal{S}$ may never actually get around to fulfilling $\mathcal{O}$. On the other hand, the penalty paid by $\mathcal{S}$ will be lower (for the time being) than in the case where $\mathcal{S}$ rejects $\mathcal{O}$ outright. It seems in general reasonable to view $\mathcal{S}$ as paying some intermediate penalty which is positively related to the importance of $\mathcal{O}$ and inversely related to the length of $\mathcal{O}$'s expiration period.
2. $\mathcal{M}$ may leave it unclear to $\mathcal{U}$ whether $\mathcal{S}$ will get around to fulfilling $\mathcal{O}$ before $\mathcal{O}$ expires.

   Consider, for example, the following exchange:

   ▷ $\mathcal{U}$: `I consider fuel consumption to be an important criterion.`
   ▷ $\mathcal{S}$: `The car has quite a powerful motor.`

   Unlike the utterance "The car has a great hifi set", this response by $\mathcal{S}$ leaves open the possibility that $\mathcal{S}$ will soon proceed to say something about the car's fuel consumption, having now made an indirectly relevant preliminary remark.

[4]Note, by contrast, that in contexts such as legal debate it is not unusual for one party to raise a large number of issues that will have to be addressed at some point by the other party. This behavior is accepted by both sides because the resources required for the necessary obligation bookkeeping are available.

$\mathcal{S}$ should, however, be viewed as paying some penalty for not addressing the obligation directly, if only because she has kept $\mathcal{U}$ in the dark for a while with regard to the prospect that the obligation will be fulfilled.

3. If there exists simultaneously with $\mathcal{O}$ another obligation $\mathcal{O}'$, $\mathcal{M}$ may fulfill $\mathcal{O}'$ but not $\mathcal{O}$.
   Here is an example:

   ▷ $\mathcal{U}$: Reliability is the most important factor for me.
   ▷ $\mathcal{S}$: I'll tell you something about the car's reliability.
   ▷ $\mathcal{U}$: Does the car have white-walled tires?
   ▷ $\mathcal{S}$: It doesn't have white-walled tires.

   At the point where $\mathcal{S}$ has to choose her second move, $\mathcal{S}$ has accumulated two obligations: to say something about the car's reliability and to say whether it has white-walled tires. $\mathcal{S}$'s second move fulfills only the second obligation, but it does not signify a rejection of the first one. $\mathcal{S}$ should not be seen as paying a penalty for neglecting the first obligation; the existence of the second obligation provides a good excuse.

Realization in the System

As was indicated above, the idea that obligations have different expiration periods is represented simply in the present prototype through the association with each obligation $\mathcal{O}$ of a given number of moves within which $\mathcal{O}$ is expected to be fulfilled (cf. the numbers above the arrows in the left-hand side of Figure 1).

The three intermediate statuses Accepted, Possibly Accepted, and Delayed correspond to the three cases mentioned in the previous subsection. Whereas obligations that have been fulfilled or rejected are removed immediately from the table of $\mathcal{S}$'s obligations, as long as an obligation has one of the three intermediate statuses it remains in the table of obligations for $\mathcal{S}$ until its expiration period has elapsed.

The main differences among the consequences of these three statuses concern the penalty that is incurred by a move that gives an existing obligation the status in question. The exact formulas and numbers currently used in the prototype are highly tentative and somewhat arbitrary, but we present them here for concreteness and as a stimulus for discussion:

1. If a move $\mathcal{M}$ changes the status of an obligation $\mathcal{O}$ to Possibly Accepted, the penalty paid by $\mathcal{S}$ is the Penalty per Move, i.e., the quotient p/e, where p is the total penalty associated with $\mathcal{O}$ and e is the length of its expiration period.
   The rationale is that if $\mathcal{S}$ keeps leaving it unclear whether she will fulfill $\mathcal{O}$ in spite of having a chance to do so, then by the time $\mathcal{O}$ has expired the total penalty should be the same as if $\mathcal{S}$ had rejected $\mathcal{O}$.[5]
2. If $\mathcal{M}$ changes the status of $\mathcal{O}$ to Accepted, only half of the Penalty per Move is paid.
   As argued above, the penalty in this case should be lower than in the first case. This does not mean that $\mathcal{S}$ can in general escape an obligation fairly easily just by accepting it and then not fulfilling it: The dialog move by $\mathcal{S}$ that signals acceptance of $\mathcal{O}$ at the same time creates a further obligation with basically the same content as that of $\mathcal{O}$. So such a move is comparable to the tactic of taking up a new loan in order to pay off an existing one. (The question of how such a move may benefit $\mathcal{S}$ is discussed in the next subsection.)
3. If $\mathcal{M}$ fulfills an alternative obligation $\mathcal{O}'$ and therefore changes the status of $\mathcal{O}$ to Delayed, $\mathcal{S}$ pays no penalty at all—provided that $\mathcal{O}'$ was a more urgent obligation than $\mathcal{O}$, that is, if the Penalty per Move for $\mathcal{O}'$ was greater than that for $\mathcal{O}$. If $\mathcal{O}'$ was *less* urgent, the difference between the two Penalty per Moves is paid.
   The rationale here is that the fulfillment of another obligation which is at least as urgent as $\mathcal{O}$ constitutes a good excuse for not fulfilling $\mathcal{O}$. On the other hand, it is less acceptable for $\mathcal{S}$ to neglect an urgent obligation in order to fulfill a trivial one.

[5]This argument is actually strictly applicable only in Situation 5, in which $\mathcal{S}$ can be given the opportunity to keep talking throughout the expiration period of an obligation.

Resulting Behavior

Now that the possible responses of $\mathcal{S}$ to a discourse obligation have been expanded, when will $\mathcal{S}$ actually choose to make use of the new options?

When two obligations that are associated with similar Penalty per Moves exist, $\mathcal{S}$ can basically choose which one to fulfill. When anticipating the effect of each move $\mathcal{M}$ on its obligations, $\mathcal{S}$ notes that any move that fulfills one of the two obligations can be made without penalty; the choice therefore depends on the expected benefits for $\mathcal{S}$ herself of each such move.

If only one obligation $\mathcal{O}$ exists and the moves that fulfill $\mathcal{O}$ happen to be unattractive to $\mathcal{S}$, $\mathcal{S}$ may decide not to reject $\mathcal{O}$ outright but rather to choose a move that changes $\mathcal{O}$'s status to Accepted or Possibly Accepted. (A familiar example of the latter tactic in everyday dialog is an attempt to change the subject inconspicuously when asked a question that one would prefer not to answer.) If $\mathcal{S}$ is lucky, $\mathcal{U}$ will proceed to create new obligations for $\mathcal{S}$—or (in Situation 5) simply to generate more than the necessary number of moves himself—in which case $\mathcal{O}$ may expire without $\mathcal{S}$ having to pay the full penalty that would be associated with its rejection. But this tactic may also backfire: If $\mathcal{U}$ refuses to allow $\mathcal{O}$ to expire, $\mathcal{S}$ will still end up having to fulfill or reject $\mathcal{O}$, and the penalty she paid for the attempt to avoid $\mathcal{O}$ will have been paid in vain.

The possibilities just mentioned show that, in order to juggle obligations optimally, $\mathcal{S}$ would actually have to anticipate how $\mathcal{U}$ will respond to a move that creates an intermediate status for an obligation. For example, suppose that $\mathcal{U}$ has just asked an obviously important question and that $\mathcal{S}$ anticipates that $\mathcal{U}$ will keep repeating the question until he gets a direct answer. In this case, $\mathcal{S}$ should not even try in the first place to avoid answering the question. The explicit anticipation of the user's next move has not been realized in MICROPRACMA, but it is handled in a general way within the full PRACMA system with the technique of *global anticipation feedback* (Ndiaye & Jameson, 1996). Accordingly, integration of MICROPRACMA's new techniques into the PRACMA system will allow the use of this strategy in connection with obligation management to be explored.

By not anticipating $\mathcal{U}$'s next moves, in effect MICROPRACMA embodies a short-sighted approach to the problem of escaping from unwanted obligations: All other things being equal, it chooses the move that yields the lowest *immediate* penalty. Whether this move turns out to be the best one for $\mathcal{S}$ in the long run depends partly on chance and partly on the dialog skills of $\mathcal{U}$. This short-sighted approach may be typical of human dialog behavior in cases where anticipation of the dialog partner's moves is either too error-prone or too resource-consuming.

Situation 4: Taking Into Account the Obligations of Both Dialog Participants

Definition of the Situation

$\mathcal{S}$ now takes into account the fact that $\mathcal{U}$, as well as $\mathcal{S}$, faces discourse obligations that arise during the dialog.

Theoretical Considerations

The discourse obligations faced by $\mathcal{U}$ are basically the same in nature as those faced by $\mathcal{S}$. They are created mainly by $\mathcal{S}$'s moves and to a lesser degree by those of $\mathcal{U}$ himself. Moreover, since the moves that create obligations are perceived by both dialog participants, it is not fundamentally more difficult for $\mathcal{S}$ to keep track of $\mathcal{U}$'s obligations than it is for $\mathcal{S}$ to keep track of her own.

But why is it in fact necessary for $\mathcal{S}$ to monitor $\mathcal{U}$'s obligations? There are three main reasons:

1. When $\mathcal{S}$ considers a potential move $\mathcal{M}$ that would create an obligation $\mathcal{O}$ for $\mathcal{U}$, $\mathcal{S}$ should take into account the *cost* to herself of imposing $\mathcal{O}$ on $\mathcal{U}$.

   A speaker cannot in general afford to impose arbitrarily many obligations on her dialog partner. Examples illustrating this point will be given in the next subsection.

2. An obligation for $\mathcal{U}$ which is created by $\mathcal{S}$'s move $\mathcal{M}$ will influence $\mathcal{U}$'s future dialog moves and so influence the ultimate desirability of $\mathcal{M}$ for $\mathcal{S}$.
   Consequently, if $\mathcal{S}$ assesses the expected benefits of its own moves by anticipating $\mathcal{U}$'s subsequent moves, $\mathcal{S}$ must take $\mathcal{U}$'s new obligations into account when performing the anticipation.
3. $\mathcal{S}$'s interpretation of a move by $\mathcal{U}$ must take into account the extent to which $\mathcal{U}$'s selection of this move was influenced by $\mathcal{U}$'s obligations.
   More specifically, there is an important distinction between a *spontaneous* move by $\mathcal{U}$—i.e. one that did not fulfill any obligation of $\mathcal{U}$—and a move by $\mathcal{U}$ that was influenced by an obligation. For example, the utterance by $\mathcal{U}$ "My name is Bill" creates an obligation for $\mathcal{S}$ to introduce herself—but this is only fully the case if $\mathcal{U}$'s move is spontaneous; not, for example, if it is a response to $\mathcal{S}$'s utterance "My name is Sue".

Realization in the System

MICROPRACMA maintains two tables of obligations, which represent the obligations of $\mathcal{S}$ and $\mathcal{U}$, respectively. The procedures for processing obligations are basically the same whether it is those of $\mathcal{S}$ or those of $\mathcal{U}$ that are involved. In fact, in the implementation, exactly the same procedures are used, with a parameter specifying whose obligations are involved. The bottom part of Figure 1 shows some examples of obligations that can only be faced by the user $\mathcal{U}$ in the example domain (assuming, as we have in all of our examples, that the user takes the role of the buyer).

The three ways (discussed more abstractly in the previous subsection) for $\mathcal{S}$ to take $\mathcal{U}$'s obligations into account are realized as follows:

1. The obligation-creation methods illustrated in the left-hand side of Figure 1 also specify for each obligation $\mathcal{O}$ that is created the estimated cost of imposing it on the dialog partner (these estimates are not shown in the figure). Such an estimate is based on two factors:
   - How disagreeable the fulfillment of $\mathcal{O}$ is likely to be for $\mathcal{U}$.
     This factor can often only be roughly estimated by $\mathcal{S}$, but it should be taken into account. This factor presumably explains, for example, why a salesperson will hesitate to ask a customer about his income (valuable as this information would be) whereas a question about the customer's place of residence is unproblematic.
   - The penalty that is associated with nonfulfillment of the obligation.
     An obligation that is associated with a high penalty constrains $\mathcal{U}$'s behavior more strongly than does a weaker obligation; it should therefore be imposed only when $\mathcal{S}$ has a good reason to do so. For example, $\mathcal{S}$ may hesitate to ask $\mathcal{U}$ directly about his evaluative reaction to a statement about the car under discussion (e.g., with the question "What do you think of that [= the fact that the car gets 9 miles per gallon]?"). But $\mathcal{S}$ may be willing to impose a weaker obligation of the same sort on $\mathcal{U}$ simply by making the statement and then giving $\mathcal{U}$ the chance to make the next move (cf. the illustration of the obligation class Express Evaluation at the bottom of Figure 1).
2. As was noted above, MICROPRACMA does not explicitly anticipate $\mathcal{U}$'s next move when selecting a move of its own. Such an anticipation is not in general necessary for the determination of a rough heuristic evaluation of a possible move. For example, the computation of the expected utility of a question by $\mathcal{S}$ can be based on the assumption that the question is most likely to be followed by an answer. The fact that such an answer is made likely by a newly created obligation—and the fact that the answer will not necessarily actually be given by $\mathcal{U}$—need not be taken into account explicitly by $\mathcal{S}$ when it computes the expected utility of a question.[6]
3. When $\mathcal{S}$ has to respond to a move $\mathcal{M}$ made by $\mathcal{U}$, one of the first things that $\mathcal{S}$ does is to note $\mathcal{M}$'s impact on $\mathcal{U}$'s obligations (as well as its impact on $\mathcal{S}$'s own obligations). When doing this, $\mathcal{S}$ notes in particular whether $\mathcal{M}$ fulfilled any obligation that was faced by $\mathcal{U}$. If this is not the case, $\mathcal{M}$ is

[6]For a discussion of the advantages and limitations of the anticipation of the user's subsequent moves, see Ndiaye and Jameson (1996).

classified as being *spontaneous*; this classification is taken into account by some of the rules that determine which obligations (if any) a move creates for S. For example, an Expression of Interest by U (e.g., "Comfort is my highest priority") imposes a stronger obligation on S if it is spontaneous (cf. Figure 1).

Resulting Behavior

The main consequence of adding the features discussed in this section to MICROPRACMA is to prevent S from exhibiting certain maladaptive tendencies that it displays in Situations 2 and 3:

1. S now responds more appropriately to nonspontaneous moves by U.
   For example, exchanges such as the following one no longer occur:
   ▷ S: `Hello.`
   ▷ U: `Hello.`
   ▷ S: `Hello.`
2. S is less inclined to impose a large number of strong obligations on U.
   To do so would be appropriate only for a dialog participant (such as a police interrogator) whose dominant role allowed her to attach negligible weight to the factor *cost of imposing obligations*.

Situation 5: Taking Turns Shorter or Longer Than One Utterance

Definition of the Situation

Up to now we have been assuming that S and U both adhere to an unnaturally rigid system of turn taking: Each participant, after producing a single one-sentence dialog move, allowed the other participant to take the next turn. In general, of course, turns can vary greatly in terms of length. While we will not attempt here to model all of the ways in which turn taking is accomplished (see, e.g., Sacks et al., 1974; O'Connell et al., 1990; Oreström, 1983), we now consider the following possibilities: A speaker who has the turn can keep it as long as he or she likes, producing a sequence of moves that ends with a release of the turn.

Theoretical Considerations

Relationships of Turn Release to Obligations

In this situation there is a new dialog move of the type Release Turn. Furthermore, in the special case where a participant releases the turn before saying anything at all (except perhaps for a back-channel item, not modeled explicitly here), it is convenient to view the participant as having performed the move Pass Up Turn (cf. Traum & Hinkelman, 1992).

One issue that arises is: How do these two new move types affect the status of a speaker's existing obligations? (Without loss of generality, we consider for concreteness the case where the speaker is the system S.)

Pass Up Turn appears to signal the rejection of any obligation O that S faces at the moment. After all, S has just been given a chance to fulfill O, and she has neither done so nor made any other move that could lead to an intermediate status for O (cf. Situation 3). Note, for example, that it is only in extreme cases that people remain completely silent when they are greeted or asked a question and then given the turn—however disagreeable it might be for them to give a response.

Release Turn, by contrast, seems in itself to have no effect on the status of existing obligations. Consider, for example, the following exchange:

▷ U: `I consider reliability extremely important.`
▷ U: `I consider comfort important.`

▷ $\mathcal{U}$: [Release Turn]
▷ $\mathcal{S}$: The car just recently passed its inspection.
▷ $\mathcal{S}$: [Release Turn]

When $\mathcal{S}$ releases her turn here, she has not yet addressed her obligation to say something about the attributes of the car that are related to comfort. Yet her failure to do so, even though she could have, doesn't seem to constitute a rejection of the obligation. She is simply giving $\mathcal{U}$ a chance to say something, which he might well want to do at this point. It is only if $\mathcal{U}$ passes up his new turn and $\mathcal{S}$ continues to remain silent that her silence will signify rejection of the remaining obligation.

Assessing the Benefits of Turn Release

A second issue is: What criteria should $\mathcal{S}$ apply when evaluating the benefits associated with the moves Pass Up Turn and Release Turn? In other words, when should a speaker decide that it's in her best interests just to keep quiet and let her dialog partner speak? This may seem like an elementary question; but it appears to have attracted little attention in spite of the vast amount of research that has been done on turn taking.

One approach is for $\mathcal{S}$ to anticipate what $\mathcal{U}$ will say if given the turn now and to evaluate $\mathcal{U}$'s anticipated move according to $\mathcal{S}$'s own criteria: If $\mathcal{U}$'s anticipated move seems more desirable than the best one that $\mathcal{S}$ could produce, this fact should incline $\mathcal{S}$ to release the turn. Once again, the reader is referred to the paper by Ndiaye and Jameson (1996) for a discussion of this type of approach.

A simpler strategy focuses on one important consequence of a decision by $\mathcal{S}$ to release the turn: the consequence that $\mathcal{U}$ is given a chance to address any existing discourse obligations that he might have. By contrast, as long as $\mathcal{S}$ continues to speak, $\mathcal{U}$'s obligations will be expiring. On the whole, it is in $\mathcal{S}$'s interest to allow $\mathcal{U}$ to fulfill $\mathcal{U}$'s obligations; indeed, $\mathcal{S}$ will often have intentionally created these obligations in the expectation of ultimate benefits. Accordingly, the total weight of $\mathcal{U}$'s current obligations can be used as a simple index of the desirability for $\mathcal{S}$ of giving up the turn.

Realization in the System

The main change to MICROPRACMA required for this situation is the introduction of the two new special moves Release Turn and Pass Up Turn. Both of these moves signal to the top-level control algorithm that the next move is to be selected by the other party. When $\mathcal{S}$ is selecting a move, Pass Up Turn is one of the candidate moves if $\mathcal{S}$ has just received the turn, whereas Release Turn is among the possible moves otherwise. In connection with the tracking of the expiration of obligations, these two moves are viewed as taking no time.

The effects of these moves on existing discourse obligations are taken into account by straightforward changes to the methods for updating existing obligations.

The above-mentioned strategy for assessing the benefits of these moves is realized as follows: $\mathcal{S}$ computes the sum of the Penalty per Moves of all of $\mathcal{U}$'s current obligations, and this quantity serves as an index of the total weight of these obligations, which in turn determines the assessed benefit of releasing the turn. The weight that this index has in the evaluation of $\mathcal{S}$'s possible moves is a parameter that can take various values, which lead to different dialog styles as noted in the next subsection.

Resulting Behavior

If MICROPRACMA is run with a low value for the parameter just mentioned, $\mathcal{S}$ starts each dialog with a long turn in which (among other things) it asks every question and makes every statement that promises to yield any benefit at all. The human user cannot keep track of all of the obligations that these dialog moves create for him. And in any case, by the time he has a chance to say something he no longer feels bound by the obligations, except perhaps for the very most recent ones.

If this parameter is set to a very high value, $\mathcal{S}$ releases the turn as soon as $\mathcal{U}$ has incurred even a weak obligation. For example, every time $\mathcal{S}$ makes a statement about a particular car, $\mathcal{S}$ releases the turn so as to give $\mathcal{U}$ a chance to express an evaluative reaction. Turns of $\mathcal{S}$ that consist of several moves can still occur if the moves before the last one preceding Release Turn don't create any obligations for $\mathcal{U}$.

If the parameter is set to an intermediate value, $\mathcal{S}$ will occasionally create more than one obligation for $\mathcal{U}$ within a turn, sometimes even letting the first obligation expire (e.g., asking a sequence of two questions, of which the second effectively replaces the first).

Concluding Remarks

The topic of discourse obligations has attracted less attention than it deserves from researchers interested in the pragmatic aspects of natural language generation in dialog. The conceptualization presented here appears to capture some fundamental facts about the ways in which dialog obligations are created, modified, and taken into account. Though we will continue to develop this conceptualization and to apply it within a different domain (Wahlster et al., 1995), we hope that other researchers will feel stimulated to propose alternatives concerning either the details or the basic assumptions of the conceptualization.

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Poodle, dog or animal? Specificity of object names as a result of flexible concept-word activation

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Abstract
In referential communication objects can be labeled at different levels of abstraction. According to Rosch et al. (1976) three levels of abstraction can be distinguished: the subordiante level, the basic level and the superordinate level. Two kinds of approaches are discussed which all suggest that an intermediate level of abstraction is preferred by speakers in referential communication (the so called basic level). In the cognitive-functional approach including the theories of Rosch et al. (1976) and Hoffmann (1984) it is stated that perceived objects are categorized first at an intermediate level of abstraction and are therefore preferentially named at this level of lexical specificity. On the other hand in the communicative-funcional theory of Cruse (1977) it is assumed that this level of lexical specificity is preferred because of its greater communictional utility. It is shown that recent empirical evidence cannot be explained by these two approaches since the level of specificity of the produced object labels vary to a large degree in dependency to situational factors. An alternative theoretical framework is presented in which it is assumed that the lexical specificity of object lables is determined by a variety of contextual factors. In this model object labeling is regarded as a cascade process of concept activation and activation of word representations. Since the concept activation process is determined by contextual factors and is also temporally extended, concepts may vary over contexts and also during the time course of speech production. Empirical studies - both behavioral and neurophysiological - are reported in which the process of categorization and object naming was investigated. The studies support the assumption of a temporally extended process of concept activation and categorization.

1. Introduction

In every-day communication speakers refer to objects using utterences like "look at the black dog". Referential noun phrases such as "the black dog" in the example are usually comprised of an article, a noun coding the object class of the given object and - optionally - one or more attributes. The present paper will be focussed on the selection of an object class label in referential communication. One and the same object can be labeled at different levels of *lexical specificity*. For example, an object which has four legs, a tail and black short fur and which barks can be named as "poodle", as "dog" or as "animal". Thus, objects can be named at different levels of lexical specificity because they belong to different conceptual categories (or object classes) which differ in their *level of abstraction*. The more abstract categories (e.g. ANIMAL) include the less abstract ones (e.g. DOG or POODLE) by class inclusion. For these conceptual categories there are words available which encode them linguistically. According to Rosch, Mervis, Gray, Johnson & Boyes-Braem (1976) three levels of abstraction can be distinguished: the subordinate level (POODLE), the basic level (DOG) and the superordinate level (ANIMAL)[1]. In this paper two issues are addressed: (i) Which level of lexical specificity is preferred in referential

[1] In the present work reference to an object is indicated in the text through regular writing (e.g. poodle), and referene to a conceptual category is marked through upper case letters (e.g. POODLE). Object labels are eventually indicated through quotation marks (e.g. "poodle").

communication and which are the situational factors determining specificity of an object label? (ii) How can the cognitive process involved in the selection of an object label be conceptualized theoretically and investigated empirically?

According to prevailing theoretical frameworks - the cognitive psychological basic-level theory of Rosch et al. (1976) and the linguistic theory of Cruse (1977) - an intermediate level of abstraction ("dog") is preferred. Though, they give different reasons for this assumption: Rosch et al. (1976) state that perceived objects are categorized first at an intermediate level of abstraction (the basic level) and are therefore preferentially labelled at this level of lexical specificity (*cognitive-functional perspective*). On the other hand, Cruse (1977) points out that an intermediate level of specificity is preferred because of its greater communicational utlility (*communicational-functional perspective*). Both preferred-level approaches will be discussed in greater detail below. More recent empirical evidence shows, however, that there is a reasonable situational variability in lexical specificity. In particular, a high percentage of labels at a subordinate level which cannot be explained by the already mentioned frameworks were found under certain circumstances (e.g. Grosser, Pobel, Mangold-Allwinn, & Herrmann, 1989; Hoffmann & Kämpf, 1985; Jolicoeur, Gluck & Kosslyn, 1984; Tanaka & Taylor, 1991). Therefore, an alternative model is proposed in which the lexical specificity of object labels is explained in terms of flexible activation of concepts and of word representations (Kiefer, Mangold-Allwinn & Barattelli, 1995). In the following sections the cognitive-functional and the communicative-functional framework is described and discussed in respect to empirical evidence before we move to the proposed model.

2. Preferred-level approaches

2.1. Cognitive-functional perspective: Rosch's basic level theory

Rosch et al. (1976) suggest that an intermediate level of abstraction - the *basic level* - is of particular significance for object categorization[2]. According to Rosch and coworkers instances of categories at that level are sufficently similar because they have many attributes in common. Simultaneously, instances of the same basic level category differ in many attributes from instances of other basic level categories. Thus, basic level categories are very *differentiated* from each other. Members of the same *subordinate category*, on the other hand, are also very similar to each other and share even more attributes than members of the same basic level category. However, they also have many attributes *in common* with *other* subordinate categories. As a result, subordinate categories are less differentiated than basic level categories. *Superordinate categories*, at last, are most differentiated since members of a given category differ in many attributes from members of other

[2] A very similar model has been proposed by Hoffmann and coworkers (e.g. Hoffmann, 1984; 1986; Hoffmann & Kämpf, 1985) in which the preferred level is called the level of primary concepts ("Primärbegriffe"). This model, however, will not be desribed in this paper since both Rosch et al.'s (1976) and Hoffmann's theory overlap in many aspects.

superordinate categories. But they also include a very heterogeneous set of members sharing *only a few* attributes. Rosch et al. (1976) determined the basis level empirically as the most inclusive level of abstraction at which (i) objects have many attributes in common, (ii) objects show a high physical similiarity in the overall shape, (iii) there is a high identifiability of averages of shapes and (iv) many motor movements can be made in common to all members of a category.

Rosch et al. (1976) hypothesize that objects are categorized first at the basic level before they are categorized at the subordinate or superordinate level. Categorization is supposed to be faster at the basic than at the subordinate level because subordinate categories are less differentiated than basic level categories, and subordinate categorial identification requires therefore the sensory analysis of additional object attributes. Superordinate category membership, on the other hand, cannot be determined by perceptual attributes of the object such as the shape because category members are too dissimilar. For that reason, objects are first categorized at the basic level, and superordinate category membership is then inferred from the basic level category membership, i.e. it is retrieved from long-term memory that a member of the category DOG belongs to the superordinate category ANIMAL.

In a series of experiments Rosch et al. (1976) could show that categorization of objects at the basic level requires less time than categorization at the subordinate or at the superordinate level. Finally, the authors assumed that speakers should use object labels at the basic level most frequently because categorial identification is fastest at that level of abstraction. The empirical results confirm their assumption: Using a free-naming task they could demonstrate that speakers overwhelmingly use labels at the basic level. In sum, the findings corroborate the assumption that there is a level of abstraction at which objects are categorized first and preferentially named.

2.2. Communicative-functional perspective: the theory of Cruse (1977)

In contrast to Rosch and coworkers who give reasons for the preference of the intermediate level of abstraction from a cognitive perspective, Cruse (1977) analyzes the functionality of object names in a given communicative situation. For his theoretical analysis he refers to the "logic of conversation" as proposed by Grice (1975). Cruse (1977) assumes that speakers obey the "cooperative principle" which is specified by the so-called Grice's maxims (Grice, 1975). In this context, the most important maxim is the maxim of quantity which states that speakers should make their contribution to a conversation as informative as required, but also not more informative than it is required. Cruse (1977) furthermore asserts that an intermediate level of lexical specificity mostly fulfills the requirements of the cooperative principle (e.g. for the purpose of communication it may be most frequently sufficient to know that an object is a DOG, whereas it is overly informative (or redundant)

to know that it is a POODLE and it is eventually uninformative that it is an ANIMAL). Therefore, he terms this level the "neutral level of specificity".

Cruse (1977) distinguishes between marked and unmarked utterances. An utterance is unmarked if it includes a lexical item of the neutral level of specificity. In addition, the author suggests that the neutrality is inherent to these lexical items and therefore calls them of an "inherently neutral specificity" (INS). Utterances remain also unmarked if the use of a level of specificity other than the neutral level is justified by the communicative context. Cruse (1977) calls these lexical items of a "contextually neutral specificity" (CNS). Imagine, for example, you are in a shop where different kinds of apples - Granny Smith and Golden Delicious - are sold. It is not informative for the shop keeper if you just ask for "apples". In order to enable him to identify exactly the apples you have in mind you have to use the more specific term such as "Granny Smith". Although it is not further elaborated in Cruse's (1977) theory the concept of unmarkedness of an utterance is based on the implicit underlying assumption that the speaker always has the communicative goal to enable an addressee the identification of an object. Accordingly, Cruse (1977) assumes that speakers will convey only as much information as it is necessary for object identification. As it will be pointed out in the following sections speakers may persue other goals than enabling identification.

Utterances are marked if they do not include an INS or if the use of a more specific or abstract level of specificity is not justified by the context. Thus, such utterances convey either more or less information which is sufficient for the sole purpose of object identification. Particularly, they bear intentional or affective information about goals or the affective state of the speaker. For example, when a speaker refers to a poodle in an utterance such as "What a beautiful animal" he or she wants to express that he or she likes this poodle very much.

In sum, the communicative-functional approach suggests that an intermediate level of lexical specificitiy should be preferred in communication since it mostly fulfills the requirements of the cooperative principle and is therefore of the highest communicative functionality. Levels of specificity other than the intermediate one are particularly used when additional information such as the intention or the affective state of the speaker should be conveyed.

3. Further empirical evidence on the preferred level of lexical specificity

According to the described cognitive-functional and communicative-functional framework a dominance of object labels at an intermediate level of abstraction (basic level) can be expected. In contrast to this assumption, a relatively high portion of more specific object labels were reported in several studies. Grosser et al. (1989) found a dominance of basic level names in a free-naming study, but with an percentage of 30 % the portion of

subordinate level names was unexpectedly high. Moreover, an average of 15 % of the subjects did not know a more specific name for the objects presented. Thus, knowlegde of the category and the category label appears to be an important variable for lexical specificity. The significance of *prior knowledge* and *expertise* could be demonstrated in a study of Tanaka & Taylor (1991). They found that experts used in the domain of expertise subordinate names as frequently as basic level names and categorized objects at the subordinate level as fast as at the basic level. Bird experts even named birds more frequently at the subordinate level than at the basic level. Objects of outside the domain of expertise were dominantly named at the basic level.

Typicality of the subordinate category for the basic level category has been under a long-standing debate in cognitive psychology as a factor influencing the level of object categorization and naming. However, the findings are contradictory so that further investigation is needed to clarify the influence of this variable. In the already mentioned study of Grosser et al. (1989) no covariation of typicality and lexical specificity was observed. Jolicoeur et al. (1984) found that atypical objects (e.g. PENGUIN) were dominantly named at the subordinate level, whereas typical objects were labeled at the basic level (e.g. ROSE). This is in line with a study of Murphy & Brownell (1985) where atypical instances were categorized faster at the subordinate level than at the basic level. Murphy & Brownell (1985) hypothesized that atypical subordinate categories are as differentiated as basic level categories and can therefore be accessed as fast as basic level categories (*differentiation hypothesis*). Hoffmann & Kämpf (1985) observed on the other hand that both atypical and very typical objects were named most frequently at the subordinate level. Only objects of an intermediate typicality were predominantly named at the basic level. Similar to Murphy and Brownell (1985), Hoffmann & Kämpf (1985) assume that instances of atypical and typical subordinate categories mostly have salient outlines which can be used as cues for categorial identification. The outline of an object is also thought as the relevant information for basic level categorization. Since the outline of an object is rapidly processed by the visual system categorization based on this kind of visual information would be relatively fast. We will turn again to this issue in a later section of this paper.

In the above described experiments object labeling was only investigated in situations where object labels were not directed to an addressee. The question can however be raised if aspects of the communicative situation affect the level of lexical specificity. In a series of experiments Grosser et al. (1989) investigated this issue. In one study subjects were instructed to name an object (in the context of other objects) either in order to impress an imagined addressee or to facilitate him or her object identification (*social conditions*). The third experimental condition consisted of a free-naming task where they just had to produce the object label which first came into their minds (*non-social condition*). Analysis revealed an effect for social vs. non-social condition: In the social condition objects were

labeled for about 80 % at the subordinate level, whereas in the non-social conditions there was a weak preponderance for basic level names. The two social conditions (impression vs. facilitation), however, did not differ from each other. The results suggest that in social conditions when object labels are directed to an addressee subordinate labels are more functional than basic level labels. This finding is in direct contradiction to Cruse's (1977) communicative-functional approach which predicts a dominance of basic level names in referential communication. In a second experiment Grosser et al. (1989) also varied the communicative goal. They found that more basic level labels were produced when subjects were requested to facilitate identification than when they had to impress a partner or to enable him to identify objects unambigously.

Grosser et al. (1989) also demonstrated that speakers adjust the level of lexical specificity to the cognitive and linguistic competence of the listener. This experimental variation was done by introducing the partner to the subjects either as an adult or as a child. It turned out that more basic level names were produced if the partner was a child than if he was an adult (in the experimental situation the partner was always male). Since children first acquire basic level names during language development (e.g. Brown, 1958; Mandler, Bauer & McDongough, 1991; Rosch et al., 1976) adults obviously take the limited cognitive and linguistic knowledge of children into account and adjust the level of lexical specificity such that children are able to understand the utterance. The dominant use of basic level names when utterances are directed to children is in line with findings from analyses of mother-child dialogs where the basic level was also prevalent in maternal speech (Mervis & Mervis, 1982; but see Lucariello & Nelson, 1986).

In the studies which have been reported so far, lexical specificity was mainly investigated in experimental situations where subjects solely produced single object labels which were not integrated into a coherent text. Moreover, subjects always named one object only once and were not required to refer several times to one and the same object during discourse. Therefore, Kiefer, Barattelli & Mangold-Allwinn (1993) studied the influence of the communicative goal, speaker's prior knowledge and discourse context on lexical specificity during discourse production. They reanalyzed data of a study conducted by Mangold-Allwinn, v. Stutterheim, Barattelli, Kohlmann & Koelbing, (1992). In this study subjects had the task either to describe the appearence of a construction made out of different wooden parts for an imagined partner who was not actually present (communicative goal: *description*) or to instrue him the construction of the object complex out of the single parts (commmunicative goal: *instruction*). In addition, *prior knowledge* was varied by showing one half of the subjects a movie in which the construction of the object complex was demonstrated, and the subjects also had the opportunity to practice construction several times. The other half of the subjects did not have that opportunity. Finally, *referential* movement was introduced as a factor into analysis (v. Stutterheim & Klein, 1989; Mangold-Allwinn et al., 1992). This variable can be characterized as the

status of a reference to an object during discourse. Speakers may refer to an object for the first time in discourse (*introduction*), speak again about this object immediately after a previous reference (*maintenance*) or they may refer to the same object at a later point in discourse (*re-mention*).

Statistical analysis revealed the following pattern: subordinate names were most frequently produced in introductions, basic level names particularly in re-mentions. In maintenances no category label was dominantly given, and it was referred to an object using pronouns. This result indicates that a maximum of information about an object (i.e. the highest portion of subordinate labels) is conveyed in introductions, whereas the level of specificity is reduced in further references to the same object probably to avoid redundancy. Furthermore, communicative goal and the factor "prior knowledge" only affected lexical specificity on introductions. Overall, the percentage of subordinate names was higher for the goal "description" than for the goal "instruction". When the communicatve goal was to describe the appearence of the object complex - independently on the kind of prior knowledge - more subordinate labels were produced than the goal was to instrue the construction. On the other hand, for the goal "instruction" prior knowledge had an influence on lexical specificity. When subjects had the opportunity to practice construction more specific labels were produced than they did not have such an experience.

These findings can be interpreted as follows: For the goal "description" subordinate object labels may be more functional than for the goal "instruction". In descriptions it is important to convey as much information as possible to an addressee so that she or he is able to get an impression of the appearence of the object complex. For instructions, however, it is sufficient to convey only the amount of information which enables the addressee to identify the intended object. Moreover, the results also suggest that for the communicative goal "description" prior practice of construction was not necessary to extract the appropiate object information which allows for specific categorization and naming. On the other hand, extense practice was necessary when the goal was to instrue the construction of the complex. Perhaps, subjects attended more to the details of the objects when they had to describe the object complex in comparison with construction or the goal "instruction" was just more demanding (e.g. for sequencing the single operations mentally) so that cognitive ressources could not be efficiently allocated to the process of object categorization.

In conclusion, the reported empirical findings indicate that basic level names are *not* the standard names in referential communication. The level of lexical specificity rather varies with perceptual properties of object attributes relevant to categorization (object outline), cognitive prerequisites of the speaker (prior knowledge/expertise) and aspects of the communicative situation (communicative goal, partner). In particular, more subordinate names were observed than it was predicted by the cognitive-functional and the communicative-functional approach. Kiefer et al. (1995) therefore propose a model which

takes the situational variability into account (for a more general framework of object naming, see Mangold in this issue; Mangold-Allwinn, Barattelli, Kiefer & Koelbing, 1995). This model will be described in the next section in more detail.

4. A model on the determination of lexical specificity

4.1 Architecture and basic processes

In the proposed model object naming is considered as a cascade process of *concept activation* and *activation of word representations* (see also Humphreys, Riddoch & Quinlan, 1988; Sacchett & Humphreys, 1992). The articulated object label is the word representation with the highest activation which is eventually phonologically and motorically encoded. (The process of phonological and motor coding is not further specified in the model, but see Dell, 1986; Levelt, 1989; Schade, 1992.). In the model it is assumed that during the time course of perceptual analysis of object attributes a cognitive representation of the object - the concept - is formed which subsequently activates word representations.

Both concepts and word representations are thought not to be simply retrieved from long-term memory as it has been suggested by a prevailing view (e.g. Murphy & Medin, 1985; for a discussion see Barsalou, 1993a; Jones & Smith, 1993; Mandold-Allwinn, 1993). They are rather *generated* out of components during the time course of speech production or comprehension (e.g. Barsalou, 1982, 1993a,b; Herrmann, 1985; Herrmann & Grabowski, 1994; Mangold-Allwinn, 1993). These components are stored in long-term memory and can be activated to varying degrees. It must be noted that the components are not considered as a kind of semantic primitives which cannot be divided further. They rather represent *different aspects* of objects and words (but also of events or abstract ideas). Furthermore, it is assumed that each component has an activation threshold, and only when the activation of a component exceeds the *threshold value* the component is part of the object or word representation. In general, two different kinds of components can be distinguished: so called *non-word components* which constitute concepts and *word components* which constitute word representations (e.g. Herrmann, 1985; see also Engelkamp, 1990). A further subdivision refers to the *modality* components can belong to. According to Herrmann & Grabobski (1994) there are sensory, abstract, motor and emotive-evaluating components. *Sensory components* code perceptual attributes of objects, events or words (such as color, shape, smell, sound etc.). *Abstract components* represent amodal ("semantic") knowledge which is independent of sensory experience (such as that an apple is a fruit, is healthy etc.). *Motor components* represent motor sequences like the imagined contractions of the muscels during chewing. Finally, *emotive-evaluating* components contribute to the affective tone concepts or words may have.

Concepts and word representations are considered as temporary and flexible representations since the activation pattern of components which constitute these representations may vary from situation to situation and also during the time course of speech production (see Mangold in this issue and also Barclay, Bransford, Franks, Carrell & Nitsch, 1974; Barsalou, 1982; 1993a; 1993b; Herrmann & Grabowski, 1994; Kintsch, 1988; Mangold-Allwinn, 1993). Long-term knowledge on the other hand is represented in the model by connections between the components which are relatively stabile. Both non-word and word components are heavily interconnected, and through these connections activation can be spread out in the network. This mechanism enables the activation of components which are not originally activated by the sensory input.

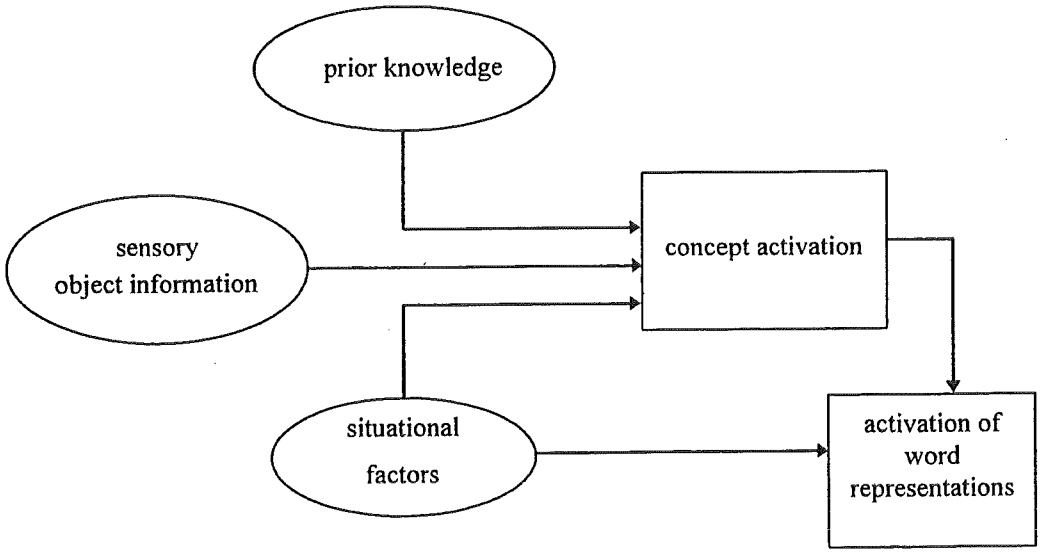

Figure 1: From perceived object information to activated word representations

The process of object naming is divided in two subprocesses: *concept activation* and *activation of word representations* (see figure 1). Both subprocesses are determined by situational factors (e.g. communicative goal, partner or discourse context) and by properties of the speaker's long-term conceptual and linguistic knowledge structure. In more detail, the process of object naming is described as following: Perceptual analysis of the object attributes leads to activation of non-word components which constitute the concept. First sensory components such as the shape of the object are activated which in turn activate abstract components coding knowledge indepedent of sensory modality. It is assumed that the membership to an object category is coded by these abstract components and that there are category components representing the membership to subordinate, basic and superordinate level categories. Several category components may be activated at the same time by the sensory components, the category component with the highest activation, however, determines the level of categorization. Subsequently, category components activate associated word components so that word representations are formed. Category components are associated with word representations at the same level of abstraction (e.g.

POODLE-"poodle"), but also with word presentations at higher levels of abstraction (e.g. POODLE-"dog" or POODLE-"animal"), but connection strength decreases with the level of abstraction of the given word representation (see also figure 2). Thus, the connection POODLE-"poodle" is strongest and the connection POODLE-"animal" is weakest, for example. Finally, there are also inhibitory connections between word representations. These inhibitory connections ensure that the word representation at the same level of abstraction as the dominantly activated category component is usually activated most strongly.

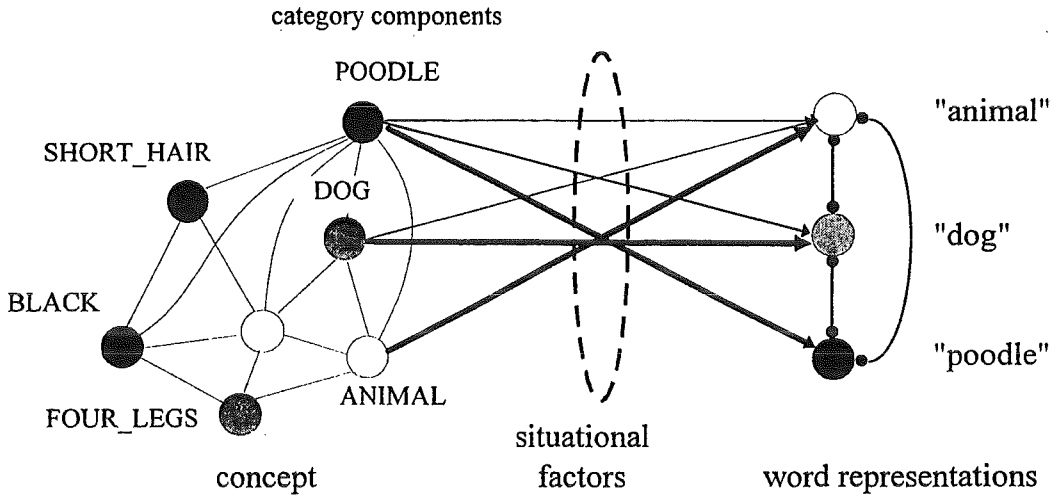

Figure 2: Conncetions between category components and word components

However, when situational factors such as partner representations, the communicative goal or the discourse context require a more abstract object name (e.g. when the partner is a child to whom a more specific label such as "poodle" is not available) the representation of the situational context inhibit the more specific word representation. As a result, the more abstract word representation becomes dominantly activated since it is released from inhibition and also receives input from category components. This process makes modulation of the activation of word representations possible without any change in the conceptual activation pattern. At the present there is no empirical evidence available which confirms the described modulation of activating word representations. However, it is at least plausibel that the level of categorization (at the subordinate level) remains the same and that only a basic level name is used when adult speakers label objects for children at the basic level and not at the subordinate level as they do it for adult addressees (Grosser et al., 1989). At the present, the issue if the level of categorization and the level of lexical specificity can diverge under certain circumstances has not been clarified yet and it clearly deserves further investigation.

In the next section the core assumptions on the process of concept activation and - as part of it - on the process of categorization will be elaborated further.

4.2. Perception, concept activation and categorization

Categorization of objects is regarded as part of the process of concept activation because membership to an object category resembles one fraction of conceptual information. In this sense concept activation is the more general process and categorization the more specific one.

As already described above, information on perceptual attributes of the object is extracted by the perceptual system (particular by the visual system) and is delivered to the stored structure of non-word components where first sensory and then abstract components - among them the category components - are activated. There is empirical evidence available that object attributes are processed in parallel by the visual system, but at a different speed. It could be demonstrated that global features (i.e. the overall shape of an object) are processed faster than local features (e.g. detail feature within the border of the overall shape; e.g. Hughes, Layton, Baird & Lester, 1984; Navon, 1977). In this context Navon (1977) coined the term "*global precedence*". The significance of shape information for categorization was already recognized by Rosch et al. (1976) who showed that objects can be identified at the basic level only from outline information. Murphy and Brownell (1985) also hypothesized that the contour of an object plays an important role in categorization and that the basic level advantage might be accounted for by its categorial identifiability from contour information (see also Hoffmann & Kämpf, 1985). On the other hand, Murphy & Brownell (1985) assume that for atypical objects (e.g. penguin) the outline may be sufficient for subordinate categorization so that atypical objects can be categorized faster at a subordinate level than at the basic level. Using an artificial hierarchy of concepts Zimmer & Biegelmann (1989, 1990) found a basic level advantage in categoriziation only for the case that basic level concepts were defined by the object contour. When basic level concepts were defined by detail features reaction time needed for categorization was the same as for subordinate categorization.

Kiefer et al. (1995) conclude from these findings that objects are categorized at the most specific level of abstraction for which sensory information is sufficent for categorial identification. Furthermore, it is assumed that for basic level categorization contour information is sufficient whereas for subordinate categorization detail information (based on local features) is needed. It follows that at an early time of perceptual analysis when only contour information is available objects are categorized at the basic level unless shape information is sufficient for subordinate categorization as it is the case when atypical objects or - possibly - objects of the domain of expertise are categorized. If shape information is sufficient for subordinate categorization objects should be categorized at the subordinate level also already at an early time. However it is assumed that objects are usually categorized at a subordinate level only at a later time point when detail attributes are also analyzed by the visual system. In line with Rosch et al.'s (1976) and Jolicouer et al's (1984) suggestions it is hypothesized that superordinate categorization cannot be

performed directly from the perceptual input, but requires top-down activation of the appropiate category component after basis level (or subordinate level) categorization. Thus, superordinate categorization is based on top-down long-term memory access.

In the next section experiments will be described in which the process of categorization (and its influence on lexical specificity of the produced object label) was investigated. Furthermore, it will be discussed if the empirical findings fit with the theoretical assumptions pointed out above.

5. Analyzing the process of categorization and object naming

5.1. The effect of time pressure

As it was pointed out above it is assumed that the process of concept activation and categorization is temporally extended depending - among other factors not considered here - on the already described time course of global and local feature analysis. A very simple method to investigate the time course of the dominante level of categorization during speech production is to vary the amount of time which is available for the speaker to name an object. If it is true that at an early time point basic level categorization dominates and at a later point subordinate categorization then variation of time pressure on object naming should affect lexical specificity accordingly.

Pobel (1991) carried out such an experiment using a free-naming task where he induced time pressure on the subjects in one condition and no time pressure in the other condition. He obtained the following result: when time pressure was induced objects were named for 52 % at the basic level and for 29 % at the subordinate level. 18 % of the answers were not analyzed because object were not named correctly or subjects only knew a label at the basic level and not at the subordinate level. Without time pressure objects were named at the subordinate level for 52 % and at the basic level for 31 %. Again 18 % of the answers were not analyzed. The results clearly support the hypothesis that objects are named more specifically if more time is available to complete task. However, it is not obvious which processes are affected by the induction of time pressure. Is it the duration of perceptual analysis, of concept activation or of activation of word representation? In the experiment described below this issue will be further investigated.

5.2. Perceptual factors

Kiefer (1995) carried out a study to test the assumption that the speed at which object attributes are processed by the perceptual system affects the level of categorization and the subsequently produced object label. As it was already mentioned above object attributes are analyzed by the visual system in parallel, but at a different speed. Global features

(object contour) are processed faster than local features (details) and are therefore available for categorial identification at an earlier time. Since basic level categorization can be performed solely on the basis of object contour objects should be categorized (and subsequently named) at the basic level when perceptual analysis is short, and furthermore, objects with a salient contour (e.g. atypical objects) are excluded. Subordinate categorization, on the other hand, relies in addition on detail information which is extracted more slowly by the visual system. Therefore, subordinate categorization (naming) should dominate when perceptual analysis is long. Presumably, color information is also provided by the visual system at an early time (vgl. Smith, 1962). However, there has been a long standing debate whether color information (and surface information, in general) influences categorization or not (e.g. Biederman & Ju, 1988; Boucart & Humphreys, 1994; Price & Humphreys, 1989). Since subordinate categories are frequently associated with characteristic colors (e.g. fly agaric-red; titmouse-yellow; rose-red) it was investigated if color information facilitates subordinate categorization at an early time of perceptual analysis.

Kiefer (1995) varied the duration of perceptual analysis by presenting realistic photos of objects for a short (300 ms) and for a long time (600 ms). Pictures were presented masked to prevent subjects from further perceptual analysis of the image stored in the visual buffer. Furthermore, objects were displayed either as color or as black and white images. Objects were selected such that objects with a salient shape (e.g. atypical objects) which could facilitate subordinate categorization were excluded from the object set. Subjects had the task to name the objects without emphasizing the speed of the response. This was done to minimize the effect of time pressure on concept activation and word activation. Finally, typicality of the objects and familiarity of the subordinate category was measured.

It turned out that the *duration of image exposure* affected lexical specificity as expected. The percentage of subordinate labels was increased for the long exposure time (70 %) in comparison to the short exposure time (51 %). Furthermore objects were dominantly labeled at the subordinate level when exposure time was long (basic level: 27 %). However, no dominance of basic level names was found for the short exposure time (45 %). These findings are in line with an earlier study of Jolicoeur et al. (1994) who found that duration of image exposure affected only reaction time for subordinate categorization, but not for basic and superordinate level categorization.

In a separate analysis it could be shown that *familiarity* of the subordinate category affected lexical specificity: objects with high familiarity were dominantly named (60 %) at the subordinate level already at a short exposure time. Moreover, the effect of *typicality* - typical objects were dominantly named at the subordinate level - could be explained by familiarity because the most typical objects were also the most familiar ones. In sum, it could be demonstrated that familiarity (i.e. high prior knowledge/expertise) facilitates

subordinate categorization already after short visual analysis, perhaps on the basis of outline information even if the shape is not very salient. Finally, it turned out that the variation of *color information* did not affect the level of categorization/naming. The results were almost identical for both color and black and white images. They can be interpreted that shape and color information is processed separatly by the visual system and that color information is not necessarily used for categorization. In line with this interpretation there is neurophysiological evidence available suggesting that color, form and luminance information is processed by seperate pathways in the primate visual cortex (Hubel & Livingstone, 1987).

In the two previously reported experiments categorization and object naming processes were investigated by manipulating variables presumably affecting certain stages of the naming process (e.g. perceptual analysis) and registrating their influence on lexical specificity. A rather different way to study categorization processes is to monitor the electrical activity of the working brain during task performance. In the next section an experiment is reported where event-related potentials were recorded while subjects categorized objects at different levels of abstraction.

5.3. Event-related potentials as a tool for on-line analysis

Event-related potentials (ERPs) are a powerful tool for on-line analysis of cognitive processes because they have a temporal resolution in the range of milliseconds (e.g. Kiefer & Dehaene, 1996; Snyder, Abdullaev, Posner & Raichle, 1995). On the other hand, they also convey spatial information on the distribution of electrical activity accross the head. Particularly, if ERPs are recorded using a dense array of electrodes (e.g. 64 and more) meaningful inferences about the brain areas involved in a particular process can be drawn.

Tanaka, Weisbrod, Luu, Rentz & Kiefer (in prep.) recorded ERPs from 64 electrodes while subjects performed an object categorization task. Subjects were first presented with a category name either at the subordinate, basic or superordinate level and subsequently with an image of an object. In one half of the trials the category name and the object matched and in the other half they did not. Subjects' task was to decide if the category name labeled the depicted object correctly. ERPs which were elicited by the object to be categorized at different levels of categorization were subjected to analysis.

Level of categorization had the following effects on ERPs: At about 130 ms after the onset of the object ERPs to *subordinate categorizations* started to differ from ERPs to basic and superordinate categorizations over left temporo-parietal regions. This increased activity for subordinate categorization could be generated in inferior temporal areas which are involved in *visual object identification* (e.g. Kosslyn, 1994). Hence, this effect can presumably be related to enhanced visual processing for subordinate categorization - perhaps the extraction of detail information. Later, at about 230 ms the ERPs to

superordinate categorizations started to diverge from the ERPs to the other conditions over left frontal regions. Left frontal effects can be observed in a variety of tasks which involve *access to "semantic" information* (i.e. retrieval of abstract information about objects or events) such as naming objects (Spitzer, Kwong, Kennedy, Rosen & Belliveau, 1996), generating the use of an object (Abdullaev & Posner, in press; Snyder et al., 1995), sentence processing (Curran, Tucker, Kutas & Posner, 1993) or semantic priming during a lexical decision task (Kiefer, Kern, Weisbrod, Maier & Spitzer, 1995). It can be concluded that the increased activity for superordinate categorization is presumably due to extended semantic processing which is not necessary for basic and subordinate categorization because the latter two categories can be identified on the basis of visual information. As it was pointed out above it has been suggested that superordinate categorization is performed by memory retrieval after the object has been categorized at the basic level. Thus, it is well consistent with both theoretical assumptions and empirical evidence that the left frontal effect reflects access to abstract categorial information.

To summarize the findings, it appears to be possible to delineate the time course of categorization processes using ERPs. The process of subordinate categorization seems to enhance visual processing with an onset at 130 ms. The effect of superordinate categorization onsets later at 230 ms supporting the view that objects are first categorized at the basic level before they can be categorized at the superordinate level (through memory retrieval). Furthermore, the results show that categorization processes involve different brain regions depending on level of specificity. This also suggests that categorization processes may vary functionally (enhanced visual processing vs. enhanced semantic processing) as it has also been suggested by several models (e.g. Hoffmann & Kämpf, 1985; Kiefer et al., 1995; Rosch et al., 1976). Taken the results together, they also demonstrate that ERP recording appear to be a promising technique for on-line analysis of categorization processes.

6. Conclusion

The present work was aimed to clarify the selection of a level of lexical specificity in object naming. It was shown that cognitive models assuming a preferred level of abstraction (such as the basic level theory of Rosch et al., 1976) cannot account for the situational variability of the produced object names. Although Cruse's (1977) functional-communicative theory predicts a greater situational variability it restricts the function of object naming to object identification and does not consider other functions such as desriptions of objects. Furthermore, Cruse's (1977) theory completely ignores cognitive prerequisites of speech production which are essential in explaining lexcial specificity.

An alternative framework is presented in which it is assumed that lexical specificity of object labels is resulting from a process of (i) activation of concepts and (ii) activation of

word representations. Both activation of concepts and of words are supposed to be influenced by situational factors. In the proposed model it is also suggested that concepts and also the level of categorization (as part of conceptual information) vary during the time course of speech production with the outcome of perceptual analysis. Particularly, it is hypothesized that with ongoing perceptual analysis when both contour and detail features of objects are extracted objects are dominantly categorized at the subordinate level. Accordingly, objects should be preferentially named at the subordinate level. On the other hand, if objects can be categorized on the basis of contour information which is provided by the visual system at an early time categorization can occur rapidly as it is the case for basic level categorization and for subordinate categorization of objects with salient contour (e.g. penguin). Experiments varying time pressure or varying the duration of perceptual analysis confirmed these assumptions. In addition to traditional behavioral measures such as reaction time or verbal responses, a first study using ERPs suggests that neurophysiological methods may be promising in testing theoretical predictions on categorization processes.

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NETWORK MODELS AND FORMAL THOUGHT DISORDER: PRIMING IN SCHIZOPHRENIC PATIENTS

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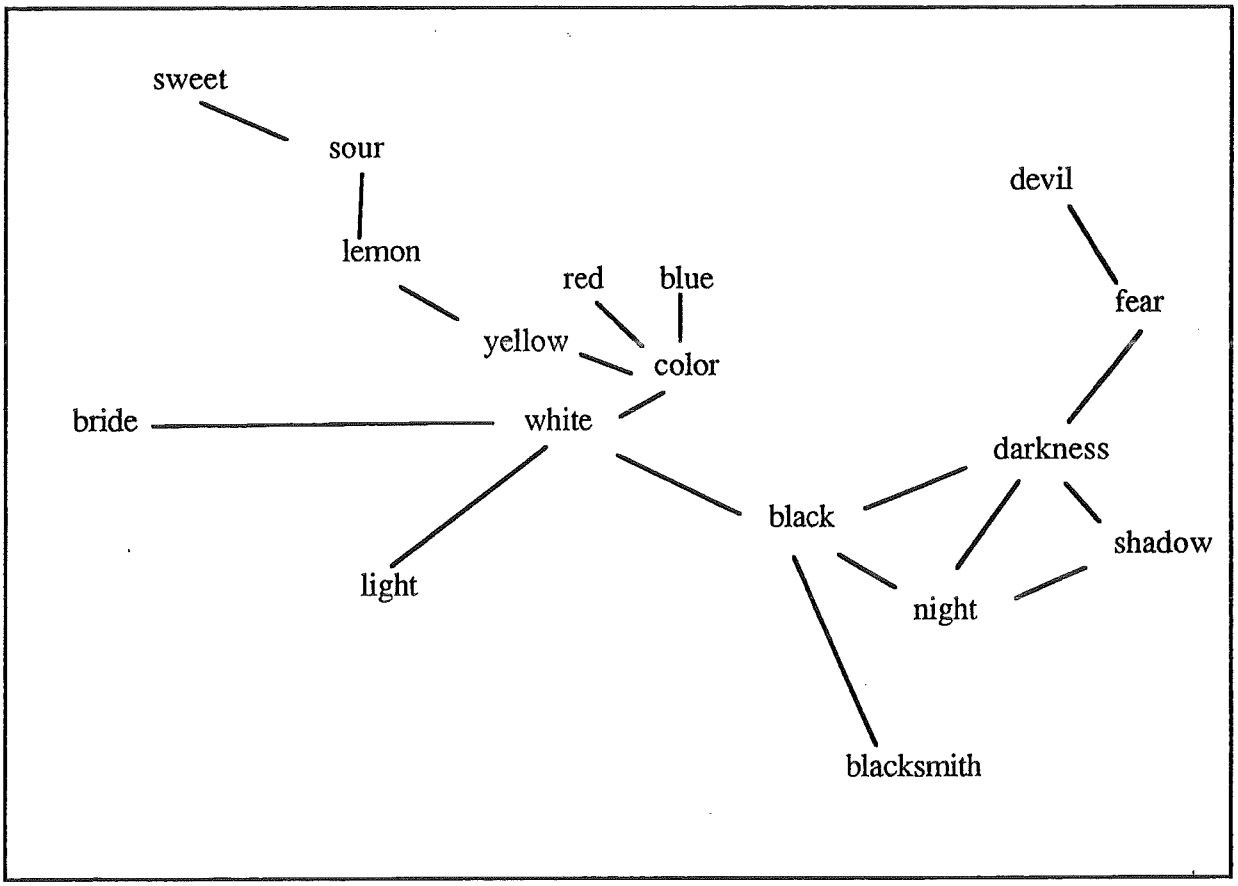
Based on current network models of semantic memory several studies were designed to investigate the nature of formal thought disorder in schizophrenia. In order to examine dysfunctional associative processes in this patient group, we used three different methods, the lexical decision task, the word-association test, and the measurement of pauses in spontaneous speech.

Experimental evidence is provided to demonstrate that some characteristic features of schizophrenic thinking - in particular the rapid shift of associations, the indirect relationship of associations, the increased occurence of clang associations, the overly abstract or overly concrete use of concepts, and the lack of context–sensitivity - can be explained in terms of an increased activation or disinhibition in semantic networks.

1. INTRODUCTION: NETWORK MODELS OF SEMANTIC MEMORY

The way semantic information is stored in humans has been unraveled to some extent by experimental psychological studies of language production and comprehension. In particular, the "mental lexicon" where word meanings are stored, probably together with other features of words, has been investigated using tasks in which word–associations play a major role. For example, it is long known that a given stimulus word often produced a specific "associated" word, if the person is asked to name "just what comes to mind when hearing ...". In this word-association paradigm, "black" produces "white", "lemon" produces "sour", and "sour" produces "sweet". A large number of studies using word association paradigms suggest that semantic information is stored in the form of an **associational network** (see Figure 1). According to current network models of semantic memory, semantic (and possibly other) features of words are represented as "nodes" in a network. In the course of an utterance, these semantic units become activated for a short period of time and thereafter either decay rapidly or are actively inhibited (Collins and Loftus 1975, Neely 1977, 1991). This model of lexical access further asserts that concepts activated in a semantic network by a prime serve as a source of activation that spreads to other related concepts ("spreading activation theory"). Such spreading of activation to nearby nodes in the semantic network lowers their thresholds of being activated.

Figure 1: Structure of associational (semantic) memory as suggested by research on word-associations



2. SCHIZOPHRENIA AND WORD-ASSOCIATIONS

A great number of word-association studies with normal subjects and patients had been conducted by the turn of the century. This influenced the very concept of schizophrenia, as it was formed by Eugen Bleuler in 1911. From the studies of word-associations in this patient group conducted by Bleuler himself and by his assistant C.G. Jung, it was concluded that dysfunctional associative processes had to be regarded as one of core features of schizophrenia. In particular, schizophrenic thinking has been characterized by **loose, mediated, indirect, oblique, and clang or rhyming associations**. Bleuler noted that in the utterances of schizophrenic patients, "the associations tend to proceed along new lines", and "indirect associations [...] receive unusual significance". In addition to contextually inappropriate intrusions of normal associations, Bleuler emphasized the occurrence of clang–associations in schizophrenic speech:

> "Furthermore, clang associations are very frequent. Head-bed; frog-bog; sad-mad-bad; beaten-betrayed-beloved-bedecked. ... the identity or even the similarity of one single

sound suffices to give the direction of the association. Thus, the clang association very often has the schizophrenic mark of the bizarre" (Bleuler 1911/1950, pp. 24-25).

Subsequent studies replicated the results of Bleuler and Jung, and Cramer (1968) summarized the findings as follows: Schizophrenic patients give significantly fewer of those responses which occur with the greatest frequency to a given stimulus in the normal population, and at the same time give more idiosyncratic responses. These associative disturbances are correlated with the chronicity of the disorder. In addition, more perseverative responses, clang-related responses, and distant responses have been found in schizophrenic patients. The bottom line of the studies using the word association test appeared to be that schizophrenic patients suffer from a "less stable, less well organized associative network" (Cramer 1968, p. 192).

From a clinical perspective, up to the present schizophrenic thinking is defined by disturbed associative processes, as can be seen from the description of characteristic features of schizophrenic thought given in the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition, revised: "A disturbance in the form of thought is often present. [...] The most common example of this is loosening of associations, in which ideas shift from one subject to another, completely unrelated or only *obliquely related* subject" (DSM–III–R, p. 188, italics added). "Clanging. Speech in which sounds, rather than meaningful, conceptual relationships govern word choice" (DSM–III–R, p. 393). We want to present several psychological methods to investigate the nature of formal thought disorder in schizophrenia.

3. WORD-ASSOCIATION TECHNIQUES

For more than a century, word associations has been studied using the **word association test**: A subject is reading or hearing a word and has to respond by saying the first word that comes to mind thereafter.

From a methodological perspective the word association test has its limitations. Most notably, the classification of the types of associations can only be made post hoc. For this as well as for other reasons the word-association test is hardly used in clinical practice and research at the present time. However, there is a growing interest in psycholinguistic aspects of formal thought disorder in schizophrenia, which in part has been brought about by new techniques to study associative processes.

The technique of **lexical decision**, in which the subject has to decide whether a given string of characters is a word or not, has been widely employed to investigate word asso-

ciations in normal subjects. To test specific types of associations, word pairs can be presented either simultaneously or one after the other. In a typical experiment, the effect of the semantic relation between the words on the time it takes to decide whether the second string of characters in fact was a word and on the accuracy of the performance is recorded. A robust phenomenon that has been discovered using this technique is the **semantic priming effect** (cf. Meyer & Schvaneveldt 1971). If a word is shown first („prime") and then a string of characters is shown („target") and the subject is asked to press a key labeled "yes" if the second string is a word, and a key labeled "no" if it is not a word, the response is faster if both words are semantically related. To give an example: "table" is recognized faster as a word if it is presented shortly after "chair" as compared to being presented shortly after a non-related word such as "cloud". This reduction in reaction time is called the semantic priming effect.

4. EMPIRICAL FINDINGS

In recent years, the concept of associational networks and the method of semantic priming in lexical decision tasks has been applied to the study of thought disorder in schizophrenic patients by a number of authors (see Neely 1991). Most notably, Maher et al. (1987) found that thought disordered (TD) schizophrenic patients display a **larger semantic priming** effect in a lexical decision task than not thought disordered (NTD) schizophrenic patients. At first glance, this finding appears to be contradictory to the data reported above according to which schizophrenic patients suffer from a weakening of associations. The stimulus material in the experiment of Maher et al. consisted of pairs of strongly related words, pairs of non-related words, and word-non-word pairs. The priming effect was calculated as the diference score of mean reaction times (RT) between the related and the non-related condition (i.e., as "gain" in RT caused by semantic relatedness). Hence, if TD schizophrenic patients suffered from particularly loose and weak associative processes, as suggested by the word association test literature, the opposite finding was to be expected.

Maher explained this appearant contradiction the following way: In the schizophrenic patient, there is no pathology of the associative network itself. Instead, the access to the lexical items during the production of utterances is disturbed, most likely in the sense that associative processes are heightened or overly active. This would explain the faster RTs to related words in lexical decision tasks, and, at the same time, the clinical observations of loose associations, the latter phenomenon being caused by the unrestrained propagation of activity in a semantic network delivering various associated, but not intended lexical items to the speech production system.

Up to the present, only a few studies - all on normal subjects - have been carried out on such indirect associations (Balota & Lorch 1986, De Groot 1983, McNamara & Altarriba 1988). They have produced evidence of a limited indirect semantic priming effect in normal controls under certain boundary conditions (i.e., the effect was small, not robust, and its existence depended upon experimental conditions, and the timing of stimuli). According to the network model of semantic memory as described above, spreading of activation is postulated to dissipate with distance, and there is empirical evidence that such an inverse relationship between semantic distance and the amount of activation exists. Considering the heightened occurence of indirect/mediated associations of schizophrenic patients in word-association tests, there is an urgent demand to scrutinize this phenomenon using the lexical decision technique.

Whereas semantic priming has been recognized since the early 1970s and has been investigated in numerous studies, comparatively few studies using the paradigm of lexical decision have addressed phonological associations. Most of the respective studies have been carried out in the general framework of information processing models of language production and comprehension, and depending on the underlying theoretical assumptions, various experimental designs have been used. These efforts led to partly conflicting results with respect to the influence of phonological similarity on reaction times and error rates in lexical decision tasks. Up to the present, we have little or no information considering phonological priming effects in schizophrenic patients.

The following studies were designed to investigate the nature of formal thought disorder in schizophrenia using three different psychological methods: (1) priming phenomena in a lexical decision task, (2) the word-association test, and (3) the measurement of pauses in spontaneous speech. We will provide a brief description of the three approaches to the measurement of associative processes and a summary of the relevant findings.

5. DIRECT AND INDIRECT SEMANTIC PRIMING IN SCHIZOPHRENIC PATIENTS

Guided by clinical experience we proposed that there should be differences in indirect associations between schizophrenic patients and normal control subjects and that these differences should be detectable by the method of lexical decision. In particular, according to the hypothesis of overly activated associations in schizophrenia, there should be more indirect priming in schizophrenic patients than in normal control subjects.

In this study of 50 schizophrenic inpatients and 50 normal control subjects a lexical decision task was used involving the recognition of words which were preceded (primed) by directly

associated, indirectly associated, or non–associated words (Maier 1995, Spitzer et al. 1993). Psychopathology was rated using the Brief Psychiatric Rating Scale (BPRS; cf. Overall and Gorham 1976), and the patient group was split into high and low thought disorder groups (29 TD patients vs. 21 NTD patients).

Two versions of a lexical decision experiment (i.e., two stimulus lists) were designed with the following relations between prime and target:

(1) semantically related words (e.g., hen–egg)
(2) indirectly semantically related words (e.g., lemon–sweet)
(3) unrelated words (e.g., sofa–wing)
(4) word-nonword (e.g., drift–kribe)

Subjects and patients were assigned to both stimulus sets with two different stimulus onset asynchronies (SOAs) of 200 ms and 700 ms, respectively.

All subjects and patients were tested individually. They were told that they would be presented with pairs of words or strings of letters which would come together quite closely in time; their task was simply to read the first word, and then to decide as quickly and accurately as possible whether or not the second string of letters was a real German word. Responses were indicated by pressing one of two keys and reaction times as well as errors were measured.

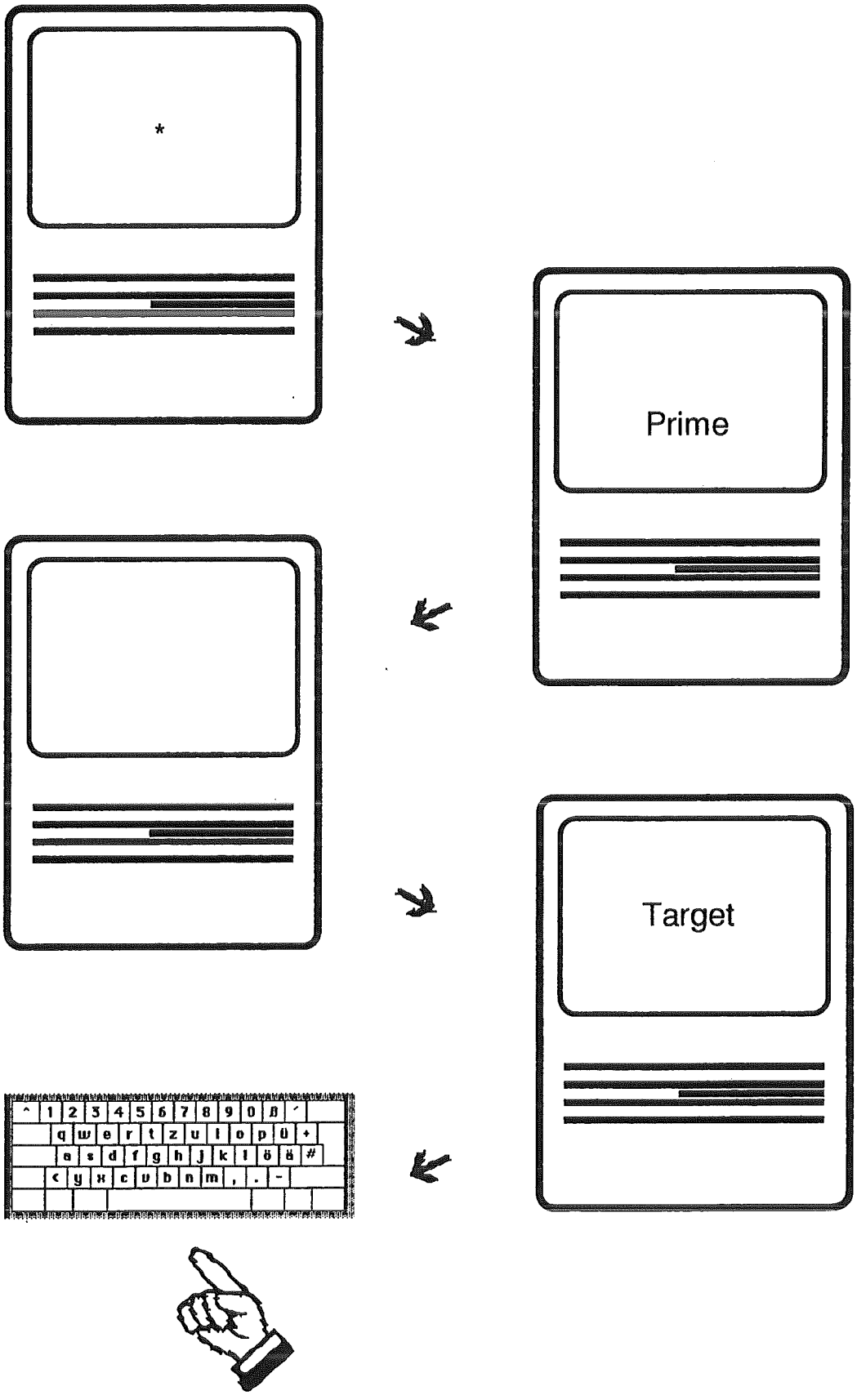
Prior to the initiation of each trial, the computer screen was blank. Once a trial was initiated, a fixation point was displayed in the center of the screen for 700 ms, followed by presentation of the prime for 200 ms. Then the screen again went blank for either 0, 200, or 500 ms, and then the target was presented until the response was made. Both primes and targets were presented in the middle of the screen, centered over where the fixation point had been. Following the subject's response, the screen again went blank and a new trial could then be initiated by the subject (see Figure 2).

Priming effects in the three groups, normal control subjects, NTD and TD patients, were operationalized as the percentage of gain in RT due to the related conditions compared to the unrelated condition, according to the following formulae:

$$\text{semantic priming (SP\%)} = \left(1 - \frac{\text{RT [related condition]}}{\text{RT [unrelated condition]}}\right) \times 100$$

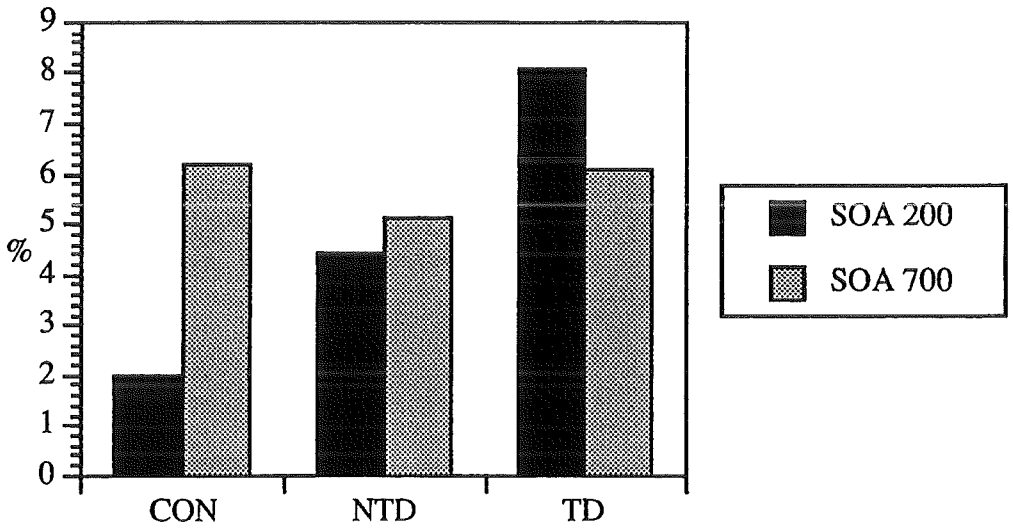
$$\text{indirect priming (ISP\%)} = \left(1 - \frac{\text{RT [indirectly related condition]}}{\text{RT [unrelated condition]}}\right) \times 100$$

Figure 2: Sequence of events in a single trial of the lexical decision task



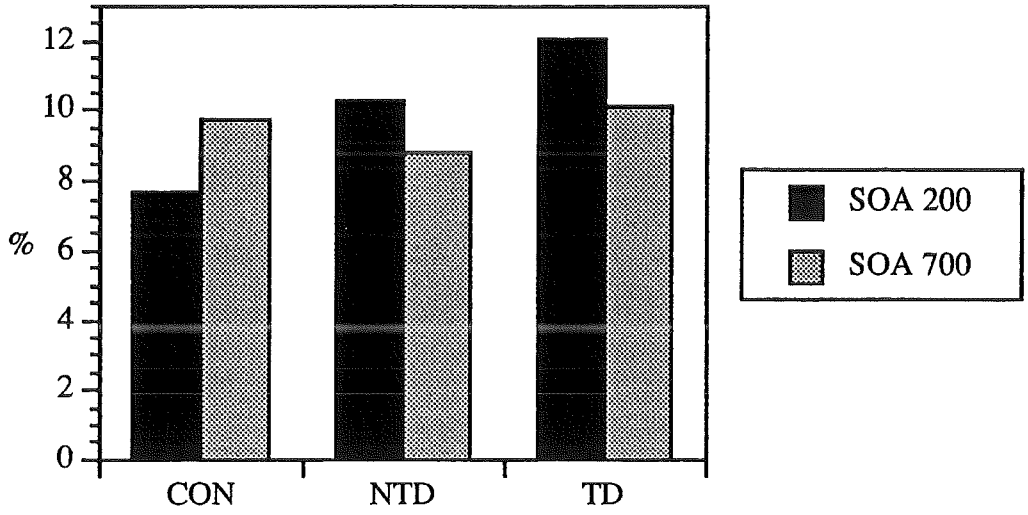
The main finding of the experiment consists in a larger indirect semantic priming effect in schizophrenic TD patients (8.1%) at the short SOA of 200 ms as compared to the control group (2.0%). At the longer interval between prime and target (SOA = 700 ms) significant indirect semantic priming was obtained in both groups (see Figure 3). The fact that the larger indirect semantic priming effect in schizophrenic patients occurred at the short SOA of 200 ms indicates that it must be mainly due to automated processes. Regarding the direct semantic priming, the findings of Maher (1987) of a comparatively larger amount of direct priming in TD patients could not be replicated: Although TD patients showed a numerically larger priming effect compared with NTD patients and controls, especially at the shorter SOA of 200 ms, there were no significant effects of group or SOA (see Figure 4). The finding that there are no significant group differences concerning the direct priming effect at both SOAs as well as the indirect priming at the SOA of 700 ms implies that schizophrenic thought is not characterized by new and different associations, but rather by an increased and inappropriate availability of normal associations.

Figure 3: Indirect semantic priming in 50 controls, 21 NTD and 29 TD patients at two different SOAs



From a network theory point of view of associative (semantic) memory, it is questionable whether the (most) common association - used as prime in the associated condition to produce semantic priming - is the best probe for the general activation of the network. In normal controls focused activation may lead to the activation of the closest adjacent associations (nodes in the semantic network), and hence, produce semantic priming and little, if any, indirect semantic priming (at short SOAs). In contrast, the unfocused general activation supposedly present in schizophrenia may not only lead to a more pronounced activation of close associations (nearest nodes), as suggested by Maher et al. (1987) and Manschreck et al. (1988), but may also lead to the activation of more distant nodes.

Figure 4: Direct semantic priming (%) in 50 controls, 21 NTD and 29 TD patients at two different SOAs



6. STATE OR TRAIT VARIABLE?

In order to test whether increased indirect priming is rather a state or a trait marker, we investigated the priming effects of 17 schizophrenic inpatients in a repeated-measures design. The first investigation was carried out in the first, the second in the last week of a rehabilitation program which took on average two months. The procedures were the same as in the previous experiment, except that only the short SOA of 200 ms was used.

Figure 5: Direct (SP%) und indirect (ISP%) priming in 17 schizophrenic patients at the beginning and at the end of a rehabilitation program

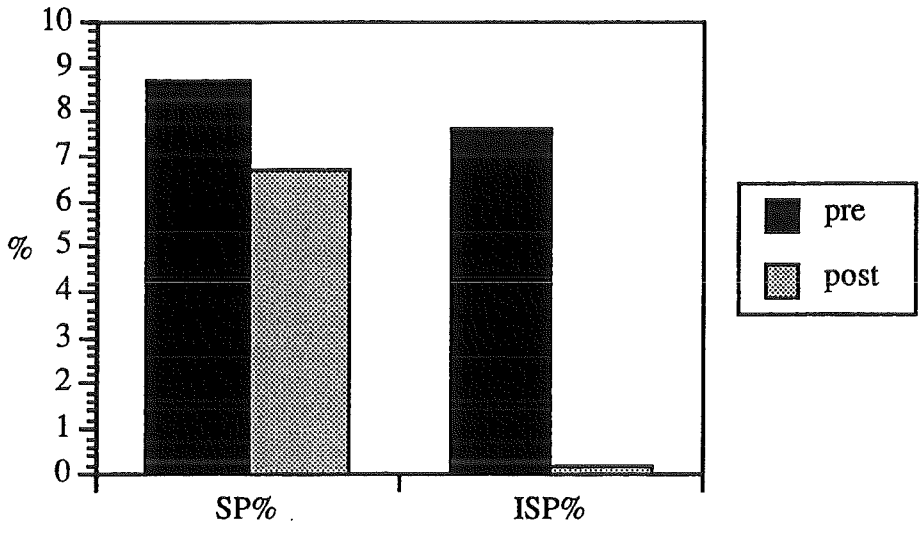


Figure 5 shows a little, but not significant decrease of the direct priming effect from the first to the second test session. Regarding indirect priming, there can be seen a significant decrease over time [$t(16) = 2.39$; $p = .0297$]. Significant indirect semantic priming was obtained only at the first test session, whereas at the second test session the indirect priming did not reach significance. This is in line with the conclusion drawn in the previous experiment indicating that indirect semantic priming is a better (more sensitive) indicator for dysfunctional processes in the semantic network than direct priming effects.

7. PHONOLOGICAL PRIMING

As already mentioned, there are only a few studies investigating phonological relations between prime and target using the lexical decision paradigma, and the results are very conflicting. Regarding the higher amount of phonological associations found in word-association tests and in the spontaneous speech of schizophrenics, we carried out an experiment to test rhyme associations in this patient group (Spitzer et al. 1994c).

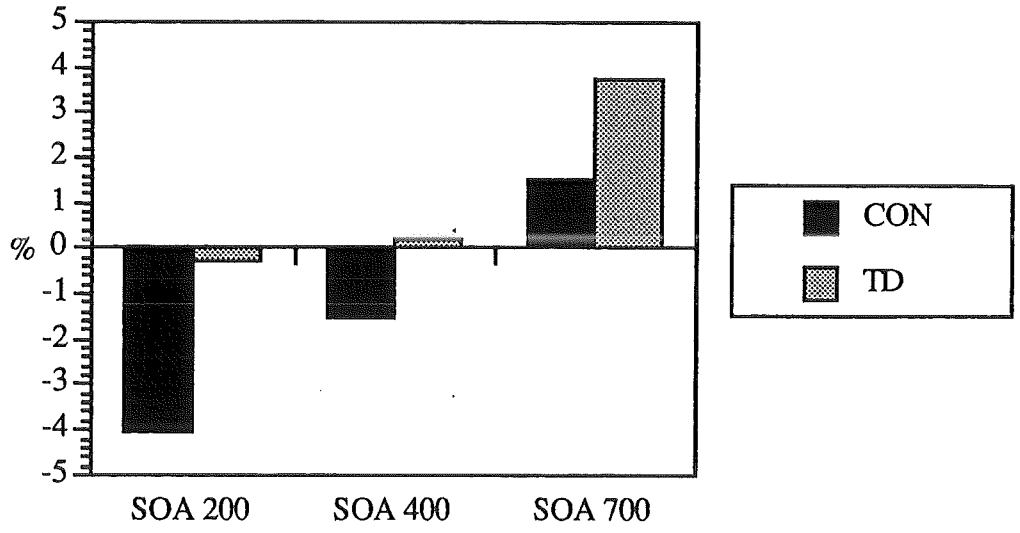
Subjects consisted of 36 schizophrenic TD inpatients and 84 normal control subjects. The procedures were the same as in the previous experiments, except that three different SOAs of 200, 400, and 700 ms per subject/patient were used (henceforth referred to as "short", "medium", and "long" SOA). Moreover there was a phonologically related condition instead of the indirectly related word pairs. As rhyming was the predominant phonological relation as reported in the literature on the word asssociation test, and as the clinical examples of clanging are most often rhymes, phonological relatedness was operationalized as a rhyming relation between prime and target.

Figure 6 shows the amount of phonological priming in relation to the three SOAs in TD patients and controls. At the short SOA of 200 ms, the rhyming relation caused significant inhibition in normal controls [$t(83) = 3.70$; $p = .0004$], whereas there was almost no effect at the medium SOA of 400 ms, and a significant facilitation at the long SOA of 700 ms [$t(83) = 1.99$; $p = .05$]. In the TD patients, there was no inhibition at the short and the medium SOA and a weak trend towards faciliation at the long SOA (not significant).

Therefore we could demonstrate that, in contrast to normal controls who show phonological inhibition in a lexical decision task with a short stimulus onset asynchrony, there is no such phonological inhibition in thought disordered schizophrenic patients. The fact that in normal control subjects such phonological inhibition occurs at short SOAs suggests that the phenomenon is most likely due to an automated process. The failure of such an automatic inhibitory process in TD schizophrenic patients is in line with the growing evidence of a

dysfunctioning of inhibitory processes in these patients.

Figure 6: Phonological priming (%) in relation to the three SOAs in 36 patients and 84 controls



8. WORD ASSOCIATION TEST

The word-association test as described by Jung (1906/1979) and by Aschaffenburg (1899) was used. Subjects were 20 normal controls and 20 schizophrenic inpatients (9 NTD, 11 TD). A list of 100 words was prepared. The subject/patient was instructed to listen to each word that was read aloud by the experimenter and to respond by saying aloud the first word that came to mind after the word was read. Word-associations were analyzed qualitatively on the basis of the Jungian classification scheme.

As expected, separate one–way ANOVAs revealed significant group effects for the following dependent variables (percentages of the respective types of associations):
- direct semantic associations [$F(2/37) = 23.94$; $p = .0001$],
- indirect/mediated associations [$F(2/37) = 10.95$; $p = .0002$],
- rhyme associations [$F(2/37) = 4.9$; $p = .013$],
- perseverations [$F(2/37) = 3.97$; $p = .0274$].

Post-hoc tests (Scheffé) showed significant differences between the controls and the TD group for all dependent variables. The results of the statistical analyses indicate that, compared with the control group, schizophrenic TD patients show significant less direct semantic associations in the word-association test, but more indirect and rhyme associations, as well as more perseverations (associations not concerning the actual, but a previous stimulus word).

Figure 7: Frequency of direct semantic associations in 20 controls, 9 NTD and 11 TD patients

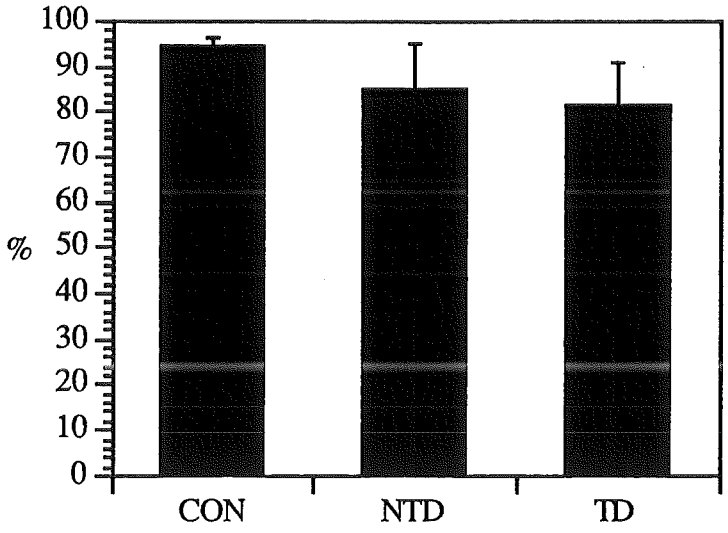


Figure 8: Frequency of indirect semantic associations in 20 controls, 9 NTD and 11 TD patients

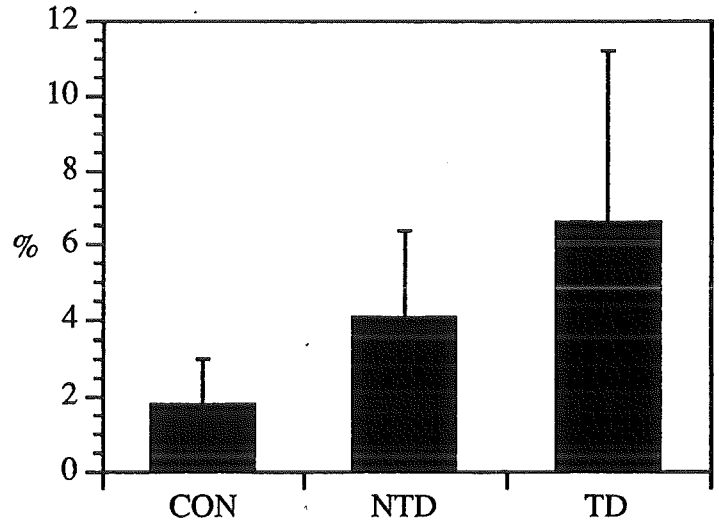


Figure 9: Frequency of rhyme associations in 20 controls, 9 NTD and 11 TD patients

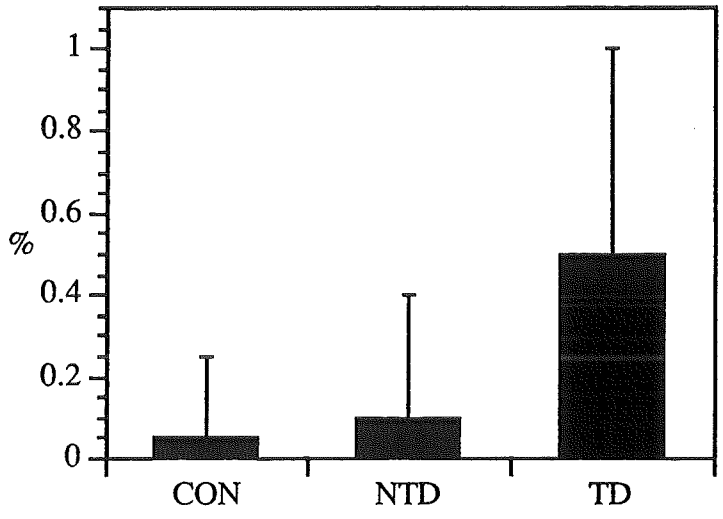
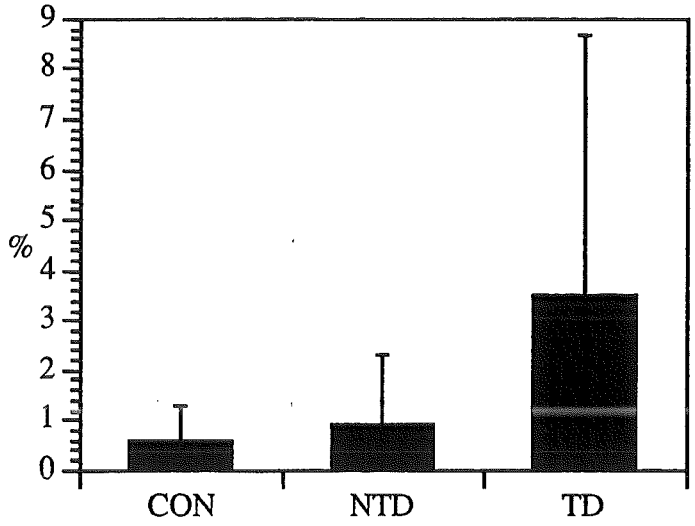


Figure 10: Frequency of perseverations in 20 controls, 9 NTD and 11 TD patients



9. CONCRETISM

A bias in the semantic preferences of schizophrenic patients towards the more abstract and/or the more concrete meaning of a word or an utterance has been reported by a number of authors. Although the term "concretism" is hard to find in modern textbooks, clinicians use it to refer to instances of "concrete thinking" in cases of schizophrenia and organic mental disorder.

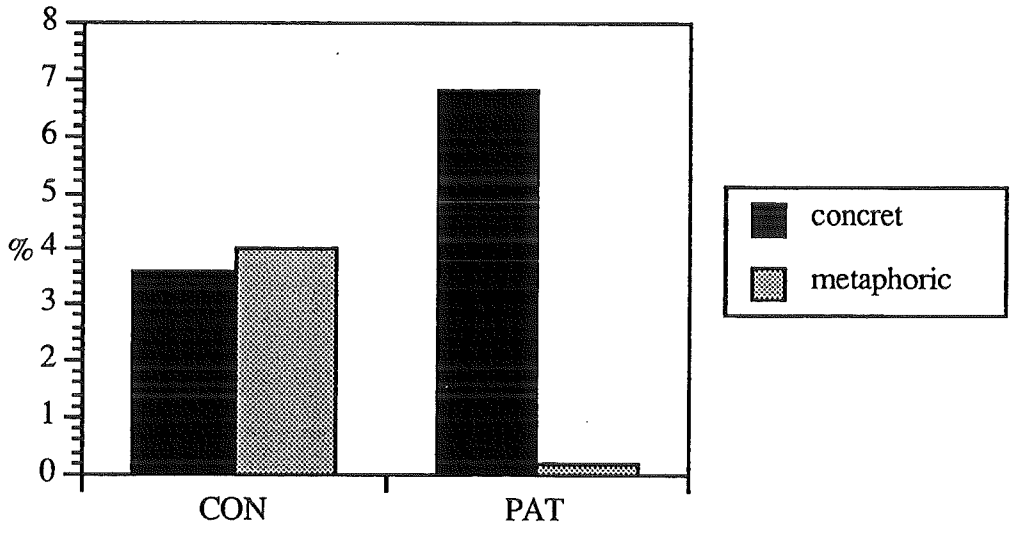
In order to investigate the nature of schizophrenic concretism in detail, the method of lexical decision was used to probe for the activation of literal and metaphoric meanings of metaphoric statements (Spitzer et al. 1994b). 43 normal control subjects and 35 schizophrenic patients had to perform a visual lexical decision task shortly after they had listened to a proverb. The stimulus material consisted of 60 metaphorical statements as primes, and of the following targets: 10 concretely related words (to the last or to the most prominent word of the proverb), 10 metaphorically (abstractly) related words, 10 non–related words, and 30 non–words (for an example see Table 1). The interstimulus interval was 1200 ms.

Table 1: Relations between prime and target in a concretism experiment

condition	auditory prime: "He is skating on thin ice"
concretely related	snow
abstractly related	risk
non–related	chair/grief
non–word	toble

The abstract and concrete priming effects in both groups are displayed in Figure 11. A two factor ANOVA with group (controls vs. patients) and condition (abstract vs. concrete) as independent factors showed a significant interaction [$F(1/76) = 5.97$; $p = .0168$], indicating a group–dependent difference in the priming effect of concrete and abstract meanings: Whereas in normal control subjects both, the concrete and the abstract meaning produce a significant priming effect, in schizophrenic patients only a concrete priming effect could be detected.

Figure 11: Concrete and metaphoric priming effects of normal controls (n = 43) and schizophrenic patients (n = 35)



The main findings of this experiment may be interpreted as follows: The comparatively large concrete semantic priming effect in schizophrenic patients is in line with the above mentioned results of lexical decision studies on semantic and indirect semantic priming. Hence, this large concrete priming effect may be taken as one more piece of evidence in favor of the hypothesis of an increased activation level in the semantic network. The finding of a significant abstract priming effect only in normal control subjects but not in the patient group corresponds directly to the clinical observation of concretism in schizophrenic patients. The study has clearly demonstrated that little or no abstract meaning is activated in schizophrenic patients more than a second after a metaphoric statement has been uttered; instead, one or a few concrete meanings are highly active.

10. MEASUREMENT OF PAUSES IN SPONTANEOUS SPEECH

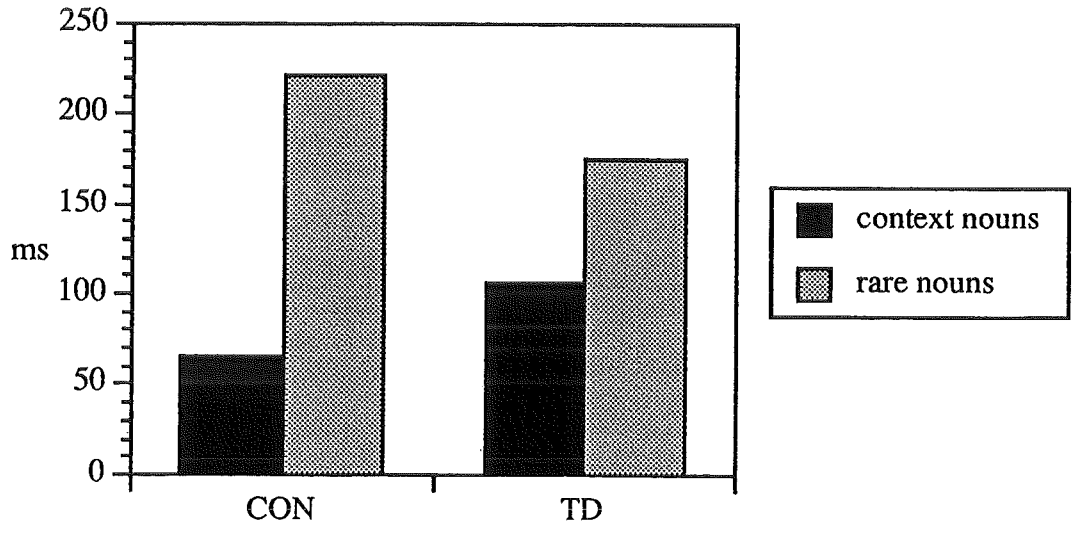
If lexical access in schizophrenic TD patients is impaired or dysfunctional due to overly activated or disinhibited associative processes in the semantic network, this should also be

detectable in measures of spontaneous speech.

In order to obtain a comparable sample of spontaneous speech, 20 subjects and 11 schizophrenic TD patients were asked to describe one and the same picture, a photographic reproduction of Breughel's painting "The Wedding Fiest". Speech was audiotaped using a small tape recorder and a sensitive microphone. Verbatim transcripts of all speech samples were produced. From the audiotape, speech was digitized on an Apple Macintosh personal computer, and pauses were measured by visually inspecting the spaces between the oscillographically displayed digitized words (for a description see Spitzer et al. 1994a).

Eight words were identified as the nouns that were mostly used in each of the two groups. These words were suggested by the context (henceforth referred to as „context nouns") and occurred in at least half of all texts produced by the members in each group. Therefore, we verified that the context depndent nouns were in fact frequently used by a considerable proportion of all subjects/patients. A second subset of words was identified: These words occurred only once within the entire set of the descriptions, i.e., they were rare and obviously not - at least not strongly - suggested by the context provided by the picture. This resulted in the identification of 188 (control subjects), and 103 (TD patients) rare nouns.

Figure 12: Duration of pauses (ms) in spontaneous speech before context nouns and rare nouns in 20 controls and 11 TD patients



The duration of pauses before context nouns and rare nouns in the texts obtained by the two groups is displayed in Figure 12. Two-tailed t-tests showed a highly significant difference between the length of pauses before the context nouns and the rare nouns in control subjects, but no significant difference in the TD patient group: In normal control subjects, the pauses before within-sentence nouns suggested by the context are significantly shorter than the

pauses before words not suggested by the context [65.5 ms vs. 221.5 ms; $t(19) = -3.8$; $p = .0012$]. No such relation, i.e., no context dependency of the pauses before nouns was found in TD schizophrenic patients (106.4 ms vs. 175.5 ms).

11. SUMMARY

In order to investigate dysfunctional associative processes in schizophrenic patients we used three different psychological methods, the lexical decision task, a word-association test, and the measurement of pauses in spontaneous speech.

In this way we could demonstrate that a general dysfunctional lexical access causes schizophrenic (TD) patients

(1) to produce more pronounced indirect semantic priming effects in a lexical decision task, a phenomenon which decreases according to the decline of acute symptomatology,

(2) to produce clinically overt clanging verbal behavior in the word-association test and different phonological priming effects,

(3) to respond with less direct and more indirect associations in the word-association test,

(4) to activate little or no abstract meaning after a metaphoric statement has been uttered, and

(5) to display an unusual pattern of hesitation phenomena before nouns within sentences.

These findings are in line with the hypothesis that in schizophrenic TD patients the access to lexical items is disturbed, most likely in the sense that associative processes are heightened/overly active or disinhibited, but that there is no pathology of the associative network itself.

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Flexible conceptual and lexical representations as prerequisites for the production of contextually adequate referential descriptions

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1 Introduction

It is an integral part of most communicative interactions to verbally refer to objects which can be accomplished by using *referential descriptions*. Frequently, a reference is established with a noun phrase, which in its most elementary form consists of an article and a noun, labeling the category of the target object (e.g. „a poodle", „the dog"). In addition, referential noun phrases can be modified by specifications of selected attributes of the object (like its color or its size). (Instead of giving a fully elaborated noun phrase, the object alternatively can be referred to by using a pronoun like „it" or „this".)

As soon as a speaker is going to produce a referential noun phrase, he or she has to make some decisions: It must be decided, whether to give an indefinite or a definite article, the object's category may be labeled at a more general or a more specific level, and additional attributes may be specified in order to complement the information about the object's category. With respect to the number of alternatives given in this situation, it becomes understandable that a considerable variability of object references can be observed in experiments as well as in daily communicative interactions. One of the research goals in the psychology of language production is to explain this variability by identifying situational and cognitive factors that determine the design of referential descriptions. In order to explain the interaction of these factors, models of the information processing going on in the speaker's cognitive system during the production of object references are developed and tested in experiments.

In our research projects, we have been concerned with studying the determinants of referential descriptions of concrete and visible objects by speakers for more than eight years. In the following text, we first will give a short *overview* of the factors found in our research to have effects on *article*, *attribute* and *category label* selection. In trying to integrate these findings into a more general framework, theoretical assumptions about the basic principles of reference production have led to the development of a process model. Here we will discuss our assumptions about the specific features of the system components that necessarily must be available in order to enable the speaker to produce exactly the kind of referential descriptions that have been observed in our experiments. To our view, these features are provided by sub-systems that are designed to bring about a specific performance as a contribution to the overall performance of the speaker system. We then will elaborate on the way in which these systems interact with each other during the production of an object reference.

2 *Determinants of referential descriptions*

In order to investigate the effects of situational determinants on reference selection, an experimental setting was constructed, in which the factors under study (e.g. the visible attributes of objects in the context of the target object, the speaker's goal, characteristics of the partner like being present or absent or his/her linguistic competence) systematically have been manipulated. Subjects in these experimental settings then have been instructed to produce referential descriptions for a series of objects. The referential noun phrases that have been produced by the subjects have been transcribed and classified with respect to those features that were assumed to covariate with the conditions manipulated in the experimental setting. The categorization scheme used for the analysis of object references (cf. Barattelli, Koelbing & Kohlmann, 1992) also allowed to determine for each reference its status of *referential movement* (Stutterheim & Klein, 1989): This value indicates, whether the information conveyed by the reference was *newly introduced* into the discourse, whether it was *maintained*, or *re-mentioned*.)

2.1 Article selection

A number of experiments was conducted to answer the question about what situational factors determine the selection of either an indefinite or a definite article. According to psycholinguistic assumptions, the *definite article* is used either if the object already has been introduced into the discourse by a previous reference and thus is well-known to both communication partners, or if the target object is to be isolated unambiguously from a number of context objects. In the first case (*pre-mention*), the definite article can be considered to be a hint for the partner, that a cognitive representation of the object already has been activated which may be used by him or her for further information processing purposes. In the second case (*isolation and identification*) using the definite article emphasizes the separation of the intended object from other objects the target possibly may be confounded with. In all other cases a referential noun phrase preferably will be started with an *indefinite* article.

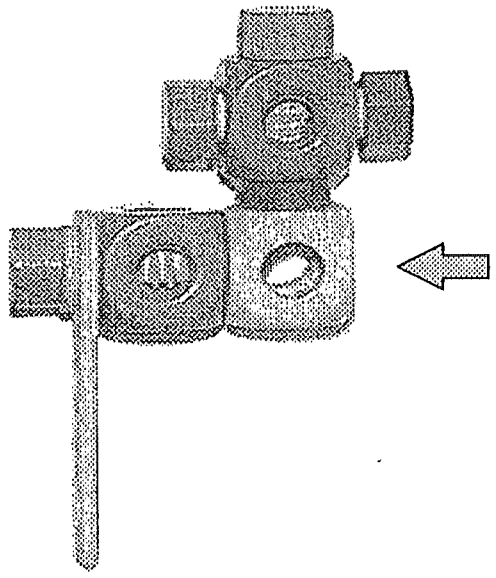

Figure 1: A structure assembled from objects of different shape, color, and size

The *dynamic principle of activating and re-activating object representations* in referential communication can be illustrated by specification frequencies of indefinite and definite articles in the course of referential movement. If a speaker is going to describe a structure assembled from objects of different shape, color and size (cf. figure 1) to a partner, indefinite articles predominantly are selected when referring to an object for the first time. (According to our assumptions outlined so far, this was to be expected.) On the other hand, when a reference is re-mentioned (after some other objects have been named meanwhile), the definite article is used predominantly. And for the maintenance of a reference, speakers in our experiments frequently produced pronouns. The other *principle of unambiguous identification of an object* with a definite article can be observed in cases, where speakers are asked not to describe but to *instruct the partner* how to assemble the structure from objects. For references in instructions, it is most important for the partner to unambiguously differentiate the object meant by the speaker from a number of context objects. As a consequence, in instructions definite articles are even used frequently in cases, where the target object is mentioned the first time.

In other experiments additional situational factors have been manipulated. For example, in instructional discourses subjects either had to produce object references for a partner, who was co-present in the situation and assembling the structure following the speaker's instructions, or they had to speak on a tape (which was to be played to listeners later in time and at a different location). We also manipulated the kind of information subjects could collect prior to discourse production. In one condition, the speakers only were allowed to inspect the structure (*state-oriented* experience), in the second condition, the speakers had learned themselves how to assemble the structure from the objects (*action-oriented* experience). In all conditions it was emphasized by the results that article selection is determined by a number of situational factors as well as different sources of information (e.g. features of the structure in the process of creation, or reactions of the partner) which makes clear that deciding for an indefinite or definite article is not a simple process but a process in which many constraints are interacting with each other. (A further elaboration on article selection can be found in the second chapter of Mangold-Allwinn, Barattelli, Kiefer & Koelbing, 1995.)

2.2 Attribute selection

The selection of attributes is critical, when a partner has to unambiguously identify the target on the basis of attribute information given to him or her by the speaker. (Which again is the case, for example, when the partner is listening to a speaker's instruction of how to assemble the structure from a set of objects). The attribute (or the combination of attributes) specified by the speaker must apply to the target object only and must not be found for one of the context objects. If more than one way is possible to give unambiguous attribute information (*multiple codability*), speakers prefer to specify *perceptually salient attributes* (like color). The target object's color frequently is mentioned even in situations where it would not be necessary for unambiguous object identification. This is the most important reason for the production of *overspecified* referential descriptions, that is, of messages, that contain more than the information minimally needed for object discrimination. Further determinants of overspecified object references are (at least in the German language) the attribute's *syntactical role* (e.g. the shape attribute being coded as a noun like 'triangle' or as a modifier like 'triangular'), and *characteristics of the partner*. The latter include the fact whether the partner

is present or absent in the communicative situation, the partner's perceptual conditions (e.g. if he or she can see identical color information as the speaker or not) and the partner's cognitive-linguistic competence (which is different for children than for adult partners).

The importance of partner characteristics for attribute selection, which has been observed in a number of naming experiments, has lead to the assumption that giving overspecified object references is based on an *orientation* of the speaker's speech production *towards the listener*. But, as an alternative, overspecification also may be a consequence of the way in which the speaker's *perceptual and linguistic system interact* during reference production. On the other hand, less attention has been given to *underspecified* referential descriptions. (Underspecifications are referential descriptions, that do not contain all the attribute information necessary for an unambiguous object identification.) In the beginning of research on reference production (cf. Olson, 1970; Herrmann & Deutsch, 1976), underspecified referential descriptions simply have been treated as errors in naming experiments. However, if a reference to a target object is re- mentioned it can be observed that referential noun phrases will be significantly shorter. At the same time, there is a significant increase in the frequency of ambiguous (underspecified) object references. Even in these situations communicative information exchange obviously still works satisfactorily, which is only possible, because information given by the speaker and information, which is currently activated in the listener's working memory, complement each other for an adequate understanding and processing of referential descriptions. Furthermore, in accordance with this dynamics it can be observed, that speakers tend to specify the target's color less frequently or even not at all, if the partner is able to infer the object's color from its category label without much effort: A speaker would probably refer to a ball with „the red ball", but not to a banana with „the yellow banana".

However, the principles for attribute selection described so far only apply to discourses, in which unambiguous object identifications are the prevailing function of referential communication (e.g. in *instructional* discourses). For discourse goals different from that (for example, to give a *description* of a structure consisting of objects of different shape, color, and size) other functions of object references (e.g. characterizing instead of isolating the target) become more important. This is indicated by varying frequencies of attribute selection, and especially for color selection: Whereas in instructional discourses color predominantly is used for the reference to objects being newly introduced into the discourse and for re-mentions of a reference, there are weaker differences between the three states of referential movement for descriptional discourses.

Again, additional situational determinants have effects on attribute selection. A comprehensive overview is given in chapter 3 of Mangold-Allwinn, Barattelli, Kiefer & Koelbing (1995).

2.3 Level selection

Even in simple referential noun phrases the speaker produces a label for the target object's category. The *hierarchical structure* of conceptual, pre-verbal knowledge is mirrored in hyperonymic and hyponymic relations of object descriptions: The label may be specific (subordinate: „poodle"), abstract (superordinate: „animal"), or in between (basic level: „dog"). According to assumptions both in cognitive psychology as well as in linguistics, in referential descriptions the object's category predominantly will be selected on the middle (*basic*) level of

abstraction. However, there are different explanations for this effect in both disciplines: The assumption of a basic level advantage in cognitive psychology is based on architectural and processual peculiarities of the organization and retrieval of conceptual knowledge from long-term memory, whereas linguistic approaches concentrate on the maximally possible communicative instrumentality of category labels at the basic level.

In contrast to the assumption of a basic level advantage, a considerable variability of level selection can be observed in naming experiments. References at an abstract level are rare, but a number of situational factors (like the time that is given to the speaker for reference production, or the linguistic competence, that is smaller for younger than for grown-up partners) can cause a shift in frequency from basic level category labels towards more specific ones. The principles and determinants of category label selection are further elaborated in Kiefer (this volume), in Mangold-Allwinn, Barattelli, Kiefer & Koelbing (1995; chapter 4) and in Kiefer, Mangold & Barattelli (1995).

2.4 Summary

It has become obvious, that speakers, when producing a referential description for a target object are taking many aspects into account. Determinants of reference selection include features of the perceivable context of the target object (i.e. attributes of the context objects) as well as features of the local discourse context. Additional factors include the speaker's cognitive resources (general knowledge, prior experiences with the objects, communicative goals) and partner characteristics (the partner's perceptual conditions and cognitive resources). All these factors are conceptualized as *constraints* for the production of a referential noun phrase, and the reference produced may be conceived of as the *optimal solution* for the problem defined by the constraints (*constraint satisfaction problem*). In a situation of reference production, constraints are defined both at a global and at a local level. At the *global level*, the discourse goal of the speaker and general characteristics of the partner are pre-set, and in each cases of reference production constraints at the *local level* are inferred from these global constraints. However, the nature of local constraints being derived from global ones, is further modified when the factors are interacting with each other.

Based on the observations being made in many naming experiments, five *sub-systems* have been identified, that provide specific contributions to the speaker system when producing a referential description. The architecture and functioning of the sub-systems have to be designed in a way that enables the speaker system to produce exactly those kinds of situation-specific referential descriptions, that have been observed in our studies. The sub-systems will be described more in detail in the following section.

3 Sub-systems for the production of situation-specific object references

In our model of the production of situation-specific object references, five sub-systems are integrated, and every one of them provides a different contribution to the information-processing of the speaker during the production of an object reference. The contributions of these sub-systems are:

- The sensorial information perceived from the target and its context objects is analyzed (= *perceptual sub-system*);
- a flexible representation of the target object and of the word components of the referential description is constructed (= *representation sub-system*);
- permanent non-verbal and verbal knowledge is stored and accessed (= *sub-system for permanent information storage*);
- temporary non-verbal and verbal knowledge is stored and accessed (= *sub-system for temporary information storage*);
- the lexical representation of the referential description activated in the representation system will be encoded (= *articulatory-motor sub-system*).

As can be seen, specific aspects of the speaker system's performance are provided by specialized sub-systems. However, from this it may not necessarily be inferred that two systems with different performance contribution have to be found in different locations or must be thought of being modularized. The distinction rather is based on the different *kinds* of information-processing aspects, that are necessary in order to achieve the performance of the speaker-system that is producing a context-specific object reference. For example, in an activation-spreading network long-term memory corresponds to the structure of the connections between nodes and their weights, whereas in the same network the contents of working memory may be identical to the activation pattern of the nodes. In this example, two sub-systems with different functions are combined within the same network.)

Two sub-systems - the perceptual system and the articulatory-motor system - are tailored to interact with the speaker's environment. It is a common feature of the three remaining systems to provide the representation and storage of information and knowledge. Differences exist, however, with respect to the time, for which the information is represented or stored in the system and thus for which it is relevant for reference production. Whereas *permanent* information already exists prior to the referential discourse and probably will continue to be valid after the discourse, *temporary* information is gathered during communicative interaction with the partner and will become mostly irrelevant, as soon as the discourse is over. Finally, even shorter storage periods are characteristic for prevailing representations of the target object and the words to be produced, because these representations are just generated 'on-the fly', and they will most probably become invalid as soon as the referential description has been encoded by the articulatory-motor system and when the next reference already is in preparation. The three systems for information representation and storage will be discussed more in detail further on.

3.1 System for permanent information storage

Permanently stored *non-verbal* knowledge is needed in order to *categorize* the target object based on sensorial information that is provided by the perceptual system. The object's category the speaker has decided for in the categorization process will become a component of the conceptual representation of the object, generated in the representation system. As soon as the

speaker has come to a category decision, additional information about the target object, that cannot be perceived, but is known about the object, can be retrieved from the permanent information storage (for example, functional attributes). Permanent *verbal* knowledge includes word order rules, labels for attributes, and rules for article selection.

3.2 System for temporary information storage

If a speaker has had prior experiences with the objects before he or she refers to them in the discourse, and if this information is forgotten again soon after the discourse, then this information is part of the *non-verbal* knowledge temporarily stored in the memory system discussed here. This system also includes knowledge about previous interactions with the partner in the discourse, and it further may be plausible to include the communicative goal, a speaker pursues with his or her discourse production. The speaker's temporary *verbal* knowledge may be conceived of as the *discourse protocol* (cf. Herrmann & Grabowski, 1994), which enables the speaker to refer to topics that have been mentioned by him or his partner earlier in the discourse. The most important aspect of this knowledge for object reference is whether the target has been mentioned previously or not.

3.3 Representation system

The sub-system for building *intermediate representations* of objects (conceptual representation) and of words (lexical representation) will be discussed more in detail here. One way of understanding the building and use of an object representation (as a prerequisite for planning a referential description) is to conceptualize the process in a way, in which object information is copied from the speaker's environment (*perceived* object information) or from the permanent storage areas (*known* object information) into the representation system and used there without modification. By that, a categorization can be done as soon as sufficient evidence is provided that the object definitely is a member of the category. After that, additional information stored together with the object's category in permanent memory will become part of the object representation. It characteristically is assumed in this approach, that the same object at different occasions is represented in the same way; that is, that the object representation is independent of the situation and parameters of the speaker system. Dynamic transformations of the object representation (e.g. changes in time) are not considered as being important, too.

In contrast to that our model - very much in the same way as authors like Barsalou (Barsalou & Medin, 1986), Kintsch (1989), Strube (1987) or Herrmann (Herrmann, 1985; Herrmann & Grabowski, 1994) - is based on the assumption, that in the process of producing an object reference object concepts are generated in the representation system 'on the fly', and that concepts are affected by many context factors. The generation of a concept for one is based on sensorial information provided by the perceptual system. Additional information components (e.g. object category, functional attributes, temporary attributes of an object like its location) of the concept are retrieved from the sub-systems for the storage of permanent and of temporary knowledge. This information is integrated into the concept, too. It is obvious that concepts of the same object need not be invariant across situations; on the contrary, - dependent on the constraints prevailing in the situation - conceptual components may contribute more or less to the concept, that is, their weight within the concept can be high or

low. For that, we speak of *flexible concepts* of objects. (One import determinant for the composition of the object concept is the speaker's goal, and this view is similar to the conceptualization of Barsalou's (1983) goal-dependent ad-hoc-categories.)

Conceptual representations not only are context-dependent and thus flexible, but they also continually change during the generation process. One reason for this dynamic variability is, that information components of a concept will be provided by the perceptual system or by the systems for storage retrieval not at once, but with varying time delays. Mangold-Allwinn (1993), for example, could show that sensorial information is available earlier in the process of concept generation than abstract, semantic information. In addition, internal processes of activation spreading cause time-dependent variations.

3.4 Connectionist networks as a metaphor for modeling and simulating concept generation

Cognitive processes (like the production of object references), predominantly are modeled within the framework of a *metaphor* or an *analogy* (cf. Gentner & Grudin, 1985). This will become especially important as soon as the model or a section of it is intended to be simulated with a computer program. (For the simulation of reference production see Eikmeyer & Schade, this volume). Cognitive processes may either be conceptualized as *symbol processing* or as the spreading of activation in a *connectionist network.* Without going to discuss the advantages and disadvantages of both approaches in detail, we will try to explain in short, why a connectionist approach for the modeling the architecture and functioning of the representation system is preferred by us.

- In a connectionist network, representations (e.g. of objects) are formed by the activation states of many nodes. As these states are changing easily and continuously, a huge variety of different shades of the same object can be represented.

- Multiple connections between nodes bring about a strong interdependency of the nodes' activation states. These reciprocal influences of conceptual components very much correspond to the 'inner' contexts of concepts, which are postulated for concepts by Goschke & Koppelberg (1990).

- After external activation of a (highly interactive) network with many interconnections, the pattern that is formed by the activation states of the network's nodes is continuously changing, until a stable pattern of activation distribution across the nodes - the *attractor* - has been reached. Whereas the characteristics of the attractors in a network (the *attractor landscape*) are determined by network parameters like node dynamics and connection structure, the attractor that will eventually occur is dependent of the kind of external activation feeded into the net. By that, different input patterns can result in the same attractor, which allows - despite of the flexibility of the conceptual representations - to separate object concepts into categories and to establish basic similarity relations between concepts.

- As was said, the activation pattern that emerges in an interactive connectionist network not only is a function of characteristics of the nodes and the connection structure, but also of

activation input, that comes from other (external) nodes. Thus, activation states of external nodes can influence the activation pattern formed by the network, which in a simple way mirrors the context-dependency of object concepts.

- Internal interdependencies of the nodes' activation states as well as influences by external activation input may be conceived of as a set of *constraints* in the net, and the emerging activation pattern then is the best solution for the constraint-satisfaction problem defined by these constraints. It is possible for connectionist networks to include even contradictory or opaque-defined conditions into the set of constraints; nevertheless, optimal solutions (given the specific conditions) are provided without extensive information processing (which is, as a contrast, necessary in symbol processing systems for constraint satisfaction).

- In interactive connectionist networks, activation spreads across nodes, and it takes some time until a stable activation pattern is found. Within this time, a number of intermediate states will be passed; by that it can happen that components of the concept are highly activated for some time, but eventually will loose importance within the final pattern. On the other hand, components, which are not activated much in the beginning, can become more and more relevant during the spreading of activation going on. This behavior corresponds to time-dependent dynamics of generated concepts.

In a similar way as for the representation system, the metaphor of connectionist networks can be applied fruitfully to the modeling of the systems for the temporary and permanent storage of information. At last, it will be discussed how the sub-systems interact for the production of a situation-specific object reference.

4 Interaction of systems during the production of an object reference

The sub-systems described in the previous section interact with each other for the production of a referential description that is adapted to the prevailing communicative situation of the speaker. In this final section we will shortly discuss how information is exchanged between the five sub-systems in this process:

- The whole process starts with the analysis of sensorial information about the target object in the perceptual system. A representation of the target object will be generated by the representation system on the basis of sensorial information that is provided by the perceptual system. Different types and different modalities of sensorial information will be at available at different times: Color information, for example, can become a component of the conceptual representation early in the generation process, whereas information about details of the objects' form will enter the concept only later.

- Based on sensorial object information available so far, additional information is retrieved from permanent object knowledge. This information at first is used for a continuous and on-line categorization of the object. Always the categorization of the object will be as specific as it can be justified by the sensorial information available so far.

- Following categorization, additional object information, that is retrieved about the object from permanent knowledge, becomes part of the concept. Again, retrieved information

components from permanent memory are available with different delays. For example, *concrete* information about an object will become a component of the concept earlier than *abstract* information.

- In addition to sensorial object information and information retrieved from permanent knowledge, situational factors like the speaker's goal affect the composition of the generated concept.

- Because activation for some time spreads across the nodes of the net, the concept is continuously changing and passes intermediate activation patterns.

- Based on the concept, a lexical representation of the referential description is formed and encoded by the articulatory-motor system.

The interaction of the sub-systems in the production of object reference must not necessarily be assumed to be sequential. In Mangold-Allwinn, Barattelli, Kiefer & Koelbing (1995) we have postulated a *cascade-model*, according to which the information processing starts earlier in the first system than in follow-up systems. But already from the beginning information will be passed on continuously from the first to the second system and can modify processes going on there. Also, sub-systems which have started later, still can influence the information-processing in sub-systems that are located earlier in the chain.

5 Concluding Remarks

Although the task of referring to an object in a discourse as is performed easily and without much attention by a speaker, it might have become obvious that this task nevertheless is a rather complex one. Information about quite a number of personal and situational factors, that is important for the formulation of referential descriptions, have to be taken into account when planning speech output. From that it is concluded, that sub-systems with different architectures and function contribute to the information processing going on in the speaker system. In our projects, we could identify some of the factors that affect form and/or contents of referential noun phrases. In order to explain the interdependencies observed in many experiments so far, our assumptions have been integrated into a *model* of reference production. However, as our assumptions concerning the processes involved in reference production still are at speculative level, it would be desirable (1) to see working simulations of the processes taking place in theses sub-systems, and (2) to conduct experiments in which the assumptions incorporated in the model are tested empirically. At the end of 1994, our projects has been brought to an end, but research on reference production is continued by other research groups. For example, as was mentioned above, *computer simulations* of selected aspects of reference production are programmed and tested by Hans-Jürgen Eikmeyer and Ulrich Schade (see this volume; Eikmeyer, Schade & Kupietz, 1994), *experiments* on information processing during object naming are conducted, amongst others, by research groups at the Max-Planck-Institute for Psycholinguistics (e.g. Levelt, Schriefers, Vorberg, Meyer, Pechmann & Havinga, 1991).

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Discourse and conceptualization in expressing epistemic modality

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0. Introduction[1]

This paper attempts to explain some of the linguistic properties of epistemic modal expression forms in Dutch, with an eye towards the vexed question of the status of 'qualificational categories' such as epistemic modality in language processing, and the implications for how linguistic structures and processes relate to conceptual structures and processes. Section 1 sketches the theoretical background for this investigation, section 2 discusses method, data, and some general features of the analysis. Section 3 presents some major observations regarding the linguistic properties of epistemic modal expression forms in connection with their informational status in discourse. Section 4 attempts to explain these observations in terms of two functional principles, and section 5 discusses some of the theoretical implications regarding the status of epistemic modality in language and conceptualization.

1. The background

The research reported here has its roots in the functionalist tradition in linguistics, and particularly in the model of Functional Grammar (FG - Dik 1978, 1989) - but it is also inspired by a discontent with the limits of FG (and of much of functionalist grammar theory in general, for that matter). In fact, like so many other linguistic grammars, FG has been conceived as a model of linguistic structure only, and despite its declared interest for it, in actual practice it has had little explicit concern for matters such as how a grammar could fit in a wider interactional and cognitive perspective, and what this might imply for the FG model itself. Such would seem crucial for the plausibility of the model, however, for, after all, in a functionalist perspective, language is considered a means of the human organism to communicate, and more specifically to transmit and receive information - so a plausible model of the linguistic capacity should be integratable into a larger model of the human being as an interaction and information manager, and this obviously involves much beyond syntax, including, quite crucially, its relationship with the processes and structures for acquiring, storing and using general information about the world - human conceptualization, in other words. In line with this I have argued for the need to develop a wider concept of a functional grammar (called Functional Procedural Grammar - De Schutter and Nuyts 1983, Nuyts 1992a), which implies at least the following major changes to the FG model:

(i) In order to fully represent meaning, one needs 'deeper' levels of representation than those present in current FG. Currently, the basic level of representation in FG, called the

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1 This paper has also been presented in a keynote lecture at the International Conference on Functional Approaches to Grammar, Albuquerque, NM, July 1995. This research has been sponsored in part by the Alexander von Humboldt-Stiftung.

'predication', is basically a predicate-argument structure, of the type in (1b), which is thus composed of the lexical material of a specific language.

(1) a. John hides pink elephants in his backyard
b. hide $(John)_{Ag}$ $(pink\ elephants)_{Go}$ $(his\ backyard)_{Loc}$

This type of representation may be adequate as a linguistic-semantic representation, but against Dik's (1987) own view in this respect, there are reasons to assume that a model of conceptual meaning requires a qualitatively different, viz. more abstract, non-linguistic type of representation, which is linked with linguistic representation by means of a probably quite rich system of verbalization procedures (Nuyts 1990a, 1992a).

(ii) Several phenomena which are currently dealt with in terms of linguistic structure should be dealt with at the deeper 'pre-predicational' levels. This includes, notably, the 'pragmatic functions', i.e. matters related to the topicality and focality of utterance parts. In current FG these functions are assigned rather late in grammar, even after the syntactic functions subject and object. But there are various indications that information structuring should already figure at very deep, pre-verbal levels, so that it can help trigger syntactic function assignment, for example, but also, even more profoundly, the choice for basic construction types and lexical materials (Nuyts 1990b, 1992a).

(iii) Like so many other grammatical models, FG takes a quite static, integrative and representation oriented approach to grammar. We may actually need a more process oriented view, assuming greater flexibility and more interactive processing, also in syntax (Nuyts 1992a, 1993c).

These points are not just a matter of mere theoretical luxury, but are actually crucial to fully grasp certain - and probably quite many - types of linguistic problems. The domain of epistemic modality is a case in point, as I will try to show.

In fact, the tricky behavior of qualificational categories such as tense, aspect, and modality has recently led to the introduction in a few functionalist frameworks, including Role and Reference Grammar (RRG - Foley and Van Valin 1984, Van Valin 1990, 1993) and FG (Hengeveld 1989, 1990, Dik 1989) - see also Bybee (1985) for a more theory independent proposal in this direction - of a 'layered' or 'hierarchical' structure. In FG, which has the most sophisticated proposal of this kind to date, this implies the development of the level of the predication as illustrated in (1b) into a representation of the type shown in Figure 1 below.[2] The core of this structure is still the predication, which represents the state of affairs referred at in the utterance. But it is surrounded by a system of increasingly wider levels - like the shells of an onion, so to speak - each of which harbors specific types of qualificational categories, in the form of operators and satellites. In FG, operators, marked with the Greek character π, are grammatical expressions of qualifications, and satellites, marked as σ, are lexical, and more specifically mainly adverbial expressions of qualifications. The precise position of qualifications

2 As the details do not matter here, this Figure is a considerable simplification of the actual proposal in FG. See Hengeveld (1989, 1990) for a full presentation.

in this system depends on their semantic nature and on their semantic scope relationships. Below the Figure is a list of some of the most important types of operators and satellites situated at each level.

Figure 1: Layered clause structure in Functional Grammar (considerably simplified)

$$[\pi_4 \text{ ILL (S) (A) } (\pi_3 [\ \pi_2 [\pi_1 \text{ pred } (\text{arg}_1) \ldots (\text{arg}_n)\ \sigma_1]\ \sigma_2\ ]\ \sigma_3)\ \sigma_4]$$

π_1-operators and σ_1-satellites: additional properties of the state of affairs, including:
- π_1: qualificational aspect ((im)perfective, progressive, etc.), predicate negation
- σ_1: additional participants, manner, spatial orientation

π_2-operators and σ_2-satellites: setting of the state of affairs, including:
- π_2: tense, quantificational aspect (iterative, semelfactive, habitual, etc.), objective modality (epistemic and deontic), polarity
- σ_2: spatial setting, temporal setting, setting relative to other states of affairs (cause, co-occurrence, condition, reason, purpose)

π_3-operators and σ_3-satellites: validity of the propositional content, including:
- π_3: subjective modality (epistemic, boulomaic), evidentiality
- σ_3: propositional attitude, source, evidence, motivation, condition

π_4-operators and σ_4-satellites: communicative strategy of the speaker, including:
- π_4: mitigation or reinforcement of illocutionary force
- σ_4: manner of speech act, communicative setting of speech act

Now, the introduction of some such kind of layered representation in linguistic theorizing is no doubt a very plausible step towards an account of the complex behavior of qualificational categories in language (even if the actual proposals, including the FG proposal, are problematic in several respects - Nuyts 1994). But it also generates a few important questions, which relate quite directly to the issues brought up above. In particular, one may wonder where in a grammar such a layered representation actually belongs. Van Valin (1990) has pointed out that while the FG proposal would seem linguistic-semantic in nature, his own proposal in RRG is purely syntactic: it is primarily intended to account for the positioning of (mainly grammatical) expressions of qualifications in languages. And, so he argues, one certainly needs such a syntactic level of layering. On the other hand, if we view the matter from a cognitive perspective, intuitively, the issues involved in qualificational categories, such as one's conception of time and space, of moral acceptability, of probability, of evidence, etc. would not seem specifically linguistic, but rather general cognitive categories, inherent to our knowledge and thinking in general. But if so, should a layered representation not rather be situated at the conceptual level, then? Or do we need one at different levels, rather than at one, as is currently assumed in most proposals? And if so, what should its properties at those different levels be, and how should they be related? And how does this matter affect the operation of the grammar - how does it affect pragmatic function assignment, e.g.?

Hopefully, an in depth study of the linguistic expression forms of a qualificational category such as epistemic modality can help us settle at least some of these questions. In fact, if by epistemic modality we understand a speaker's estimation of the chances that a certain state of affairs may be true or not in the world, then most Western European languages have a considerable variety of alternative expression forms for it: modal auxiliaries as grammatical operators; modal adverbs such as *maybe* or *probably* as satellites in FG terminology; but also

predicative modal adjectives, of the type *it is possible, it is probable,* etc., and full-fledged predicates such as the mental state predicates *think* and *believe*. Obviously, the interesting question arises in which respects these forms differ, and which factors may cause a speaker to choose one of them. If we manage to find out about these, we may be able to infer what is needed in terms of cognitive infrastructure in order to get from the concept of epistemic modality to the actual variety of expression forms. The following presents a tiny part of what such an investigation may reveal (see Nuyts 1994 for a comprehensive analysis).

2. Method, data, general observations

This investigation is supported by data from a large corpus of Dutch spoken and written language.[3] The written data (more than 500.000 words) involve expository prose taken from journals, magazines, and popular scientific publications. The spoken data (more than 200.000 words) are interviews and debates, mainly from Dutch and Belgian TV.[4]

In this corpus, focus has so far mainly been on one (hopefully) representative expression form within each category of expression types mentioned. The adverb and adjective is *waarschijnlijk* "probably, probable", as in (2) and (3).

(2) Jan is waarschijnlijk thuis
"John is probably home"
(3) Het is waarschijnlijk dat Jan thuis is
"It is probable that John is home"

The auxiliary investigated is *kunnen* "may", which is generally considered the most prototypical epistemic modal in Dutch, although it can have other meanings as well. It can also express dynamic modality, i.e. a capacity or an inherent potential of the subject, as in (4), and deontic modality, and particularly moral acceptability, as illustrated in (5). The epistemic meaning, which interests us here, is illustrated in (6).

(4) Jan kan goed hardlopen
"John can/is able to sprint well"
(5) . Je kan een politieke vluchteling niet terug naar huis sturen
"You should not/it is morally unacceptable to send a political refugee back home"
(6) Jan kan/zou kunnen thuis zijn
"John may/might be home"

For the mental state predicates, focus has been on *denken* "think" in its qualificational meaning.

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3 The use of Dutch in this study (the author's native language) has been determined by the fact that the very subtle semantics of the phenomena under investigation often require native intuitions. The confinement to one language has obvious limitations - but that's the eternal problem of the depth vs. the width of one's investigation, of course.

4 Some of the assumptions drawn from the corpus analysis are currently being tested in a series of experiments at the Max-Planck-Institute for Psycholinguistics (e.g. Nuyts and Vonk in prep.), but I cannot go into these here.

In fact, this predicate, like all other mental state predicates, also has a more literal 'mental state or process' reading, which is illustrated in (7). Such uses do not involve a speaker qualification of a state of affairs in terms of its probability. Rather, they describe the process of 'thinking', of reasoning with knowledge. The examples in (8) on the other hand do express an epistemic evaluation.

(7) a. Zwijg es even, ik ben aan het denken
"Shut up for a minute, I am thinking"
b. Ik denk aan de gevolgen die dit kan hebben
"I am thinking of the consequences this may have"
c. Ik was aan het denken dat we eigenlijk een grote stommiteit gedaan hebben
"I was thinking that we have actually been really stupid"

(8) a. Ik denk dat Jan thuis is
"I think John is home"
b. Jan is thuis, denk ik
"John is home, I think

In principle, the qualificational reading of these predicates can occur only when they are used with a complement sentence, as in (8a), or parenthetically, as in (8b).

For the sake of completeness, Tables 1 and 2 show the frequencies per 10.000 words of the different meanings of the auxiliaries and the mental state predicates in the corpus, and Table 3 presents an overview of the frequency of all four expression forms in their epistemic meaning.

Table 1: Frequencies of *kunnen* in its different meanings (per 10.000 words)

	expository	spoken	total
Dynamic	63.71	44.86	51.71
Deontic	1.15	6.66	4.66
Epistemic	6.70	3.06	4.38

Table 2: Frequencies of *denken* in its two meanings (per 10.000 words)

	expository	spoken	total
Epistemic	1.95	26.96	7.91
Process	3.83	13.21	6.06

Table 3: Frequencies of the epistemic modal adverb, adjective, mental state predicate, and modal auxiliary (per 10.000words)

	expository	spoken	total
Adverb	1.89	2.63	2.09
Adjective	0.37	0.05	0.28
MS Predicate	1.95	26.96	7.91
Auxiliary	6.70	3.06	4.38

From the analyses, it appears that the use of these expression forms - and thus their frequencies as shown in Table 3 - is determined by at least four important factors:

(i) The subjectivity vs. intersubjectivity of the epistemic qualification. This involves a speaker indication regarding whether the sources for his/her information are purely within him/herself, or only accessible by him/herself - i.e. subjectivity - or whether they are generally known or accessible for everyone, including the hearer - i.e. intersubjectivity (this factor to a large extent explains the very high frequency of the mental state predicate in spoken language). (See also Nuyts 1992b, 1996a.)

(ii) The performativity vs. descriptivity of the epistemic qualification, viz. the question whether the speaker is making an epistemic evaluation him/herself, at the moment of speaking, with a full commitment to it - i.e. performative - or whether (s)he is reporting another person's epistemic evaluation of a state of affairs, without being committed to it him/herself - i.e. descriptive.

(iii) Interaction strategy, i.e. the use of expression forms to achieve different kinds of strategic effects, such as hedgings and other politeness effects, ironical effects, argument management, etc.

(iv) The informational status of the epistemic qualification versus other elements in the utterance in the discourse context.

The different expression forms offer the speaker quite different possibilities in connection with one or more of these four factors. The first three of them will have to remain entirely unexplored here (see Nuyts 1994 for a comprehensive discussion of all factors and their interactions), the rest of this paper will be focussed on factor (iv): information structure.

3. The informational status of the different expression forms in the corpus data

First of all, there is a considerable difference in the average informational status of the adverbs vs. predicative adjectives (Nuyts 1993a): the adjective construction is in the overwhelming majority of cases used to focalize the epistemic qualification, while the adverbs are never used as such in the corpus. In fact, the adverbs would even seem to inherently disallow focalizing

the epistemic qualification: several of their grammatical properties - not only in Dutch, but also in English or German, as has repeatedly been noted in the literature - point in that direction. Thus unlike the adjectives, the adverbs cannot be questioned (cf. (9/10)), they cannot be used to contrast alternative epistemic evaluations (cf. (11/12)), they cannot be negated (cf. (13/14)), and they do not occur in negative form (cf. (15/16)). As I have argued elsewhere (Nuyts 1992b, 1993a, 1994), all these features can be explained as indications that the modal adverbs have in some sense grammaticalized their aversion for being focalized.

(9) a. *Probably they have run out of fuel?
b. *Did/Have they probably run out of fuel?
(10) Is it probable that they have run out of fuel?

(11) a. *Not only possibly but even probably they have run out of fuel
b. *They have not only possibly but even probably run out of fuel
(12) It is not only possible, but even probable that they have run out of fuel

(13) a. *Not probably they have run out of fuel
b. *They have not probably run out of fuel
(14) It is not probable that they have run out of fuel

(15) a. *Improbably they have run out of fuel
b. *They have improbably run out of fuel
(16) It is improbable that they have run out of fuel

Now, one might at first sight expect to find a similar situation for the mental state predicates. As mentioned, these predicates when used epistemically occur in two construction types, viz. complementing, as in (8a), and parenthetical, as in (8b), and one might be inclined to relate the parenthetical form and the adverbs on the one hand, and the complementing form and the predicative adjectives on the other hand. In fact, the adverbs and the parenthetical predicates behave in a remarkably similar way in terms of grammatical and usage properties. Parentheticals are by definition very loose elements in the clause, but also the adverbs are known to have a very free status, in Dutch even more than in English. Hence, the parentheticals and adverbs can occur in exactly the same clausal positions in Dutch. Only sentence initial position would seem an exception, as normally only adverbs can occur there - but see (28) below. Thus, it is not surprising that the parentheticals, like the adverbs, never occur in focus in the corpus, and they have exactly the same grammatical properties as the adverbs: unlike the complementing forms, they cannot be questioned (cf. (17/18)), contrasted (cf. (19/20)), negated (cf. (21/22)), or take a negative form (cf. (23/24)). So they too appear to have grammaticalized their non-focus status.

(17) *Did/Have they, you think, run out of fuel?
(18) Do you think they have run out of fuel?

(19) *They have run out of fuel, I not only think but know for sure
(20) I not only think they have run out of fuel, I know it for sure

(21) *It is dangerous, I don't think, to run out of fuel in the desert
(22) I don't think it is dangerous to run out of fuel in the desert

(23) *They would run the risk, I doubt, of running out of fuel in a desert
(24) I doubt they would run the risk of running out of fuel in a desert

Since the complementing mental state predicates do allow each of these grammatical features, however, just like the modal adjectives, and given the syntactic similarity with the adjectives (which are also complementing), one might expect to find that they too are often used to focalize the epistemic expression. This turns out not to be the case, however. In actual practice there are no clear corpus cases in which the complementing predicate is focal, and in the overwhelming majority of cases it is clearly not: either an aspect of the state of affairs itself, or another qualificational category such as negation, is usually informationally much more important.

An interesting observation in this connection is also that the difference between the parenthetical and complementing forms of the mental state predicate is quite frequently blurred. (25)-(28) are just a few selective examples, all of them from the spoken corpus. The predicate in (25)

(25) Een warme zondagkamer, een geur van, ik denk, bloemkool of spruitjes of zo, sportberichten op de radio, en dan moest je dat spel doen, waar je totaal geen zin in had.
"A warm Sunday-room, a smell of, I think, cauliflower or sprouts or something, sports messages on the radio, and then you had to play that game, which you did not feel like at all."

is strictly speaking not a parenthetical, since it lacks the subject-verb inversion required in parentheticals in Dutch. It can be considered an elliptical variant of a complementing construction, in which only the predicate and the most important constituent in the complement clause is expressed. The full version would be something like 'a smell of, I think that it is cauliflower or sprouts, or something'. But obviously, apart from the inversion matter, this usage has every feature of a parenthetical use. In (26).

(26) Als er dus nieuwe gegevens zijn [...] die twijfel geven over die onvervalsbaarheid, dan denk ik toch dat het goed is dat wij daar in de Kamer nog eens over praten met de verantwoordelijke Staatssekretaris.
"So if there are new facts [...] which raise doubts about this non-falsifiability, then I think it is good to talk about this again in Parliament, with the responsible secretary of state."

the if-clause is obviously not conditional for the subject of the mental state predicate's thinking that the issue should be raised again in Parliament, but for the appropriateness of raising the issue again in Parliament. In other words, the mental state predicate, although it is syntactically integrated, is informationally parenthetical. In (27)

(27) Maar enige zelfcensuur denk ik dat er op zijn plaats zou zijn ...
"But some selfsensorship I think that would be in order ..."

the mental state predicate is grammatically integrated to the extent that it takes the entire clause apart from the subject as its complement. But it behaves like a parenthetical relative to the 'embedded' subject, which occupies sentence initial position, the position normally taken by the subject of the complementing predicate. This is a perfect example of a syntactic 'blend'. Finally, in (28),

(28) Ik denk wat er had moeten gebeuren dat is dat iemand van de regering 14 dagen in een huishouden had gezeten van een oprechte minima.
"I think what should have happened is that someone from the government had spent 14 days in a real minimum income household."

although the mental state predicate lacks inversion, and although it is clause initial - a position where one would not expect a parenthetical - it is grammatically unintegrated with the rest of the clause, and thus parenthetical.

In these and many more similar corpus cases - most of which are certainly not prototypical according to 'official Dutch grammar', but spoken language defies prescriptive grammar, as is well known - there seems to be a tendency to reduce the main clause status of the complementing mental state predicates, and to make them relatively freewheeling elements in the utterance, just like the parentheticals and the adverbs. The same tendency may actually be at work in the English complementing mental state predicates' preference to occur without the complementizer *that* (a tendency which to some extent also occurs in German), causing a kind of juxtaposition of the main and the embedded clause, or also in processes such as subject or object raising, which also blur the boundaries between main and embedded clause. The parenthetical uses of these predicates are probably no more than the endresult of this tendency.

The modal auxiliaries show yet another tendency. First of all, it should be pointed out that - against common Dutch wisdom - the epistemic reading of the modal *kunnen* is quite unstable. The frequency indications of this modal in Tables 1 and 3 above are actually misleading, because the overwhelming majority of them is actually ambiguous between a dynamic and an epistemic reading. Thus, in (29)

(29) Zijn hervormingen stelt hij dan ook voor met in het achterhoofd een versterking van de Europese eenheid die, in zijn filosofie, solied en onomkeerbaar kan gemaakt worden door het pure ontwikkelen van massa.
"He [Jacques Delors] therefore presents his reforms with, in the back of his mind, a strengthening of European unity which, in his philosophy, can/may be made solid and irreversible by the pure development of mass."

it is totally impossible, also in its wider context, to determine whether the modal should be taken in its dynamic or its epistemic meaning (I cannot further explore this interesting phenomenon as such here). The cases in which this modal is unambiguously epistemic are very rare, but the remarkable thing is that there turns out to be one type of syntactic pattern in which it can only get an epistemic reading, viz. in construction type (30), in which the modal is so to speak complementing. (31) is a corpus case.

(30) Het kan/zou kunnen (zijn) dat ...
"It may/might be that ..."

(31) Vanaf 18 mei hebben wij geen enkel teken van leven niet meer van mijn zoon gevonden. Het zou kunnen zijn dat wij van 13 tot 18 mei een teken van leven hebben indien dat hij bankopvragingen heeft gedaan.
"After May 18th, we have not found any signs of life from my son anymore. It might be that from May 13th till 18th we have a sign of life if he has done bank withdrawals."

This type of construction thus seems to be specializing for the epistemic reading, which is of course directly contradictory to the tendency away from the complementing structure in the mental state predicates.

In terms of information structural properties, however, the epistemic modals appear quite like the mental state predicates. Not surprisingly, none of their clause internal occurrences has focus, and in the complementing version there are a few corpus cases in which the modal is possibly focalized, but in the majority of cases the most important information is not the epistemic qualification, but some aspect of the state of affairs in the embedded clause. In terms of grammatical properties, the sentence internal modals again do not allow questioning, they cannot be contrasted, and they do not allow negation. The complementing version of the modals is not entirely free in all these respects either, though, unlike the complementing mental state predicates and the adjectives: thus, it does allow questioning, but it only marginally allows contrasting, and it disallows negation. These properties are illustrated in (32)-(37).

(32) Kunnen ze zonder benzine gevallen zijn? (epistemic reading (nearly) impossible)
"Could/Is there a chance that they have run out of fuel?"
(33) Kan het zijn dat ze zonder benzine gevallen zijn? (epistemic reading possible)
"Could it be/Is there a chance that they have run out of fuel?

(34) *Ze kunnen niet alleen maar moeten wel zonder benzine gevallen zijn
"They may not only, but must have run out of fuel"
(35) ??Het kan niet alleen zijn, het moet zo zijn dat ze zonder benzine gevallen zijn
"It not only may be, it must be the case that they have run out of fuel"

(36) Ze kunnen niet zonder benzine gevallen zijn (epistemic reading impossible)
"They may not have run out of fuel"
(37) *Het kan niet zijn/zou niet kunnen zijn dat ze zonder benzine gevallen zijn
"It may/might not be that they have run out of fuel"

Finally, an observation which affects all expression types concerns intonation. Even if they are non-focal, epistemic expressions are not unlikely to be intonationally marked. This is even true for the inherently non-focal adverbs, parentheticals, and clause internal modals. This does not seem to involve 'normal' information structural intonation, however. Its acoustic properties are in need of investigation (on first impression, it usually involves lengthening the pronunciation, and it is accompanied by very specific facial expressions), but functionally, it clearly serves to further adjust - and more specifically to strengthen - the epistemic qualification. It is thus part of the expression of the epistemic qualification as such, and it does not appear to affect the information determined intonation pattern in the remainder of the utterance. I.e. it perfectly combines with, and may even require a normal focus marking main sentence stress elsewhere

in the utterance. (See also Lötscher 1985, Anderson 1986.) This feature obviously fits in with the observed tendency towards a 'free' status of the epistemic expressions in a sentence.

4. Two functional forces

In summary, the epistemic expression types reveal a quite systematic pattern of syntactic structures, shown in (38).

(38)	Main/embedded clause structure		Flat structure
Adj./Adv.:	*Het is waarschijnlijk*	*dat XYZ*	*X waarschijnlijk YZ*
	"It is probable	that XYZ"	"X probably YZ"
MS-Pred.:	*Ik denk*	*dat XYZ*	*X, denk ik, YZ*
	"I think	(that) XYZ"	"X, I think, YZ"
Modals:	*Het kan (zijn)*	*dat XYZ*	*X kan YZ*
	"It may be	that XYZ"	"X may YZ"

The observed tendencies in these different expressions are quite different, however, and the question is how to understand this. The answer may be quite simple: it is probably the result of two partly opposing functional forces to which the epistemic expressions are subject, viz.:

(i) An iconic force: a tendency to preserve at the surface of the utterance the underlying status of the epistemic qualification as an operator over a state of affairs, as rendered in the layered clause model introduced in 1. above.

(ii) An information structural force: a tendency to shape the epistemic expression forms according to their usual informational status in discourse. As observed in 3., except for the adjectives this is usually a non-focal status.

The default non-focal status of the epistemic qualification is actually not too surprising. An epistemic qualification relativizes the truth of a states of affair, and this is normally done in the context of a discourse about that state of affairs, and not about the qualification (Steele 1975, Plank 1981). So, usually the state of affairs is the foreground information, not the epistemic qualification. Note that this peculiar informational status of the epistemic qualification is directly related to its position in the layered clause model: due to its meta-level status it normally stands apart from the structuring of the information about the state of affairs in terms of dimensions such as theme/rheme, given/new, foregrounding, etc.

Despite this connection between information structure and layering, however, the two forces pull in different directions. Thus, since main clauses prototypically carry foregrounded information and embedded clauses backgrounded information (Tomlin 1985), and since the state of affairs rather than the epistemic qualification tends to be foregrounded, the information structural force no doubt works against a main clause position for the epistemic expression and an embedded clause position for the expression of the state of affairs. From the perspective of iconicity, however, this pattern is ideal since it directly reflects the meta-status of the qualification relative to the state of affairs. The 'free-wheeling' clause internal position of the

epistemic expressions may then be a compromise: this is perfect from the perspective of the information structural force, and it is acceptable from an iconic perspective, since even if the hierarchical relationship is no longer represented, it at least still reveals the fact that the qualification is not part of the state of affairs.

In this perspective, the rational behind the tendencies observed in 3. is obvious. The fact that the epistemic mental state predicate, which has no doubt historically evolved out of the homonymous process predicate, is 'standardly' complementing can be related to the iconic force, but the tendency to reduce the main/embedded clause structure and to use the predicate parenthetically is probably due to the information structural force. This tendency may actually be fairly recent: the middle Dutch dictionary only cites complementing forms of epistemic *denken*, no parenthetical ones.[5]

It is commonly assumed that the modals have developed out of independent predicates, and this process may also be due to the information structural status of the epistemic qualification (Steele 1975, Plank 1981): grammatical markers are informationally 'low profile' expressions, and this suits the normally non-focal position of the epistemic qualification. By the way, the predicates from which the modals have developed are, at least in Dutch, in some cases semantically quite similar to the mental state predicates: e.g. *kunnen* derives from a predicate meaning "to have a mental capacity". In other words, there may have been a diachronic development from mental state predicate into modal. Now, the oldest occurrences of epistemic *kunnen* - which actually only date back to the late 19th century, hence the still quite unstable position of the epistemic use of this modal in present Dutch (cf. Nuyts 1996b) - are all sentence internal cases. The trend towards a complementing form is thus very recent, and is probably due to the iconic principle. In fact, iconically, the clause internal modal is disfavorable: as a grammatical marker it is per definition strongly integrated in the sentence - it does not even have the free-wheeling status which the adverbs and parentheticals at least have. Hence the tendency to remove the modal from the sentence representing the state of affairs, into a higher clause.

This development may again be followed by one in the opposite direction: note that the English adverb *maybe* derives from modal *may* in complementing form. Also several Dutch adverbs and adjectives have evolved from constructions with auxiliaries or auxiliary-like elements in a complementing construction: *misschien* "maybe" and *mogelijk* "possible/possibly" derive from a construction with the modal *mogen* "may", and *waarschijnlijk* "probable/probably" contains the evidential auxiliary-like predicate *schijnen* "seem". The development of the adverbs - which may be quite similar to the development of the parentheticals - can then be considered an effect of the information structural force, and the subsequent - or maybe partly parallel - development of the predicative adjective constructions may again be an effect of the iconic force. As observed, this construction appears to have specialized for expressing saliency of the epistemic qualification, and since its complementing structure is also perfect from this perspective, there are no signs of a tendency to undo this structure. Since epistemic modality is only rarely salient, however, it is no surprise that this expression form is rarely used, as can

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5 For diachronic evidence, I have consulted the middle Dutch dictionary (Verwijs and Verdam 1885-1929), as well as the 'general' dictionary of Dutch by De Vries and Te Winkel (1864-), which covers developments since middle Dutch. There are hardly any traces of old Dutch left, so I cannot take evidence for that period into account.

be seen in table 3 above.

5. Some consequences

The layered system clearly leaves deep traces in grammar, not only in terms of the in the literature often discussed dimension of the ordering and interaction of expressions of qualifications on the basis of their semantic scope, but also in terms of many other grammatical processes, such as information structuring, complementation, syntactic integration, grammaticalization, and even intonation. These observations obviously support the plausibility of this theoretical construct. But they also provide arguments for each of the points made in (i)-(iii) at the beginning of section 1. above.

First, there is a clear argument to introduce the layered system at a pre-linguistic level, and to consider it a property of a more abstract kind of conceptual representation. As I have argued elsewhere (e.g. Nuyts 1993b), since all expression forms discussed express the same basic semantic dimension of epistemic modality - as mentioned in 2., the differences between them appear due to four factors related to, yet independent of the epistemic qualification - one can assume that all these forms must originate in one and the same basic level, at which the epistemic evaluation is performed and represented. The differences between them are then caused in the course of the production processes from that level onwards, through sensitivity of the procedures to the different factors mentioned. It is implausible to assume that one of the expression forms could be basic and the other ones could be grammatically derived from it: it is totally unclear which form to choose as basic, and, more importantly, the derivational procedure would be completely unacceptable from the perspective of functional syntax (as in FG and so many other functionalist grammars). For it would require profound structure changing and lexical exchange operations (i.e. transformations), which are excluded from a functional and cognitive perspective. Hence one must assume that the different expression types are all equally basic at the 'predicational' level (in FG terms), and that the common level is therefore prior to it, and of a different quality. More directly related to the analysis in this paper, we have seen how the layered representation is at work in a quite systematic way throughout the different expression forms - grammatical, adverbial, and predicative ones - thereby diachronically even disregarding the boundaries between them, since there has been cross-feeding and -bleeding between them. This further underscores the claim that the layered representation must be prior to and more abstract than the different expression forms. Hence it presumably belongs at a conceptual level of representation. Actually, this analysis also goes against any type of theory (such as Dik's 1987 or Jackendoff's 1983) claiming that human conceptualization could have the format of (heavily language-based) predicate-argument structures.[6]

Second, the position of information structural notions is subject to the same arguments. Since this dimension determines the speaker's choice for a specific epistemic expression form, and has diachronically shaped these expression forms, again with a disregard for the differences

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6 This argument for a layered representation in conceptual structure does not imply that the principle of layering is not also needed in linguistic semantics, as is assumed in FG, or even at a fairly superficial syntactic level, as is assumed in RRG. But the properties of layering at those levels may have to be quite different from the current proposals in the literature - see Nuyts 1994 for discussion.

between them, we must assume that important aspects of this are indeed prior to the predicational level. Also the observation (cf. 4.) that the usual informational status of the epistemic qualification is directly related to its position in the layered system - which, as argued, is conceptual - suggests that information structure must be very basic in language production. This assumption is noncontroversial in language psychology (in as far as it takes this kind of phenomenon into account), see Levelt (1989). But it is in disagreement with many grammatical models, including FG, which often deal with this matter at fairly 'superficial' linguistic levels.

Third, the analysis indicates that linguistic processes can often be quite flexible and variable, in the sense that parts of an expression can have different degrees of integration, and can have a variable status in this connection, depending on the functional conditions. Thus, in the default situation when the epistemic qualification is not focal, there appears to be a strong tendency throughout the expression types (probably with the exception of the clause internal modal) to process them relatively independently of the information about the state of affairs - that is, at least, the most obvious way to understand the observed trend towards a 'free-wheeling' status of the epistemic expressions, in syntax and apparently even in intonation. Surely, the clause internal adverbs and parentheticals do influence to some extent the processes related to word ordering - but all in all this is only minimally. And the complementing forms cause the grammatical processes concerning the expression of the state of affairs to be tuned for an embedded clause structure, but even here, at least for the mental state predicates we have observed pressure not to do this.

The epistemic mental state predicates thus seem to go against the standard assumption in many grammatical frameworks that a predicate is the core which ties together an utterance: our observations clearly suggest that (unlike in their process reading) they are usually not the main predicate of the utterance (cf. Anderson 1986 for a similar claim regarding the evidential reading, as opposed to the literal perception reading, of predicates such as *hear* or *see*, which are in many respects quite comparable to the mental state predicates). In processing terms, what this seems to amounts to is that these predicates are not the - or one of the - primary or dominant elements in utterance planning and utterance construction, contrary to what would be the case for a 'classical' predicate. To see this more clearly, consider the difference between the mental state predicate in its process meaning (cf. (7) above) vs. its epistemic meaning. The process use of the predicate is the result of the speaker's intention to describe a mental process, because this is for some reason a relevant state of affairs in communication. The predicate is thus selected from the lexicon as a primary and central item for the construction of the utterance, and it ends up being an integral part, tightly integrated in the resulting linguistic expression. In structural linguistic terms, it is the 'head' of the clause. In the non-focal epistemic use of the predicate, however, the speaker still primarily intends to express information about the state of affairs, and the information about his epistemic evaluation of it is additional. That is, the predicate expressing the state of affairs proper is still the primary and central selection of lexical material for building the utterance, and the selection of the mental state predicate is only secondary. In further grammatical processing, the predicate expressing the state of affairs remains a core element for utterance construction, and, as argued, the predicate expressing the epistemic qualification is only integrated to some extent, minimally as a parenthetical, maximally in a preposed clause linked with the major clause by means of the complementizer *that* - but even in the latter case it is probably not appropriate to characterize it as the head of the clause.

The processing of epistemic expressions is probably quite different in the few cases when the epistemic qualification does get focal, however. The qualification may then be integrated together with the state of affairs in the information structuring processes, and is probably further processed tightly integrated with the rest of the utterance. Thus, it will get encoded in a construction type which allows a clear marking of the focality of the qualification: in any case a complementing construction, and, as observed, preferentially a predicative adjective construction. In this case there is no tendency to reduce the main/embedded clause structure or to work towards a free-wheeling status for the epistemic expression, and the special intonation is probably not available, since the expression of the qualification must be fully integrated in the normal information structural intonation pattern. In this case the epistemic expression may be considered the head of the construction.[7]

In summary, the production process of an utterance is sometimes much less tightly integrated than would be expected on the basis of the strictness of grammatical structure assumed in most linguistic grammars. It is quite common for grammars to treat parentheticals, e.g., which obviously defy this structural strictness, as extra-clausal (and thus extra-grammatical) elements with a completely separate status. But, as shown, the difference between parentheticals and some other grammatical elements is not so obvious, and keeping these phenomena out of the realm of grammar - and, correspondingly, disregarding their implications for one's conception of syntactic processing - is no doubt a mistake. Also, against a strong tendency in grammars to assume the opposite, the status in grammar even of quite central structural categories is clearly not always the same. Even one and the same formal element can figure quite differently, depending on the functional conditions. Thus, as observed, functionally 'complementation' is not always the same process, and predicates are not always predicates in the same way. After all, linguistic structure is no more than a means of coding different kinds of much more basic conceptual and interactional factors, and function uses form in a more flexible way than we sometimes think.

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7 How the notions of integration vs. non-integration of expression forms and primary vs. secondary lexical selection of predicates as used in the foregoing discussion can be 'translated' in terms of an 'incremental' model of language production (which is now widely accepted in language psychology - cf. Kempen and Hoenkamp 1987, Levelt 1989) is actually not entirely obvious. The basic plausibility of such a type of model is beyond doubt, but it probably has limits, to the extent that even in spoken language a clause has a certain degree of grammatical cohesion, in which the component elements - including the first produced ones - usually show different syntactic interdependency relations with some or all other components. In any case, an incremental model will somehow have to deal with the empirically grounded difference between a predicate which is the head of its clause and one which is not, and between a constituent which is grammatically integrated in the clause and one which is not (irrespective of when in the production process it is actually uttered).

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Sprechplanung und kognitive Beanspruchung:

Eine experimentelle Untersuchung zur Funktion des Arbeitsgedächtnisses bei der Produktion komplexer sprachlicher Äußerungen

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0. Einleitung

In der vorliegenden Arbeit werden zwei Ziele verfolgt: (a) Aufbauend auf dem inzwischen mehrfach replizierten Befund, daß die Beschaffenheit der Kommunikationssituation die sprachliche Wiedergabe eines Ereignisses in vorhersagbarer Weise auf der konzeptuellen Ebene kodeterminiert (z.B. Rummer, Grabowski & Vorwerg, 1995), soll hier gezeigt werden, daß die Kommunikationssituation auch die Charakteristika des sprachlichen Planungs*prozesses* beeinflußt. Als zentrales Konstrukt wird in diesem Zusammenhang der mit der Sprechplanung einhergehende Grad *kognitiver Beanspruchung* betrachet. Es wird die Annahme geprüft, ob der Grad der mit der Sprachproduktion einhergehenden kognitiven Beanspruchung in Abhängigkeit von den Merkmalen der Kommunikationssituation variiert. (b) Darüber hinaus wird die Frage gestellt, ob die situationsspezifischen Unterschiede in der inhaltlichen Zusammensetzung der Äußerungen auf die partnerbezogenen Ziele des Sprechers zurückgehen oder ob sie auf Unterschiede in den mit der Sprachproduktion einhergehenden kognitiven Prozesse zurückzuführen sind. Im letzteren Falle wären die situationsspezifischen Unterschiede in der inhaltlichen Zusammensetzung der Äußerungen nicht als eine vom Sprecher intendierte Adaption an die Erfordernisse der Kommunikationssituation zu erklären, sondern ursächlich wären Verarbeitungsbeschränkungen des kognitiven Systems oder Charakteristika der im kognitiven System ablaufenden Planungsprozesse.

Bevor auf diese beiden Punkte näher eingegangen wird, ist es erforderlich, einige theoretische Vorbemerkungen zu machen. Dabei sind insbesondere drei Fragen bedeutsam, die im folgenden Abschnitt behandelt werden sollen: (1) Welche Aspekte der Sprachproduktion beanspruchen die Zentrale Exekutive des sprecherseitigen Arbeitsgedächtnisses in nennenswertem Umfang? (2) Wie lassen sich diese unterschiedlichen Beanspruchungsquellen im Rahmen einer Sprachproduktionstheorie angemessen beschreiben? und (3) In Abhängigkeit von welchen situativen Merkmalen variieren ereignisbezogene Äußerungen in welcher Weise? Jeder dieser Fragen ist ein Abschnitt gewidmet.

1. Kognitive Beanspruchung beim Sprechen

Das Sprechen wird in kognitionswissenschaftlichen Lehrbüchern häufig als Beispiel für eine hochautomatisierte, das Arbeitsgedächtnis des Menschen nur geringfügig beanspruchende Tätigkeit bezeichnet (siehe z.B. Barsalou, 1992). Experimentelle Untersuchungen zeigen jedoch, daß dies lediglich für grammatische oder phonologische Prozeßkomponenten der Sprachproduktion gilt (siehe aber Jeffrey & Underwood, 1995; Takano & Noda, 1993). Die konzeptuelle Planung einer Äußerung beansprucht das kognitive System eines Sprechers demgegenüber in erheblichem Umfang (z.B. Jou & Harris, 1992; Power, 1985).

Wie experimentelle Untersuchungen zeigen (für eine Übersicht vgl. Rummer, im Druck), lassen sich bei der Sprechplanung drei Quellen kognitiver Beanspruchung separieren. Kognitive Beanspruchung kommt demnach zustande, durch (1) die Rekonstruktion des Sachverhalts, über den geredet werden soll; (2) die flexible Adaption an die Komunikationssitaution, insbesondere an den oder die Kommunikationspartner; und (3) die Elaboriertheit von Handlungsschemata, auf die ein Sprecher im Hinblick auf die jeweilige Kommunikationssituation zurückgreifen kann. Als vierte Quelle kognitiver Beanspruchung kann angenommen werden, daß (4) die von Sprecher antizipierten Folgen, die sich aus einer Äußerung ergeben, positiv mit dem Grad der kognitiven Beanspruchung kovariieren. Bezogen auf diese Beanspruchungsquelle liegen keine genuin

sprachbezogenen Befunde vor; es kann allerdings davon ausgegangen werden, daß sich die Befunde aus dem Bereich des nicht-sprachlichen menschlichen Verhaltens (eine Übersicht gibt Reason, 1990) auch auf die Sprechplanung beziehen lassen.

Während es sich bei Punkt (1) um ein vorsprachliches Phänomen - nämlich den kontrollierten Abruf von deklarativem Wissen aus dem Langzeitgedächtnis (Baddeley, 1986 spricht von Recollection) - handelt, beziehen sich die unter (2), (3) und (4) aufgeführten Beanspruchungsquellen auf die Sprachproduktion im engeren Sinne. Entsprechend sollten sich diese Beanspruchungsquellen im Rahmen einer Sprachproduktionstheorie rekonzeptualisieren lassen. Im folgenden wird eine Rekonzeptualisierung auf der Basis der Sprachproduktionstheorie von Herrmann und Grabowski (1994) vorgenommen.

2. Ein Modell sprachlicher Planungsprozesse

Die folgenden Ausführungen beziehen sich auf die Konzeption sprachlicher Makroplanung, die von Rummer, Grabowski und Vorwerg (1995) vorgelegt wurde. Der theoretische Rahmen dieses Modells, das auf der Modellierung zentraler Prozesse in der Sprachproduktionstheorie von Herrmann und Grabowski (1994) basiert, wird hier nur grob umrissen (für eine ausführliche Darstellung siehe Rummer, im Druck).

Herrmann und Grabowski (1994) unterscheiden im Hinblick auf die Sprachproduktion drei vertikal rückgekoppelte Teilsysteme, die gemeinsam das Sprachproduktionssystem eines Individuums konstituieren. Die Sprechplanung - realisiert durch *Selektion*, *Aufbereitung* und *Linearisierung* der aktuell verfügbaren (d.h. im Arbeitsgedächtnis repräsentierten) Information - erfolgt auf der hierarchisch höchsten Ebene, der *Zentralen Kontrolle*. Diese Zentrale Kontrolle, die hinsichtlich ihrer *Kapazität* begrenzt ist, beinhaltet ein operationales (prozedurales) Subsystem, die *Zentrale Exekutive*, und ein (deklaratives) Speichersystem, den *Fokusspeicher*. Die Zentrale Exekutive arbeitet dabei über der Fokusinformation. Die Zentrale Kontrolle stellt eine bestimmte Energiemenge bereit; dabei laufen sowohl die (längerfristige) Repräsentation von Informationen im Fokusspeicher als auch deren Verarbeitung durch die Zentrale Exekutive in Abhängigkeit von dieser begrenzten Energiemenge ab (vgl. auch Just & Carpenter, 1992).

Neben der Zentralen Kontrolle beinhaltet das Sprechersystem *Hilfssysteme* und den sogenannten *Enkodiermechanismus*. Diese Teilsysteme, die im Zusammenhang mir der hier interessierenden Fragestellung nur von mittelbaren Interesse sind, sind etwa für die Textkohärenz sowie für grammatische und phonologische Prozesse bei der Sprachproduktion zuständig und arbeiten weitgehend *automatisch*, d.h. sie sind nicht oder zumindest nur in geringem Maße kapazitativ begrenzt. In operationaler Hinsicht bedeutet dies, daß nahezu unbegrenzt viele dieser Prozesse gleichzeitig ablaufen können.

Die mit der Makroplanung von Äußerungen einhergehende kognitive Beanspruchung kann nun etwa deshalb unterschiedlich hoch sein, weil Sprecher bei der Planung je nach Kommunikationssituation in unterschiedlichem Maße auf vorgefertigte (und im Langzeitgedächtnis repräsentierte), die Zentrale Exekutive entlastende prozedurale Schemata zurückgreifen können.

Die äußerungsbezogene Makroplanung unterscheidet sich jedoch nicht nur im Hinblick auf die von ihr ausgehende kognitive Beanspruchung, sondern auch hinsichtlich der *Flexibilität*; d.h. hinsichtlich der Variabilität der Äußerungsproduktion. Die Variabilität der Sprechplanung kann etwa darauf zurückgehen, daß ein Sprecher die Randbedingungen (etwa durch die Systemumgebung) in unterschiedlich hohem Maße berücksichtigen kann, je nachdem, welchem Planungsmodus die Sprachproduktion unterliegt. In diesem Sinne sollte etwa die Steuerung des Sprachproduktionsprozesses auf der Basis proze-

duraler Schemata weniger flexibel (und weniger beanspruchend) sein als ein Steuerungsmodus, in dem permanent (im Einklang mit der Rückmeldung aus der Systemumgebung) *entschieden* wird, welche Information als nächstes ausgewählt wird, etc.

Nimmt man für die beiden Dimensionen "kognitive Beanspruchung" und "Flexibilität" je eine hohe und einen niedrige Ausprägung an, so ergeben sich durch deren Kombination vier Steuerungsarten, die im folgenden näher beschrieben werden. In Tabelle 1 befindet sich eine Darstellung dieses heuristischen Modells der sprachlichen Makroplanung.

Tabelle 1: Modell der sprachlichen Makroplanung nach Rummer et al. (1995)

	geringe Flexibilität	hohe Flexibilität
geringe kognitive Beanspruchung	Schemasteuerung	(Reizsteuerung)
hohe kognitive Beanspruchung	kontrollierte Produktion schematisierter Äußerungen	Ad-hoc-Steuerung

(a) Bei der *Reizsteuerung* gibt die Zentrale Exekutive die Kontrolle weitgehend an die Hilfssysteme ab. Reizgesteuertes Sprechen ist nur in respondenter Funktion möglich. Im Extremfall reagiert ein Sprecher lediglich (quasi-)reflektorisch auf Äußerungen seines Partners und nimmt keinen planmäßigen Einfluß auf das Gespräch. Vergleichbar sind Äußerungen, wie sie Weizenbaums (1966) Computerprogramm ELIZA produziert. Im Falle komplexer ereignisbezogener Sprachproduktion (wie sie hier untersucht wird) spielt die Reizsteuerung kein Rolle.

(b) Bei der *Schemasteuerung* greift der Sprecher aufgrund seiner Situationseinschätzung auf schematisiert vorliegendes prozedurales Wissen oder Können darüber zurück, in welcher Weise in der jeweiligen Kommunikationssituation zu sprechen ist. Die der Schemasteuerung zugrundeliegenden prozeduralen Schemata beinhalten unser standardisiertes Ausführungswissen über Texte, Diskurse, verbale Darstellungsmodalitäten und dergleichen (vgl. Herrmann et al., 1992). Sie enthalten Selektions-, Aufbereitungs- und Linearisierungsprogramme, die in Form von verketteten Wenn-Dann-Regeln im Langzeitgedächtnis repräsentiert sind und bei Bedarf ins Arbeitsgedächtnis "kopiert" werden, und stellen die Hilfssysteme und den Enkodiermechanismus ein. Auch die Schemasteuerung erfolgt weitgehend automatisch, ist jedoch, da sie auf schematisierten Operationen basiert, nur wenig flexibel.

(c) Bei der *Ad-hoc-Steuerung* werden von der Zentralen Exekutive des Sprechersystems ad hoc - unter Berücksichtigung der Kommunikationssituation - Entscheidungen über den Fortgang der eigenen Sprachproduktion gefällt. Bei der Ad-hoc-Steuerung des Sprechens überwacht die Zentrale Kontrolle die Sprachproduktion nicht nur im "Hintergrund" (wie dies bei der Reiz- und Schemasteueurng der Fall ist), sondern sie gibt die Sprechplanung zu keinem Zeitpunkt aus der Hand. Dies beansprucht das Sprechersystem zum einen in hohem Maße, zum anderen ist dieser Steuerungsmodus, bedingt durch die permanente Rückbindung der in der Zentralen Exekutive ablaufenden Prozesse an die Kommunikationssituation, außerordentlich flexibel.

(d) Bei der *kontrollierten Produktion schematisierter Äußerungen* verbleibt die Kontrolle - ähnlich wie bei der Ad-hoc-Steuerung - weitgehend auf der Ebene der Zentralen Kontrolle. Dabei verfolgt der Sprecher die Zielsetzung, eine Äußerung zu produzieren, die den im Sprechersystem (deklarativ) repräsentierten normativen Vorgaben entspricht. Aufgrund des Fehlens von standardisiertem Ausführungswissen ist die kognitiv beanspruchende Prozeduralisierung dieses Wissens erforderlich. Die kontrollierte Produktion

schematisierter Äußerungen kann jedoch auch dann erfolgen, wenn ein Sprecher über situationsadäquate prozedurale Schemata verfügt; etwa dann, wenn (wie dies in öffentlichen Redesituationen häufig der Fall ist) die negativen oder positiven Folgen, die an die Äußerung gebunden sind, ein gewisses Maß übersteigen. Die kontrollierte Produktion schematisierter Äußerungen ist in hohem Maße kognitiv beanspruchend und außerordentlich wenig flexibel.

Bei den beschriebenen Planungsprozessen handelt es sich um typisierte Modi sprachlicher Makroplanung. Zumeist kommen sie nicht in "reiner Form" vor. Allerdings kann davon ausgegangen werden, daß jeweils eine Planungsart die äußerungsübergreifende Makroplanung dominiert.

Wie lassen sich nun die in Abschnitt 1. unter (2) bis (4) genannten Beanspruchungsquellen im Rahmen des Modells der sprachlichen Makroplanung rekonzeptualisieren?

Die unter (2) genannte *flexible Adaption* an eine Kommunikationssituation bzw. an einen Kommunikationspartner erfordert den Planungsmodus der *Ad-hoc-Steuerung*. Um den permanenten Veränderungen der Kommunikationssituation Rechnung tragen zu können, muß der Sprecher ad hoc entscheiden, welche der verfügbaren Informationen jeweils als nächstes selegiert werden soll.

Die unter (3) beschriebenen *Übungseffekte* gehen auf den Erwerb und die Verwendung prozeduraler, die Sprechplanung steuernde Schemata zurück (*Schemasteuerung*). Dabei wird angenommen, daß sich prozedurale Handlungsschemata dann herausbilden, wenn bestimmte Abfolgen kognitiver Prozesse häufiger generiert werden (vgl. z.B. Norman & Shallice, 1986). Nachdem ein solches Schema aufgerufen wurde, läuft es automatisch ab, d.h. der Steuerungsprozeß selbst verbraucht nahezu keine kognitive Kapazität. In diesem Zusammenhang ist - unter Vorwegnahme des folgenden Absatzes - darauf hinzuweisen, daß die kognitive Verfügbarkeit eines prozeduralen Schemas kein hinreichender Grund für dessen Instantiierung ist.

Bei der unter (4) aufgeführten Quelle kognitiver Beanspruchung bei der Sprechplanung - der hohen Bedeutsamkeit des Resultats der Sprachproduktion für den Sprecher - wird, um ein Maximum an Kontrolle über das Resultat der Äußerung zu erreichen, der Steuerungsmodus der *kontrollierten Schemasteuerung* gewählt - und zwar unabhängig davon, ob der Sprecher über ein adäquates prozedurales Handlungsschema verfügt oder nicht.

Wie bereits in der Einleitung erwähnt wurde, wird die Sprechplanung am Beispiel des Redens über Ereignisse behandelt. Im folgenden Abschnitt wird dieser Gegenstand in den hier relevanten Punkten kurz umrissen. Im Zentrum steht dabei der Einfluß der Kommunikationssituation auf die Äußerungsproduktion.

3. Reden über Ereignisse

Eine zentrale Annahme, die dieser Arbeit zugrundeliegt, ist, daß die ereignisbezogene Sprachproduktion von der Beschaffenheit der Kommunikationssituation und den Zielen des Sprechers kodeterminiert wird. Evidenz für diese Sichtweise ergibt sich v.a. aus (qualitativen) diskursanalytischen Untersuchungen (vgl. z.B. Quasthoff, 1980). Im Zentrum der Betrachtung stehen hier die Begriffe *Erzählen* und *Berichten*, wobei die Tatsache, ob in einer bestimmten Kommunikationssituation berichtet oder erzählt wird, vor allem von der Beschaffenheit der Kommunikationssituation und der Zielsetzung des Sprechers abhängt. Gemäß diskursanalytischen Untersuchungen sind hier insbesondere der *Institutionalisiertheitsgrad* der Kommunikationssituation und die sprecherseitige *Zielsetzung* bedeutsam (für eine Übersicht siehe Rummer, Grabowski, Hauschildt &

Vorwerg, 1993). Vereinfacht läßt sich festhalten, daß die Produktion von Erzählungen dann erwartet werden kann, wenn die Ereigniswiedergabe in einem *informellen* Kontext erfolgt und der Sprecher das Ziel verfolgt, seinen Partner zu *unterhalten*, während die Produktion von Berichten dann zu erwarten ist, wenn in einer *institutionalisierten* Kommunikationssituation unter dem Ziel über das Ereignis geredet wird, den Partner zu informieren. Von Bedeutung für die Fragestellung dieser Arbeit sind v.a. zwei Beobachtungen. (1) In der diskursanalytischen Literatur findet sich gelegentlich die Aussage, ein wesentliches Merkmal des Erzählens liege darin, daß ein Sprecher versucht, um seinen Partner zu unterhalten, Bezüge zu nicht ereignisbezogenem Wissen herzustellen (vgl. z.B. Quasthoff, 1980). Entsprechend sollte in Erzählungen häufiger auf Sachverhalte referiert werden, die sich nicht auf das entsprechende Ereignis beziehen. (2) Die zweite Beobachtung bezieht sich auf situationsspezifische Unterschiede in der Flexiblität der Äußerungsplanung. Bereits Schank und Abelson (1977, S. 61) stellten fest, daß "it is characteristic for institutionalized public situations with defined goals . . . that the social interactions be stilized". Vor einem ganz anderem theoretischen Hintergrund gelangt Gülich (1980) zu ähnlichen Aussagen. Danach reduziert die institutionelle Rahmung der ereignisbezogenen Sprachproduktion die Anzahl von Freiheitsgraden, die einem Sprecher für die Planung seiner Äußerung verbleiben. Der Institutionalisiertheitsgrad der Kommunikationssituation und die Zielsetzung des Sprechers sollte also sowohl die Beschaffenheit der Äußerungen als auch Charakteristika der jeweils im kognitiven System eines Sprechers ablaufenden Prozesse beeinflussen.

Rummer et al. (1995) überprüfen dies anhand eines Rollenspielexperiments. Aufgrund der Tatsache, daß das in der hier vorliegenden Arbeit berichtete Experiment sowohl unter Verwendung des selben Referenzereignisses als auch auf der Basis des gleichen experimentellen Grunddesigns durchgeführt wurden, fällt die Darstellung des Experiments relativ ausführlich aus.

Um sicherzustellen, daß alle Versuchspersonen über eine vergleichbare Repräsentation des Ereignisses verfügen, und darüber hinaus zu gewährleisten, daß die mit der Rekonstruktion des Ereigniswissens einhergehende kognitive Beanspruchung (siehe Abschnitt 1., Punkt (1)) für alle Versuchspersonen vergleichbar ist, wurde das Ereigniswissen filmisch unter experimentell kontrollierten Bedingungen induziert. Der Film hat eine Länge von ca. 6 Minuten und zeigt den Diebstahl einer Brille in einem Optikfachgeschäft. In der anschließenden Kommunikationsphase wurde die Sprachproduktion unter einer institutionalisierten und einer nicht-institutionalisierten Kommunikationsbedingung verglichen. In der institutionalisierten Kommunikationsbedingung erfolgte die Ereigniswiedergabe unter dem Sprecherziel, den Partner zu *informieren*; in der nicht-institutionalisierten Bedingung unter der Zielsetzung, den Partner zu *unterhalten*. Die institutionalisierte Kommunikationssituation wurde als die Sprachproduktion gegenüber einem Polizisten operationalisiert, der sich nach den Vorkommnissen im Optikfachgeschäft erkundigt; die informelle Kommunikationssituion wurde operationalisiert als die Sprachproduktion gegenüber einem Nachbarn, der sich nach den Vorkommnissen im Optikfachgeschäft erkundigt.

Um Flexibilitätsunterschiede nachweisen zu können, wurde die eine Hälfte der Versuchspersonen unter (moderaten) Zeitdruck gesetzt, während die übrigen Versuchspersonen ohne Zeitdruck über das Ereignis reden sollten. Es ergibt sich das in Tabelle 2 dargestellte 2 x 2 Design mit unabhängiger Messung.

Tabelle 2: Design des Experiments von Rummer, Grabowski und Vorwerg (1995)

	ohne Zeitdruck	mit Zeitdruck
Polizistsituation	$n = 10$	$n = 10$
Nachbarsituation	$n = 10$	$n = 10$

Die Äußerungen der Versuchspersonen wurden auf Magnetband aufgezeichnet, anschließend transkribiert und in Segmente zerlegt. Jedem Segment wurde eine inhaltsbezogene Kategorie zugewiesen. Eine detaillierte Darstellung des inhaltsanalytischen Analyseinventars geben Rummer et al. (1995) sowie Rummer (im Druck). Im Zusammenhang mit der hier interessierenden Fragestellung reicht es aus, zwischen solchen Thematisierungen zu unterscheiden, die auf das Ereignis referieren (t_1) und solchen, die sich auf außerhalb des Ereignisses liegende Sachverhalte beziehen (non-t_1). Hinsichtlich der Thematisierung von Ereigniswissen wird darüberhinaus eine Differenzierung nach dem Detaillierungsgrad vorgenommen, mit dem jeweils auf das Ereignis referiert wird. Hierzu wurde die filmische Ereignisvorlage a priori in Einheiten, sogenannte *Episoden*, zerlegt. Bezogen auf jedes Segment einer Äußerung läßt sich nun feststellen, ob dieses dem Detailliertheitsgrad der Episoden entspricht oder ob das jeweilige Segment auf einer höheren oder niedrigeren Granularitätsebene auf das Ereignis bezug nimmt. Wählt ein Sprecher eine feinere Auflösung, so wird das entsprechende Segment als *Detaillierung* kategorisiert; wählt er eine gröbere Auflösung, so wird das Segment als *Makroproposition* kategorisiert. Die Häufigkeiten, mit der bestimmte Kategorien in den Äußerungen vorkommen, sind die unabhängigen Variablen der Untersuchung.

Wie erwartet ergeben sich hinsichtlich der Thematisierung von Ereigniswissen keine statistisch bedeutsamen Unterschiede zwischen den Äußerungen in der Polizist- und Nachbarsituation (Mann-Whitney: $p > .1$). Dieses Fehlen von Unterschieden gilt für die Thematisierung von Ereigniswissen generell, also unabhängig vom jeweiligen Detailliertheitsgrad. Hinsichtlich der Thematisierung von nicht auf das Ereignis referierendem Wissen ergeben sich signifikante Unterschiede zwischen Nachbar- und Polizistsituation. Erwartungsgemäß referieren Versuchspersonen, die einem Nachbarn gegenüber über das Ereignis reden, signifikant häufiger auf Sachverhalte, die nicht Teil des induzierten Ereignisses sind, als die Versuchspersonen, die der Polizistbedingung zugewiesen wurden.

Während der Zeitdruck in der Polizistsituation nahezu keinen Einfluß auf die Beschaffenheit der Äußerungen hat, zeigt ein Vergleich zwischen den Bedingungen mit und ohne Zeitdruck in der Nachbarsituation deutliche Effekte hinsichtlich mehrerer der hier erhobenen abhängigen Variablen. Versuchspersonen, die unter der Zeitdruckbedingung über das Ereignis reden, produzieren generell weniger Thematisierungen als solche, die ohne Zeitdruck über das Ereignis reden.

Die Ergebnisse von Rummer et al. (1995) stellen somit eine experimentelle Bestätigung der oben formulierten Beobachtungen dar. (1) Die Resultate ereignisbezogener Sprachproduktion unterscheiden sich in Abhängigkeit von der Beschaffenheit der Kommunikationssituation in vorhersagbarer Weise: In der informellen Kommunikationssituation wird signifikant häufiger auf außerhalb des Ereignisses liegende Sachverhalte referiert als in der institutionalisierten Kommunikationssituation. Inwieweit dies seitens der Sprecher intendiert ist und in der Absicht erfolgt, bestimmte kommunikative Zielsetzungen zu erreichen (wie dies die erwähnten diskursanalyitisch arbeitenden Autoren nahelegen), wird noch zu diskutieren sein.

(2) Aus der je nach Kommunikationssituation unterschiedlichen Wirkung des Zeitdrucks läßt sich folgern, daß die Sprechplanung in den beiden hier untersuchten Kom-

munikationssituationen unterschiedlich flexibel ist. Die Ergebnisse bestätigen also auch in diesem Punkt die Befunderwartungen. Die Sprechplanung in der institutionalisierten Kommunkationssituaton erweist sich als robuster gegen Zeitdruck und damit weniger flexibel als die Sprachproduktion in der informellen Kommunikationssituation.

Im Hinblick auf die Fragestellung nach einem je nach Kommunikationssituation unterschiedlichen Steuerungsmodus des Sprachproduktionsprozesses lassen die Ergebnisse dieses Experiments eine erste Eingrenzung des Suchraums zu. In Tabelle 3 findet sich nochmals eine Darstellung des Modells der Planungsarten, wobei die Tabelle die Eingrenzung des Suchraums abbildet.

Tabelle 3: Modell der sprachlichen Makroplanung

	geringe Flexibilität	hohe Flexibilität
geringe kognitive Beanspruchung	Schemasteuerung (Polizistsituation?)	(Reizsteuerung)
hohe kognitive Beanspruchung	kontrollierte Produktion schematisierter Äußerungen (Polizistsituation?)	Ad-hoc-Steuerung (Nachbarsituation)

Da Reizsteuerung generell nur im Falle respondenten Sprechens möglich ist, läßt der Nachweis einer größeren Flexibilität der Selektionsprozesse in der Nachbarsituation den Schluß zu, einem Nachbarn gegenüber würden die Versuchspersonen die Ereigniswiedergabe unter Zugrundelegung der Ad-hoc-Steuerung planen. Im Hinblick auf die Ereigniswiedergabe in der Polizistsituation ist allein auf der Basis des Nachweises von Flexibilitätsunterschieden keine eindeutige Zuordnung einer Steuerungsart möglich. Je nachdem, ob die Sprechplanung die Zentrale Kontrolle eines Sprechers in hohem oder geringem Maße beansprucht, kann die Äußerungsproduktion auf *schemagesteuerte* Prozesse (dies ginge mit einer geringen kognitiven Beanspruchung einher) oder auf die *kontrollierte Produktion schematisierter Äußerungen* (dies ginge mit einer hohen kognitiven Beanspruchung einher) zurückgeführt werden. Um hier eine Entscheidung vornehmen zu können, führte Rummer (im Druck) das im folgenden beschriebene Experiment durch.

4. Experiment

4.1 Methode und Versuchsplan

Diesem Doppelaufgabenexperiment liegt das gleiche experimentelle Design, die gleiche Operationalisierung der Kommunkationssituation (Polizist- vs. Nachbarsituation) und die selbe Ereignisvorlage zugrunde wie dem Experiment von Rummer et al. (1995). Es wird also ebenfalls ein 2 x 2 Versuchsplan mit unabhängiger Messung zugrundegelegt. Dabei wird jedoch statt der Zeitdruckbedingung eine Doppelaufgabenbedingung eingeführt.

Das Grundprinzip des Doppelaufgabenparadigmas besteht darin, daß ein Sprecher eine klar definierte Aufgabe (Sekundäraufgabe) zeitgleich mit der interessierenden Aufgabe (Primäraufgabe) ausführt. Im Zusammenhang mit dem hier berichteten Experiment ist es wichtig, daß sowohl die Leistung in der Primäraufgabe als auch die Leistung in der Sekundäraufgabe sowohl unter Einzel- als auch unter Doppelbearbeitungsbedingungen erfaßt wird. Nur so lassen sich die zwischen beiden Aufgaben auftretenden Interferenzen angemessen quantifizieren. Prinzipiell ist es wünschenswert, daß das Aufteilungsverhältnis der Ressource bei den zu vergleichenden Gruppen identisch ist. Weiterhin sollten sich

die Interferenzunterschiede nach Möglichkeit auf einer der beiden Aufgaben nachweisen lassen; für die konkrete Umsetzung des Experiments sollte also eine der beiden Aufgaben priorisiert werden. Ein weiterer Punkt, der berücksichtigt werden muß - und der im Zusammenhang mit der hier vorgelegten Arbeit von besonderer Bedeutung ist - ist die Tatsache, daß das Aufteilungsverhältnis der Ressource während der Sprachproduktion variieren kann. Entsprechend sollte die gewählte Sekundäraufgabe die Möglichkeit bieten, während des gesammten Sprachproduktionsprozesses Messungen vorzunehmen. Die Sekundäraufgabe sollte also *lokale* Messungen ermöglichen. Zunächst wird die für dieses Experiment konstruierte Sekundäraufgabe kurz beschrieben.

Die hier eingesetzte Sekundäraufgabe ist so konzipiert, daß ihre Bearbeitung die Zentrale Kontrolle des Sprachproduktionssystems beansprucht. Vereinfacht ausgedrückt bedeutet dies, daß die Aufgabe (kontrollierte) Entscheidungsprozesse beinhaltet. Darüber hinaus ist es (aus Gründen, die hier nicht weiter erörtert werden sollen) wichtig, daß sie nicht auf der Verarbeitung spachlichen Materials beruht. (Zu einer ausführlichen Diskussion der mit der Untersuchung sprachlicher Informationsverarbeitungsprozesse einhergehenden Anforderungen an die Gestaltung von Doppelaufgabenexperimenten vgl. Rummer, im Druck, insbesondere Kapitel 3 und 4.)

Die Sekundäraufgabe besteht darin, auf zwei unterschiedliche Lichtsignale hin eine Reaktionstaste auszulösen. Gegenüber der Versuchsperson ist eine rote und eine grüne Lampe angebracht. Diese Lampen leuchten in für die Versuchspersonen nicht vorhersehbarer Abfolge und variablem zeitlichem Abstand auf. Immer dann, wenn eine der Lampen in direkter Folge aufleuchtet (also dann, wenn das jeweilige Signal identisch mit dem vorherigen Signal ist), soll die Versuchsperson so schnell wie möglich eine Reaktionstaste auslösen; wechselt das Lichtsignal, so soll eine Reaktion unterbleiben. Die Leistung in der Sekundäraufgabe wird einerseits durch die Korrektheit der Reaktionen, andererseits durch die Reaktionszeiten indiziert. Es ist darauf hinzuweisen, daß jede Reaktion zu dem gleichzeitig erfolgenden sprachlichen Output einer Versuchsperson in Beziehung gesetzt werden kann. Die Aufgabe bietet also die Möglichkeit lokaler Messung.

Zunächst wird - analog zum Vorgehen im Experiment von Rummer et al. (1995) - das Ereigniswissen via Film induziert. Anschließend lernen die Versuchspersonen den Umgang mit der Sekundäraufgabe. Schließlich wird eine Baseline erhoben; d.h. die Sekundäraufgabenleistung wird unter Einzelbearbeitungsbedingungen gemessen. Dies ist erforderlich, um interindividuelle Unterschiede in der Sekundäraufgabenleistung bei der statistischen Auswertung (Kovarianzanalyse) herausrechnen zu können. In der Kommunkationsphase müssen die Versuchspersonen unter der Nachbar- bzw. Polizistbedingung über das Ereignis reden, wobei der eine Teil der Versuchspersonen ohne die Sekundäraufgabe parallel dazu zu bearbeiten (Kontrollbedingung), der andere Teil der Versuchspersonen bei gleichzeitiger Bearbeitung der Sekundäraufgabe (Experimentalbedingung) über das Ereignis spricht. Es ergibt sich folgender Versuchsplan (siehe Tabelle 4).

Tabelle 4: Versuchsplan des Experiments von Rummer (im Druck)

	ohne Sekundäraufgabe	mit Sekundäraufgabe
Polizistsituation	$n = 14$	$n = 14$
Nachbarsituation	$n = 14$	$n = 13$

Zunächst werden die Ergebnisse der Sekundäraufgabe referiert. Bei der anschließenden Darstellung der Primäraufgabenergebnisse werden vier abhängige Variablen berücksichtigt: *Detaillierungen*, *Episoden*, *Makropropositionen* und *nicht auf das Ereignis referie-*

rende Thematisierungen. Da eine sinnvolle Interpretation von Doppelaufgabenexperimenten nur auf der Basis von Leistungsdaten möglich ist, werden keine Häufigkeitsdaten, sondern über die Redezeit gewichtete Häufigkeitsdaten (im physikalischen Sinne also pro Zeiteinheit verrichtete Arbeit) referiert.

4.2 Ergebnisse

(1) Ergebnisse der Sekundäraufgabe

Die Ergebnisse der Sekundäraufgabe lassen weder hinsichtlich der Fehlreaktionen (Kovarianzanalyse: $F < 1$) noch hinsichtlich der Reaktionszeiten ($F < 1$) Unterschiede zwischen den Experimentalgruppen erkennen. Tabelle 5 zeigt Mittelwerte für die gegen die Baseline korrigierten Fehlreaktionen und Reaktionszeiten. Die Daten sind also gegen individuelle Leistungsunterschiede korrigiert.

Tabelle 5: Mittelwerte der Sekundäraufgabe

	Polizistsituation	Nachbarsituation
Anteil der Fehlreaktionen	$\overline{x}$=14.71%	$\overline{x}$=11.65%
mittlere Reaktionszeit	$\overline{x}$ = 244.14	$\overline{x}$ = 217.29

(2) Ergebnisse des Primäraufgabe

Als abhängige Variablen werden die Thematisierungsleistungen der Versuchspersonen für (1) *Detaillierungen*, (2) *Episoden*, (3) *Makropropositionen* und (4) *nicht auf das Ereignis referierende Äußerungsteile* (non-t_1) berichtet. Kritisch im Hinblick auf die erwarteten Belastungsunterschiede zwischen den Kommunikationssituationen ist die Variable "Detaillierungen". Es kann vorausgesetzt werden, daß die Produktion besonders fein auflösender Ereignisthematisierungen (aufgrund der hierbei erforderlichen Schlußfolgerungs- und Recollectionprozesse) das sprecherseitige Arbeitsgedächtnis in besonderem Maße beansprucht. Dies sollte sich als statistischer Haupteffekt für den Faktor 'Doppelaufgabe' zeigen. Führt die Bearbeitung der Sekundäraufgabe in der Nachbarsituation zu einem größerem Rückgang der Detaillierungsleistung als in der Polizistsituation, so läßt sich daraus schließen, daß die mit der Sprachproduktion einhergehende kognitive Beanspruchung hier größer ist.

(1) Der Anteil von "Detaillierungen" ist bei den Versuchspersonen, die parallel zur Sprachproduktionsaufgabe die Sekundäraufgabe bearbeiten, erwartungsgemäß deutlich geringer als in der Kontrollbedingung ($F_{1,54} = 8.71$; $p < .01$). Darüber hinaus ergibt sich eine tendenzielle Interaktion zwischen dem Faktor 'Doppelaufgabe' und dem Faktor 'Situation' ($F_{1,54} = 3.51$; $p < .07$). Die Belastung durch die Doppelaufgabe beeinträchtigt die Detaillierungsleistung in der Nachbarsituation stärker als in der Polizistsituation. Der Haupteffekt für den Faktor 'Doppelaufgabe' spricht dafür, daß die Produktion von Detaillierungen die Zentrale Kontrolle des Sprechers grundsätzlich beansprucht, während die höhere Beeinträchtigung in der Nachbarsituation darauf schließen läßt, daß hier ein generell höherer Beanspruchungsgrad gegeben ist. Abbildung 1 veranschaulicht die Ergebnisse.

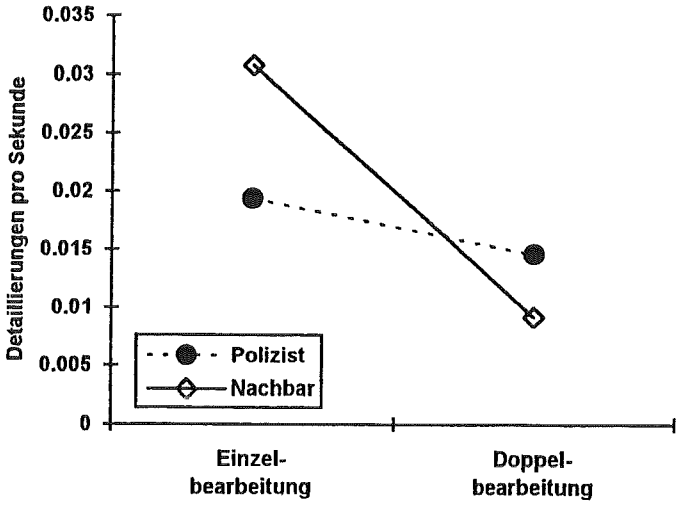

Abbildung 1: Mittelwerte der Detaillierungen pro Sekunde

(2) Hinsichtlich der Ereignisreferenzen auf mittleren Detailliertheitsniveau (Episoden) ergibt die varianzanalytische Auswertung einen tendenziellen Haupteffekt für die Kommunikationssituation ($F_{1,54} = 3.44$; $p < .07$). In der Polizistsituation produzieren die Versuchspersonen demnach einen (tendenziell) höheren Anteil von Episoden als in der Nachbarsituation. (3) Im Hinblick auf Makropropositionen ergeben sich keine statistisch bedeutsamen Ergebnisse.

(4) Hinsichtlich der Thematisierungsleistung für nicht auf das Ereignis referierende Äußerungseinheiten (non-t_1) zeigt sich eine Tendenz für den Faktor 'Situation' ($F_{1,54} = 4.01$; $p < .06$). Versuchspersonen, die in der Nachbarsituation über das Ereignis reden, produzieren pro Zeiteinheit mehr Thematisierungen, die nicht auf das Ereignis referieren, als die Versuchspersonen, die einem Polizisten gegenüber über das Ereignis reden.

4.3 Diskussion

Weil sich hinsichtlich der Sekundäraufgabe keine statistisch bedeutsamen Unterschiede zwischen den Experimentalbedingungen ergeben, stützt sich die Diskussion auf die Ergebnisse der Primäraufgabe. Diese lassen den (vorsichtigen) Schluß zu, daß die sprachliche Makroplanung in der Polizistsituation weniger kognitiv beanspruchend ist als in der Nachbarbedingung. Dies wird insbesondere durch die Ergebnisse für die abhängige Variable "Detaillierungen" nahegelegt. Die sprachliche Rekonstruktion des Ereignisses auf einem hohen Detailliertheitsniveau beinhaltet - das zeigt auch der statistische Haupteffekt für den Faktor 'Doppelaufgabe' - kognitv beanspruchende Prozesse. Eine in der Polizist- und in der Nachbarsituation unterschiedlich hohe Detaillierungsleistung ist somit als kritisch im Hinblick auf die von der Sprachproduktion ausgehende kognitive Beanspruchung zu werten.

Die Rückbindung dieses (aus alltagspsychologischer Sicht überraschenden) Ergebnisses an das hier zugrundegelegte Modell der Steuerungsarten läßt nun eine Zuordnung der in den beiden untersuchten Kommunikationssituationen zugrundeliegenden Steuerungsprozesse zu. Danach läßt sich die Sprachproduktion in der Nachbarsituation als eher ad-hoc-gesteuert (in hohem Maße flexible Sprechplanung bei hoher kognitiver Beanspruchung), die Sprachproduktion in der Polizistsituation als eher schemagesteuert (wenig flexible Sprechplanung bei geringer kognitiver Beanspruchung) kennzeichnen. Tabelle 6 veranschaulicht dies.

Tabelle 6: Modell der sprachlichen Makroplanung

	geringe Flexibilität	hohe Flexibilität
geringe kognitive Beanspruchung	Schemasteuerung (Polizistsituation)	(Reizsteuerung)
hohe kognitive Beanspruchung	kontrollierte Produktion schematisierter Äußerungen	Ad-hoc-Steuerung (Nachbarsituation)

Im folgenden Abschnitt 5 wird der Frage nachgegangen, ob der höhere Anteil von nicht auf das Ereignis referierenden Thematisierungen in der Nachbarsituation seitens der Versuchspersonen intendiert ist, oder ob es sich dabei um ein Phänomen handelt, das möglicherweise auf die kapazitative Begrenzung der Zentralen Kontrolle und die Charakteristika des Steuerungsprozesses zurückzuführen ist.

5. Zur Funktion der nicht-ereignisbezogenen Äußerungsteile

Um herauszufinden, inwieweit der in der informellen Kommunikationssituation höhere Anteil von Thematisierungen, die nicht auf das Ereignis referieren, seitens der Versuchspersonen im Hinblick auf die Erfordernisse der Kommunikationssituation produziert wird, ist es zunächst erforderlich, die Ergebnisse des Experiments neu zu gruppieren. Aggregiert man die Thematisierungsleistungen und unterscheidet lediglich, ob eine Thematisierung auf das Ereignis (t_1) oder nicht auf das Ereignis (non-t_1) referiert, so ergibt sich das in Abbildung 2 veranschaulichte Ergebnis: Während in der Nachbarsituation die Thematisierungsleistung vor allem im Bereich der direkten Referenzen auf das Ereignis (t_1) beeinträchtigt wird (rechtes Diagramm), geht in der Polizistsituation vor allem die Leistung für nicht auf das Ereignis referierende Thematisierungen (non-t_1; linkes Diagramm) zurück.

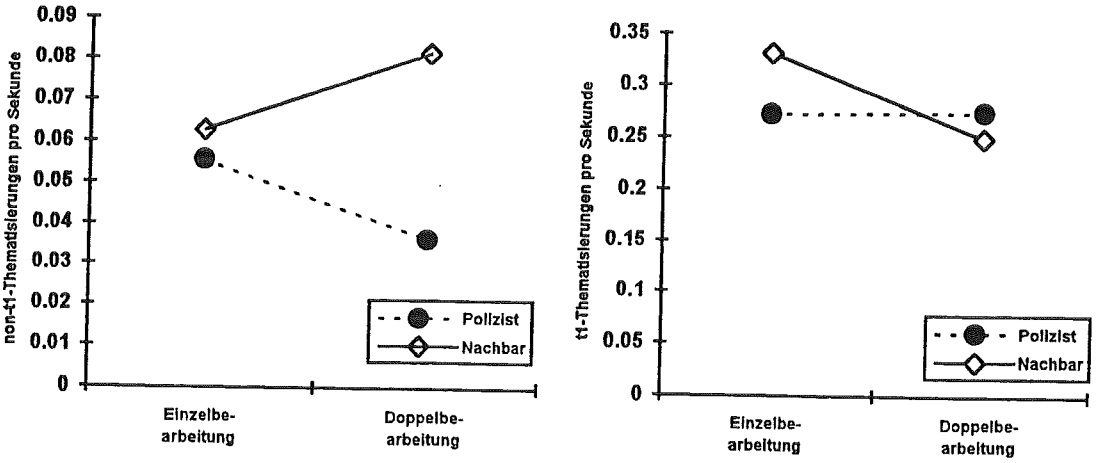

Abbildung 2: Interaktionsdiagramme für die Variablenklassen non-t_1 (links) und t_1 (rechts)

Die Kovarianzanalyse ergibt im Falle der Variablenklasse t_1 eine signifikante ($F_{1,54} = 5.45$; $p < .05$), im Falle der Variablenklasse non-t_1 eine nicht-signifikante Interaktion ($F_{1,54} = 2.1$; $p > .1$). Hier werden zwei Erklärungsmöglichkeiten für diese Heterogenität aufgezeigt, wobei zunächst eine Beschränkung auf die nicht auf das Ereignis referierenden Äußerungseinheiten (non-t_1) erfolgt.

Die Tatsache, daß sich die nicht auf das Ereignis referierenden Thematisierungen so deutlich von den Ereignis-Thematisierungen unterscheiden, kann theoretisch auf zwei unterschiedliche Ursachen zurückgeführt werden, die im Hinblick auf die behandelte Fragestellung eine gegensätzliche Interpretation nach sich ziehen: (1) Die Versuchspersonen produzieren die entsprechenden Äußerungsteile in strategischer Absicht, d.h. aufgrund der hohen Relevanz für ihre Zielsetzung, den Partner zu unterhalten. In diesem Falle ist davon auszugehen, daß die Produktion dieser Äußerungsteile das kognitive System des Sprechers im hohem Maße beansprucht (diese Interpretation entspricht weitgehend der traditionellen Sichtweise); oder aber (2) das den nicht auf das Ereignis referierenden Thematisierungen zugrunde liegende Wissen ist unter der Nachbarbedingung leichter verfügbar als in der Polizistbedingung. In diesem Falle ist davon auszugehen, daß die Produktion dieser Äußerungsteile das kognitive System nur in geringem Maße beansprucht. (Für die Ergebnisse hinsichtlich der Ereignis-Thematisierungen gilt Entsprechendes.)

Der Grad der mit den jeweiligen Thematisierungen (Ereignis- vs. nicht-Ereignis-Thematisierung) einhergehenden kognitiven Beanspruchung läßt sich anhand der jeweils korrespondierenden Reaktionszeiten erfassen. Hierzu werden jeweils pro Versuchsperson die während des Sprechens produzierten Reaktionszeiten danach unterschieden, ob sie während der Thematisierung von Ereignis- oder nicht-Ereigniswissen produziert wurden. Pro Versuchsperson wird dabei jeweils eine mittlere Reaktionszeit für die mit Ereignis-Thematisierungen korrespondierenden und eine für die mit nicht-Ereignis-Thematisierungen korrespondierenden Reaktionen errechnet. Diese mittleren Reaktionszeiten stellen die Ausgangsbasis für die weiteren statistischen Analysen dar.

Für die beiden oben genannten Alternativerklärungen bedeutet dies folgendes: Im Falle der absichtsvollen und *kontrollierten* Produktion nicht ereignisbezogener Äußerungsteile (1) wäre davon auszugehen, daß die mit diesen Thematisierungen korrespondierenden Reaktionszeiten kürzer sind als die mit Ereignis-Thematisierungen korrespondierenden Reaktionszeiten. Im Falle des Zutreffens der Alternativerklärung (2) sollten diese Reaktionszeiten länger oder gleich lang sein wie diejenigen Reaktionszeiten, die zeitgleich mit der Thematisierung von Ereigniswissen (t_1) produziert werden.

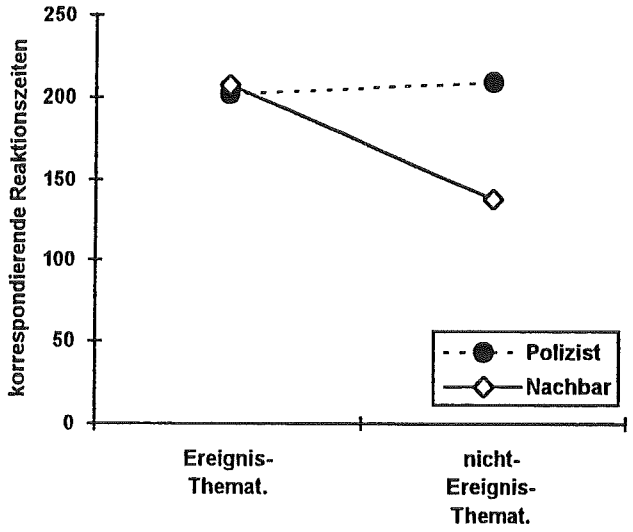

Abbildung 3: Reaktionszeiten, aufgeschlüsselt nach Kommunikationssituation und korrespondierender Thematisierungsart

Abbildung 3 gibt die mit der Thematisierung von Ereignis- und nicht-Ereigniswissen korrespondierenden mittleren Reaktionszeiten je nach Experimentalbedingung wieder. Die in der Abbildung veranschaulichten Reaktionszeiten sind über die Baseline korrigiert; sie stellen also Differenzen zwischen der während des Kommunikationsphase erbrachten individuellen Leistung und der jeweiligen Baseline dar.

Die Kovarianzanalyse weist eine signifikante Wechselwirkung zwischen der Kommunikationssituation und der korrespondierenden Thematisierungsart nach ($F_{1,12} = 4.82; p < .05$[1]). In der Nachbarsituation fallen die mit der Thematisierung außerhalb des Ereignisses liegender Sachverhalte einhergehenden Reaktionszeiten verglichen mit den Reaktionszeiten, die mit der Produktion von Ereignis-Thematisierungen einhergehen, deutlich kürzer aus. Die mit diesen Thematisierungen einhergehenden Reaktionszeiten sind auch kürzer als die in der Polizistsituation produzierten Reaktionen. Im Hinblick auf die Ereignisthematisierungen unterscheiden sich die Reaktionszeiten nicht in Abhängigkeit von der Kommunikationssituation.

Diese Ergebnisse der Sekundäraufgabe belegen, daß die Thematisierung nicht ereignisbezogenen Wissens das kognitive System in der Nachbarsituation in geringerem Maße beansprucht als in der Polizistsituation. Die Produktion nicht ereignisbezogener Thematisierungen erfolgt also nicht in kontrollierter Weise, sondern dient eher der Entlastung des Sprachproduktionssystems. Möglicherweise gleichen die Versuchspersonen die höhere kognitive Beanspruchung in der Nachbarsituation (die sich vor allem aus der Planung der Ereigniswiedergabe ergibt) dadurch aus, daß sie Sachverhalte thematisieren, die ihnen kognitiv direkt verfügbar sind. In diesem Falle ließen sich die zwischen beiden Kommunikationssituationen vorgefundenen Unterschiede - also der höhere Anteil von nicht auf das Ereignis referierenden Thematisierungen in der Nachbarsituation - nicht darauf zurückführen, daß ein Sprecher versucht, seine Partner durch die Anbindung des Ereigniswissens an andere Wissensdomänen zu unterhalten, sondern diese Thematisierungen dienten etwa dazu, das eigene, durch die Äußerungsplanung in hohem Maße beanspruchte kognitive System zu entlasten oder zwischen den Planungseinheiten (erinnerlich unterliegt die Planung in der Nachbarsituation der Ad-hoc-Steuerung) auftretenden Unterbrechungen mit sprachlichen Material zu "füllen", um unerwünschte Redepausen zu vermeiden.

6. Fazit

Eingangs wurden zwei Fragestellungen als grundlegend für diese Arbeit genannt: (1) Es wurde die Frage gestellt, inwieweit die mit der Sprechplanung einhergehende Beanspruchung des kognitiven Systems von den Merkmalen der Komunikationssituation abhängt; (2) es wurde versucht, eine Antwort für die Frage zu finden, welche kognitiven Prozesse für die in früheren Experimenten vorgefunden situationsspezifischen Unterschiede in der Komposition der Äußerungen verantwortlich sind. In diesem Abschnitt werden die Ergebnisse des Experiments nochmals auf diese beiden Fragestellungen bezogen. Zunächst wird jedoch kurz auf das der Untersuchung zugrundeliegende Modell der sprachlichen Makroplanung eingegangen.

Um eine systematische experimentelle Untersuchung äußerungsübergreifender sprachlicher (Makro-) Planungsprozesse vornehmen zu können, wurde hier ein Modell der Planungsarten entwickelt, das leitende Funktion für die empirische Forschung haben

[1] Die geringe Anzahl von Freiheitsgraden resultiert daher, daß nicht für jede Versuchsperson Reaktionen für beide hier unterschiedenen Thematisierungsarten vorliegen.

sollte. In Anbetracht der mit der hohen Komplexität sprachlicher Planungsprozesse verbundenen methodischen Probleme ist dabei die Rückführung von Planungsprozessen auf eine möglichst einfache Variablenstruktur wichtig. Die zentrale Variable ist dabei die mit der Äußerungsplanung einhergehende kognitive Beanspruchung, die auf der Basis von Doppelaufgabenexperimenten experimentell manipuliert und gemessen werden kann.

Im Hinblick auf eine Beurteilung der Nützlichkeit dieses Modells ist festzustellen, daß es sich insofern bewährt hat, als sich durch die Anwendung des Modells die Möglichkeit ergibt, sprachliche Makroplanungsprozesse in systematischer Weise experimentell zu untersuchen, die bislang im Rahmen eines klassischen experimentellen Vorgehens nicht zugänglich waren. In Anbetracht der Bedeutung, die dieser Gegenstand - etwa für die Erforschung der Schnittstelle zwischen Sprechen und Denken - hat, sind die erhblichen Aufwendungen, die mit der Anwendung dieses Modells verbunden sind, gerechtfertigt. Von zentraler Bedeutung ist dabei jedoch die Art der im Rahmen des Doppelaufgabenparadigmas eingesetzten Sekundäraufgabe. So zeigt das hier berichtete Experiment etwa, wie bedeutsam die Möglichkeit *lokaler Messung* ist. Die Anwendung des Doppelaufgabenparadigmas auf die Produktion komplexer Äußerungen kann nur dann als sinnvoll erachtet werden, wenn innerhalb der Äußerungen auftretende Veränderungen der Ressourcenaufteilung erfaßt werden können. Ähnlich bedeutsam ist die Art des im Rahmen der Doppelaufgabe verwendeten Materials. So läßt sich etwa aus der Tatsache, daß eine Sprachproduktionsaufgabe (Primäraufgabe) mit sprachlichen Material (Sekundäraufgabe) interferiert, nicht auf das Vorliegen zentraler Beanspruchung schließen. Nur wenn derartige strukturelle Interferenzen auszuschließen sind, lassen sich Leistungseinbußen auf eine Überlastung der zentralen Planungskomponente zurückführen. Das in der Sekundäraufgabe verwandte Material sollte also grundsätzlich nicht sprachlicher Art sein.

Im Rahmen des hier berichteten Experiments konnte (unter Hinzuziehung der Untersuchung von Rummer et al., 1995) gezeigt werden, daß die im kognitiven System ablaufenden Planungsprozesse systematisch in Abhängigkeit von den Merkmalen der Kommunikationssituation variieren - und zwar unabhängig von der Art des zu versprachlichenden Sachverhalts: Die Sprachproduktion in der informellen Kommunikationssituation unterliegt dem Steuerungsmodus der Ad-hoc-Steuerung; die Sprachproduktion in der institutionalisierten Kommunikationssituation unterliegt der Schemasteuerung. Entgegen der Intuition ist die Sprachproduktion in der informellen Kommunikationssituation in höherem Maße kognitiv beanspruchend als die Sprachproduktion in der institutionalisierten Kommunikationssituation.

Dieses Ergebnis läßt nun die Frage aufkommen, ob der (mehrfach replizierte) Befund, daß sich Unterschiede zwischen den hier untersuchten Kommunikationssituationen (Polizist- und Nachbarsituation) vor allem auf die Äußerungsteile beziehen, die nicht auf das Ereignis referieren, auf Unterschiede in der sprecherseitigen Zielsetzung zurückzuführen sind oder ob die Merkmale der im kognitiven System des Sprechers ablaufenden Steuerungs*prozesse* als Ursache für das Zustandekommen dieser Unterschiede zu betrachten sind.

Die Ergebnisse zeigen eindeutig, daß die je nach Kommunikationssituation unterschiedliche Komposition der Äußerungen nicht auf kontrollierte Prozesse zurückzuführen ist. Vielmehr deuten sie darauf hin, daß unterschiedlichen Häufigkeiten der Thematisierung nicht ereignisbezogenen Wissens eine Folge der unterschiedlichen Planungsmodi sind, unter denen die Sprachproduktion jeweils abläuft. Die Produktion nicht ereignisbezogener Thematisierungen in der Nachbarsituation läßt sich dann darauf zurückführen, daß der Sprecher die Zeiträume, die zwischen den einzelnen Planungseinheiten der Ad-hoc-Steuerung liegen, mittels der Thematisierung von kognitiv leicht verfügbarem Wis-

sen "überbrückt". Dies Annahme erklärt auch den höheren Anteil von nicht-Ereignis-Thematisierungen in der Doppelaufgabenbedingung (siehe Abbildung 2). Sollte sich diese Sichtweise weiter bestätigen, so hätte dies Konsequenzen für die Interpretation einer Vielzahl von Daten, die im Zuge der Alteritätsforschung erhoben wurden. Viele der hier gefundenen Partnereinflüsse lassen sich möglicherweise als Epiphänomene interpretieren (siehe auch Barattelli, Weiß & Mangold, subm.; Dell & Brown, 1991; Roßnagel, 1995).

Die hier vorliegende Arbeit versteht sich unter anderem als ein (dringender) Appell für eine in höherem Maße prozeßorientierte Sprachproduktionsforschung, auch (und besonders) was die höheren kognitiven (Planungs-) Prozesse angeht. Wie hier dargelegt wurde, besteht Grund zu der Annahme, daß Befunde, in denen es um die sprecherseitige Adaption an die Kommunikationssituation (insbesondere an den Kommunikationspartner) geht, in höherem Maße auf Charakteristika der im kognitiven System des Sprechers ablaufenden Prozesse zurückzuführen sind, als dies bislang angenommen wurde.

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Construction of Mental Images and their Use in a Listener Model

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Abstract

The research in Artificial Intelligence concerning the connection between vision and natural language systems relies on what is often called reference semantics. In the situation of a listener not able to see a reported scene, the utterances of the speaker must be perceptually anchored and coherent in order to be understandable. Accordingly, the reporter must be able to anticipate the listeners' understanding by means of mental images. In this paper, we demonstrate the construction of mental images and their comparison to visual perception on the level of spatial relations. The results are used to improve the understandability of planned utterances.

1 Introduction

In Artificial Intelligence (AI), the research areas computer vision and natural language processing have generally been studied intensively but independently from each other. Only few attempts have been made towards the integration of image understanding and natural language descriptions for real word image sequences.

The project VITRA – **VI**sual **TRA**nslator, 1985-1995, cf. [7, 6]) – as part of the German special collaboration programme SFB 314, *AI & Knowledge-Based Systems*, dealt with the relations between speaking and seeing, and aimed at a completely operational form of reference semantics for what is visually perceived.

2 The VITRA Project

Within VITRA, several scenarios were considered in order to construct a system for incremental natural language description of image sequences:

- Answering questions about traffic scenes
- Simultaneously describing video scenes
- Incremental multi-media route descriptions
- Natural language interaction with an autonomous robot system

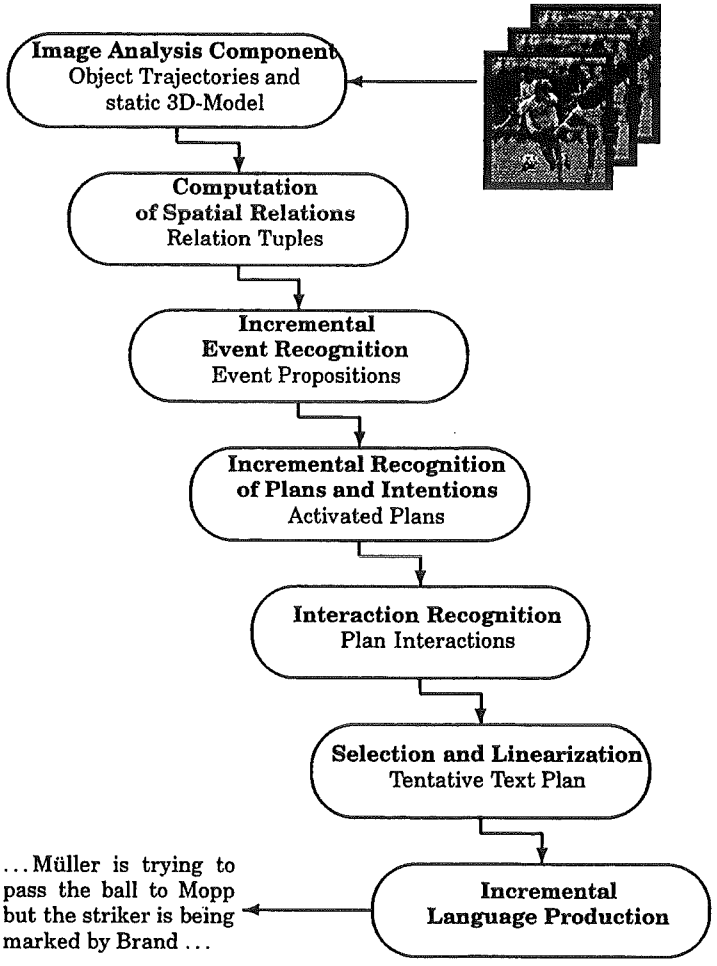

Figure 1: Cascaded Processing in VITRA

The processing in the VITRA system forms a kind of cascade which is shown in Fig. 1. An image sequence in form of digitized video frames builds the input for the processes on the sensory level. Stating the locations of the visible objects at consecutive points in time, the image analysis component incrementally constructs a geometrical scene description. Its contents is further interpreted by the processes on the cognitive level: spatial relations, interesting motion events as well as presumed intentions, plans, and interactions of

the observed agents are extracted. The produced conceptual structures form the connection between visual data and natural language concepts such as spatial prepositions, motion verbs, temporal adverbs, and purposive or causal clauses. After a suitable description of the scene is chosen by the selection component, the linearization module forms a tentative text plan which builds the basis for the transformation into natural language utterances. In terms of reference semantics, explicit links between sensory data and natural language expressions are established.

3 Spatial Relations in VITRA

Processing of spatial relations is described in more detail in the section written by Klaus-Peter Gapp. There, he describes the distinction made in VITRA between the "basic meaning" of a spatial preposition (cf. [5]) represented by spline functions and a concrete instantiation which depends on the object to be located (LO) and one or more reference objects (RO). According to *instantiation rules* depending on the reference object(s), a spatial proposition is created for every instance of a spatial concept. It builds the basis for the computation of the degree of applicability of the considered concept with respect to the actual position of the LO (cf. [3, 13]). The applicability distribution of a whole region is called *applicability region* or *potential field*. We distinguish several classes of spatial relations, as, e.g., topological or projective. This kind of computation can be used both for the generation of suitable spatial description and for the analysis of spatial expressions.

4 A Listener Model with Mental Images

4.1 Anticipation of the Listeners' Imagery

For the listeners of an objective description, it is crucial to understand each assertion in its corresponding context. In the following, the incremental generation of descriptions of short soccer scenes is taken as an example for the use of a listener model with mental images. The resulting report is similar to a live radio coverage, i.e., simultaneously and in an objective manner, to an audience not able to see the game. Currently, we use a bird's-eye projection of the perceived 3D scene onto a 2D plane with mobile objects idealized to mere points.

The logical distinction between the contextually given anchor points of an utterance – essentially given by the definite noun phrases and their pro-forms – and the other components of the assertion which are the actually informative parts – here, we are especially interested in verbs and prepositions – leads to the following questions:

Question of Reference: Can the listener of an assertion uniquely identify the contextual objects in question by means of the given noun phrases?

Question of Plausibility: Is the listener able to integrate the newly communicated information into the present context (which thereby becomes the context for the next assertion)?

And finally:

Question of Correctness: Does the listener's interpretation of the assertion correspond to the speaker's intention? Or is it necessary to modify the assertion in order to reach the communicative goal intended?

Here, we emphasize on two concrete aspects of these questions:

(1) Can the speaker use anticipations of the listeners' *mental images* evoked by the former description in order to choose optional locative deep case fillers as modifications of assertions that otherwise would lead to a correctness problem?

(a) Miller attacks Smith.
⟶ *(b)* Miller attacks Smith near the left penalty spot.

(2) Can the speaker also use the anticipated mental images to extend his ability to use under-specific definite descriptions in a legitimated way?

(a) Brown crosses the upper side line.
⟶ *(b)* Brown crosses the line.

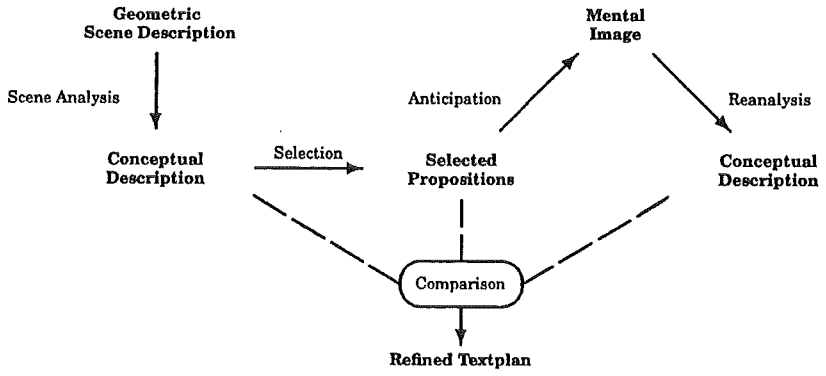

Figure 2: Anticipation Feedback Loop

An additional component with the particular task of improving the text of the speaker system concerning communicative aspects is given by a listener model (cf. [13, 12, 1]): It enables the system to deal with the above-mentioned questions of plausibility, correctness, and reference by anticipating the listeners' understanding of a planned statement. According to the approach of reference semantics, the listeners have reached a deep understanding of the description only if they are able to create mental images structurally corresponding to percepts. In generalizing Grice's Maxim of Quality to graded

concepts (cf. [4]), it is postulated that a listener interprets an utterance of the speaker as a description of a maximally typical occurrence of the mentioned event in the given context; deviations have to be communicated explicitly (cf. [12, Chapter 6]). Therefore, the successful construction of a highly typical image is taken as a proof of the planned assertion's plausibility: The listeners are assumed to be able to integrate the newly communicated event within the given context.

Three steps of processing within the *anticipation feedback loop* (cf. Fig. 2) of the listener model are distinguished: (a) the construction of a visual *pseudo-percept*, (b) the analysis of this *mental image*, which is necessary to explicitly represent the implicatures the listeners derive from the utterance, and (c) the comparison of this anticipated understanding with the intended effects of the utterance and the resulting changes in the generation processes.

4.2 Construction of Mental Images

The listener model starts with the event proposition – in Fig. 3 this is *(*pass* W1 Ball W3)* – chosen by the incremental event selection component of VITRA: it represents the core of the planned utterance.

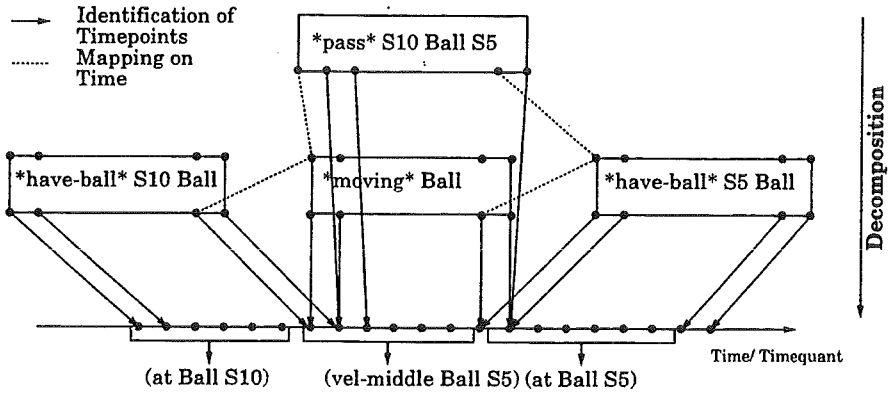

Figure 3: Decomposition of a **pass** Event

The construction of mental images is done in two steps: the temporal concretization which results in the *propositional elementary structure* and, based on that, the spatial concretization which is competent for the generation of the mental images. An event proposition is recursively defined by its subevents (with their temporal relations) down to primitive propositions. The definition of the considered event must be expanded and adapted to the situational constraints in order to achieve spatio-temporal coherence between the required spatial restrictions of the involved objects during each phase of the event and the context (cf. [11]). Further constraints given by optional deep case fillers also have to be associated with the appropriate part of the event (cf. [8] and [10]). I.e., in order to find a basis for the spatial concretization, the temporal concretization explicits the spatial and temporal relations between objects, relations which are implicitly contained in the utterances. Fixing the dura-

tion of the elementary sub-events then results in the propositional elementary structure, the temporally ordered sequence of sets of elementary spatio-temporal relations. Each set restricts the scene for exactly one instant (time quantum).

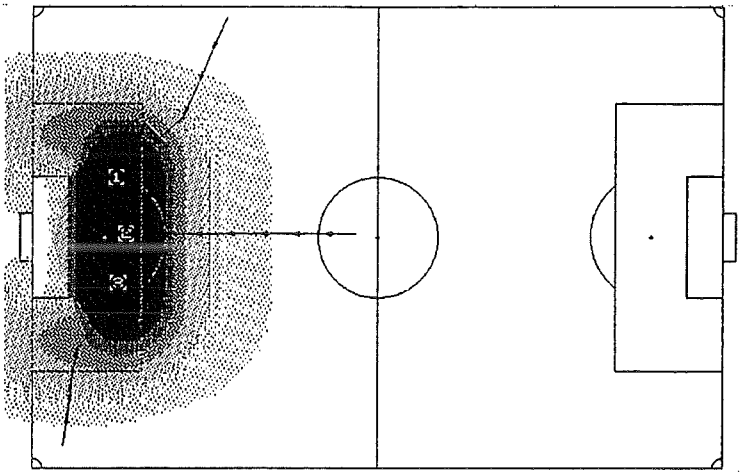

Figure 4: Context-sensitive Approximation of each Player Standing in Front of the Goal Area

This data is transformed in the spatial concretization to a sequence of snapshots by approximating particular locations and velocities for all objects considered successively for each time quantum. To do so, we apply the so-called *hill-climbing algorithm* to the potential fields that correspond to the relations concerning the LOs respectively. If there are several propositions at one time they are combined using algebraic average. The features of the hill-climbing algorithm cause the approximation to be performed in a context-sensitive manner (cf. Fig. 4), i.e., the resulting optimal position of an object depends on its starting position at the beginning of the approximation.

4.3 Comparing the Intended and the Anticipated Understanding

The above descibed process generates an imaginative cinematographic scene which can be reanalysed by the same means as the visual percept. The resulting sets of propositions, then, are compared to those based on the geometrical scene description. In order to relate the propositions forming the intended understanding with the equivalent propositions representing the anticipated effects, precisely one of three types of criteria is taken into consideration: Relation, reference object or degree of applicability (DA) (cf. Table 1).

All pairs of associated propositions are additionally rated and ordered with respect to the relevance of the digression they express: The numerical difference between the two degrees of applicability and a measure of the "conceptual distance" between the involved relations and ROs are combined to a general ranking of the three types. Those pairs exceeding a given threshold

Type of Difference		Source	Relation	LO	RO	DA
1	Relation	Visual Percept	near	Miller	Smith	0.95
		Mental Image	at	Miller	Smith	0.92
			$\neq$	=	=	=
2	RO	Visual Percept	near	Miller	Smith	0.95
		Mental Image	near	Miller	Russel	0.92
			=	=	$\neq$	=
3	DA	Visual Percept	near	Miller	Smith	0.95
		Mental Image	near	Miller	Smith	0.48
			=	=	=	$\not\approx$

Table 1: Examples of Criteria of Equivalence for Spatial Relations

of difference lead to changes in the sentence finally uttered. The prominent opportunity for such changes are optional deep cases, particularly the locative forms, like Source, Goal, or Location (cf. [2], [9], and especially [8]). In fact, those pairs of differing propositions already tell us what kind of fillers can repair the utterance's communicative problem.

If the part of the proposition pair derived from the geometrical scene description has a higher degree of applicability than the one originated by analysing the mental image then this proposition obtained by the speaker's perception must be uttered because it assumedly is not present in the mental model of the listeners after understanding the event proposition. In the other case – the proposition from the mental image has the higher degree of applicability of the pair – the proposition from the visual percept should be mentioned, too. However, a correction of the location falsely deduced may be added, indicating that the speaker is aware of this contextual difficulty: "Miller stands *to the left of* Scott, *not behind* him."

The following sentences are part of a longer example produced by the speaker system. The modifications initiated by the listener model are emphasized:

1. Miller, the goal keeper, has the ball.
2. He plays the ball to Moll, the defender, *near the upper side line.*
3. – 7. ... *(no penalty area is mentioned)*
8. Michels, the left-wing, has got the ball *at the penalty area.*

Since at the beginning of a report there is no previous information given concerning the involved objects, the image for the first utterance uses standard positions of the goal keeper and the ball as its context: While it happens to be correct that the goalie is in his goal area, the ball's position (at the middle point) has to be changed by the hill-climbing procedure. In this case, everything works fine with the utterance proposed. For the second utterance, Moll's standard position has to be used, too, since this player had not been

mentioned before: But in contrast to the previous utterance this location (cf. Fig. 5b) differs a lot from the one perceived (cf. Fig. 5a).

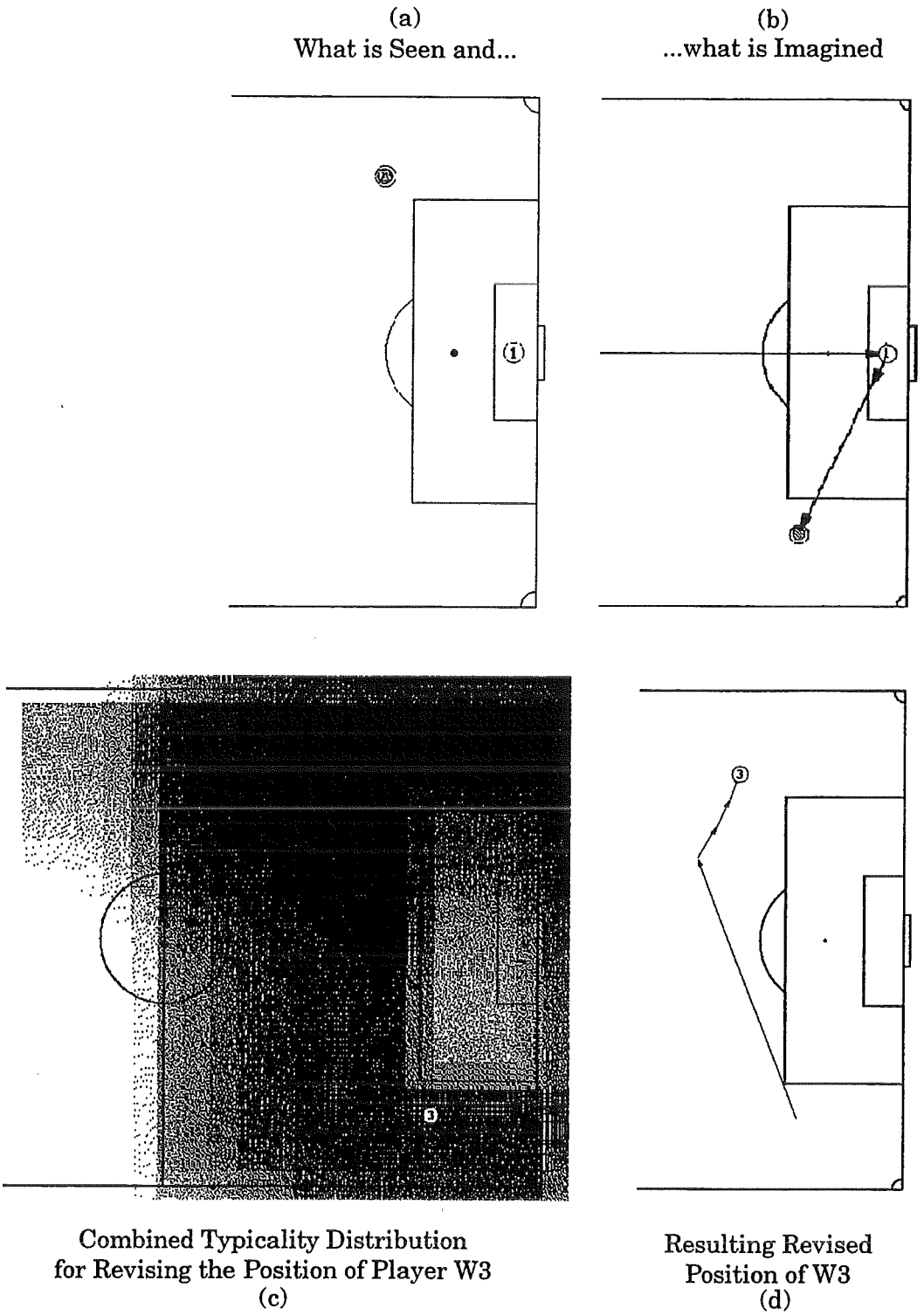

Figure 5: Visual Percept, Mental Image and its Revision

We can extract the following pair of propositions which applies the same relation ("near") to different reference objects:

Visual Percept: *((near W3 upper-side-line) 0.79)*

Mental Image: *((near W3 lower-side-line) 0.84)*

This leads to the additional prepositional phrase (PP) *"near the upper side line"* in the second utterance.

These modifications in the planned statement now have to be integrated in the anticipated understanding of the listeners. The position of the object in question is changed using the hill-climbing algorithm: Hereby, not only the additional relation must hold, but also all those relations that have already held before correctly. This prevents the system from constructing *new* difference propositions. In our example, additional to *(near W3 upper-side-line)*, the relations *(in W3 right-half-field)* and *(near W3 right-penalty-area)* have to be taken into account. These three relations generate the compound typicality distribution of Fig. 5c and result in the revised position of player W3, shown in Fig. 5d. The position found obviously corresponds extremely well to the speaker's perception.

In the eighth utterance, the decision to use an additional locative prepositional phrase for communicating an optional deep case is motivated as above. In this case, the position of Michels (W11) resulting from the previous understanding – not his standard position – comes out to be not exactly as was observed. A highly relevant difference is found (first case of classification in Table 1):

Visual Percept: *((close W11 left-penalty-area) 0.97)*
Mental Image: *((at W11 left-penalty-area) 0.99)*

A listener model with mental images demonstrates a type of focusing that does not – directly – depend on previous mentioning but on the *imaginative visual focus* of an utterance. The corresponding mental image – forming the context of the next utterance – exactly contains those spatial implicatures the listener assumedly was able to derive: Therefore, the uniqueness of the reference of a definite description need not be bound to the whole discourse universe but can be restricted to the much smaller set of objects involved in the actual imaginative visual focus. This suffices to determine whether a description is ambiguous or not, and therefore shrinks the set of attributes necessary to uniquely distinguish an object from the others.

In the image anticipated for utterance 7, Michels happens not to stand close enough to that part of the soccer field to be considered really – as in the speaker's percept (cf. Fig. 6) – *at* the left penalty area. Therefore, a corresponding modification should be added. In contrast to the former example, the analysis of the mental image constructed for the previous sentence here did focus on the reference object to be used in the additional PP, i.e., the left penalty area; simultaneously, the alternative right penalty area was not focused. Correspondingly, the *under-specified* definite description "the penalty area" can be assumed to be uniquely identifying in this situation the RO intended, although it is ambiguous with respect to the whole discourse universe. Thus, the listener model suggests for utterance 8 the additional PP "at the penalty area", although none of the penalty areas ever were mentioned before during the description.

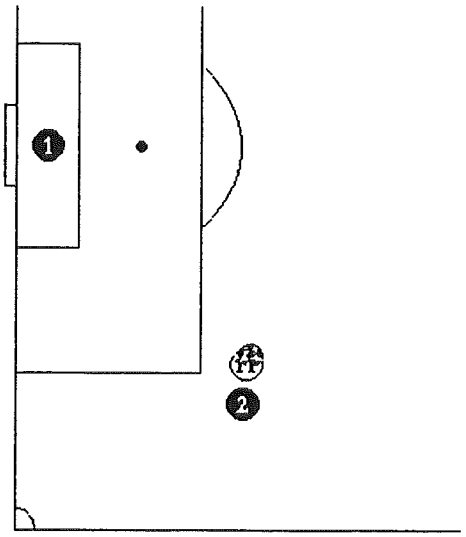

Figure 6: Focused Region of Utterance 7

5 Conclusion

In this paper, we demonstrated how an anticipation feedback loop based on reference semantics can be used to improve speakers' reports to an audience unable to see the scene. Based on the planned utterance, the corresponding event proposition is expanded to a temporally ordered sequence of sets of elementary spatio-temporal relations. For each of these sets a mental image is constructed representing the listeners' presumed contextual information. This process generates an imaginative cinematographic scene which is reanalysed and compared to the visually perceived one. The text plan is adapted to the results of this comparison of the intended and anticipated understanding of the utterance. Optional deep case fillers may be added, under-specified definite descriptions may be applied. By this anticipation of the listener's imagery, redundancies, misunderstandings and false inferences can be reduced and coherence and understandability of the report can be improved.

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Einführung zu Perspektivierungsprozessen bei der Sprachproduktion

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Zusammenfassung

Das Reden über eine Situation bedingt die Einnahme einer bestimmten Perspektive. In diesem Papier sollen Mechanismen diskutiert werden, die diese Perspektive während der Sprachproduktion determinieren. Zur Versprachlichung einer konzeptuellen Struktur stehen einem Sprecher oder einer Sprecherin in der Regel eine Vielzahl von Verbalisierungsoptionen zur Verfügung. Dazu zählen die Wahl geeigneter lexikalischer Ausdrucksmittel ebenso wie die Festlegung der Beziehung zwischen den einzelnen Satzbestandteilen durch syntaktische und prosodische Merkmale. Es wird davon ausgegangen, daß die konzeptuelle Struktur während der sprachlichen Aufbereitung auf der konzeptuellen und semantischen Ebene mit entsprechenden Perspektivierungsmarkierungen versehen wird. Als wesentliche Parameter fungieren dabei der Kontext der Äußerung, aber auch Reihenfolgevarianzen im Zuge der inkrementellen Verarbeitung. Eine Veranschaulichung erfolgt an Hand der sogenannten Transferprädikate, indem beispielsweise die Entscheidung zwischen den Verben "kaufen" und "verkaufen" analysiert wird. Die ermittelten Mechanismen werden auf inkrementelle Weise im Rahmen des kognitiv orientierten Sprachproduktionsmodells SYNPHONICS modelliert unter Berücksichtigung von Erkenntnissen aus der theoretischen und der Computerlinguistik.

1. Einführung

Einer der verschiedenen Teilprozesse während der Produktion einer sprachlichen Äußerung ist die Abbildung einer konzeptuellen Struktur auf eine perspektivierte semantische Struktur. Diese Abbildung ist mehrdeutig, wobei hier nur die eine in den sogenannten Allosätzen manifestierte Richtung untersucht werden soll. Dieser Terminus bezeichnet das Phänomen, daß mehrere Äußerungen konzeptuell äquivalent, aber formal und pragmatisch unterschiedlich sein können[1].

[1] Die Mehrdeutigkeit in der anderen Richtung bezieht sich darauf, daß eine Äußerung auch mehrere propositionale Gehalte repräsentieren kann. So kann die Äußerung "Peter ist krank." sehr unterschiedliche Situationen beschreiben abhängig davon, auf welche Person der Ausdruck "Peter" referiert und an welcher Krankheit diese Person laboriert.

(1) a. Hans hat Maria das Buch verkauft.
b. Maria hat das Buch von Hans gekauft.
c. Das Buch hat Hans Maria verkauft.
d. Maria ist das Buch von Hans verkauft worden.
e. Dieser hat ihr ein Buch verkauft.
f. Der blonde Hans hat der neunzehnjährigen Maria das Mathebuch verkauft.
g. Hans hat Maria das Buch verscherbelt.

Allosätze werden in (1) illustriert: (1a-g) drücken die gleiche konzeptuelle Struktur aus, sofern in allen Sätzen auf die gleiche Situation, die gleichen Personen und das gleiche Buch referiert wird. Bei Zugrundelegung eines modularen Ansatzes zur Modellierung des Sprachproduktionsprozesses ergeben sich fünf Fragen zur Spezifikation der Perspektivierungsmechanismen:

I. Wie sieht eine konzeptuelle Struktur aus bzw. wie wird sie repräsentiert?
II. Durch welche Parameter wird die Perspektivierung beeinflußt?
III. Wann bzw. in welchen Submodulen wird die Perspektive berechnet?
IV. Wie sehen die inkrementell ablaufenden Prozesse der Perspektivierung aus?
V. Wie sieht eine perspektivierte semantische Struktur aus bzw. wie wird sie repräsentiert?

Diese Fragen können aufgrund ihrer Komplexität nicht alle in diesem Papier gründlich behandelt werden. Das folgende Kapitel setzt sich mit den Strukturen und Modulen in der konzeptuellen und der semantischen Phase während der Sprachproduktion auseinander. Dabei werden in den jeweiligen Teilabschnitten die Fragen I., II., III. und V. auf der Grundlage des Sprachproduktionsmodells SYNPHONICS angerissen. Im Fokus des dritten Kapitels steht die vierte Frage mit besonderem Augenmerk auf Phänomenen der thematischen Varianz, illustriert an Hand der Auswahl adäquater Prädikate bei der Verbalisierung von Transfersituationen. Dabei werden beispielsweise (1a) und (1b) gegenübergestellt. Abschließend folgt ein Ausblick.

2. Deklarative Aspekte der Perspektivierung

2.1 Allgemein

SYNPHONICS[2] ist eine computerlinguistische Modellierung des Sprachproduktionsprozesses von der konzeptuellen Inhaltsplanung bis zur lautsprachlichen Realisierung, die Ergebnisse der Psycholinguistik und kognitiv orientierten Linguistik mit theoretisch-linguistischen Überlegungen verbindet. Die Implementation des Gesamtsystems, d.h. sowohl der Prozeßsteuerung als auch der Wissensbasen, erfolgt im Rahmen des von Carpenter entwickelten logikbasierten Programmiersystems ALE (Attribute Logic Engine, vgl. Carpenter (1992)), das auf Prolog aufsetzt. Primäre Datenstrukturen dieses

[2] SYNPHONICS steht als Akronym für Syntactic and Phonological Realization of Incrementally Generated Conceptual Structures. Eine ausführliche Einführung findet sich u.a. in Abb et al. (1995).

Programmiersystems sind getypte Merkmalsstrukturen. Der konzeptuelle, semantische, syntaktische und phonologische Strukturaufbau und die phonetische Interpretation bis hin zur artikulatorischen Parametrisierung werden im Rahmen von ALE mit Hilfe eines Constraint-Systems gesteuert, wobei eine Informationsanreicherung mittels der Operation der Unifikation erfolgt.
Die zugrundeliegende Systemarchitektur wird bestimmt durch die Annahme der globalen Eigenschaften der Modularität, Rückkopplungsfreiheit, Inkrementalität und Parallelität. Das SYNPHONICS-Architekturmodell beinhaltet in Anlehnung an Garrett (1988) und Levelt (1989) die kognitiv motivierten, globalen Ebenen der Konzeptualisierung (*Conceptualizer*), Formulierung (*Formulator*) und Artikulation (*Articulator*) für die außersprachliche, sprachliche, d.h. die semantische, syntaktische und phonologische, sowie artikulatorische Verarbeitung, wobei hier nur die für diesen Beitrag relevanten Bereiche beschrieben werden.

2.2 Repräsentation einer konzeptuellen Struktur

Die grundlegenden konzeptuellen Elemente, aus denen die außersprachliche Wissensbasis aufgebaut ist, sind im SYNPHONICS-Ansatz *referentielle Objekte* (i.f. RefO abgekürzt; vgl. Habel 1986); neben Objekten – im engeren Sinne – werden auch Ereignisse durch eigenständige RefOs repräsentiert. Die Identifizierbarkeit von RefOs über Referenzindizes sowie ihre Vernetzung mittels einbettender relationaler Information bilden die Grundlage für die inkrementelle Verarbeitung partieller Datenstrukturen in SYNPHONICS. Die Datenstruktur für RefOs verfügt somit über drei Hauptmerkmale: Das Merkmal *Prädikationen* enthält eine Menge konzeptueller, d.h. außersprachlicher, Prädikationen, und das Merkmal *Adresse* hat eine Konstante zum Wert, mit der auf dieses RefO verwiesen werden kann. Von besonderer Relevanz im hier diskutierten Zusammenhang ist schließlich das Merkmal *Relationen*, dessen Wert eine Relationenmenge ist, welche Informationen über die erwähnte Vernetzung der RefOs unter Angabe der Adresse des Relationspartners und der Art der Relation birgt. Abbildung (1) zeigt ein RefO mit der konzeptuellen Prädikation *buch* der Adresse *r3* und einer Relationenmenge, die beschreibt, daß dieses RefO als Thema (*theme*) in einer Situation *s1* fungiert und von einem Objekt *r1* besessen (*poss*) wird.

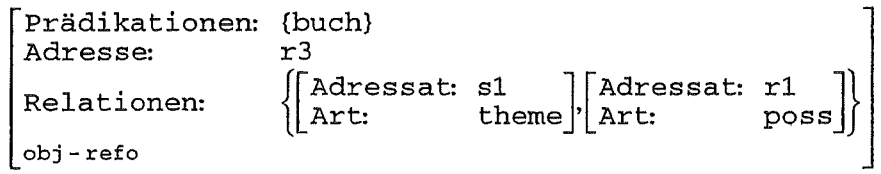

Abb. (1): Exemplarisches RefO

Bezüglich der obigen Frage I. nach der Repräsentation einer konzeptuellen Struktur bilden die RefOs die zentrale Struktur: Eine konzeptuelle Struktur wird durch eine Menge miteinander vernetzter RefOs dargestellt.

2.3 Repräsentation eines Kontexts

Doch neben den zu versprachlichenden RefOs, die mithin den Inhalt der geplanten Äußerung ausdrücken, müssen noch weitere Informationen zur Berechnung der Perspektive in das Sprachproduktionsmodell fließen, um die Angemessenheit der Äußerung zu gewährleisten. Dabei handelt es sich um kontextuelles Wissen, das es aufgrund der Komplexität zunächst zu strukturieren gilt. Dazu postuliere ich zwei Einteilungsdimensionen: Die Einteilung in der einen Dimension ist in Abbildung (2) dargestellt:

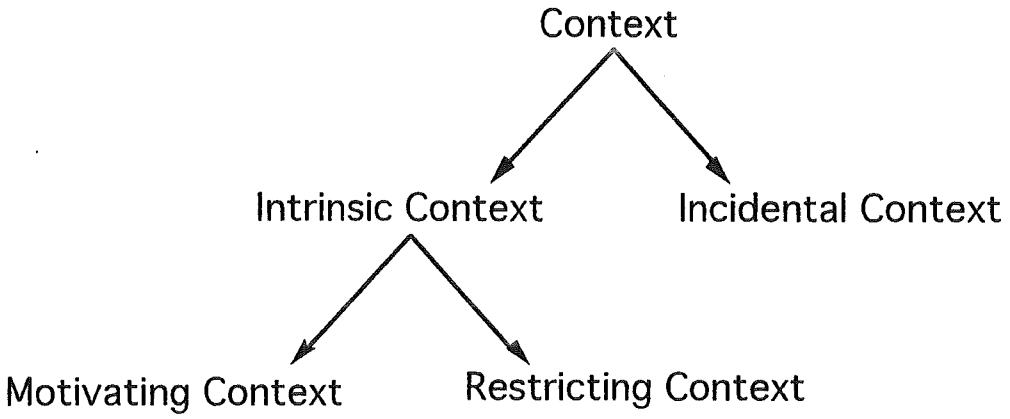

Abb. (2): Kontexteinteilung nach Wissensnutzung

Dabei wird der gesamte Kontext einer sprachlichen Äußerung erst in den intrischen und den nebensächlichen Kontext aufgeteilt (*intrinsic context* vs. *incidental context*). Diese Einteilung wurde von Clark & Carlson (1981) bei Untersuchungen zum Sprachverstehen vorgenommen und ist auch für die Modellierung der Produktionsseite sinnvoll. Die Sektion des intrinsischen Kontext umfaßt genau das Wissen, das zur Berechnung der Perspektive einer Äußerung notwendig ist, während der nebensächliche Kontext darauf keinen Einfluß hat. Van Dijk (1981) nennt dazu das Beispiel, daß die Haarfarbe des Gesprächspartners oder der Gesprächspartnerin bei direkten Diskursen stets zum Kontext gehört, da sie wahrgenommen wird, aber praktisch nie auf die Perspektive von Äußerungen einwirkt. Beim intrinsischen Kontext bietet sich eine weitere Aufteilung an: Eine Sektion des intrinsischen Kontexts verursacht den Prozeß einer Äußerungsproduktion überhaupt erst, während der übrige Teil deswegen relevant ist, da diese Sektion darüber hinausgehende Informationen zur Perspektivierungsberechnung birgt. Ersterer Teil wird als *motivating context* bezeichnet und ist angelehnt an den Quaestio-Ansatz von Klein und von Stutterheim (vgl. u.a. Klein & von Stutterheim (1987) oder von Stutterheim (1995)). Jede sprachliche Aussage kann als eine Deckung eines vom Sprecher bei der Hörerin vermuteten Informationsbedarfs aufgefaßt werden. Die Sektion des motivierenden Kontexts zeichnet sich somit durch eine die Informationslücke repräsentierende Unterspezifiziertheit aus oder aber enthält Informationen, die die Sprecherin für falsch hält und durch ihre Aussage zu korrigieren beabsichtigt. Zur Berechnung der Perspektive einer Äußerung ist dieses Wissen jedoch nicht hinreichend, sondern bedarf es zudem des Zugriffs auf die weitere, als *restricting context* bezeichnete Sektion des intrinsischen Kontexts. Die Informationen dieser Sektion tragen dazu bei, daß

mittels Perspektivenauferlegung im Rahmen der möglichen Versprachlichungen zur Deckung des Informationsbedarfs eine kontextuell angemessene Äußerung produziert wird. Diese Trennung manifestiert die Doppelrolle des Kontexts als motivierender und zudem restringierender Parameter der Äußerungsproduktion. Dabei sorgt die Sektion des motivierenden Kontexts natürlich bereits für sich für eine erhebliche Restriktion im Rahmen aller möglichen Verbalisierungsprozesse, während die Sektion des restringierenden Kontexts auf dieser Basis Wissen für perspektivische Verfeinerungen zur Angemessenheit der Äußerung liefert.

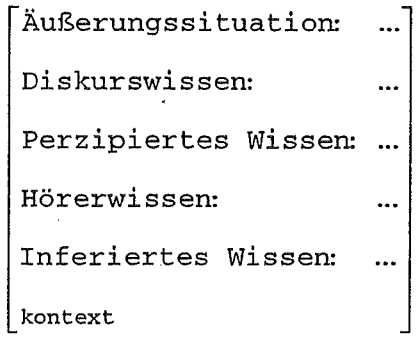

Abb. (3): Kontexteinteilung nach Wissensquellen

Dazu orthogonal läßt sich der Kontext einer Äußerung nach den Wissensquellen gliedern, aus denen die Informationen geschöpft werden, was in Abbildung (3) wieder mittels einer Merkmalsstruktur dargestellt ist. Es gibt fünf Sektionen: Die Sektion *Äußerungssituation* enthält der aktuellen Situation inhärente Informationen über Sprecher oder Sprecherin, Hörer oder Hörerin, Ort und Zeit sowie die Art des Gesprächs. Die Sektion *Diskurswissen* umfaßt Wissen, das im aktuellen Diskurs bereits übermittelt wurde. Die Sektion *Perzipiertes Wissen* schließt das Wissen ein, das während des Diskurses neben den verbalen Äußerungen auf andere, beispielsweise visuelle oder taktile Weise wahrgenommen wird. Die Sektion *Hörerwissen* birgt das Wissen, von dem die Sprecherin glaubt, das es schon vor dem Diskurs beim Hörer vorliegt, was naturgemäß mit einem Unsicherheitsfaktor behaftet ist, der aber auch bei den anderen Sektionen vorliegt. Die Sektion *Inferiertes Wissen* besteht aus den Informationen, die die übrigen Sektionen zwar nicht explizit enthalten, aber aus diesen mit gewöhnlichen Inferenzfähigkeiten gefolgert werden können.
In beiden Einteilungsdimensionen setzen sich die einzelnen Sektionen aus Mengen von RefOs zusammen, wobei insbesondere aber nicht nur die Sektion des motivierenden Kontexts unterspezifizierte RefOs enthalten kann.
Bezüglich der obigen Frage II. nach den Parametern der Perspektivierung bilden die beiden Untersektionen des intrinsischen Kontexts, die sich jeweils in die Sektionen der weiteren Einteilungsdimension nach Wissensquellen gliedern lassen, die maßgebliche Wissenstruktur.

2.4 Beschreibung der relevanten Submodule

An Hand des relevanten Ausschnitts aus der SYNPHONICS-Architektur in Abbildung (4) werden nun die Module und Submodule eingeführt, in die diese Datenstrukturen einfließen, während auf die konkreten Perspektivierungsberechnungen erst im folgenden Kapitel exemplarisch eingegangen wird. Ein Sprachproduktionsprozeß wird ausgelöst, wenn RefOs eines motivierenden Kontexts in den Konzeptualisierer eingegeben werden, also eine Intention vorliegt, für deren Erfüllung dem Sprecher eine sprachliche Äußerung das probateste Mittel erscheint. Diese Datenstruktur fließt parallel in zwei Submodule des Konzeptulisierers, den *Contextualizer* und den *Salience Evaluator.*

Dem Contextualizer kommt die Aufgabe zu, an Hand des motivierenden Kontextes sowie unter Zugriff auf den gesamten sprachlichen Kontext die stets zu aktualisierende Sektion des intrinsischen Kontexts zusammenzustellen, d.h. die Informationen, die für die Perspektivierungsberechnungen notwendig sind. Anders ausgedrückt bedeutet dies, daß aus dem gesamten Kontext die Sektion des restringierenden Kontexts gefiltert werden muß, die zusammen mit der Sektion des motivierenden Kontexts, wie beschrieben, die Sektion des intrinsischen Kontexts bildet (vgl. Abb. (2)), die dann auch die Ausgabestruktur aus diesem Submodul darstellt.

Der motivierende Kontext fließt zudem in den Salience Evaluator, ein Submodul, das für den Inhalt der Äußerung zuständig ist. Dieses Modul greift auf die konzeptuelle Wissensbasis (*Conceptual Knowledge Base*) zu und entnimmt dieser sukzessive die RefOs, die notwendig sind, um den durch den motivierenden Kontext gekennzeichneten Informationsbedarf seitens der Hörerin zu decken, mithin verbalisiert werden sollen. Dabei werden nicht nur solche RefOs ausgewählt, die im motivierenden Kontext unterspezifiziert sind, sondern auch solche die kontextuell vollständig spezifiziert sind, deren Versprachlichung aber als Verankerung der neuen, damit verknüpften Informationen notwendig ist. Diese Relation spiegelt sich in Perspektivierungsphänomenen wie Fokus-Hintergrund-Gliederung und Topik-Kommentar-Gliederung wider, auf die hier nicht näher eingegangen werden kann[3]. Der Name des Submoduls steht in Zusammenhang mit der Eigenschaft der Inkrementalität, die für das System aufgrund dessen kognitiv orientierter Ausrichtung zur Erklärung der hohen Geschwindigkeit der menschlichen Sprachproduktion essentiell ist. Das bedeutet, daß zu keinem Zeitpunkt in einem Modul alle RefOs, die zusammen die konzeptuelle Struktur einer Äußerung bilden, gleichzeitig bearbeitet werden. Statt dessen werden sie einzeln sukzessive durch die Module gereicht, wobei die Reihenfolge durch den Verlauf der Extraktion der RefOs aus der konzeptuellen Wissensbasis gegeben ist, die wiederum durch die vom Salience Evaluator festgestellte Rangfolge der Salienz der zu verbalisierenden RefOs abhängt.

Die Ausgabestrukturen aus diesen parallel geschalteten Submodulen Contextualizer und Salience Evaluator, d.h. der intrinsische Kontext und RefO-Inkremente, fließen dann in ein weiteres Submodul des Konzeptualisierers, den *Pragmatic Encoder,* ein. Der Pragmatic Encoder ist eines von zwei Submodulen, in denen Perspektivierungsberechnungen auf der Grundlage kontextuellen Wissens durchgeführt werden. Die Ausgabe des Pragmatic Encoders ist je RefO-Inkrement eine mit *Pragmatic Representation* bezeichnete Struktur, die somit

[3] Eine ausführliche Einführung findet sich u.a. in Günther et al. (1995).

auch die vermittelnde Information zwischen den beiden Hauptmodulen Konzeptualisierer und Formulator darstellt.

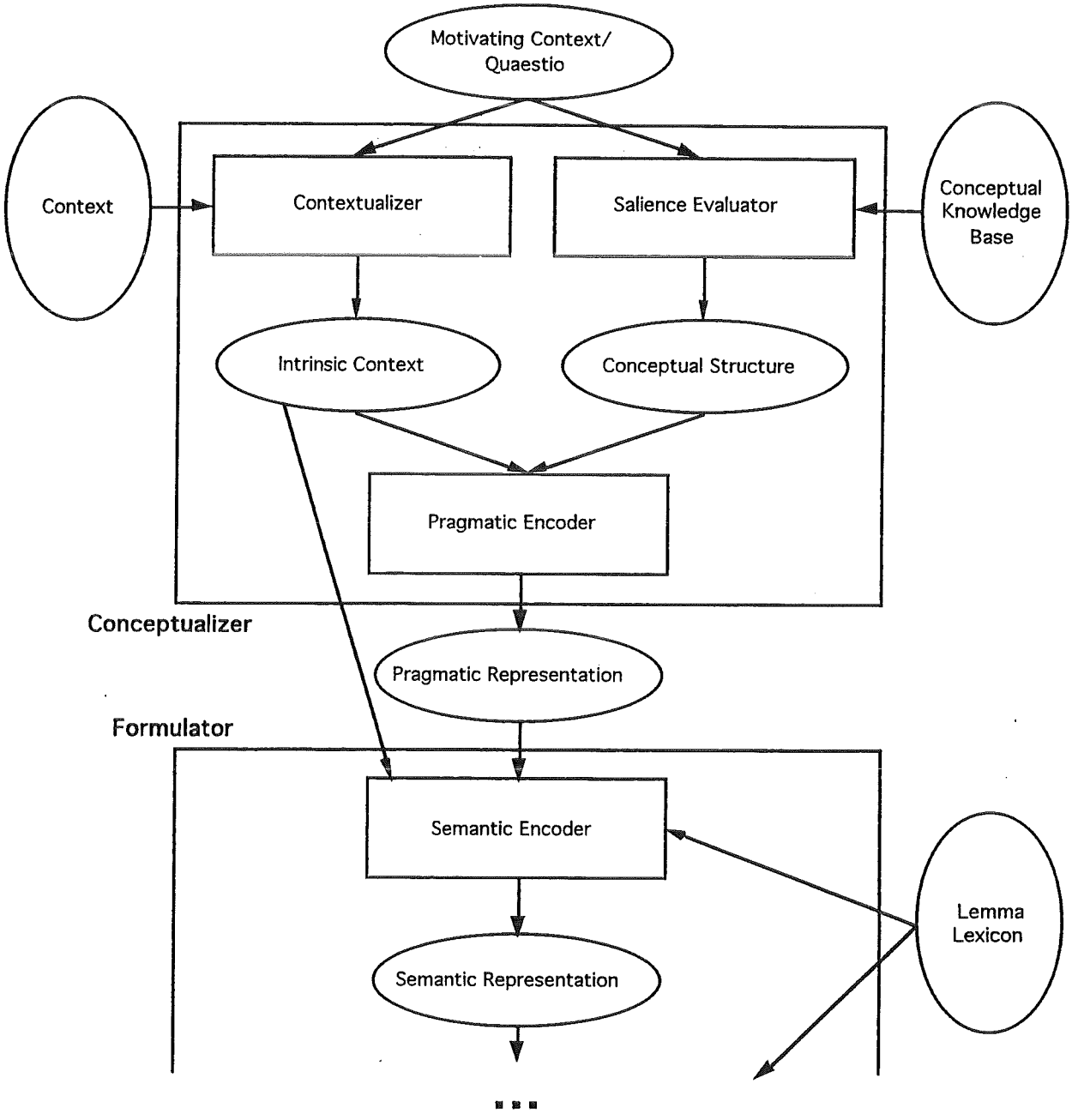

Abb. (4): Ausschnitt aus der SYNPHONICS-Architektur[4]

Als erstes Submodul des Formulators fungiert der sogenannte *Semantic Encoder*, der neben der pragmatischen Repräsentation der Äußerungsinkremente auch den vom Contextualizer zusammengestellten intrinsischen Kontext als Eingabeparameter erhält. Auch im Semantic Encoder werden Perspektivierungsberechnungen durchgeführt, um die Voraussetzung für die

[4] In dieser Abbildung sind Module als Rechtecke, Input- bzw. Output-Strukturen als horizontale Ellipsen und passive Wissensabasen als vertikale Ellipsen dargestellt.

kontextuelle Angemessenheit der Äußerung zu schaffen. Der Unterschied zu den Prozessen des Pragmatic Encoder besteht darin, daß der Semantic Encoder Berechnungen anstellt, die spezifischen Wissens über die zu produzierende Sprache bedürfen, was aufgrund der Zugriffsmöglichkeiten auf das spezifische Lemma-Lexikon gewährleistet ist, während der Pragmatic Encoder als Submodul des Konzeptualisierers keinen Zugang zu einzelsprachspezifischen Wissensbasen hat.
Bezüglich der obigen Frage III. nach der Lokalisierung der Perspektivierungsberechnungen bedeutet dies, daß im Pragmatic Encoder die Prozesse der Perspektivierung ablaufen, die sprachunabhängig sind und deren Resultate in der pragmatischen Repräsentation repräsentiert werden, hingegen im Semantic Encoder darauf aufbauend weitere sprachspezifische Perspektivierungsprozesse vollzogen werden.

2.5 Repräsentation einer perspektivierten semantischen Struktur

Die Ausgabe des Semantic Encoders wird als Semantic Representation bezeichnet und stellt eine genuin semantische Repräsentation dar, die in drei Teile untergliedert ist: Das Merkmal *ref-info* enthält die referentielle Informationen über ein RefO, die später den Zugriff auf den Teil des Lexikons ermöglichen, der funktionale Elemente wie Artikel und Quantoren enthält. Das Merkmal *core-info* umfaßt den deskriptiven Gehalt eines RefOs, der die Extraktion eines Lemmas aus der Kernpartition des Lexikons erlaubt. Schließlich enthält die Einbettungsinformation *embedding-info* Wissen über die Beziehungen zwischen dem aktuell zu verarbeitenden RefO und weiteren Inkrementen, wie beispielsweise thematische Relationen.
Bezüglich der obigen Frage V. nach der Struktur einer perspektivierten semantischen Struktur bedeutet dies, daß die Resultate der Perspektivierungsberechnungen als Merkmale innerhalb der semantischen Repräsentation markiert sind. Damit sorgt die Perspektivierung für die Ausfilterung einer semantischen Repräsentation aus der Menge aller für die eingegebenen konzeptuellen Inkremente möglichen semantischen Repräsentationen, was wiederum eine kontextuell angemessene Äußerung gewährleistet.
Diese Struktur wird dann der weiteren syntaktischen sowie phonologischen und phonetischen Verarbeitung unterzogen und schließlich lautsprachlich realisiert.

3. Prozedurale Aspekte der Perspektivierung

3.1 Allgemein

Dieser Abschnitt befaßt sich der obigen Frage IV. und damit der Spezifikation der Perspektivierungsberechnungen. In diesem Ansatz soll eine Analogie zwischen der Perspektivierung und der kontextuellen Angemessenheit einer Äußerung auf der einen Seite und einer Grammatik und der Wohlgeformtheit einer Äußerung auf der anderen Seite gezogen werden, was durch folgendes Zitat aus Green (1994:2) motiviert wird:

"Just as grammars limit the possible expressions of a language to those that satisfy certain constraints (including constraints on relations among details of the internal structure of those forms), cultures associated with languages impose conditions on the felicitous USE of those expressions, limiting felicitous use to those contexts which satisfy certain constraints."

Der Produktionsprozeß einer Äußerung kann also als ein sukzessives Restringieren aller sprachlichen Zeichen, die die kommunikative Intention erfüllen, aufgefaßt werden. Dieser Restriktionsprozeß ist in zwei Klassen einteilbar, und zwar nach Restriktionen hinsichtlich der Wohlgeformtheit und nach Restriktionen hinsichtlich der Angemessenheit.
Das Erreichen von Wohlgeformtheit ist Gegenstand einer Grammatik und nicht dieses Papiers. Innerhalb einer constraintbasierten Grammatiktheorie wie der HPSG (vgl. Pollard & Sag (1987:44) lassen sich wohlgeformte Zeichen formal wie folgt repräsentieren:

Wohlgeformte Zeichen = $WP_1 \wedge WP_2 ... \wedge WP_m \wedge WP_{m+1} \wedge WP_{m+2} ... \wedge WP_n \wedge (L_1 \vee L_2 ... \vee L_p)$

Dabei sind WP_1, WP_2 ... WP_m universale Wohlgeformtheitsprinzipien, WP_{m+1}, WP_{m+2} ... WP_n einzelsprachliche Wohlgeformtheitsprinzipien und L_1, L_2 ... L_p Elemente des sprachspezifischen Lexikons. Die Prinzipien und Lexikonelemente liegen dabei in Form von Constraints vor, deren konjunktive und disjunktive Verknüpfung für ein Herausfiltern der wohlformten Zeichen einer Sprache aus allen Zeichen sorgt. Diese wohlgeformten Zeichen sind jedoch in einer speziellen Äußerungssituation bei weitem nicht alle angemessen.
Sprecherinnen und Sprecher streben neben der wohlgeformten Verbalisierung einer konzeptuellen Struktur aber stets auch eine kontextuelle Angemessenheit der Äußerung an, was einen erheblichen Anteil an der Erfüllung der die Äußerungsproduktion auslösenden Intention hat. Dieser Aspekt benennt die Motivation der Perspektivierung, in deren Rahmen im Verlauf der Sprachproduktion vor den Wohlgeformtheitsbeschränkungen bereits entsprechende Angemessenheitsbeschränkungen mittels zusätzlicher Prinzipien vorgenommen werden, was ich formal analog ausdrücke:

Kontextuell angemessene Zeichen = $AP_1 \wedge AP_2 ... \wedge AP_q \wedge$ Wohlgeformte Zeichen

Dabei sind AP_1, AP_2 ... AP_q Angemessenheitsprinzipien zur Perspektivierung, die im oben beschriebenen Modell je nach Sprachspezifität in den Submodulen Pragmatic Encoder und Semantic Encoder angewendet werden, nachdem die vorgeschalteten Submodule Contextualizer und Salience Encoder die benötigten Informationen geeignet vorstrukturiert haben (vgl. Abb. (4)). Die grammatikalischen Wohlgeformtheitsprinzipien dagegen werden in anschließenden Submodulen des Formulators angewendet.
Zusammengefaßt wird im Verlauf der Sprachproduktion ein im Kontext angemessenes und wohlgeformtes sprachliches Zeichen aus der Menge aller sprachlichen Zeichen mittels dreier Constraintkategorien herausgefiltert: Die universalen Wohlgeformtheitsprinzipien müssen in allen Sprachen erfüllt sein, die einzelsprachlichen Wohlgeformtheitsprinzipien nur in der aktuell produzierten Sprache und die Angemessenheitsheitsprinzipien nur im aktuellen

Kontext. Im folgenden Abschnitt werden die Angemessenheitsheitsprinzipien für die Verbalisierung von Transfersituationen vorgestellt.

3.2 Thematische Varianz am Beispiel der Transferprädikate

Die Mechanismen der Perspektivierung werden an Hand der Gruppe der Transferprädikate illustriert, denen auf der sprachlichen Ebene Verben des Besitzwechsels entsprechen, z.B. "geben", "nehmen", "verkaufen", "rauben", "verleihen" oder "bekommen". An den zugrundeliegenden Situationen sind in aller Regel mindestens drei Objekte beteiligt: der Übergebende, der Empfänger und das zu übergebende Objekt. Um derartige Situationen zu verbalisieren, stellt die deutsche Sprache zahlreiche Verben zur Verfügung, deren Auswahl von der Art des Transfers und der thematischen Einbettung abhängt, die der Sprecher den beteiligten Objekten beimißt. Zwischen diesen beiden Aspekten ist zu unterscheiden: Die Art des Transfers wird auf der konzeptuellen Ebene innerhalb der Prädikationenmenge des RefOs gekennzeichnet (vgl. Abb. (1)). Exemplarische Prädikationen sind: Transfer mit vs. ohne Gegenleistung des Empfängers, Transfer mit dauerhaftem vs. zeitweiligem Verbleib des Objekts beim Empfänger oder Transfer mit vs. ohne Einwilligung des Übergebenden. Es wird deutlich, daß diese Prädikationen nicht hinreichend zur eindeutigen Auswahl eines Besitzwechselverbs sein müssen. Beispielsweise kann eine Transfersituation, die durch die Prädikationen "mit Gegenleistung des Empfängers", "mit dauerhaftem Verbleib beim Empfänger" und "mit Einwilligung des Übergebenden" gekennzeichnet ist, durch mindestens zwei Besitzwechselverben, nämlich "kaufen" und "verkaufen", verbalisiert werden. Die Auswahl zwischen diesen Verben hängt von der thematischen Einbettung der beteiligten Objekte ab. Dieser Aspekt soll im folgenden im Vordergrund stehen, während es sich bei der Art des Tranfers von nun an exemplarisch stets um Verkaufssituationen handelt. Die unterschiedliche Gewichtung im Rahmen der thematischen Einbettung der Objekte wird durch Perspektivierungsmarkierungen wie etwa die Hervorhebung eines Objekts als aktiv handelndes und damit agentiv zu versprachlichender Ausdruck verdeutlicht.
Dabei kann ein Sachverhalt im mentalen Modell der Sprecherin von vornherein perspektiviert repräsentiert sein oder im Verlauf der semantischen Enkodierung aufgrund kontextueller Informationen mit Perspektivierungsmarkierungen versehen werden. Bei dieser Art der Perspektivierung ist der semantische und nicht der pragmatische Enkodierer zuständig, da dabei sprachspezifisches Wissen benötigt wird, indem ein Abgleich mit den Lexikoneinträgen stattfindet, ob für die betreffende Konstellation überhaupt ein Lemma zur Versprachlichung existiert (vgl. Abb. (4)).

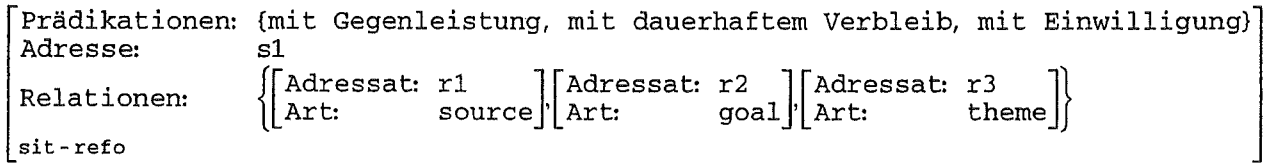

Abb. (5): RefO einer Transfersituation

Ein nicht-perspektiviertes RefO einer Transfersituation ist in Abbildung (5) dargestellt. Relevant ist hier nur die Relationenmenge, die auf die Objekte *r1*, *r2* und *r3* verweist, die als Quelle (*source*), Ziel (*goal*) und als Thema (*theme*) der Transfersituation fungieren. Diese Relationenmenge kann durchaus auch informationsärmer sein, etwa wenn einige Partizipanten der Situation unbekannt oder für die Versprachlichung nicht relevant sind. Wenn dieses RefO in dieser Form vom Salience Evaluator aus der konzeptuellen Wissensbasis extrahiert und weitergereicht wird, sind die vorliegenden Informationen, wie erwähnt, nicht hinreichend zur eindeutigen Auswahl eines Lexikoneintrags, so daß der vom Contextualizer bereitgestellte intrinsische Kontext berücksichtigt werden muß. Durch Unifikation dieser Strukturen findet eine hinreichende Restriktion der vorhandenen Informationen statt, die zudem dahingehend inkrementell verläuft, daß während dieser Berechnungen kein weiteres zu versprachlichendes RefO vom semantischen Enkodierer bearbeitet wird. Mittels vier unterschiedlicher Kontexte werden im folgenden die daraus resultierenden Perspektivierungsvarianten demonstriert. Im folgenden seien *r1* mit "Hans", *r2* mit "Maria" und *r3* mit "Buch" bezeichnet.
Der Kontext in Abbildung (6) drückt aus, daß in einer nicht näher gekennzeichneten Situation ein Objekt *r1* als Agent und ein Objekt *r3* als Thema auftreten. Diese Informationslücke könnte durch die explizite Frage: "Was hat Hans mit dem Buch gemacht?" seitens des Hörers manifestiert werden oder aber aus anderen Gründen "im Raum stehen".

```
[ Prädikationen: {}
  Adresse:       var
  Relationen:    {[Adressat: r1   ],[Adressat: r3   ]}
                 {[Art:      agent],[Art:      theme]}
  sit-refo
]
```

Abb. (6): Intrinsischer Kontext zu (2a)

Eine Unifikation der RefOs aus Salience Evaluator (vgl. Abb. (5)) und aus Contextualizer (vgl. Abb. (6)), wobei die Mengen jeweils vereinigt werden, liefert eine derart angereicherte und damit perspektivierte Struktur, daß nur noch eine Versprachlichung mittels des Besitzwechselverbs "verkaufen" wie in (2a) in Frage kommt.

(2) a. Hans hat das Buch verkauft.

Der Kontext in Abbildung (7) unterscheidet sich dahingehend vom vorigen, daß dort zudem eine Relation zu einem als Experiencer fungierenden Objekt *r2* etabliert ist.

```
[ Prädikationen: {}
  Adresse:       var
  Relationen:    {[Adressat: r1   ],[Adressat: r2         ],[Adressat: r3   ]}
                 {[Art:      agent],[Art:      experiencer],[Art:      theme]}
  sit-refo
]
```

Abb. (7): Intrinsischer Kontext zu (2b)

Auch hier wird bei der Perspektivierung "verkaufen" als adäquates Besitzwechselverb berechnet, jedoch drückt der Kontext eben zudem einen Informationsbedarf hinsichtlich einer Integration des Objekts *r2* in die Situation aus, so daß eine Versprachlichung wie in (2b) angemessen ist.

(2) b. Hans hat Maria das Buch verkauft.

Im Kontext in Abbildung (8) nimmt dagegen das Objekt *r2* die Rolle des Agenten ein, während keine Beziehung zum Objekt *r1* vorliegt.

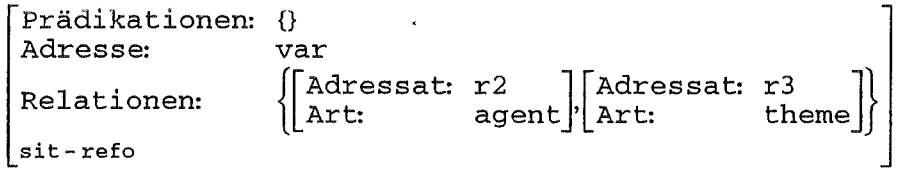

Abb. (8): Intrinsischer Kontext zu (2c)

Um diesem Informationsbedarf angemessen gerecht zu werden, d.h. insbesondere die Agentenrolle vom Objekt *r2* zu explizieren, ist das Besitzwechselverb "kaufen" notwendig, dessen zugehöriges Lemma auch einzig dem Abgleich mit den vereinigten Prädikations- und Relationsmengen der RefOs aus den Abbildungen (5) und (8) erfüllt. Die Versprachlichung dieser Situation ist in (2c) ausgedrückt.

(2) c. Maria hat das Buch gekauft.

Gegenüber dem vorigen ist im Kontext in Abbildung (9) zudem eine Relation zu dem Objekt *r1* in der Rolle des Experiencers etabliert.

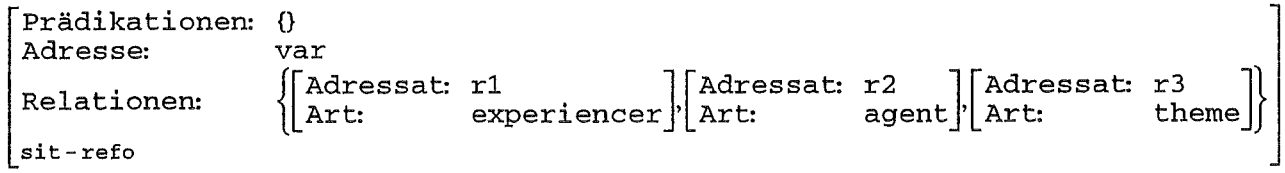

Abb. (9): Intrinsischer Kontext zu (2d)

Auch hier stellt "kaufen" das geeignetste Besitzwechselverb dar, darüber hinaus ist es kontextuell angemessen auch das Objekt *r1* in der diesem zukommenden Rolle zu verbalieren, wie es in (2d) geschieht.

(2) d. Maria hat das Buch von Hans gekauft.

Dagegen ist vor diesem Kontext eine Versprachlichung wie beispielsweise in (2b) nicht angemessen, obwohl diese Äußerung die gleiche konzeptuelle Struktur und ebenfalls mit allen beteiligten Objekten beschreibt. Der Kontext in Abbildung (9) gibt jedoch eine

Perspektivierung mit dem Objekt *r2* in agentiver Rolle vor, wohingegen ein Wechsel zu einer Versprachlichung mit *r1* in agentiver Rolle wie in (2b) unangemessen und damit der dem Sprachproduktionsprozeß zugrundeliegenden Intention nicht förderlich wirkt.
In diesem Abschnitt wurde an Hand der Illustration der Modellierung der inkrementellen Berechnung von Transferprädikaten einer der Perspektivierungsvorgänge im semantischen Enkodierer vorgestellt.

4. Ausblick

Neben den Berechnungen von Transferprädikaten laufen im pragmatischen und semantischen Enkodierer noch diverse weitere Perspektivierungsmechanismen ebenfalls auf inkrementelle Weise ab. Diese sind für ein Sprachproduktionsmodell essentiell, da sie die Ausfilterung einer kontextuell angemessenen Äußerung aus der Menge aller die kommunikative Intention erfüllenden Äußerungen determinieren.
Orthogonal zu der Aufteilung in einzelsprachabhängige und einzelsprachunabhängige Perspektivierungsberechnungen lassen sich diese auch in absolute und relationale Perspektivierungsprozesse gliedern. Relationale Perspektivierungsprozesse beziehen sich auf die Vernetzung der einzelnen Inkremente beim Aufbau einer Äußerung und die Möglichkeiten, diese variabel zu gestalten. Prozesse der absoluten Perspektivierung dagegen betreffen einzelne Inkremente unabhängig von deren Beziehungen zu den übrigen Äußerungsbestandteilen. Phänomene der relationalen Perspektivierung umfassen die hier am Beispiel der Transferprädikate vorgestellte thematische Varianz, die Linearisierung mit dem Spezialfall der Topik-Kommentar-Gliederung (vgl. (1c)), die Passivierung (vgl. (1d)) sowie die im Deutschen prosodisch manifestierte Fokus-Hintergrund-Gliederung. Phänomene der absoluten Perspektivierung betreffen die Art der referentiellen Bezugnahme auf Entitäten (vgl. (1e)), die Selektion, d.h. die Auswahl der zu verbalisierenden Prädikationen aus allen zur Verfügung stehenden Informationen in der Wissensbasis, (vgl. (1f)) sowie die generelle Aufbereitung der gewählten Prädikationen je nach Gesprächspartner oder -partnerin und Äußerungssituation (vgl. (1g))[5].

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