EMPHATIC GENERATION: EMPLOYING THE THEORY OF SEMANTIC EMPHASIS FOR TEXT GENERATION

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Abstract
The paper deals with the problem of text generation and planning approaches making only limited formally specifiable contact with accounts of grammar. We propose an enhancement of a systemically-based generation architecture for German [Bateman et al., 1991] by aspects of the theory of semantic emphasis [Kunze, 1991]. Doing this, we gain more control over both concept selection in generation and choice of fine-grained grammatical variation.

1 INTRODUCTION
The extension of linguistic representation to levels of abstraction above syntax is an important theoretical goal; current efforts in this direction include [Alshawi, 1992, Grover et al., 1993, Jackendoff, 1990]. However, problematic with most of these developments is their restriction to, as it is termed in systemic-functional theory [Halliday, 1978], ideational information. As [Grover et al., 1993] report, diverse sentences such as He found it in the park and It was in the park that he found it are assigned identical semantic representations by the Alvey grammar, and it is common for variations such as these to be relegated to ‘pragmatic’ interpretations of invariant semantic forms. We claim that such variation also requires a semantic representation based on a textual semantics that augments the existing ideational semantics. The importance of such a broadening of semantic representations is already clear in work on text generation [Horacek and Zock, 1993, Meteer, 1991, Bateman et al., 1993], and has been argued also for analysis [Matthiessen et al., 1991]. Unfortunately, accounts of text organization and text planning achieved within text generation often make only limited formally specifiable contact with accounts of grammar (e.g., [Grosz and Sidner, 1986, Mann and Thompson, 1987, Hovy, 1987, Hovy et al., 1992]); and contrariwise, formal accounts such as discourse representation theory, although beginning to make contact with higher levels of rhetorical organization (e.g., [Lascarides and Asher, 1991]), are typically restricted to describing anaphoric relations and quantification. In this paper, we present one particular extension to a textual semantics, showing its integration

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and use in dealing with some related problems in text generation. The extension is based on the semantic analysis of the structure of lexical fields in German developed by Kunze (e.g., [Kunze, 1991]), combining this with the systemic-functionally driven mode of text generation pursued in the text generation project KOMET [Bateman et al., 1991]. A computational representation of the semantic information posited by Kunze’s theory of semantic emphasis (Theorie der semantischen Emphase) is under development for the lexical entries of the text analysis project KONTEXT [Firzlaff and Haenelt, 1992]. We describe here how this information is now used as an additional source of functional constraints during grammatical decision making and how this allows a natural contact with certain text organization decisions. We briefly illustrate the work with two examples: first, our approach to a central problem in knowledge-based natural language processing, that of how to relate domain models to levels of linguistic knowledge and processing; and second, a demonstration of the co-constraints between emphasis distribution and certain textual decisions. Finally, we discuss the directions that this work now opens up for future investigation, including application of NLP components to real-world domains [Teich et al., 1994] and generalizations to languages other than German (cf. [Kunze, 1992]).

2 EMPHASIS THEORY

The theory of semantic emphasis [Kunze, 1991] proposes explanations concerning the meaning of situation descriptions communicated by natural language texts and its relationship to possible syntactic realizations. One aspect of the theory will be outlined here, namely how a syntactic realization depends on semantics. Moreover, it will be shown how grammatical features can be derived systematically.

The theory provides prototypical descriptions of situations. These descriptions are called basic semantic schemes. They are given in terms of predicate-argument-structures called propositions. For instance, the basic semantic scheme for situations of change-of-possession is:

\[
(\text{cause (act (a)}
\begin{align*}
\text{et (bec (have (a1, a2))}) \\
\text{bec (not (have (a3, a4))))})
\end{align*}
\]

This can be paraphrased as: An action of \(a1\) causes \(a2\) to get \(a1\) and \(a3\) to lose \(a4\).\(^1\) Since this description is prototypical it provides just one transferred object: it is denoted by \(a2\) and \(a4\) because it can be regarded from different points of view. Furthermore, \(\text{ref(a)}\) might either be the same as \(\text{ref(a1)}\) or as \(\text{ref(a3)}\), but \(\text{ref(a1)}\) and \(\text{ref(a3)}\) must be different.

So, each participant of a situation may be referred to more than once in the corresponding description. Each of these references corresponds to a specific role (deep case) which, in turn, mirrors a specific point of view towards the referent. The roles are derived systematically rather than being determined in a more or less intuitive way (e.g., [Fillmore, 1968]): they are derived according to a set of well-defined recursive rules (cf. [Kunze, 1991, pp78–89]); the derivation process follows the propositional structure bottom-up. A basic predicate has at least one elementary argument (represented by some variable) to which an initial role value is assigned. The other predicates only take propositional arguments and modify the (initial or intermediate) role values assigned to the elementary arguments. For instance, the basic predicate have assigns the role <locat, have> to its first argument as initial value. The predicate bec further specifies <locat,
have> as <goal, have>. The predicate et, on the other hand, never changes a role. The predicate cause does not affect a <goal, have> in its second argument.

The roles derived for the basic semantic scheme in question are:

- a <agens, act>
- a1 <goal, have>
- a2 <to-obj, have>
- a3 <source, have>
- a4 <from-obj, have>

The second column of this table is the maximum case frame of verbs that can be used to describe a change-of-possession in which one object is transferred. However, in a phrase that describes a situation only some roles of the maximum case frame are verbalized. Roles that are not verbalized are said to be blocked.

Moreover, some aspect of a situation is put into the foreground, which means that in a suitable phrase, the corresponding role(s) is (are) verbalized with semantic emphasis. In terms of the theory of semantic emphasis this is reflected by the parameter of emphasis, which is assigned to partial propositions of a basic semantic scheme. These assignments are the result of a rule-based distribution. A basic semantic scheme entails the information where to start the distribution. As far as the change-of-possession is concerned the starting point is the second argument of the predicate cause, namely the proposition with the predicate et. Therefore the et-proposition has emphasis. A proposition that has emphasis distributes it top-down to one of its arguments. Accordingly a proposition that has emphasis can only be the argument of a proposition that also has emphasis. Consequently, one of the have-propositions has emphasis, and the act-proposition may have emphasis.

According to a general rule at least one of the roles of a proposition with emphasis must be verbalized. Furthermore, its grammatical realization must be in nominative, genitive, dative or accusative case. The choice of the grammatical case mainly depends on the role. Secondly, it is determined by the subset of roles that are not blocked and belong to propositions with emphasis. On the other hand, the roles of propositions without emphasis need not be verbalized at all, but if one of them is verbalized, its grammatical realization can only be by oblique case, i.e. by a prepositional object. The choice of suitable prepositions depends on the role.  

In Figure 1 we present some sample sentences. Their propositional descriptions are derived from the basic semantic scheme of change-of-possession. Note that if we add emphasis information and select the roles that are to be verbalized, we construct the semantic forms derivable from the basic semantic scheme. (In the figure, “—” indicates that the corresponding role is blocked, i.e. no grammatical case is assigned to it. Propositions with basic predicates that have emphasis and the corresponding information concerning the grammatical realizations are in bold face.)

For reasons of illustration we have chosen a specific lexical field. However the principles of the theory of semantic emphasis also apply to other fields [Kunze and Firzlaff, 1993], e.g., change-of-location, creation, measuring, verba dicendi. For each of these fields the theory provides a prototypical description (i.e. a basic semantic scheme) to which the rules we presented here and other constraints must be applied in order to derive a specification of possible grammatical realizations.

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2 The theory of semantic emphasis has been worked out for German. However, most of its principles apply to other languages as well.
(1) Sie verliert den Schlüssel. (She loses the key.)

(cause (act (agens, act: ref(she) ... [ — ] )
   et (bec (have (goal, have: a1, ... [ — ]
            <to-obj, have: ref(key) ... [ — ] ))
   bec (not (have (source, have: ref(she), ... [ nominative ]
            <from-obj, have: ref(key) ... [ accusative ] ))))

(2) Sie wirft den Schlüssel weg. (She throws away the key.)

(cause (act (agens, act: ref(she) ... [ nominative ] )
   et (bec (have (goal, have: a1, ... [ — ]
            <to-obj, have: ref(key) ... [ — ] ))
   bec (not (have (source, have: ref(she), ... [ — ]
            <from-obj, have: ref(key) ... [ accusative ] )))

(3) Er schickt ihm eine Einladung. (He sends him an invitation.)

(cause (act (agens, act: ref(he) ... [ nominative ] )
   et (bec (have (goal, have: ref(him), ... [ dative ]
            <to-obj, have: ref(invitation) ... [ accusative ] ))
   bec (not (have (source, have: ref(he), ... [ — ]
            <from-obj, have: ref(invitation) ... [ — ] )))

(4) Er schickt eine Einladung an ihn. (He sends an invitation to him.)

(cause (act (agens, act: ref(he) ... [ nominative ] )
   et (bec (have (goal, have: ref(him), ... [ to-phrase ]
            <to-obj, have: ref(invitation) ... [ — ] ))
   bec (not (have (source, have: ref(he), ... [ — ]
            <from-obj, have: ref(invitation) ... [ accusative ] )))

Figure 1: Basic semantic forms of sample sentences
3 GENERATION ARCHITECTURE

The general architecture of the KOMET system has been described in detail elsewhere [Bateman et al., 1991]; it follows very closely the modularities entailed by the linguistic stratification assumed within systemic-functional linguistics (e.g., [Halliday, 1978]). Of most relevance here is the necessity of specifying the relationship between an abstract grammatically-oriented semantics and an account of the context of situation. This relationship underlies the main reason for adopting a systemic-functional orientation in text generation: grammatical and lexical decisions are related to the deployment of communicative goals in their communicative context. The project includes the development of a large systemic-functional grammar of German [Teich, 1992] and the construction on the basis of the original Penman English Upper Model [Bateman et al., 1990] of a revised upper model ontology that spans both the semantic requirements of German and English [Henschel, 1993, Henschel and Bateman, 1994]. Input to the grammar component is expressed in the Penman Sentence Plan Language (SPL) [Kasper, 1989]. However, in contrast to Penman, where the SPL is largely equivalent to A-Box assertions made against a T-Box component combining the Upper Model and domain model, in KOMET we allocate the generation system external domain model to the higher stratum of context. This provides the theoretical space for the flexible mapping from domain model concepts to Upper Model concepts required. Context is organized into three areas [Halliday, 1978, Martin, 1992] — only one of which, field (the socially significant activities, participant-types and activity sequences of the communicative context), is relevant to us here.

We relate the information of the theory of semantic emphasis to this architecture as follows. We adopt basic semantic schemes as abstract general characterizations of a subtype of the field of context; i.e., one of the contexts in which interlocutors can understand themselves to be is classifiable abstractly as, for example, an exchange of (generalized) possession. This is then related to the semantic classes available in the Upper Model by means of realization: according to the distribution of semantic emphasis over the basic semantic scheme, a particular Upper Model concept is selected as appropriate together with a particular configuration of semantic roles. This semantic specification then forms the basis of possible SPL expressions that can be passed on to the lexicogrammar for expression. As described in [Matthiessen and Bateman, 1991, Chapter 9], the Upper Model is only one of three bodies of semantic information necessary for generation. Semantic emphasis distribution also shows co-constraints with decisions in another component, the Text Base, where information concerning textual statuses such as thematicity, given-/newness, identifiability, etc. is maintained for constraining those grammatical decisions sensitive to such distinctions. To these we add a component for grammaticalized semantic emphasis, which represents the distribution of semantic emphasis that is visible from the grammar.3 In the examples below, we will represent such textual statuses as additional annotations present in the SPL semantic specifications; this is the normal way in which textual information is captured in SPL.

3This is entirely analogous to Jackendoff’s [Jackendoff, 1983, p404/5] view of ‘argument structure’ as an abbreviation for that part of conceptual structure that is “visible from the syntax” — this is simply extended systemically to include representations of textual statuses.
4 EXAMPLES

Given that each semantic form both has a propositional content (Sachverhaltsrepräsentation) and indicates, given a particular emphasis distribution, a particular textual status of the participants in the proposition, we elaborate two examples of how we can make use of these two aspects in our generation architecture:

- **Example 1**: of emphasis information providing grounds on which a process type in the Upper Model can be chosen.

- **Example 2**: of the mutual constraints between emphasis information and textual statuses.

**Example 1: Choice of Upper Model type**

Since the introduction of the Penman Upper Model (e.g., [Bateman et al., 1990]) in 1985, interfacing with a generation system by means of an abstract linguistically motivated ‘ontology’ has become widespread (cf., e.g., the ontologies of the LILOG system [Klose et al., 1992] and many others; see [Bateman, 1992] for extensive discussion). Although this is usually achieved by direct subordination of domain concepts to ‘Upper Model’ (or equivalent) concepts, this is known to be insufficient — domain concepts often need to change their Upper Model classification depending on their appearance in particular texts and text organizations. Here we illustrate how this general problem of flexibly allocating domain concepts to appropriate Upper Model concepts can be partially solved by an allocation of the semantic emphasis theory.

Our illustration of the control of semantic choice by emphasis information is drawn from the field of change-of-possession. This already constrains the possible choices of an Upper Model type of process of a proposition to be verbalized to action. Without this specification of field, choice between all four process types in the Upper Model is completely open. As shown in Section 2, a field specification of change-of-possesion has the maximum case frame: \(<\text{agens, act}>, \langle\text{goal, have}\rangle, \langle\text{to-obj, have}\rangle, \langle\text{source, have}\rangle\) and \(<\text{from-obj, have}\rangle\). As an example, we will consider the cases where two or three of these five roles have been blocked according to particular emphasis distributions. In such cases, a process type action with an instantiation of two Upper Model roles must be chosen. If the \(<\text{agens, act}>,\) is blocked and the \(<\text{source, have}\rangle,\) and the \(<\text{from-obj, have}\rangle\) have emphasis and are not blocked or if both the \(<\text{agens, act}>,\) and the \(<\text{from-obj, have}\rangle\) have emphasis and are not blocked and the \(<\text{source, have}\rangle\) has emphasis and is blocked, then action process, subtype dispositive-material-action, must be chosen (the relevant information is highlighted):\(^5\)

A representation of a situation type, such as change-of-possesion, plus emphasis information thus makes it possible to constrain

\(^4\)By application of a notion similar to Jackendoff’s [Jackendoff, 1990, p26] ‘semantic field feature’.

\(^5\)This situation corresponds to examples (1) and (2) in Figure 1. Note also that in the case of the \(<\text{agens, act}>,\) not being blocked, it will be co-referential with the \(<\text{source, have}\rangle,\).
choice and, in a number of cases, even determine choice of a concept in the Upper Model.

**Example 2: Emphasis distribution and textual status**

For illustration of the control of emphasis distribution by textual statuses, we have chosen the example of dative shift. Dative shift is motivated by the perspective on a process and the focus/nonfocus on a particular participant in that process in a text, i.e., very broadly, dative shift is *textually* motivated. More specifically, it is motivated here by invoking a specific emphasis distribution. We represent emphasis information as attributed to Upper Model roles of the SPL representation of a clause in terms of inquiries.\(^6\)

Only with the emphasis information can we distinguish between a dative-shifted and a nondative-shifted grammatical realization of the ideational part of the SPL.\(^7\)

Sample SPL 1: Er schickt ihm eine Einladung. (He sends him an invitation.)

```
(send / directed-action
   :actor (he / person)
   :recipient
     (him / person
      :emphasis-q emphatic)
   :actee (invitation / object))
```

Sample SPL 2: Er schickt eine Einladung an ihn. (He sends an invitation to him.)

```
(send / directed-action
   :actor (he / person)
   :recipient
     (him / person
      :emphasis-q nonemphatic)
   :actee (invitation / object))
```

In sample SPL 1, the recipient is verbalized with emphasis (by dative case) and the actee is in focus position. Here, it does not have emphasis (and is thus assigned oblique case).

In our current architecture [Bateman et al., 1993], this kind of textual variation is represented in a *local-level discourse semantics* that mediates information between the global-level discourse organization (represented as stages in a generic structure potential (GSP; cf. [Hasan, 1978])) and rhetorical structures (RST; cf. [Mann and Thompson, 1985]) and the grammar. The local-level discourse semantics (based on [Martin, 1992]) contains textual linguistic information that controls the *textually-relevant* options in the grammar, such as topic and focus selection (cf. [Sgall et al., 1986]), reference and information structure. Given a representation of propositional content, the text planner keeps track of textual decisions in thematic development and reference attribution and selects from the *textually-relevant* emphasis potential that option that is appropriate in a given context. Consider a piece of text as it typically occurs in the domain we deal with in [Teich et al., 1994] (arts and artists’ biographies) that provides a context for the choice of emphasis distribution in sample SPL 1:

(1) Seit 1898 beschäftigte sich Behrens mit den Gestaltungsproblemen von Industrieprodukten. (2) Er entwarf unter anderem Flaschen für die Serienherstellung in einer grossen Glasfabrik. (3) 1899 schickte der Großherzog von Hessen ihm eine Einladung nach Darmstadt zu kommen und sich einer Gruppe junger Künstler anzuschliessen ...\(^8\)

Typically, in biography texts, the artist the text deals with acts as the *hypertheme* of the text. Moreover, one of the typical thematic developments by which a biography

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\(^6\)For a description of the mechanism of the chooser/inquiry interface between semantics and grammar in Penman-type generation architectures, of which *komet* is an example, see [Mann, 1983].

\(^7\)These correspond to examples (3) and (4) in Figure 1.

\(^8\)English: In 1898 Behrens turned to problems of industrial production and designed a number of prototype flasks for mass production by a large glass works. In 1899 the Grand Duke of Hessen sent him an invitation to come to Darmstadt and join a group of young artists...
text proceeds is selecting temporal locations (as in (1)) or reselecting the hypertheme as theme of the next sentence (as in (2)). This textual organization is accordingly produced by the text planner. Then, given this textual status, all references to the participant constituting the hypertheme (here: Behrens) belong to information already introduced. Being the hypertheme and the given information is reflected in the participant receiving emphasis status. Grammatically, this is realized in the assignment of nonoblique case to the participant and its ordering in the clause. In sentence (3), the recipient role thus receives emphasis status and cannot appear in the focus position which is generally reserved for pieces of information that are new in the discourse and not thematic (cf. *Er schickte eine Einladung ihm). The problematic gap between the high-level textual organization and grammatical expression is thus appropriately bridged.

5 CONCLUSIONS, SIGNIFICANCE AND FUTURE WORK

We have shown that emphasis information can provide more control of choices in generation on the higher strata of the linguistic system (semantics). Ideationally, emphasis distribution and blocking of roles constrains the possible process types of the Upper Model to be chosen. In the grammar, it consequently constrains choice in case assignment. We have also sketched the aspect of emphasis theory that is relevant for textual decisions in thematicity and information structure which attribute certain textual statuses to the participants in the discourse. These are reflected grammatically for example in relation changing phenomena such as dative shift. In a current application of NL analysis and generation components to the domain of arts and artists’ biographies [Rostek et al., 1994], the mechanisms described above in the discussion of example 1 provide one component of a domain model that is used both by analysis and generation [Teich et al., 1994].

Some next steps for this work are clear. Many of the examples put forward by Kunze are argued in terms of textual acceptability that goes beyond single clauses. We are now, therefore, investigating the relationship of emphasis information and textual statuses we have sketched in the discussion of example 2 more closely, also considering other fields, such as creation, change-of-location and verba dicendi.

A further step is to investigate the multilingual applicability of the framework — for example, in [Kunze, 1992], Kunze proposes an analogous treatment for the field of change-of-possession in English. It will be interesting to investigate the applicability to English of a detailed account that has been worked on the basis of a language other than English — the reverse of what normally occurs! Semantic emphasis may support an improved interface between textual organization and grammatical decisions for English also, although, at least in a systemic-functional account, somewhat more functionally differentiated proposals have been made for the phenomena that Kunze gathers together under semantic emphasis (for example, given-new information, theme-rheme information, and modal responsibility of the grammatical subject — all of which are independently variable; cf. [Martin, 1992]). The precise relationship of semantic emphasis to these needs to be clarified.

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