Towards the Generation of Preverbal Messages
for Spatial Descriptions

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26th July 1995

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1 Introduction

Too complicated, too complicated
You know this crazy scene
Too complicated, too complicated
No one says what they mean

Van Morrison

A speaker describing a spatial configuration of objects has to solve a complex planning problem in order to fit the description to the communicative demands. First of all the speaker must behold the spatial objects at hand and cognize their shape, size, intrinsic orientation, and their respective positions. The result of this cognition phase is a perspective-specific spatial representation, the „world depiction".[1] Next to spatial features the speaker's[2] spatial representation comprises also certain salience features that play a role in marking the objects as possible *reference objects* which provide space for localizing other objects, the *primary objects*.

To talk about the spatial representation, which has been constructed by the visual mechanisms, the information must be processed through several modules until the speaker is able to articulate utterances. Despite their fundamental differences in the details, all psycholinguistic models of language production draw a distinction between three major processing stages: on the conceptual level the speaker must select the relevant information from the representation at hand: she must decide what to say. Additionally, the speaker must choose a linearization strategy: she must decide how to say it.

Both, the selection and linearization depend to a high degree on the beliefs a speaker has of what the partner or addressee already knows and what he might be interested in. The result of the conceptual selection and linearization task is a pre-linguistic *message structure* with propositional contents *tailored to the addressee* that serves as input for the formulator, where grammatical and phonological encoding takes place. Such a pre-linguistic message structure provides sortal information about the entities to be mentioned, as well as information about tense, modality, whether an entity has been mentioned before, which information is focused, which belongs to the background, and what the topic of the proposition is.

The pre-linguistic message structure is converted into linguistic form by means of grammatical and phonological encoding. In the process of grammatical encoding, semantically appropriate lexical items are retrieved from the lexicon and linearized according to the argument structure of these lexical items.

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[1] „Sachverhaltsrepräsentation" in the terminology of STUTTERHEIM (1995). Depictions — as the word is used by us — are not necessarily assumed to be analogous representations as introduced in the imagery debate (KOSSLYN (1980)). As a matter of fact, we do not make any assumptions whether a hybrid approach or a purely propositional one should be favored, although we are dealing solely with frame-based representations.

[2] In the following, the speaker is assumed to be female and the addressee is marked as a male person.

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Phonological encoding comprises the computation of the phonetic form. Both grammatical and phonological encoding are generally assumed to be lexicon-driven processes. The output of the formulator is a phonetic plan for the third stage, the articulator, which executes the motoric activities while articulating the utterance.

In this paper we are interested in the conceptual processes necessary for the generation of pre-linguistic message structures of spatial descriptions. We call this pre-linguistic message structure the „discourse representation".[3]

A speaker has to coordinate several knowledge sources while planning this discourse representation. First of all, she has to cognize situation-specific knowledge. This knowledge comprises information from the spatial representation of the scene to be described as well as information from the partner model, i.e., personal characteristics assigned to the addressee by the speaker and the speaker's beliefs of the addressee's knowledge and wants. We assume that the speaker's partner model plays an important role in the whole production process because messages are usually tailored to the informational demands of the partner.[4] Additionally, general conceptual knowledge of the world and the object classes to which the perceived objects belong must be consulted to infer additional proto-typical properties of the objects at hand. An additional important knowledge source for dialogues is the speaker's discourse model that keeps track of what has been said by whom.

To summarize, at least four knowledge sources are involved in the planning process of the pre-linguistic message structure, our so-called discourse representation:

- the world depiction (situative knowledge)

- the partner model (situative knowledge)

- the discourse model (situative knowledge)

- general conceptual knowledge (non-situative knowledge)

Based on this general characterization of the production process and the knowledge sources involved, the objectives of this paper are as follows:

1. The construction of the discourse representation is the main topic of this paper. We are explicating our assumptions on the stages and processes involved in the generation of a discourse representation for descriptions of spatial object configurations in view of the partner model. Our emphasis lies on the following questions: which information is selected by the

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[3] Apart from their form, these discourse representations we are going to generate are not related to DRSes from KAMP & REYLE's (1993) *Discourse Representation Theory* (DRT). DRSes are semantic representations constructed by syntax-driven rules in order to interpret a text. They comprise quasi-linguistic information. We are *generating* „DRSes" representing *conceptual* information.

[4] Probable exceptions are self-addressed monologues.

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speaker in the light of the partner model and how does the partner model effect the information structure, especially the focus/background, topic/ comment separation and the „informativeness" of an object? We are especially interested in the development of these structures in the planning process.

2. We are proposing a certain form of pre-linguistic message structure with the corresponding content. The pre-linguistic message structure can be represented as a sequence of discourse referents that determines the number of entities that must be mentioned by the speaker and the order in which they are uttered. Discourse representations are more comprehensive than single propositions or an order of propositions. Conceptual conditions for the referents are generated as well. They provide sortal information as well as information about focus/background structure, topic/comment structure and about the accessibility of referents. The focus/background structure is among others a prerequisite for some word order and prosodic phenomena.

3. The central means for integrating the situative and general knowledge sources and for constructing the discourse representation is the so-called „quaestio" (KLEIN & STUTTERHEIM (1987); STUTTERHEIM (1995)). The quaestio is a heuristic device to model aspects of the intention of a speaker and has been investigated in several empirical studies. Its role in the construction of the discourse representation for spatial descriptions, its role in selecting situation-specific information, and in linearizing this information will be elaborated on.

4. Based on empirical analyses and theoretical models, the system PAROLE[5] will be outlined. PAROLE is intended to model the conceptual processes for spatial descriptions in view of varying partner models and quaestiones. Our model is intended to be cognitively plausible, i.e., to reflect evidences from psycholinguistic models of language production. With increasing complexity of cognitive models computational modeling has also become an important device for detecting inherent inconsistencies of a model as well as hypotheses inherent in the model. In this sense, PAROLE can also be seen as a model of text production adopting basic assumptions from psycholinguistic and linguistic work in text production, putting them into a formal approach.

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[5] An acronym standing for PARtner Oriented Language Explication.

2 Theoretical and Empirical Foundations

In this chapter we are describing psycholinguistic models of language production, the linguistic quaestio-approach to text production, and work in text generation within AI on user modeling. Finally, we will put our emphasis on the role of the quaestio for the construction of the information structure, i.e., the focus/ background distinction, the topic/comment distinction, and the mental state of discourse referents.

2.1 Psycholinguistic Models of Language Production

We focus on two models that deal with the conceptual processes responsible for the generation of the pre-linguistic information structure. These are the modular approach of LEVELT (1989) and the interactive model described in HERRMANN & GRABOWSKI (1994). Other models as GARRETT (1976) or BOCK (1987) deal with the relation between grammatical and phonological encoding and are excluded from our examination.

2.1.1 Incremental Processing in a Modular Model: LEVELT (1989)

The probably best-known model of language production that describes the whole processing stages from conceptual to articulatory processes is LEVELT's (1989) incremental model that provides a detailed account of the way in which we move from intention to articulation. The subsystems conceptualizer, formulator, and articulator compute specific representations as input for the next subsystem. The characteristic feature of LEVELT's model is its modular structure featuring sequential processing supported by that modular nature. There is no interaction between different subsystems. Hence, although the conceptualizer is able to determine the preverbal message that it passes over to the formulator, the formulator is not able to determine parameters within the conceptualizer.

Apart from its sequential architecture there is another characteristic feature of LEVELT's model: incremental processing. Planning the preverbal message and putting it into linguistic form is a highly complex task, nevertheless speaking is a very fast process. In LEVELT's model, this velocity is accounted for by incremental processing: it is assumed that single propositions are planned and verbalized, but these propositions do not have to be entirely planned before they are shifted into the formulator; increments of a proposition may trigger grammatical and phonological encoding while planning the entire proposition has not been completed yet.

The generation starts with conceptualization processes that generate a pre-linguistic and modality-neutral propositional structure, the preverbal message. LEVELT assumes two processing steps in the conceptualizer, viz. macro- and micro-planning.

„Macro-planning entails the elaboration of the speaker's communica-
tive intention as an ordered sequence of subgoals and the selection of
information instrumental in realizing these subgoals" (JESCHENIAK
(1994:6)).

Additionally, the speaker must linearize the information at hand. The result
of macro-planning is a sequence of separate speech acts which already contain
context-relative features such as the perspective and linearized information.

Micro-planning deals with the final shaping of each speech act, comprising,
among others, the marking of discourse referents as permitting the employment
of an antecedent due to its identifiability by the addressee, enabling the pro-
duction of an anaphor; or the focusing of pieces of information. Prepared by
the conceptualizer these messages trigger the formulation processes, involving
grammatical and phonological encoding. Figure 1 gives the essential compo-
nents in a blueprint of the speaker according to LEVELT (1989:9). Boxes with
single frames represent processing components and double-framed boxes stand
for knowledge bases.

2.1.2 The Interactive Model of HERRMANN and GRABOWSKI (1994)

The model proposed by HERRMANN and GRABOWSKI (1994) differs from LEV-
ELT's approach in several respects. Similar to LEVELT, language production
entails three subsystems which must succeedingly be passed through from con-
ceptual representations via formulation to articulation. But contrary to LEV-
ELT's model, feedback processes are allowed. HERRMANN and GRABOWSKI
propose an interactive model. The principle underlying language production is
that of a feedback control system originating from cybernetics: discrepancies
between given and nominal states result in conceptual and language-specific op-
erations in order to re-establish an equilibrium. Figure 2 gives a blueprint for
the speaker according to HERRMANN and GRABOWSKI (1994:290). The model
of HERRMANN and GRABOWSKI assumes a central control which is hierarchi-
cally the superseding module for speech production. The central control consists
of a central executive comprising procedural knowledge and a so-called *focus-
memory* consisting of declarative knowledge. A central feature of the hierarchy
is the respective amount of mental attention consumed by the individual mod-
ules, i.e., the higher the module is situated in the hierarchy the more „mental
attention" it consumes. Consequently the central executive is the most attention
demanding module of the speech-production-system. It may decide to supersede
every process influencing formulation and articulation. As well as deciding to
assign specific tasks to auxiliary modules.

According to the principle of the feedback-control system, the contents of
the focus-memory must be divided into components supplying the current in-
formation and components providing the nominal status. Both the current and
nominal information states can be split into situation-specific and general com-

CONCEPTUALIZER

message generation

monitoring

discourse model,
situation knowledge,
encyclopedia, etc.

preverbal message

FORMULATOR

grammatical
encoding

surface structure

phonological
encoding

LEXICON

lemmas

lexemes

phonetic plan
(internal speech)

ARTICULATOR

overt speech
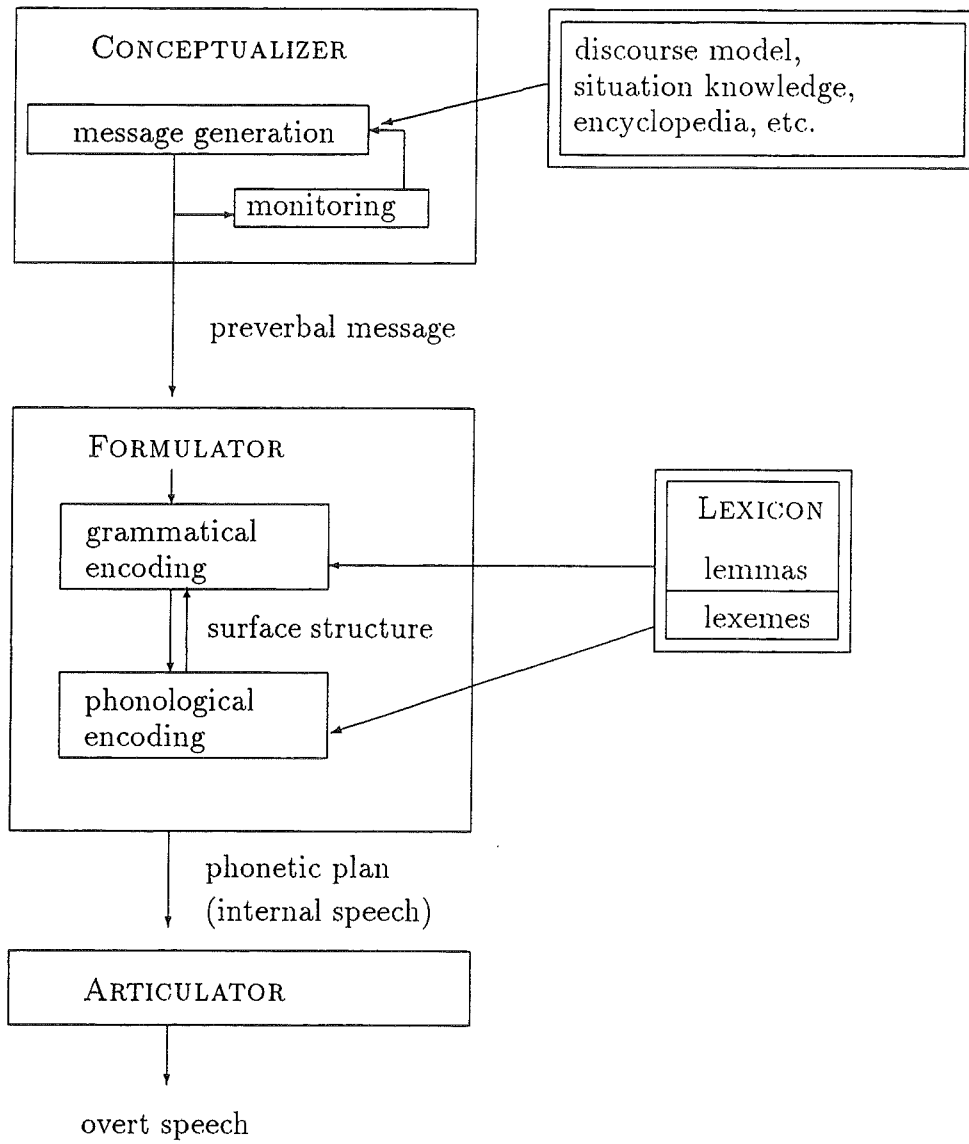
Figure 1: A Blueprint of the Speaker according to LEVELT (1989:9)

perception   long-time memory

CENTRAL CONTROL

focus memory

central executive

proto-input

adjustment of
auxiliary
systems

AUXILIARY SYSTEMS

feedback
adjustment

encoding input

ENCODING MECHANISM

phoneme sequence
with additional information
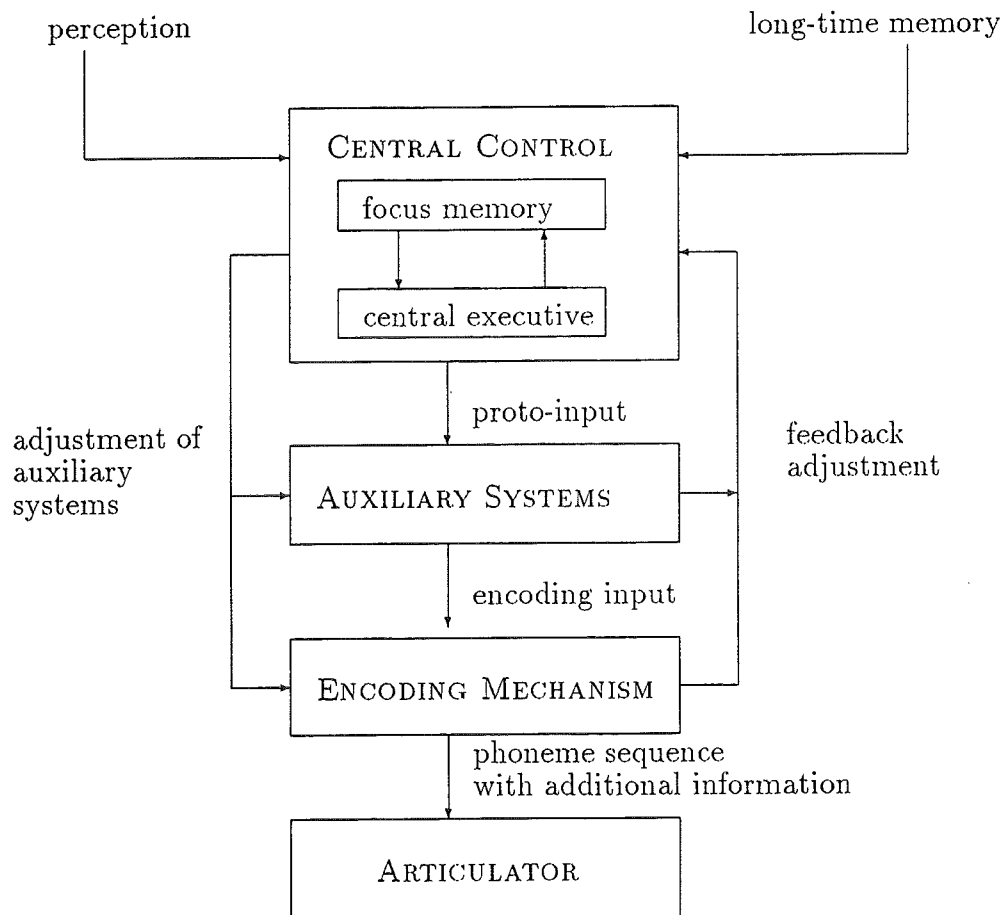
ARTICULATOR

Figure 2: A Blueprint of the Speaker according to HERRMANN & GRABOWSKI (1994:290)

ponents. Finally, current and nominal information states are split into speaker-related, partner-related and additional information:

current information:	nominal states:
- situation-specific:	- situation-specific:
* speaker-related	* speaker-related
* partner-related	* partner-related
* additional	* additional
- general:	- general:
* speaker-related	* speaker-related
* partner-related	* partner-related
* additional	* additional

The central executive is responsible for the selection, preparation and linearization of the focused information. The result is an ordered set of pre-linguistic propositions, the so-called *proto-input*. The additional conceptual systems, i.e., the auxiliary systems, process the proto-input in order to render the proto-input into a coherent form by means of language-specific features. Auxiliary systems are either controlled or blocked by the central executive. The output of the auxiliary systems serves as the input for encoding and is roughly identical with the preverbal messages in LEVELT's model. In the model of HERRMANN and GRABOWSKI encoding comprises grammatical and phonological encoding as well, but they assume a connectionist architecture. Finally, the authors assume three main kinds of processes in language production:

1. Schema-driven production. This occurs when a stereotypical schema has been triggered that determines how to produce an utterance. Examples are: telling a joke, giving a recipe, or describing a room.

2. Stimulus-driven processing. This occurs when the utterance of the partner constitutes the stimulus for production. Examples are greeting situations, or chats about the weather.

3. Ad-hoc driven production. In this case the decisions how to start speaking, how to linearize the information, etc., are made in an ad-hoc manner.

These are only three prototypical ways of conducting the production process. In real situations all three occur intertwined and cannot be separated clearly.

2.1.3 Evaluation of the Models

Our evaluation of both models is confined to their descriptions of conceptual processes and the assumed relations between the conceptual level and other sub-

systems. We will not get into details but concentrate ourselves on the different incentives for separating conceptual from linguistic information.

Although LEVELT's model presents an outline of the whole production process, its description of the conceptualization processes – contrary to its detailed description of the formulator – is not very specific. LEVELT's model focuses on the subsystem responsible for grammatical and phonological encoding: the formulator. The input for the formulator is a preverbal message generated by the conceptualizer by means of macro- and micro-planning. The significance of the partner model for macro- and micro-planning has not been emphasized by LEVELT.

The modular architecture of the model raises the question whether preverbal messages are tailored to individual languages or whether they are completely language-independent so that, e.g., respective German and English utterances are based on the same preverbal message that fulfills the requirements of both languages. Indeed LEVELT assumes that particular languages require particular conceptual representations and he, among others, displays the conditions for producing deictic expressions as one example.[6] English employs a bipartite system that contrasts proximal vs. distal regions whereas Spanish, for example, is based on a tripartite system of proximal, medial, and distal regions. Hence, the preverbal messages of both languages must represent these features as well. Of course, this analysis conflicts with the modular and sequential character of LEVELT's production model and the question arises how language-specific requirements have become represented in the conceptualizer. LEVELT argues that there is interaction between the formulator and the conceptualizer but only during the acquisition phase. Mature speakers have learned how to encode and the systems have become autonomous.

However, there is evidence that interaction between grammatical and conceptual encoding occurs in the language production of mature speakers.

One indication complicating a non-interactive construction of a modular production model may be provided by the findings of CARROLL (1993). If we assume that there is a conceptual difference between the pre-linguistic conception leading to an imaginary walk and one leading to a deictic/intrinsic description of a spatial configuration, then we have to account for the significant differences in the selection of localization strategies between native English and German speakers by pointing at constraints established within the formulator. For a detailed analysis of these constraints see CARROLL (1993).

Finally, the model comprises the generation processes from intention to articulation, leaving the question open *why* a speaker is speaking, or where the intention comes from, a point that can be explained by the principle of the feedback control system underlying the model of HERRMANN and GRABOWSKI.

The model of HERRMANN and GRABOWSKI is a more towards the situated character of production oriented one than LEVELT's model. It is also more ori-

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[6]See LEVELT (1989:103ff.)

ented towards the conceptual processes. The authors give a detailed description of the components and processes engaged in generating preverbal messages for differing communicative demands. According to the authors, there is some evidence for the interaction between the formulator and conceptual processes from the investigation of speech errors. Errors on the phonetic or syllable level are not detected and corrected by means of the encoding mechanisms but by means of the central control (HERRMANN & GRABOWSKI (1994:289)). In our minds interactions of encoding mechanisms with the partner model have also a decisive impact on the generation of information structures.

We also want to mention that the behaviouristic touch of some aspects of the model, viz. the stimulus-driven production processes, seem to be too mechanistic in our opinion. Furthermore we do not favor connectionistic modeling, as done by the authors.

In our view the partner-oriented nature of speaking is emphasized best in HERRMANN and GRABOWSKI (1994) and, therefore, serves as basis for our purposes. Despite the differences between both models, we could also imagine an integration of both. If we were to abstract from sequential vs. interactive processing, both models could be viewed as complementing one another, the one having its focus on linguistic encoding, the other on conceptual processes.

2.2   The Quaestio Model

Satan, oscillate my metallic sonatas!

We have already seen that there are many processes and principles playing a role in the course of cognitive planning and verbalization. What is missing is a device making it possible to treat the relevant mechanisms in a coherent framework.

We think a modified version of the so-called „quaestio model" can serve as a heuristical device for providing that framework.[7] In this model every text can be interpreted as a complex communicative answer to an abstract textual question, i.e., the *quaestio*, determining what is at issue. The quaestio may be manifested on the linguistic surface as an interrogative clause but most often it remains implicit and has to be reconstructed by recourse to the produced text.[8]

The quaestio imposes a couple of constraints to textual structure, both on global and local levels. For example, it constrains the set of possible information structures. More specifically, this means that the abstract textual question restricts the possible range and distribution of the values the variables of the

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[7] For the original model see KLEIN & STUTTERHEIM (1987); (1992); STUTTERHEIM (1989); (1992); (1994); (1995).

[8] With respect to the feedback control system of HERRMANN & GRABOWSKI (1994) one could interpret the quaestio as a disturbance factor establishing a communicative demand. The central executive has to regain the optimal state, therefore, it triggers activities to return to equilibrium.

information structure such as topic or focus can take and which are instantiated in the discourse representation. In detail we will explicate this later on.

To produce a coherent text the speaker has to organize her message, unfolding a referential net by generating discourse referents and relating these discourse referents adequately to each other. The way in which the single discourse referents are connected, for example, by means of referential shift or maintenance, is called *referential movement*.[9]

The parts of the text directly fulfilling the demands of the textual question constitute the main structure of that text, in contrast to the heterogeneous set of possible side structures. This does not mean that side structures are not of communicative importance, but clearly a strict structural distinction between main and side structures should be drawn.[10]

Furthermore, we will distinguish informally between five referential domains[11]

1. reference to time

2. reference to space

3. reference to persons and/or objects

4. reference to „predicates" (e.g. actions, states, events, properties)

5. modal values

In each utterance these domains have to be put together by referential selection.

The communicative task also constrains the possible linearizations of single propositional units. The structured sequence of propositional units reflects the so-called *linearization criterion*. A narrative, for example, instantiates a temporal domain and requires that the temporal referent is a distinct time interval obtaining a left and right boundary. The chain of events constituting the plot of the narrative establishes a sequence of temporal points t_1, t_2, ..., t_n. In that case chronology serves as the linearization criterion. From the intrasentential point of view, carriers of the linearization criterion will tend to be shifted into a front position, as in the case of narratives in German *und dann ... und dann ...* or *und daraufhin ... und daraufhin ...* (and then ... and then ...). Explicating sequences of actions, time serves also in instructions as linearization criterion as in (1)[12]

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[9]Cf. STUTTERHEIM & KLEIN (1989: 47f.).

[10]It must be admitted however that the distinction between main and side structures is in danger of circularity (the actual quaestio is determined by examining the main structures of a text, which are in turn defined by the actual quaestio), giving room for immunization strategies. For the time being we can put this problem aside because the PAROLE system will generate main structures only.

[11]Cf. e.g. STUTTERHEIM & KLEIN (1989:46f.); STUTTERHEIM (1992:167); STUTTERHEIM (1992:5f.); the given listing has to be taken with a grain of salt — of course this is a problem of Aristotelian range.

[12]See e.g. KOHLMANN ET AL. (1989:162f.); KOHLMANN (1992:97); for an illustrative example of an instruction see also KOHLMANN (1992:113).

(1) *Zuerst hab ich 'n Mann gesehen ... Dann ist er etwas schneller gelaufen ... Dann kam von rechts jemand auf ihn zu ... Dann kam von links jemand ...*

(2) *... Dann schiebt ma quer dazu in diese graue Steine diese roten Steine, diese roten flache Steine mit der Furch ... Dann nimmt mer des rote Stück, das aussieht wie's unnere Stück von nerer Zahnbürst ... Dann nimmt ma ...*

In narratives including the referential domain „time" a shift is only licensed as referential movement, whereas within the domain „modality" only maintenance is tolerated. A shift results in a departure from the main structure.

The quaestio instantiates referential domains and thereby instantiates the activation state of possible referents.[13] Looking at a quaestio such as *What's the position of the objects in respect to each other?* we see that by means of that quaestio the objects are instantiated as possible topics, the spatial relations are focused and move into the foreground. In the domain of modality the value to be chosen is factual. In this case only maintenance is possible. As a consequence this referential domain moves into the background, implicating some lower level of activation.

In principle it is not necessary to instantiate referential values in each referential domain for each sentence. As a consequence the discourse representation might be underspecified in some respects. In cases such as reference to objects or persons this is trivial. But there are linguistic categories like tense or mood that must obligatorily be realized. Here default rules determine the slot fillers in the domain of the formulator. Generic sentences for example lack temporal values in the discourse representation, and therefore default rules trigger the realization of present tense in German or gnomic aorist in Ancient Greek, pointing at languages possessing morphological means for encoding this linguistic category.

Summarizing, we can state that the quaestio imposes

- the textual structuring into main vs. side structures

- the instantiation of referential domains within each utterance

- the possible types of referential selection and referential movement

- constraints for possible information structures

2.3   Partner Modeling

Partner modeling, in general, can be described as the process of tailoring any form of linguistic behavior or output towards the recipient of that output. Partner modeling occurs in language production in at least three areas which have been subject to scientific scrutiny. It occurs in literature and has been noted

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[13]We do not employ the term *activation* in the sense of connectionistic modeling.

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and described in UMBERTO ECO's *The Role of the Reader*. Secondly it has been examined and implemented in expert systems within AI and has been labeled *user modeling*. Thirdly, and most importantly for us, partner modeling occurs in models of natural language production. After a brief look at user modeling we will examine the treatment of partner modeling in natural language production and its relevance to our model.

2.3.1 User Modeling

Sophisticated text-generation systems, as TAILOR (PARIS (1992), (1993)), include a user model and a discourse model within their architecture in order to enhance the interactive capabilities of these systems. The goal is to generate appropriate texts for different users by employing a user model.

In order to help the system to generate the appropriate texts successfully in PARIS' understanding the user model ought to contain information about

1. „the user's domain knowledge

2. the user's goals and plans

3. specific beliefs the user has about the domain

4. specific preferences or interests

5. a description of the grammatical recourses understood or preferred by the user

6. some attributes about the user" (PARIS (1992:17f.))

Furthermore a user model needs to be linked to the knowledge base which contains information about specific items and their underlying concepts. Based on this information the user model establishes a user profile which in turn influences the output of the system. Expert systems generating texts must therefore be provided with the means for acquiring a user model. This can be achieved through various ways (CHIN (1993)). Generally dialog systems are preferred, which are able to evaluate the users expertise either through direct questioning or observation throughout a session. PARIS' system TAILOR is able to provide descriptions of objects. Giving the task of describing a telephone TAILOR needs to know the objects previously known to the user. The output depends as follows (see PARIS (1993:13))

- User Model:

  - Objects known: nil

- Task: Describe Telephone

TAILOR output:

> *A telephone is a device that transmits soundwaves. Because a person speaks into a transmitter of a telephone, a varying current is produced. Then, the current flows through the receiver. This causes soundwaves to be reproduced.*

- User Model:

  - Objects known: loudspeaker, microphone

- Task: Describe Telephone

TAILOR output:

> *A telephone is a device that transmits soundwaves. The telephone has a housing that has various shapes and various colors, a transmitter that changes soundwaves into current, a curly shaped cord, a line, a receiver to change current into soundwaves and a dialing mechanism. The transmitter is a microphone with a small disc-shaped metal thin diaphragm. The receiver is a loudspeaker with a small aluminum diaphragm. The housing contains the transmitter and it contains the receiver. The housing is connected to the dialing-mechanism by the cord. The line connects the dialing mechanism to the wall*

There is a discussion about the status of the discourse model in relation to the user model.[14] The discourse model contains the discourse protocol, i.e., a „list“ of the referents already introduced into the discourse and the statements made about them. The current discussion deals with the problem that, when a statement about something has been made, let's say proposition p about the domain d has been uttered, then p becomes part of the user's domain knowledge about d and needs to be included in the information contained in the user profile and therefore within the user model.

The resulting question concerning the actual status of the discourse model is whether or not it is more beneficial to construct the discourse model as part of the user model, as an independent module or as the module that contains the user model.

For the modeling of natural speech-production it is certainly rather important to note and describe the importance of the speaker's knowledge of the

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[14]See the special issue on user modeling in *Computational Linguistics, 14, 3,* 1988.

course of the discourse as it enables the speaker for example to favor anaphoric constructions, to assess the potential amount of information that can now be inferred by the hearer and, therefore, mustn't be explicated.

Pointing at the example taken from the TAILOR system one crucial discrepancy between the effects of user modeling and natural partner modeling is, as we will show in more detail later, the fact that if one may assume the user/hearer to know something about the domain, as opposed to knowing nothing, the output would more likely decrease instead of an increase as it was in the case of the telephone description. We will show the results of KINGSBURY's measurements of the length of directions by Bostonites to other Bostonites and non-Bostonites later. However, there are elements of user modeling that are congruent to features playing a role in natural language production. The *listener-profile* for example is somewhat identical with that part of the speaker's knowledge of the hearer that is currently activated as it has a bearing on the discourse. The discourse model is securely a part of the speaker's knowledge of what has been stated before. However, our model will have to obey the demands of cognitive adequacy and must therefore structure the discourse model in such a way that it incorporates empirical findings concerning the production of anaphoric constructions, anchoring effects, and certain default settings.

2.3.2 The Role of the Partner Model in Communication: Some Empirical Findings

Speakers may not always be aware of the potential ambiguities inherent in their utterances. They leave it to the context to disambiguate and specify the message. Furthermore, they trust in the addressee's ability to extract that meaning from the utterance that they wanted to convey (see KATZ (1984)) . In order to interpret the utterance correctly, the addressee must employ several recourses. Speakers in turn anticipate the employment of these interpretative recourses by the hearer and construct the utterance knowing that certain underspecifications are possible since the hearer can infer the missing information or that certain ambiguities are permissible, etc. The role of the listener model is of paramount importance in this process.

The general necessity of the inclusion of a partner model module in the modeling of the speech-production-process has been argued for and seems undisputed at the moment. Without a partner model several empirically observable phenomena cannot be explained. We will present these findings as they are relevant to our model.

Social psychologists such as KRAUSS point out

> „the traditional separation of the roles of participants in verbal communication into sender and receiver, speaker and addressee, is based on an illusion — namely that the message somehow 'belongs to' the speaker, that he or she is exclusively responsible for having generated it, and that the addressee is more-or-less a passive spectator

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to the event. I am not denying that the speaker is responsible for the physical act (...). But (...) the addressee is a full participant in the formulation of the message — that is the vehicle by which the message is conveyed — and, indeed, may be regarded in a very real sense as a cause of the message" (KRAUSS (1987:96))

The listener plays an essential part in the causation of speech production in a communicative setting. He is in part responsible for the verbalization of the mental representation (world-depiction) through the following means:

1. Back-channeling: Some results of back-channeling (YNGVE (1970)), — which is the phenomenon of verbal and non-verbal (or quasi-verbal) responses of the listener during the speaker's discourse, such as *yes, hmmm, I see, uh-huh,* facial expressions, nods, gestures, etc. — are specified and experimentally displayed by KRAUSS and WEINHEIMER (1964) and KRAUSS ET AL. (1977). KRAUSS and WEINHEIMER described the effect of back-channeling on the development of the redundancy of words and phrases within a discourse. In general, the effect is, that exact repetitions of phrases and/or words are less likely when back-channeling occurs. In the event of back-channeling the usage of abbreviations and phrase-reductions increases. Back-channeling also has a significant bearing on the course of the discourse. KRAUSS ET AL. have shown that the availability of visual contact between speaker and listener greatly influences the efficiency of the discourse .

2. Common ground: The influence of common ground, i.e., the shared knowledge, shared associations, shared sentiments, and shared defaults, between speaker and listener has been identified and described by KINGSBURY (1968), KRAUSS ET AL. (1968), CLARK and MARSHALL (1981), FUSSELL and KRAUSS (1984). The amount of common ground influences the lexicalization preferred by the speaker, for example what kind of words to use (KRAUSS ET AL. (1968)), whether to describe objects more figuratively or literally (FUSSELL & KRAUSS (1984)). Furthermore, it influences the type versus token ratio in the speakers' discourse (FUSSELL & KRAUSS (1984)) as well as the length and specificallity of descriptions (KINGSBURY (1968)).

3. Social factor(s): Further research has demonstrated that non-egocentric localization demands more mental attention than egocentric localization (see BÜRKLE ET AL. (1986)). It seems therefore imaginable that the social-factor-constraint is one that favors either enhanced ad-hoc steering, in the case of non-egocentric localization, or more automated steering, in the case of the probably more schematized egocentric localization.

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2.3.3 Partner Modeling and Spatial Descriptions

In natural language production mental rotations occur in communicative local-ization efforts. There are many empirical findings, starting with SHEPARD's (1975) analysis of mental rotations, concerning egocentric- and partner-oriented localization strategies.[15] In certain situations speakers are likely to perform mental rotations. This can be marked verbally in the discourse: *From your point of view, the ball is to the left of the chair*. It can also remain unmarked and a statement of the type *x is left of y* can be ambiguous in regard to its per-spective, i.e., the location of the origo. If a speaker was to localize something egocentrically, the speaker trusts in the cognitive capabilities of the addressee to recognize the egocentricity of the localization and to perform the necessary mental rotations herself. The necessary information concerning the addressee's capabilities influencing these processes is supplied by the partner model.

In one principle this process is congruent to the processes involving the selections of linearization schemata, lexicalization strategies, and redundancy patterns. This principle is the influence of the listener on the speech production process.

HERRMANN and GRABOWSKI have shown that within our cultural framework and given situations speakers overwhelmingly „decide" to employ an egocen-tric localization strategy, unless the social relationship between speaker/hearer is such as student/professor or grown-up/child. HERRMANN and GRABOWSKI named this phenomenon „Es–dem–anderen–leichtmachen" and described its cha-racteristics.

Assuming that the underlying world depiction of (a) *The plant is in front of the lamp* and (b) *The plant is to the left of the lamp* is identical, then it is in part the partner model which „decides to favor" one or the other realization of the conceptual proposition. The localization of the plant in this case depends on the estimation of the social relationship between speaker/hearer.

There are always various ways in which a person can describe a spatial configuration. In the case of a description of several buildings within a village-setting a speaker has to decide which building to localize first, which second, and so forth. A speaker also has to decide whether to favor a localization using the intrinsic sides of the buildings, or through performing an imaginary walk through the setting, whether to start with himself as a point of reference within that setting or to use the hearer as a point of reference.

With respect to cultural defaults we have found a set of systematically under-specified localizations whose interpretability is a result of these defaults. Many speakers, for example, who are to locate something that is on the right hand side of a square will say that an object is *in the right front* or *the right back of the square*. However, if it is in the middle of the right side they will say *on the right side*, since the center position is assumed to be the default position in

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[15]See e.g. the work described in chapter three of HERRMANN & GRABOWSKI (1994) or SHOBER (1993).

the absence of other information. Our data have shown that German speakers will indicate the side when using the preposition *next* as in *on the right side next to the bakery is a cafe*, but in describing a third object in the same row the continuation *next to the cafe is a gift shop* will mean *to the right side* as well. This can be regarded as a process of handing down previously established defaults. It will be one of the primary tasks of our system to be able to model the use of implicit information in speech-production.

Furthermore, we want to point out that not only must the partner model have access to visual or memorized information once, but continuously throughout the whole discourse. This is due to the fact that the speaker updates the partner model instantaneously whenever the addition of new information by the listener, for example through back-channeling, is perceived, which in the case of a nod would mean an increase in the amount of shared knowledge and affect the speech-production.

To summarize, the research that has been performed has demonstrated the different influences of the listener on the speech-production-process.

2.4   Information Structure

In the beginning of this paper we announced to present a model which on the conceptual level entails constraints defining the conditions that possible information structures have to fulfill. We will start by explicating what we mean by *information structure*.

It might be useful at the beginning to draw a distinction between *knowledge*,[16] referring to the relatively permanent representation of data by means of adequate data structures, and *information*, referring to a relation between the elements of a proposition or propositions. This relation is based on elements that are assumed not to be known by the hearer.[17] The bipartite structuring of propositions is mirrored in the bipartition of topic vs. comment and focus vs. background.

Often it is assumed that the meaning of a sentence can be regarded as a proposition and can be interpreted as a function of its elements. From this point of view the following sentences were to verbalize the same proposition. We can suppose that they are truth–functionally equivalent.[18]

(3)   *Der Brunnen steht vor dem RAThaus*

(4)   *Der BRUNnen steht vor dem Rathaus*

(5)   *Vor dem RAThaus steht der Brunnen*

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[16] All distinctions between knowledge, beliefs and epistemic states as well as their philosophical implications have no bearing on our discussion.

[17] See also SCHOPP (1994:17); VALLDUVÍ (1992:11f.).

[18] Modifications of illocutionary type are left aside in this paper; majuscules indicate the prominent syllables; naturally a lot can be said about the prosodic structure of these sentences, but we think it is not necessary to explicate this for our discussion.

(6) *Vor dem RAThaus steht der BRUNnen*

(7) *Es ist der BRUNnen, der vor dem Rathaus steht*

(8) *Es ist vor dem RAThaus, wo der Brunnen steht*

(9) *Vor dem RAThaus, DA steht der Brunnen*

(10) *Der BRUNnen, der steht vor dem RAThaus*

However, these sentences are by far not equivalent. Every sentence carries its own set of presuppositions.[19] Furthermore, every sentence codes a specific organization of the same proposition and this propositional organization sets up constraints under which an utterance may be created.

To communicate a proposition p to her partner a speaker has a lot of possibilities at her disposal to package the message linguistically. Which out of these possibilities — provided by a specific language — the speaker chooses is determined by a number of factors whose specifications and interactions are still quite poorly understood. The main factors constraining the options at hand are the quaestio, the content of the partner model and the chosen perspective, i.e., vantage point and orientation. These factors play a role not only in the process of linguistically encoding the message, but the main point is that they also determine the conceptual form and content of the pre-linguistic message the speaker wants to put to language. These factors play an essential role in the transformations from the conceptual via the discourse representation to the grammatical structure. Hence, to understand how verbalization works, one has to consider these factors. It should also be emphasized that there is a considerable degree of interaction between the grammatical and the lexical structure dealing with these constraint–defining factors.

These constraints manifest themselves in the speaker's discourse representation that functions as an interface between conceptual and linguistic representation. As a consequence the discourse representation and the information values declared therein determine which linguistic pattern a speaker may select for verbalization.

The role of common ground points already to the fact that a distinction between, e.g., structurally motivated syntactic operations (i.e. operations triggered by, for example, case filter, agreement or thematic structure) and means facilitating the coding of information structure as proposed by VALLDUVÍ[20] is from the point of view of language production not useful for the understanding of information structure and it is above all empirically not tenable. The role of the syntax in this point goes further than it does in questions relating to discourse configurality.[21]

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[19]These are pragmatic presuppositions, that entail the set of propositions evoked by the linguistic material which the speaker supposes the hearer knows or assumes to hold. These presuppositions establish a kind of common ground, see SEUREN (1991:287); LAMBRECHT (1994:53).

[20]Cf. VALLDUVÍ (1992:9f.).

[21]For the typological parameter of discourse configurality see KISS (1995).

Syntactic structures are not only relevant to logico–semantic interpretation in the sense of VALLDUVÍ. It must be emphasized that features of information structure are encoded by means of prosody, grammatical markers, the form of grammatical constituents, the ordering of segments within the sentence or specific lexicalization patterns etc., depending on the properties of the individual language. In short, the whole ensemble of linguistic structures a language offers can encode features of information structure.

An example might illustrate that already in this respect there is a great deal of difference between as nearly related Indo–European languages as English or Italian[22]

(11) *[What happened?] my CAR broke down* vs. *mein WAGEN ist liegenge-blieben* vs. *mi si é rotta la MACCHINA*

(12) *[What happened to your car?] my car broke DOWN* vs. *mein Wagen ist LIEGENGEBLIEBEN* vs. *la macchina si è ROTTA*

In case (11), for example, the information structure and the embedding in a situation in each of these utterances is the same, they verbalize the same proposition and they are truth–conditionally identical, yet the syntactic and prosodic structure, that means the strategies these languages employ for information packaging — to chose a term coined by WALLACE CHAFE —, are crucially different. It should be emphasized that from the point of view of the speaker these utterances are based not simply on choices between different linguistic options, but the speaker's discourse representation triggers the verbalization and constrains the interaction of information structure, syntax, semantics, and prosody.

The structuring of propositions is steered mainly by the partner model of the speaker and influences her mental representations. Following GRICE we suppose that the speaker is guided by the maxim of cooperativity, i.e., she tries „to make the structure of (...) [her] utterance congruent with (...) [her] knowledge of the listener's mental world" (CLARK/HAVELAND (1977:4)). The information packaging the speaker chooses reflects her „beliefs about how this information fits the hearer's knowledge–store".[23] And finally ELLEN PRINCE correctly states that

> „information in a discourse does not correspond simply to an un-structured set of propositions; rather speakers seem to form their utterances so as to structure information they are attempting to convey, usually or perhaps always in accordance with their beliefs about the hearer: what s/he is thought to know, what s/he is ex-pected to be thinking about" (PRINCE (1988:208))

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[22]The example is adapted from LAMBRECHT (1994:14) and SASSE (1995:4); the questions serve as contextualization devices, for the moment letting aside the problems associated with such a simulation of context.

[23]VALLDUVÍ (1992:10); see also (ibid.:13) („Information (...) unlike propositional content is crucially defined with respect to the particular hearer a sentence is addressed to").

Summarizing, *information structure* means the organization of the propositional content with respect to quaestio and partner. That means, the discourse representation is constructed in accordance to the speaker's beliefs about the hearer's knowledge, attitudinal states etc. related to p and his access to situational information. **The structuring of information is, therefore, a process of cognitive planning.**

In accordance to work of e.g. JACOBS, MOLNÁR, LAMBRECHT, VALLDUVÍ and others we assume that one must distinguish between at least two levels of information structure, namely the focus/background structure and the topic/comment structure. These categories represent clearly different aspects of propositional structuring. Their functional manifestations as well as the linguistic forms serving for verbalization must strictly be kept apart.

It is the specific contextual boundness that characterizes the focus, making the induction of contextual constraints by means of a question, as above, possible, while the topic/comment structure reflects the propositional structuring of „Satzgegenstand" vs. „Satzaussage".

In contrast to most other models we think that there is at least one more category of information that must be treated as part of information structure, i.e., *the mental state of referents*. A cognitively adequate model has to look at identifiability and accessibility of referents as moods of structuring information, tailoring the propositional content to the partner. Although there are communicatively preferred value–configurations of the categories of information structure, the strict categorical distinction between them is essential and has to be kept.[24] This is one condition for defining topic/comment without any recourse to such constructs as *given* and *new*. If the distinction between topic/comment structure and the mental state of referents is lost the validity of data gained through experimental settings is threatened.[25]

Thus, to summarize, we assume the following distinct categories of information structure:

1. focus/background structure

2. topic/comment structure

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[24]This is also correctly emphasized by e.g. MOLNÁR (1991), VALLDUVÍ (1992:16ff.), or LAMBRECHT (1994). REINHART (1982), PRINCE (1988) or VÄLIMAA–BLUM (1988) also try to keep apart the referential state, in contrast to e.g. ROCHEMONT (1986) or the most members of the modern Prague School, cf. MOLNÁR (1991:17ff.), HAJIČOVÁ (1994). But see SGALL ET AL. (1973).

[25]This essential distinction is not drawn by e.g. BLUTNER/SOMMER (1988:360) („Focus structure divides the information provided by a sentence into two parts: a focused part which is *new* (explicitly communicated) information and a remaining part which is *given* (presupposed) information"); CUTLER/FODOR (1979:49) („focus is that information which is new and unrecoverable from preceding discourse"); BIRCH/GARNSEY (1995:233) („focus is the most important and emphasized constituent in the sentence (...). On this usage, the focus of a sentence of sentence is a new and emphasized constituent, as opposed to information that is given (or presupposed (...)"), 234 („In sum, 'focus' is used here to refer to the constituent within a sentence that is newly introduced and that is most emphasized").

3. the mental state of the referents

2.4.1 Focus/Background

The focus/background distinction is a manifestation of a kind of fore- vs. background phenomenon. The focused elements are moved into foreground because they carry the information that serves to fulfill the communicative demand raised by the actual quaestio.

The contextual simulation by means of a question, a device used since HERRMANN PAUL, shows the relational character of the focus. The non focused domain(s) serve as contextual restriction for possible foci. In the following example[26]

(13) *Gestern waren Ulli und ich bei unserem Hauslieferanten. Der hat ein riesiges Sortiment, mit allen möglichen Qualitäten. Wir haben eine Menge probiert.*

(14) *Und — welche Schnäpse hat Ulli gezwitschert?*

(15) *[$_T$ Ulli] hat [$_F$ alle EDlen] Schnäpse gezwitschert, ich mußte mich mit dem REST begnügen.*

it is asked for the kind of schnaps Ulli has consumed. The contextual embedding constrain the items which can serve as fillers for this kind of slot.

2.4.2 Topic/Comment

In starting this section it has to be emphasized that topic is also essentially a relational concept.

The topic/comment structure has to be looked at as pendant to the focus/background structure, representing the relation which exists between the topic and that part of the proposition that has a relation of pragmatic *aboutness* to the discourse referents to which, by means of the topic expressions, the speaker refers to. In cognitive terms the topic should be interpreted as something like a pointer to an address in the hearer built-up data structure that the predication is about. A similar opinion is held by e.g. REINHART or by VALLDUVÍ in terms of file change semantics. The conditions to be fulfilled by a potential address are fixed by the actual quaestio.

Note that there is no limited set of addresses at the beginning of the communication, there are only constraints for something that functions as address has to adhere to.

Linguistically, marking topicness means to mark by means of a specific language this „pointerness". Naturally a pointer must point to something. One consequence of this rather trivial fact is that a speaker can predicate only on a

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[26] Only that prosodic prominences are marked that are relevant here.

referential object. That means, only referential and specific expressions function as topic expressions, including even the most generic expressions.[27]

The essential distinction between „pointerness" and address to which something points implicates the important fact that it is impossible to identify the mental state of referents with topicness — „topichood cannot be defined on referents".[28]

Notwithstanding there is an intimate interaction between the accessibility state of referents and the possibility to serve as addresses, i.e., to function as topics.

2.4.3 The Mental State of Discourse Referents

In contrast to the most other models we propose that there is at least one more category of information that must be treated as part of information structure, viz. the mental state of referents.

If a discourse referent is chosen to serve as topic, i.e., to function as an anchor point for the predication, it has to provide some conditions with respect to its accessibility state. If topicness has to be interpreted as „pointerness", the partner must have access to the address the speaker points to. As a consequence a „brand–new unanchored" item cannot serve as topic.[29]

There is a hierarchy of accessibility in respect to which the possibility to serve as topic can be restricted. Two categories must be distinguished here

- identifiability, that means the possibility to identify an address; implying that if there is no address then there is no kind of identifiability

- accessibility; if there is some kind of identifiability we must distinguish different possible ways to access the address, e.g.

  - accessible via the discourse
  - accessible via the situation
  - accessible via inferences

Naturally a definite description does not necessarily refer to a discourse referent already introduced. Therefore, inferences play an important role in constructing and structuring of information. Looking at information packaging as a „small set of instructions with which the hearer is instructed by the speaker to retrieve the information carried by the sentence and enter it into her/his knowledge–store"(VALLDUVÍ (1992:15)) we cannot reduce the relation between

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[27]See also MOLNÁR (1991:50) who proposes „daß es sich bei Referentialität, Spezifität und Definitheit eher um semantische Präferenzen als um distinktive Kriterien in bezug auf das Topik handelt". Surely there are a lot of difficulties with the notion *referential object*, but we cannot outline this point here, but cf. e.g. HABEL 1986.

[28]REINHART (1982:33).

[29]See also ARIEL 1990; LAMBRECHT (1994:165ff.).

the information a sentence encodes, the propositional content and the knowledge of the hearer to Information$_{Speaker}$ = proposition$_{Speaker}$ − Knowledge$_{Hearer}$ as VALLDUVÍ proposes. Knowledge is a dynamic system and not reducible to disjunction, inclusion and intersection of knowledge sets, and inferences are not reducible to mere activation and comparisons of knowledge stores.[30] As a consequence we cannot define background as „the part of C[on]T[ext] mutually known by speaker and hearer".[31] The speaker can treat something as background for instructing the partner in this way to infer the pertinent things and generate an adequate knowledge structure.

The above given listing of accessibility states is by far not exhaustive. Surely quite a lot of distinctions have to be made. For example the amount of referential distance in the discourse has serious repercussions for accessibility states. In our model this parameter is partly manifested in the categories for referential movement. This may also be a device for handling the influence of features of textual structure like paragraph boundaries.

2.4.4 Information Structure in SYNPHONICS

The SYNPHONICS project (GÜNTHER AT AL. (1993); GÜNTHER ET AL. (1994); SCHOPP (1994)) evolves a computational model of language production that is based on the one hand on incremental processing and on the other hand on focus theories from theoretical linguistics. Since the SYNPHONICS-System aims at quite similar processes in language production as PAROLE, we will give a more detailed description of the system and its deficiencies, as seen by us.

In accordance with LEVELT's model, increments are passed sequentially through succeeding components in the model. The current emphasis of the SYNPHONICS-project lays on the focus/background structure. Therefore the relational notion of focus (on a sentence level) is reconstructed in terms of incremental language production.[32]

The conceptualizer operates in SYNPHONICS on a knowledge base containing world and episodic knowledge and it generates a bipartite output,

> „a conceptual structure CS comprising the propositional content of the planned utterance and a contextual structure CT containing the currently relevant parts of the contextual environment" (GÜNTHER ET AL. (1994:73)).

Based on these two conceptual structures, within the formulator semantic encoding takes place to generate a semantic representation. The distinction be-

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[30] In accordance to KLIX (1993:395).

[31] GÜNTHER ET AL. (1994:75); note that this use of the term *background* has to be kept distinct from ours in *focus/background*.

[32] We will not discuss here the thesis that topic elements are regularly the first increments leaving the conceptualizer towards the formulator; see e.g. VALLDUVÍ (1992:48, 92, 126); GÜNTHER ET AL. (1994:75); SCHOPP (1994:170).

tween the bipartite conceptual structures and the semantic meaning representation is motivated by BIERWISCH and SCHREUDER's (1992) observations on context-dependency of lexical meaning. After syntactic and semantic encoding a monostratal HPSG-style representation of syntactic, semantic, and phonological information is generated.

The context (CT) representation expresses the informational demand the speaker wants to fulfill. The utterance has to meet these requirements of the CT. Each increment is checked whether or not the information supplied fulfills the informational demand expressed by CT. If the informational demand is met, the information belongs to the focus. It gets narrow focus if it matches the demands exhaustively and wide focus is assigned in case of a partial match. The information belongs to the background if it does not fulfill the demands; it is mutual knowledge. Finally, contrastive focus is assigned if the context CT expresses a claim and not a demand. In all cases, focus is realized by prosodic means.

The conception of information structure as it is developed in the SYNPHONICS–model is in several points overly simplified.

The first major difference is our refusal of the statement that

> „[f]ocus/background structure originates at the interface between the conceptual and the semantic level as a result of comparing an actual conceptual fragment with its corresponding relevant context representation"[33]

The structuring of information is a **process of cognitive planning**, taking into account several conceptual knowledge sources and highly influenced by features of the partner model. We are not sure how a model that includes the influence of the partner does so without proposing a partner model.

Secondly, beside focus/background vs. topic/comment the mental state of referents has to be considered as category of information structure.

Thirdly, the reduction of the notion of information structure to prosodic phenomena in SYNPHONICS is not tenable.[34] It may be conceded that it is by and large the case that elements in focus are regularly associated with prosodic prominence. Notwithstanding there is no such thing as „non–standard intonational stress" which often serves as definiens of focus.[35] Every prosodic configuration is partly a reflection of features of information structure. The categories superseding the generation of prosodic structure are constant, only the instantiated values are varying. Next to the fact that not each focused element carries prosodic prominence, as shown by the functioning of focus projection triggering

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[33]GÜNTHER ET AL. (1994:80); but see SCHOPP (1994:134) („Das Gebiet der Informationsgliederung nimmt (...) seinen Ursprung aus Produktionssicht im Zuständigkeitsbereich des Konzepualisierers").

[34]Cf. GÜNTHER ET AL. (1994:77, 80); for a somewhat more „liberal" view see SCHOPP (1994).

[35]See, for example, BLOK (1993:3); we are leaving aside here the strange notion of „intonational stress".

the constitution of focus domains. We have already emphasized the fact that information structure is not only coded by means of prosody. The whole ensemble of linguistic structures a language offers can code features of information structure. A delicate problem is the highly complex interaction between these linguistic means, e.g. word order and position of the nuclear accent. But we will not go here into the nuts and belts of the phonology-syntax interface.

2.5 Quaestio and Features of Information Structure

We are looking at the quaestio as a heuristical device which allows us to treat the relevant production processes in a coherent framework.

Determining what is at issue the quaestio also constrains, employing a variety of mechanisms, the set of possible information structures, the possible range and the distribution the values the variables of the information structure can take and how they are assigned to a discourse representation structure.

2.5.1 Quaestio and the Focus/Background Distinction

The quaestio has a direct bearing on the assignment of focus within the proposition. If we were to verbalize the quaestio explicitly that part corresponding to the answer of the wh-pronoun is the most likely part of the proposition to stand in focus.

Analogously to the approach of alternative semantics (ROOTH (1985)) we have an amount of potentially focused elements, the „alternatives" from which one is selected serving as focus and the rest remains alternative. The selected element is the one related to the mutual background of all „alternatives".

2.5.2 Quaestio and the Topic/Comment Distinction

The instantiation of referential domains, triggered by the quaestio, restricts what may or may not serve as a discourse referent and, following this, a referential net is unfolded in the course of a text.

We have already mentioned that the topic can be looked at as a pointer to an address located in a specified data structure. The restrictions holding vis-à-vis the possible discourse referents and their connection in the course of a text constrain the possible relations between address and predication. The cornerstone is the quaestio-defined importance for the communicative task.

In producing a coherent text a speaker has to connect the selected discourse referents adequately, steering the referential movement from utterance to utterance. The scope of these mechanisms is the domain of coherence, in other words the structural domain whose cohesion-defining relations are derived from the governing quaestio. Naturally a speaker is free to establish any topic, violating the constraints defined by a quaestio$_i$. However then, she's leaving the cohesion domain$_i$. There may be transitions of different kinds that are marked

in various ways. The speaker may produce side structures, without loosing the overall cohesion provided she adequately marks the step from main to side structure and if the referential relations between these structural domains pass restrictions not to be specified here. Cohesion splits that cannot be bridged by inferences of the hearer can occur as well.

2.5.3 Quaestio and the Mental State of Discourse Referents

To be situationally and inferentially accessible, referents must generally be located in the focus of attention. To become an element of the attentional focus an item or perceptive feature has to be considered as relevant to the communicative task. Associated with autonomous processes of perception the quaestio is one main factor that restricts the focus of attention, steering the scope or window of attention.

We can associate the mental state of referents with the focus-memory of the model of HERRMANN and GRABOWSKI (1994). The selection of focused information units in this model follows the „Prinzip der instrumentellen Stelloperation“.[36] All referents included in the focus-memory are identifiable, where identifiability may be interpreted as just a specific state of pre-activation.

The communicative task also constrains which ways of linearizing the single propositional units are possible. For example, according to the chosen discourse type a temporal domain is instantiated and a sequence of temporal points is built. These macro–structural constraints have consequence for the micro-structure of the text, determining which conditions for accessibility via discourse hold.

In short there are different levels on which the quaestio has influence upon the mental state of referents.

2.6 Quaestio and Spatial Representations

Vis–à–vis the production of spatial descriptions the quaestio is important in several aspects.

A subject cannot access categorical spatial relations without attention, i.e., without selection of spatial relations, indexing spatial arguments and thereby creating referential frames. That kind of information that may exist in the perceptual representation is necessary for categorization but it isn't made explicit on the conceptual level if it is not in the focus of attention. This is in accordance with the statement „that subjects will not have an explicit conceptual representation of things and relations they do not attend to“.[37]

We assume that a strong relation between the communicative task as triggered by the quaestio and the scope of attention exists. It was supposed that

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[36] RUMMER ET AL. (1993:10).
[37] LOGAN (1995:164).

there are two levels of conceptual representation which must be kept apart.[38] The first level constitutes a perceptual level built up by obligatory bottom–up processes. The second level is a conceptual one built up by attention.

Now, the construction of an adequate conceptual representation („Sachverhaltsstruktur") is triggered by the communicative demand, employing all accessible data that are represented on the perceptual level. Moreover, in the course of this process the quaestio establishes a specific perspective on the relevant reference objects (see STUTTERHEIM (1995)).

Within this process necessary knowledge structures are preactivated by preattentive processes and it is this kind of preactivation that is relevant to the accessibility state of referents.

One way in which the quaestio influences language production was exemplified in the instruction-experiments performed by STUTTERHEIM (1995). People were instructed to describe an object labeled either as *bridge* or as *half-bowl*. The quaestio activated the specific referent out of the spatial representation and caused the following conceptualizations. In the case of

1. *bridge*: People described the object as *standing* on the table.

2. *half-bowl*: People described the object as *laying* on the table.

We must presuppose that at least visually and linguistically generated and activated knowledge is stored or processed in a mutually compatible format.

Also features of salience are at least partially defined by the quaestio and associated principles. That means what counts as features of salience is fixed in relation to a specific communicative demand. Further features of the partner model have to be considered, e.g. the position of the hearer vis–à–vis the salience feature of proximity.

2.7 Quaestio, Partner Model and Granularity

In the following we want to sketch out the interrelatedness of the quaestio, the partner model and the granularity of the discourse.

There is a relation between the quaestio and the actual partner model. The partner model cannot be thought of just as a structure comprising all the knowledge the speaker has of her partner. The speaker calls up only that knowledge of the partner which the quaestio marks as possible relevant. That means, the specific communicative demands *select* relevant information from the partner model and these selected beliefs are continually revised during communication. This is similar to the information contained in a user profile, which is selected accordingly to the specific communicative demands and continuously updated throughout a dialogue as well.

When we talk about granularity we employ a term borrowed from photography. The idea behind it is that humans have something we call cognitive maps

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[38] Cf. also LOGAN (1995:164).

of the world in their heads. Each map has its own granularity, i.e., is more or less detailed. We have, for example, a set of maps of our home town. The difference among these maps is the zoom-factor or the fineness of the resolution, i.e., the resulting granularity. To take an example from CHRISTOPHER HABEL

> Asked how to get from a place A to place B in Hamburg people explained that one has to take the underground from A to C and then a bus from C to B. It turned out that the fact that the underground station at C and the bus terminal at C were several hundred meters apart was initially omitted. People employed a map where the underground and the bus-line intersected at point C and marked C as the appropriate point to change from the underground to the bus. After saying that then one takes the bus from C to B some people continued to explain that in order to get from the underground to the bus one has to exit the underground station, turn right on street X and walk hundred meters to the bus terminal. This information was stored on a more detailed cognitive map of Hamburg that is a one level below that of the public transportation map.

We have seen that given a communicative task of giving directions a speaker selects a map of an appropriate granularity level (G_0). If necessary a speaker can change to one below (G_{-1}) or one above (G_{+1}) the initial level (G_0). One thing a speaker cannot do is to jump down more than one level at once. In our example the speaker may, after shifting from the public transportation map (G_0) to the map of the streets of C (G_{-1}), go to a level G_{-2} by saying in order to get to the right underground exit turn left at the MacDonald's sign and head towards the ticket counter. It would be communicatively very uncooperative to say *You must take the underground from A to C and then the bus from C to B and at the MacDonald's sign you turn left ....* Where, as we have seen, it is not permissible to move down more than one granularity level at the time it is, however, permissible to jump up as many levels as you want while getting back to G_0.

The quaestio is an essential factor in the selection of cognitive maps. Quaestiones such as *how do I get to the train station?* or *how do I get to Hamburg?* are likely to demand different levels of granularity. Another factor is the knowledge a speaker has of the person asking the question. For example the question *Where is a hospital?* requires a different map depending on whether the person asking is on an interstate highway or within a city. Summarizing we can say that the quaestio and the partner model establish a frame that determines which level of our cognitive segmentation of the world is appropriate. The quaestio, furthermore, establishes a set of sub-quaestiones, which in turn may demand the selection of sub- or supra-granularity levels. The change of a granularity level goes hand in hand with the establishment of a new topic into the discourse, but not vice versa. It will therefore be marked prosodically as such.

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G_0 As for getting from A to B, go from A to C and then from C to B
G_{-1} As for C go from C_1 to C_2 and then from C_2 to C_3
G_{-2} As for C_1, go from C_{1*} to C_{1**} ...
G_0 As for B, go ...

The role of the quaestio in the establishment of the granularity level has such an impact that it may suffice to resolve the dispute (LEVELT, GARNHAM) about problems arising with the framework vertical constraint. The framework vertical constraint (GARNHAM (1989)) stems from the theoretical modeling of spatial relational terms and intends to explain the phenomena that intrinsic *above* and *under* relations cease to be applicable once an object is not in its canonical position.

While it is pretty much true that the localization *the ball is under the chair* seems very unlikely in the scenario in figure 3 below:

Figure 3: A ball under a chair?

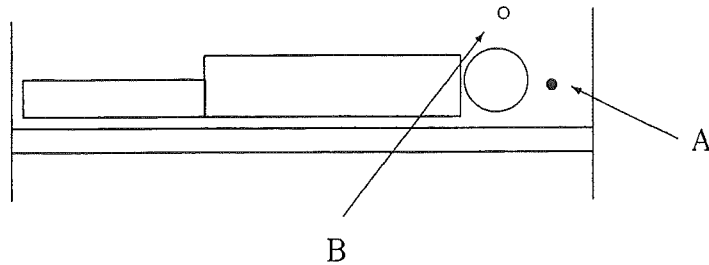The localization does not seem so clear in the scenario of figure 4. Is it possible

Figure 4: A fly above John's head.

to localize the fly as being above John's head if it was to be at point A or would that phrase more likely lead to the interpretation that the fly is at B? We suggest that at a granularity level such as G_0 *John is in bed, above his head is a fly* B is the most likely interpretation. Whereas, at a granularity level such as G_{-1} *John is in bed. His head is slowly balding and there is a fly above it*, A seems to be more likely then B. The central point is the fact that the granularity level of the discourse at any moment t influences the selection of the possible spatial localizations appropriate for the localization task at hand.

2.8 Quaestio and the Influence of the Cognition Phase on Linearization

We have already stated that the abstract quaestio fixes the linearization principle. But next to the quaestio there is an other factor influencing the linearization of the propositions namely the so called cognition phase („Kognitionsphase“).[39] This means the phase and the conditions under which the perspective–specific representation is attained. As a consequence one has to suppose that — in specific cases — already the situation model of the speaker comprises sequential information, mainly of temporal order. The plausibility of this account is strengthened by results reported by e.g. HERRMANN ET AL. (1989), ENGELBERT, HERRMANN and HAURY (1992). The authors looked at the influence the determinants of the cognition phase exert on the serialization of the transmitted information. This influence is important especially in the case of knowledge structures lacking a strict intrinsic structure such as time imposes it on events. This so called „Genese–Effekt“[40] is a main point in triggering static vs. dynamic localization sequences.[41] This is also reflected in priming effects reported e.g. by CLAYTON and HABIBI (1991) or SHERMAN and LIM (1992).[42]

If the situation model is build up through more than one cognition phase carrying different sequential information it is always the first phase that fixes the serialization of the communicated material. This is also called *anchor effect*.[43]

If the quaestio calls up a serialization different from the one acquired in the first cognition phase the speaker has no problem to manage this. But as soon as possible she will return to the primed order.[44] Nevertheless there are some characteristic differences and faults in the way single objects are located if there is a conflict between cognition phase and quaestio.[45]

One may speculate that the sequential information of the situation model comprises is not numbered but marks only precedence relations between two referential objects.

Summarizing we have to say that all these mechanisms are only poorly understood, and it has, e.g., to be investigated whether or not the serialization of information acquired through the cognition phase influences linearization in this way only if the situation model is very defective.

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[39] Cf. e.g. STUTTERHEIM (1994:262f.); SPECK (1993:7f.).

[40] Cf. HERRMANN/GRABOWSKI (1994:143).

[41] Map knowledge may trigger static and dynamic localization sequences, in contrast to road knowledge which triggers mainly dynamic localization sequences, cf. HERRMANN/GRABOWSKI (1994:148); HERRMANN ET AL. (1993:3); HAURY/ENGELBERT/GRAF/HERRMANN (1992); for the distinction between road vs. map knowledge see ENGELKAMP (1990:225ff.).

[42] See also RINCK/BOWER (1995:126); for the influence of topological distance between prime and target cf. also HERRMANN ET AL. (1993).

[43] Cf. ENGELBERT/HERRMANN/HAURY (1992:20); HERRMANN/GRABOWSKI (1994:143,146ff.); the question arises whether this anchoring effect is due to primacy.

[44] Cf. ENGELBERT/HERRMANN/HAURY (1992:33f.).

[45] Cf. ENGELBERT/HERRMANN/HAURY (1992:26ff.); HERRMANN/GRABOWSKI (1994:151.).

3 General Features of the PAROLE System

Based on the three categories of information structure, the relevance of the partner model for the construction of a discourse representation, and the role of the quaestio in integrating situative and general knowledge, we are now presenting an outline of the first version of the system PAROLE, a prototype that is intended to be able to generate discourse representations with varying information structures for a simple spatial description.

In the context of the PAROLE model the quaestio is important as the integrative means for the selection and activation of the different knowledge sources.

The discourse representation contains selected and linearized information from the speaker's visual representation and additional information marking topic and focus structures. Content and structure of the discourse representation is determined by constraints related to the partner model and other situative knowledge.

In the following we are furthermore displaying some example representations in a pseudo-prolog format. They should not be taken too seriously. Their establishment is the first step towards an implementation of our basic ideas.

3.1 The Computational Paradigm: Constraint Satisfaction

Constraint satisfaction is a general computational paradigm not restricted to any specific areas of application. Knowledge is formulated as a set of constraints on various variables. The role of the constraint satisfaction algorithms is to assign values to the variables in such a way that is consistent with all the constraints, or to determine that no such assignment exists (SHOHAM (1994:143)).

More formally, the constraint satisfaction problem can be established as follows (MESEGUER (1989)): Let $\{X_1, ..., X_n\}$ be a set of variables with values in a set of discrete and finite domains $\{D_1, ..., D_n\}$. Let $\{R_k\}$ be a set of constraints each of which shows the values mutually compatible for a variable subset. Thus

$$R_j \subseteq D_{i_1} \times ... \times D_{ij}$$

denotes the compatible values among the variables $X_{i_1}, ..., X_{ij}$. The problem is to find such an assignment of values to the variables so that all the constraints are satisfied. Every individual value assignment that satisfies all the constraints is called a solution.

According to this definition, constraints are absolute conditions; with each of them having to be satisfied and all the constraints being of equal importance. It is neither possible to violate a constraint nor to order the constraints with respect to their saliency.

PRINCE and SMOLENSKY (1993) developed a paradigm constituting *optimality theory*, which is currently being adopted to syntactic theories (GRIMSHAW

(1993)), showing that these constraints on the traditional constraint satisfaction definition can be surmounted in principle.

The basic idea in optimality theory is to formulate several conditions on well-formedness as constraints, each of which are in principle violable. Furthermore, the set of constraints may be inconsistent and the constraints are ranked in a strict dominance hierarchy. „Each constraint has absolute priority over all the constraints lower in the hierarchy" (PRINCE & SMOLENSKY (1993:2)). Determining the *optimal* analysis for a given input is, then, identical to satisfying the constraints according to the dominance hierarchy. Analyses violating the priority of the constraints, i.e., analyses satisfying lower constraints but violating higher constraints in the dominance hierarchy, are possible as well, but they do not constitute the best analyses of the input.

Although the basic ideas of optimality theory have been developed as a theory of universal grammar, dealing with phonological and syntactic structures, we see a strong correspondence between our ideas on conceptual processes in language production and the basic ideas of optimality theory. We argue that, in principle, looking at the conceptual part of the production process from a sufficiently abstract point of view, the selection and linearization processes involved in language production can best be modeled as ranked constraints. These constraints can (at least in principle) be violated. The output of the production process component which we are investigating — the discourse representation — can have an optimal form which is identical with satisfying the constraints according to their significance. The discourse representation can have a suitable form that still satisfies the communicative needs but it is not optimal in the sense that only the most relevant constraints are best satisfied.

3.2 Overview of the Architecture

We are using standard frames for knowledge representation of all knowledge sources involved. Hence, the partner model, the discourse model, conceptual knowledge and the spatial representation are all represented as particular collections of frames. The discourse representation is not represented as a frame but as a list of discourse referents and a structured list of corresponding conditions.

However, the processing mechanisms, especially the planning steps for constructing the discourse representation, are beyond the usual processes supported by frame-based systems, viz. class inheritance and simple defaults by *if-added* and *if-needed* slots.

Given the partner model and discourse model as situative knowledge and conceptual knowledge, a discourse representation as output will be planned driven by the quaestio. The general architecture is given in figure 5. In the next subchapters we are going into some of the nuts and belts of the components.
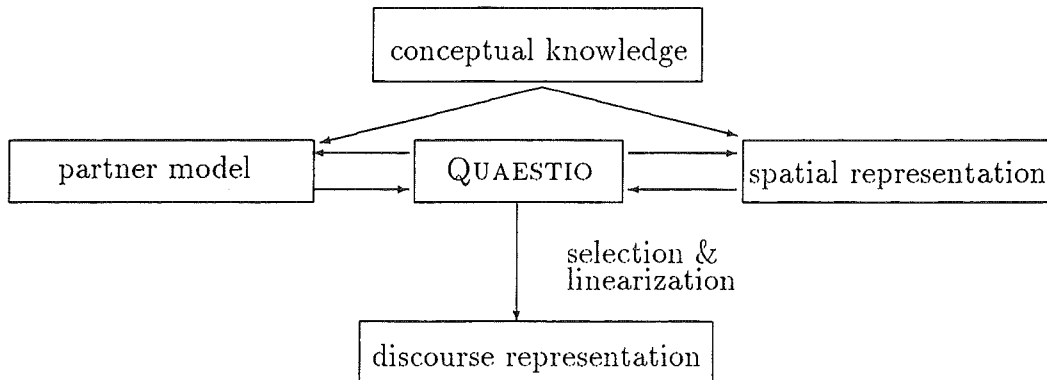
Figure 5: Architecture of the PAROLE System

3.2.1 The Spatial Representation

The spatial representation consists of two levels of representation. On the first level, a perspective-independent representation of possible object localizations is given. So to speak, this level represents the set of all possible places objects can occupy.

On the second level the corresponding representation of the actual objects to the perspective of the speaker is given. By means of the distinction between perspective-independent possible object places and the actual localizations of objects as seen by the speaker, mental rotations performed by the speaker to the perspective of the addressee are easily computable and in the light of cognitive evidence close to psychological reality.

Descriptions are sequences of propositions and every proposition contains a reference object and a primary object (the object to be localized). Thus, some objects in the spatial representation can structure their surrounding space in such a way that other objects are localizable in that space. Which of the objects will be used as reference or primary object depends on salient object features, their relevance with respect to the quaestio, and whether the object has already been mentioned before, i.e., has been introduced into the discourse model.

The last condition implies that reference and primary objects do not constitute disjunctive sets. An object can be introduced as primary object in one proposition and as the reference object in the next proposition. The other way round is not possible however: in order to function as reference object the object must belong to the mutual knowledge of the speaker and hearer. The primary object can be new and inaccessible whereas the reference object should be either known to or accessible for the addressee in order to localize the primary object correctly.

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To determine possible reference objects, the object frames contain a slot
salience_value whose filler will be instantiated depending on the saliency val-
ues for salient object features and the partner model. Additionally, the rele-
vance of the object for 'answering' the quaestio is marked in a slot-value pair
quaestio_relevance: {+, -}. For example, the frame of a specific church
„church1" could be given as:

```
frame(church1,
                [is_a:  church,
                salience_value:  Y,
                quaestio_relevance:  Q,
                speaker_position:  intr_rightof
                intr_rightof:  town_hall1,
                intr_frontof:  bus_stop1,
                has_part:  church_steeple, sal(X)])
```

A quaestio verbalized as *Where are the objects?* focuses on the *spatial re-
lations* between *objects*. Hence, on the one hand all objects will be marked as
being in the focus of attention (i.e., their slots quaestio_relevance gets the
value +) and on the other hand the spatial relations between them, as seen
by the speaker, are linguistically focused. Which one of the objects become
reference objects depends on the linearization chosen and this in turn depends
on where the speaker wants to start with her linearization, the salient object
features, and the localization of the partner.

3.2.2 The Partner Model

At the moment the partner models we use are pretty simple. We draw a dis-
tinction between a default partner model and instances of it by specific persons.
We assume that the addressee knows the same concepts as the speaker, i.e., the
set of concepts both persons know (respectively are assigned to him as known
concepts) is identical. The speaker does not belief that the addressee's general
conceptual knowledge differs from her — i.e., the speaker's — general conceptual
knowledge, i.e., that buildings have windows, churches have steeples etc.

The partner model as a frame contains slots for the cognitive competence and
the addressee's possible localization. Their fillers are instantiated by questioning
the user at the beginning of a session.

The discourse model is part of the partner model as well. Since we are at
the moment not entering real discourses, only the contribution of the partner is
copied into the discourse model. Another function of the listener model, that
will be integrated in later versions of PAROLE, is that of a pragmatic-minimizer.
A pragmatic minimizer functions in such a way that it establishes constraints
which „filter-out" information that can be left implicit. In order to select the
appropriate constraints for the appropriate selection/filtering the listener model

must again draw on the data of the listener profile. It needs to „know" the amount of mutual world- and domain-knowledge.

For example, within our cultural framework the phrase *there is a city hall with fountain* is not underspecified in terms of the localization of the fountain. Due to shared knowledge about the default structure of villages the fountain will be understood to be in the front of the city hall, unless explicitly specified to be somewhere else.

Furthermore, we want to point out that the partner model must not only once have access to visual or memorized information, but continuously throughout the whole discourse, since the speaker updates the partner model instantaneously whenever the addition of new information by the listener, for example through back-channeling is perceived.

3.2.3 The Quaestiones

The first version of our generation system requires an explicitly given question as quaestio that will be parsed and transformed into a semantic representation.

Once the quaestio exists as a semantic representation, it marks the entities and relations relevant for answering the quaestio in the spatial representation and in the partner model. The relevant parts of the partner model for answering the quaestio will be marked as well.

The quaestio's effects on the construction processes for the discourse representation are:

1. The semantic representation of the quaestio imposes tense and modality on the discourse representation.

2. The elements addressed by the interrogative will get focus status in the discourse representation.

3. Furthermore, the kind of quaestio provides the relevant schemata for the conceptual packaging of the linearized objects. For example, spatial descriptions can be given as imaginary walks, groupings, by means of intrinsic orientations, by absolute reference frames, or else.

4. The elements with topic status are only indirectly determined by the quaestio. The quaestio provides constraints that must be satisfied by the discourse referent in order to get topichood. These constraints are in the current version of the generation system:

   (a) Discourse referents from the conceptual domain selected by the quaestio may get topic status. For example, a quaestio like *Which objects exist?* marks the targeted objects as relevant. All discourse referents referring to entities within this target group may get topic status.

(b) Discourse referents referring to a unique entity that can be inferred as a typical element within the target group. For example, a town hall of which there is usually but one in a village. If the village has been mentioned in a description, then *the town hall* may get topic status even though it has not been mentioned before.

(c) Visual accessibility. If the speaker beliefs that the hearer is able to allocate an entity, the discourse referent for this entity may be marked as topic as well.

Thus, topic elements must not be brand-new elements. The three conditions for gaining topichood are only necessary ones, but by no means are they sufficient conditions. Further investigations must show how these three conditions interact and if there are others influencing topicality as well.

5. Finally, also the mental state of discourse referents is expressed in the discourse representation, viz. by means of a relation `salience(Obj,Value)`. The salience value is either determined by the distance between the discourse referent and its antecedent in the discourse model, its identification by inferability, or by means of its identification by general knowledge. For example, if the antecedent has already been mentioned in the previous clause, the value is 5. If the speaker beliefs that the addressee is able to infer the antecedent, its value becomes 4. An expression like *der Vater* (the father) is an example of the last kind. People usually have only one father and, therefore, a definite NP may be used.

3.2.4 Linearization and Conceptual Packaging

The underlying order is determined by the entities marked by the quaestio as relevant to the communicative demand, the decision where to start, and the saliency features of the objects. We have already stated that the quaestio *Which objects exist?* marks the objects as relevant (and focused). Furthermore, this quaestio is probably not sensitive to the cognitive competence of the addressee and therefore the linearization starts with the most salient object for the speaker and goes on to the next salient one etc.

Conceptual packaging is done by the application of schemata that are selected by the quaestio. For example, the quaestio *Which objects exist?* requires only one schema (viz. enumeration), whereas one and the same linearized information in the case of spatial descriptions are verbalizable in many ways (see above).

3.2.5 The Discourse Representation: Information Structure in PA-ROLE

The output of the system is a discourse representation that establishes the order of discourse referents that must be verbalized. The single propositions are listed as well. For each proposition a set of conditions is generated that provides sortal information and relations as well as topic/comment structures, focus/background structures and the status of the discourse referents, whether they are accessible or not.

3.3 Passing the Discourse Representation Over to a Formulator

Although we are not passing the discourse representation over to a formulator at the moment, in a forthcoming stage it is necessary to test the expressiveness of the discourse representation by means of its grammatical and phonological encoding.

We will outline our basic idea in how the formulator works by means of an example. Suppose the following (small) discourse representation has been constructed:

```
discourse_repr(  refos([a, b, c, d]),
                 [tense(pres), modality(fact)],
                 conds([ [pred(focus(frontof(b,a))),
                                arg(topic(town_hall(a))),
                                arg(bus_stop(b)),
                                salience(a,5)],
                        [pred(focus(leftof(d,c))),
                                arg(topic(town_hall(c))),
                                arg(church(d),
                                salience(c, 2)]]) )
```

The basic idea is as follows: the list of discourse referents states the referents which must be verbalized. The individual propositions are listed as well. Note that argument structures of retrieved lexical items do not impose a fixed order on the respective arguments. For example, one can utter *The bus stop is right of the church* or *Right of the church is the bus stop*. Which of both clauses will be produced depends on the topic/comment and focus/background distinction in the discourse representation.

The conditions provide sortal information on one hand, for example that a is an instance of the sort of town halls and on the other hand, they provide several conditions which are the result of the adaptation of the message to the addressee. For example, a is marked as being a topic element, as a reference object, and that it is marked as an object that is inferable for the addressee with a salience factor of 5. Finally, whole conceptual complexes are marked as being

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focused (those who are familiar with work on lexical semantics realize already that they match with spatial prepositions).

Encoding should work as follows: the list of discourse referents will successively be worked off. For every proposition

1. Look for an event or state discourse referent

   (a) If there are conceptual conditions matching a referent onto a verb, take the argument structure of that verb for grammatical encoding and take into account the required tense and modality as given in the discourse representation.

   (b) If no discourse referent matches onto a verb, use an appropriate copula with argument structure, tense, and modality as before.

2. The other conceptual conditions are matched onto lexical items.

3. The conditions for topic, focus, and salience function as constraints for the choice of syntactic structures and the giving of stress. For example, a discourse referent X marked as being inferable with sufficient saliency and having topic status: salience(X, 5), topic(X) triggers the selection of a syntactic structure that introduces a new topic, for example a construction such as *Was das X betrifft, ...* (as far as X is concerned, ...).

So much for the encoding process. Of course, many problems in the conversion of the discourse representation to a description still exist and we are aware of the necessity to test the adequacy of our discourse representations. For the moment however we will stop at this level. Later on we will move to the next step in order to test and refine our preverbal discourse representations.

4   A Case Study of Spatial Descriptions

Suppose a town hall, a church, and a bus stop are in the line of vision of a speaker as given in figure 6 with possible positions of a hearer on position A, B, C, at the speaker's position, or in communication via cellular phone:
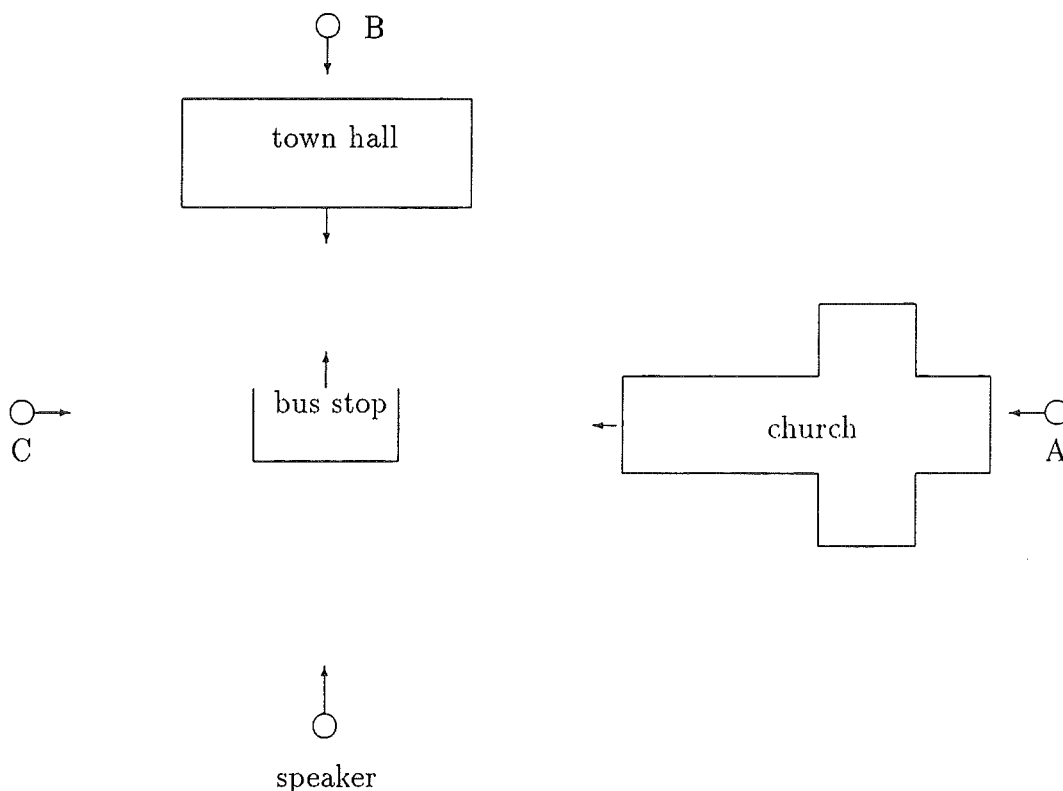

Figure 6: A Toy Village

We make the following simplifying assumptions: the speaker has a fixed position and a fixed perspective with respect to the spatial configuration she is going to describe. The addressee is either not able to see the spatial constellation or he is on position A, B, C, or next to the speaker. The goal is to explain through the model why certain localization strategies have been chosen by the speaker, depending on the personal status and position of the hearer.

The speaker-relative spatial object configuration in figure 6 can be established as a collection of frames. Seen from the speaker, for example, the church

is right of the speaker, it has a church steeple as salient part, a town hall is intrinsically right of it and a bus stop is intrinsically in front of.

Let us suppose that the cognitive competence of the addressee is estimated by the speaker as low and the addressee is on position B, i.e., rightly shifted by 180 degrees into a face-to-face position. Now suppose the quaestio is verbalized as *Where are the objects?* After being parsed, its semantic representation is

```
{A, ?L}, {object*(A), pl(A), place(?L), temp(pres),
mod(fact), forall(y ∈ A: loc(y,?L)) }
```

Having received this semantic representation, constructing the discourse representation works as follows:

1. The quaestio marks the objects in the spatial representation in terms of their relevance to each other. The spatial relations between the objects are marked as salient as well. The former is performed within the spatial representation. The objects get a slot-value pair quaestio_relevance(+). The spatial relations are perspective-dependent and they play the main role in answering the quaestio. Correspondingly they will be linguistically expressed as focused information. Hence, this information is handed down to the discourse representation: It has been noted that all local relations should be focused.

2. By means of the quaestio, within the discourse representation the conditions modal(fact) and temp(pres) have been introduced.

3. As the next step the first reference object for the linearization must be determined. Since the hearer is present, the set of possible reference objects is {speaker, hearer, all objects y in the spatial representation}. Otherwise the hearer would be excluded. Assuming that the hearer is estimated as having low cognitive competence, he will be chosen as the origo and, thus, the first reference object. This entails that the speaker must perform a mental rotation to the view of the addressee and, by that, compute the spatial representations as perceivable by the addressee. With high or normal cognitive competence, the speaker would choose herself as the origo and the first reference object or an object with high salience.

4. Based on the hearer as first reference object and the spatial representation from the hearer's viewpoint, obtained by the mental rotation, now the linearization of the objects starts. The position of the hearer and the salient parts of the objects determine the saliency values of the objects and, by that, their actual order. Since the object closest to the hearer is the town hall and since it has a certain size, it becomes the object with highest salience value. The church steeple as a salient feature of the church results in the next lower salience value by default and the bus stop gets

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the lowest value by default. Thus, the order would be addressee < town hall < church < bus stop. If the speaker would be used as first reference object, the order would be speaker < church < town hall < bus stop. However, for this to be the case the quaestio would have had to be *Which objects exist?* Since the quaestio was *Where are the objects?* the spatial configurations are of increased importance and since the localization town hall < bus stop < church is more precise in terms of the spatial relations[46] than town hall < church < bus stop, the actual order turns out to be addressee < town hall < bus stop < church.

5. After having determined the linearization order, it must be conceptually packed, either as an imaginary walk, by means of speaker-specific or hearer-specific perspective, by intrinsic orientation, or by means of the order given by the cognition phase. In this case study the addressee as first reference object constrains the ways of conceptual packaging: speaker-oriented descriptions and intrinsic orientation are both blocked, because linearization starts with the hearer which violates the default egocentric localization and therefore must be explicitly mentioned. Hence, a verbalization as imaginary walk starting from the hearer's position or a description from the hearer's perspective are possible.

   The conceptual packaging is performed with the help of schemata that provide the base for the verbal structure. For instance, an imaginary walk requires the discourse referent for the hearer as being used as a fictive observer and he will be moved along the linearized objects. An imaginary walk is also tied to specific syntactic constructions, viz. conditionals with antecedents to bridge distances or to orient the fictive observer and a consequence to localize the primary object with respect to a reference object.

6. We noted already that the quaestio establishes constraints for topic only indirectly. The objects get topic status because they belong to the conceptual class of objects selected by the quaestio. In constructing our discourse representations the influences of the other two conditions (inferability and accessibility) are modeled by the discourse and the partner model.

7. Now we can construct the discourse representation with corresponding information structure. Let us take the description from the hearer's perspective as final example:

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[46]This is due to the fact that the town hall and the bus stop and the bus stop and the church establish precise *in front of* and *right of* relations, whereas the town hall and the church are located in a complicated *right of* and *in front of* relation.

```
discourse_repr(  refos([h, a, b, c]),
                 [tense(pres), modality(fact)],
                 conds([ [pred(focus(frontof(h,a))),
                             arg(hearer(h)),
                             arg(topic(town_hall(a)))],
                         [pred(focus(leftof(a,b))),
                             arg(town_hall(a))),
                             arg(topic(bus_stop(b))),
                             salience(a,5)],
                         [pred(focus(frontof(a,c))),
                             arg(town_hall(a)),
                             arg(topic(church(c))),
                             salience(a,5)]])
```

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