A Framework for Processing Partially Free Word Order*

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Abstract

The partially free word order in German belongs to the class of phenomena in natural language that require a close interaction between syntax and pragmatics. Several competing principles, which are based on syntactic and on discourse information, determine the linear order of noun phrases. A solution to problems of this sort is a prerequisite for high-quality language generation. The linguistic framework of Generalized Phrase Structure Grammar offers tools for dealing with word order variation. Some slight modifications to the framework allow for an analysis of the German data that incorporates just the right degree of interaction between syntactic and pragmatic components and that can account for conflicting ordering statements.

1. Introduction

The relatively free order of major phrasal constituents in German belongs to the class of natural-language phenomena that require a closer interaction of syntax and pragmatics than is usually accounted for in formal linguistic frameworks. Computational linguists who pay attention to both syntax and pragmatics will find that analyses of such phenomena can provide valuable data for the design of systems that integrate these linguistic components.

German represents a good test case because the role of pragmatics in governing word order is much greater than in English while the role syntax plays is greater than in some of the so-called free-word-order languages like Warlpiri. The German data are well attested and thoroughly discussed in the descriptive literature. The fact that English and German are closely related makes it easier to assess these data and to draw parallels.

The simple analysis presented here for dealing with free word order in German syntax is based on the linguistic framework of Generalized Phrase Structure Grammar (GPSG), especially on its *Immediate Dominance/Linear Precedence* formalism (ID/LP), and complements an earlier treatment of

German word order.[1] The framework is slightly modified to accommodate the relevant class of word order regularities.

The syntactic framework presented in this paper is not bound to any particular theory of discourse processing; it enables syntax to interact with whatever formal model of pragmatics one might want to implement. A brief discussion of the framework's implications for computational implementation centers upon the problem of the status of metagrammatical devices.

2. The Problem

German word order is essentially fixed; however, there is some freedom in the ordering of major phrasal categories like NPs and adverbial phrases – for example, in the linear order of subject (SUBJ), direct object (DOBJ), and indirect object (IOBJ) with respect to one another. All six permutations of these three constituents are possible for sentences like (1a). Two are given as (1b) and (1c).

(1a) Dann hatte der Doktor dem Mann die Pille gegeben.
     Then had the doctor the man the pill given

(1b) Dann hatte der Doktor die Pille dem Mann gegeben.
     Then had the doctor the pill the man given

(1c) Dann hatte die Pille der Doktor dem Mann gegeben.
     Then had the pill the doctor the man given

All permutations have the same truth conditional meaning, which can be paraphrased in English as: *Then the doctor gave the man the pill*.

There are several basic principles that influence the ordering of the three major NPs:

- The unmarked order is SUBJ-IOBJ-DOBJ
- Comment (or focus) follows non-comments
- Personal pronouns precede other NPs
- Light constituents precede heavy constituents.

[1] The best overview of the current GPSG framework can be found in Gazdar and Pullum (1982). For a description of the ID/LP format refer to Gazdar and Pullum (1981) and Klein (1983), for the ID/LP treatment of German to Uszkoreit (1982a, 1982b) and Nerbonne (1982).

The order in (1a) is based on the unmarked order, (1b) would be appropriate in a discourse situation that makes the man the focus of the sentence, and (1c) is an acceptable sentence if both doctor and man are focussed upon. I use *focus* here in the sense of *comment*, the part of the sentence that contains new important information. (1c) could be uttered as an answer to someone who inquires about both the giver and recipient of the pill (for example, with the question: Who gave whom the pill?). The most complete description of the ordering principles, especially of the conflict between the unmarked order and the topic-comment relation, can be found in Lenerz (1977).

3. Implications for Processing Models

Syntactic as well as pragmatic information is needed to determine the right word order; the unmarked-order principle is obviously a syntactic statement, whereas the topic-comment order principle requires access to discourse information.[2] Sometimes different ordering principles make contradictory predictions. Example (1b) violates the unmarked-order principle; (1a) is acceptable even if *dem Mann (the man)* is the focus of the sentence.[3]

The interaction of ordering variability and pragmatics can be found in many languages and not only in so-called free-word-order languages. Consider the following two English sentences:

> (2a) I will talk to him after lunch about the offer.
> (2b) I will talk to him about the offer after lunch.

Most semantic frameworks would assign the same truth-conditional meaning to (2a) and (2b), but there are discourse situations in which one is more appropriate than the other. (2a) can answer a question about the topic of a planned afternoon meeting, but is much less likely to occur after an order to mention the offer as soon as possible.[4]

Formal linguistic theories have traditionally assumed the existence of rather independent components for syntax, semantics, and pragmatics.[5] Linguistics not only could afford this idealization but has probably temporarily benefited from it. However, if the idealization is carried over to the computational implementation of a framework, it can have adverse effects on the efficiency of the resulting system.

If we assume that a language generation system should be able to generate *all* grammatical word orders and if we further assume that every generated order should be appropriate to the given discourse situation, then a truly nonintegrated system, i.e., a system whose semantic, syntactic, and pragmatic components apply in sequence, has to be inefficient. The syntax will first generate all possibilities, after which the pragmatic component will have to select the appropriate variant. To do so, this component will also need access to syntactic information.

In an integrated model, much unnecessary work can be saved if the syntax refrains from using rules that introduce pragmatically inappropriate orders. A truly integrated model can discard improper parses very early during parsing, thereby considerably reducing the amount of syntactic processing.

The question of integrating grammatical components is a linguistic problem. Any reasonable solution for an integration of syntax and pragmatics has to depend on linguistic findings about the interaction of syntactic and pragmatic phenomena. An integrated implementation of any theory that does not account for this interaction will either augment the theory or neglect the linguistic facts.

By supporting integrated implementations, the framework and analysis to be proposed below fulfill an important condition for efficient treatment of partially free word order.

4. The Framework and Syntactic Analysis
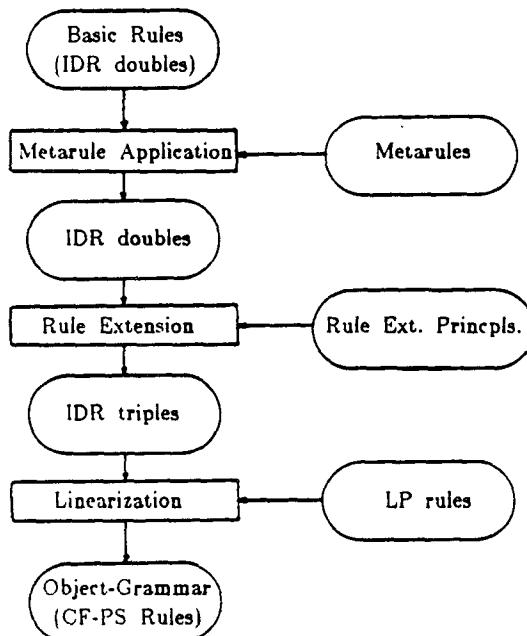
4.1 The Framework of GPSG in ID/LP Format

The theory of GPSG is based on the assumption that natural languages can be generated by context-free phrase structure (CF-PS) grammars. As we know, such a grammar is bound to exhibit a high degree of redundancy and, consequently, is not the right formalism for encoding many of the linguistic generalizations a framework for natural language is expected to express. However, the presumption is that it is possible to give a condensed inductive definition of the CF-PS grammar, which contains various components for encoding the linguistic regularities and which can be interpreted as a metagrammar, i.e., a grammar for generating the actual CF-PS grammar.

A GPSG can be defined as a two-level grammar containing a metagrammar and an object grammar. The object grammar combines (CF-PS) syntax and model-theoretic semantics. Its rules are ordered triples $\langle n, r, t \rangle$ where n is an integer (the rule number), r is a CF-PS rule, and t is the *translation* of the rule, its denotation represented in some version of intensional logic. The translation t is actually an operation that maps the translation of the children nodes into the translation of the parent. The nonterminals of r are complex symbols, subsets of a finite set of syntactic features or – as in the latest version of the theory (Gazdar and Pullum, 1982) – feature trees of finite size. The rules of the object grammar are interpreted as tree-admissibility conditions.

The metagrammar consists of four different kinds of rules that are used by three major components to generate the object

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[2] The heaviness principle requires access to phonological information in addition, but a discussion of this dependence is beyond the scope of this paper.

[3] Sentences that differ only in their discourse role assignments, e.g., do not focus on the same constituent(s), usually exhibit different sentential stress patterns.

[4] The claim is not that these sentences are not interchangeable in the mentioned discourse situations under any circumstances. In English, marked intonation can usually overwrite default discourse role assignments associated with the order of the constituents.

[5] Several more recent theories can account for the interaction among some of the components. Montague Grammar (Montague, 1974) and its successors (incl. GPSG) link semantic and syntactic rules. Work on presuppositions (Karttunen and Peters, 1979), discourse representations (Kamp, 1980) and Situation Semantics (Barwise and Perry, 1981) narrows the gap between semantics and pragmatics.

grammar in a stepwise fashion. Figure (3) illustrates the basic structure of a GPSG metagrammar.

(3)

First, there is a set of *basic rules*. Basic rules are *immediate dominance rule* (IDR) *doubles*, ordered pairs $< n, i >$, where n is the rule number and i is an IDR.

IDRs closely resemble CF-PS rules, but, whereas the CF-PS rule $\gamma \rightarrow \delta_1 \delta_2 \ldots \delta_n$ contains information about both immediate dominance and linear precedence in the subtree to be accepted, the corresponding IDR $\gamma \rightarrow \delta_1, \delta_2, \ldots, \delta_n$ encodes only information about immediate dominance. The order of the right-hand-side symbols, which are separated in IDRs by commas, has no significance.

Metarule Application, maps IDR doubles to other IDR doubles. For this purpose, metarules, which are the second kind of rules are applied to basic rules and then to the output of metarule applications to generate more IDR doubles. Metarules are relations between sets of IDRs and are written as $A \Rightarrow B$, where A and B are rule templates. The metarule can be read as: If there is an IDR double of kind A, then there is also an IDR double of kind B. In each case the rule number is copied from A to B.[6]

Several metarules can apply in the derivation of a single IDR double; however, the principle of *Finite Closure*, defined by Thompson (1982), allows every metarule to apply only once in the derivational history of each IDR double. The invocation of this principle avoids the derivation of infinite rule sets, in-

cluding those that generate non-CF, non-CS, and nonrecursive languages.[7]

Another component maps IDR doubles to IDR triples, which are ordered triples (n, i, t) of a rule number n, an IDR i, and a translation t. The symbols of the resulting IDRs are fully instantiated feature sets (or structures) and therefore identical to object grammar symbols. Thus, this component adds semantic translations and instantiates syntactic features. The mapping is controlled by a third set of *rule extension principles* including *feature co-occurrence restrictions, feature default principles*, and an algorithm that assigns the right kind of translation to each rule on the basis of its syntactic information.

The last component of the metagrammar maps the IDR triples to the rules of the object grammar. For each IDR triple all the object grammar triples are generated whose CF-PS rules conform with the *linear precedence* (LP) rules, the fourth rule set of the metagrammar. LP rules are members of the LP relation, a partial ordering on $V_T \cup V_N$. An LP rule (α, β) is usually written as $\alpha < \beta$ and simply states that α precedes β whenever both α and β occur in the right-hand-side of the same CF-PS rule.

It is the separation of linear precedence from immediate dominance statements in the metagrammar that is referred to as ID/LP format. And it is precisely this aspect of the formalism that makes the theory attractive for application to languages with a high degree of word-order freedom. The analysis presented in the next section demonstrates the functioning of the formalism and some of its virtues.

4.2 The Analysis of German Word Order

Uszkoreit (1982a) proposes a GPSG analysis of German word order that accounts for the fixed-order phenomena, including the notoriously difficult problem of the position of finite and nonfinite verbs. Within the scope of this paper it is impossible to repeat the whole set of suggested rules. A tiny fragment should suffice to demonstrate the basic ideas as well as the need for modifications of the framework.

Rule (4) is the basic VP ID rule that combines ditransitive verbs like forms of *geben (give)* with its two objects:

(4) (5. $VP \rightarrow NP, NP, V)$
$[+DAT][+ACC]$

This rule states that a VP can expand as a dative NP (IOBJ), an accusative NP (DOBJ), and a verb. Verbs that can occur in ditransitive VPs, like *geben (give)*, are marked in the lexicon with the rule number 5. Nothing has been said about the linear order of these constituents. The following metarule supplies a "flat" sentence rule for each main verb VP rule. [+NOM] stands for the nominative case, which marks the subject.

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[6] *Rule number* might be a misleading term for n because this copying assigns the same integer to the whole class of rules that were derived from the same basic rules. This rule number propagation is a prerequisite for the GPSG account of subcategorization.

[7] For a discussion see Peters and Uszkoreit (1982) and Shieber et al. (1983).

(5) $VP \rightarrow X, V \Rightarrow S \rightarrow NP, X, V$
     $[-\text{AUX}]$ $[+\text{NOM}]$

It generates the rule under (6) from (4):

(6) $(5, S \rightarrow NP, NP, NP, V)$
              $[+\text{NOM}][+\text{DAT}][+\text{ACC}]$

Example (7) gives a German constituent that will be admitted by a PS rule derived from ID rule (6):

(7) der Doktor dem Mann die Pille gegeben
     the doctor the man the pill given

I shall not list the rules here that combine the auxiliary *hatte* and the temporal adverb *dann* with (7) to arrive at sentence (1a), since these rules play no role in the ordering of the three noun phrases. What is of interest here is the mapping from ID rule (6) to the appropriate set of PS rules. Which LP rules are needed to allow for all and only the acceptable linearizations?

The position of the verb is a relatively easy matter: if it is the finite matrix verb it precedes the noun phrases; in all other cases, it follows everything else. We have a feature MC for matrix clause as well as a feature co-occurrence restriction to ensure that +MC will always imply +FIN (finite). Two LP rules are needed for the main verb:

(8a) +MC < NP
(8b) NP < −MC

The regularities that govern the order of the noun phrases can also be encoded in LP rules, as in (9a)-(9e):

(9a) +NOMINATIVE < +DATIVE
(9b) +NOMINATIVE < +ACCUSATIVE
(9c) +DATIVE   < +ACCUSATIVE
(9d) −FOCUS   < +FOCUS
(9e) +PRONOUN   < −PRONOUN

A feature FOCUS has been added that designates a focused constituent. Despite its name FOCUS is a syntactic feature, justified by syntactic facts, such as its influence on word order. This syntactic feature needs to be linked with the appropriate discourse information. The place to do this is in the rule extension component, where features are instantiated and semantic translations added to ID rules. It is assumed that in so doing the translation part of rules will have to be extended anyway so as to incorporate non-truth-conditional aspects of the meaning. For example, the full translation could be an ordered pair of truth-conditional and non-truth-conditional content, extending Karttunen and Peters's treatment of conventional implicature

(Karttunen and Peters, 1979)[8] or a function from discourse situations to the appropriate truth-conditional meaning in the spirit of Barwise and Perry (1981). The analysis here is not concerned with choosing a formalism for an extended semantic component, but rather with demonstrating where the syntax has to provide for those elements of discourse information that influence the syntactic structure directly.

Note, that the new LP rules do not resolve the problem of ordering-principle conflicts, for the violation of one LP rule is enough to rule out an ordering. On the other hand, the absence of these LP rules would incorrectly predict that all permutations are acceptable. The next section introduces a redefinition of LP rules that provides a remedy for this deficiency.

4.3 The Modified Framework

Before introducing a new definition of LP rules, let me suggest another modification that will simplify things somewhat. The LP rules considered so far are not really LP rules in the sense in which they were defined by their originators. After all, LP rules are defined as members of a partial ordering on $V_N \cup V_T$. Our rules are schemata for LP rules at best, abbreviating the huge set of LP rules that are instantiations of these schemata. This definition is an unfortunate one in several respects. It not only creates an unnecessarily large set of rules (V_N contains thousands of fully instantiated complex symbols) but also suppresses some of the important generalizations about the language. Clearly, one could extract the relevant generalizations even from a fully expanded LP relation, e.g., realize that there is no LP rule whose first element has −MC and its second element NP. However, it should not be necessary to extract generalizations from the grammar; the grammar should express these generalizations directly. Another disadvantage follows from the choice of a procedure for arriving at the fully expanded LP relation. Should all extensions that are compatible instantiations of (8a), (8b), and (9a)-(9e) be LP rules? If so, then (10) is an instantiation of (8a):

(10) $+MC$ NP
      $+DEF$ $<$ $+FIN$

      .   .

      .   .

      .   .

Yet nothing can be a matrix verb and definite simultaneously, and NPs cannot be finite. (10) is a vacuous rule. Whether it is a LP rule at all will depend on the way the nonterminal vocabulary of the object grammar is defined. If it only includes the nonterminals that actually occur in rules then (10) is not an LP rule. In this case we would need a component of the metagrammar, the feature instantiation principles, to determine

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another component of the metagrammar, the LP component.[9] LP will be redefined as a partial order on 2^F, where F is the set of syntactic features[10]

The second and more important change can best be described by viewing the LP component as a function from a pair of symbols (which can be characterized as feature sets) to truth values, telling us for every pair of symbols whether the first can precede the second in a linearized rule. Given the LP relation $\{\langle \alpha_1, \beta_1 \rangle, \langle \alpha_2, \beta_2 \rangle, \ldots, \langle \alpha_n, \beta_n \rangle\}$ and a pair of complex symbols $\langle \gamma, \delta \rangle$, the function can be expressed as in (11).

(11) $c_1 \wedge c_2 \wedge \ldots \wedge c_n$ where
$c_i = \neg (\alpha_i \subseteq \delta \wedge \beta_i \subseteq \gamma)$
for $1 \leq i \leq n$

We call the conjunct clauses LP conditions; the whole conjunction is a complex LP condition. The complex LP condition allows γ to precede δ on the right-hand side of a CF-PS rule if every LP condition is true. An LP condition c_i derived from the LP rule $\langle \alpha_i, \beta_i \rangle$ is true if it is not the case that γ has the features β_i and δ has the features α_i. Thus the LP rule $NP < VP$ stands for the following member of the LP relation $\langle \{+N, -V, +2BAR\}, \{-N, +V, +2BAR\} \rangle$. The LP condition following from this rule prevents a superset of $\{-N, +V, +2BAR\}$ from preceding a superset of $\{-N, +V, +2BAR\}$, i.e., a VP from preceding an NP.

But notice that there is nothing to prevent us from writing a fictitious LP rule such as

(12) $+\text{PRONOUN} < -\text{ACCUSATIVE}$

German has verbs like *lehren* that take two accusative noun phrases as complements. If (12) were an LP rule then the resulting LP condition defined as in (11) would rule out any occurrence of two pronominalized sister NPs because either order would be rejected.[11]

It is an empirical question if one might ever find it useful to write LP rules as in (12), i.e., rules $\alpha < \beta$, where $\alpha \cup \beta$ could be a subset of a complex symbol. Let me introduce a minor redefinition of the interpretation of LP, which will take care of cases such as (12) and at the same prepare the way for a more substantial modification of LP rules. LP shall again be interpreted as a function from pairs of feature sets (associated with complex symbols) to truth values. Given the LP relation $\{\langle \alpha_1, \beta_1 \rangle, \langle \alpha_2, \beta_2 \rangle, \ldots, \langle \alpha_n, \beta_n \rangle\}$ and a pair of complex symbols

$\langle \gamma, \delta \rangle$, the function can be expressed as in (13).

(13) $c_1 \wedge c_2, \wedge \ldots \wedge c_n$ where
$c_i = (\alpha_i \subseteq \delta \wedge \beta_i \subseteq \gamma) \rightarrow (\alpha_i \subseteq \gamma \wedge \beta_i \subseteq \delta)$
for $1 \leq i \leq n$

That means γ can precede δ if all LP conditions are true. For instance, the LP condition of LP rule (12) will yield false only if γ is $+$ACCUSATIVE and δ is $+$PRONOUN, and either γ is $-$PRONOUN or δ is $-$ACCUSATIVE (or both).

Now let us assume that, in addition to the kind of simple LP rules just introduced, we can also have complex LP rules consisting of several simple LP rules and notated in curled brackets as in (14):

(14) $\left\{ \begin{array}{lll} +\text{NOMINATIVE} & < & +\text{DATIVE} \\ +\text{NOMINATIVE} & < & +\text{ACCUSATIVE} \\ +\text{DATIVE} & < & +\text{ACCUSATIVE} \\ -\text{FOCUS} & < & +\text{FOCUS} \\ +\text{PRONOUN} & < & -\text{PRONOUN} \end{array} \right\}$

The LP condition associated with such a complex LP rule shall be the disjunction of the LP conditions assigned to its members. LP rules can be generally defined as sets of ordered pairs of feature sets $\{\langle \alpha_1, \beta_1 \rangle, \langle \alpha_2, \beta_2 \rangle, \ldots, \langle \alpha_m, \beta_m \rangle\}$, which are either notated with curled brackets as in (10), or, in the case of singletons, as LP rules of the familiar kind. A complex LP rule $\{\langle \alpha_1, \beta_1 \rangle, \langle \alpha_2, \beta_2 \rangle, \ldots, \langle \alpha_m, \beta_m \rangle\}$ is interpreted as a LP condition of the following form $((\alpha_1 \subseteq \delta \wedge \beta_1 \subseteq \gamma) \vee (\alpha_2 \subseteq \delta \wedge \beta_2 \subseteq \gamma) \vee \ldots \vee (\alpha_m \subseteq \delta \wedge \beta_m \subseteq \gamma)) \rightarrow ((\alpha_1 \subseteq \gamma \wedge \beta_1 \subseteq \delta) \vee (\alpha_2 \subseteq \gamma \wedge \beta_2 \subseteq \delta) \vee \ldots \vee (\alpha_m \subseteq \gamma \wedge \beta_m \subseteq \delta))$. Any of the atomic LP rules within the complex LP rule can be violated as long as the violations are sanctioned by at least one of the atomic LP rules.

Notice that with respect to this definition, "regular" LP rules, i.e., singletons, can be regarded as a special case of complex LP rules.

I want to suggest that the LP rules in (8a), (8b), and (14) are a subset of the LP rules of German. This analysis makes a number of empirical predictions. For example, it predicts that (15) and (16) are grammatical, but not (17).

(15) Dann hatte der Doktor dem Mann die Pille gegeben
            −FOCUS   +FOCUS   −FOCUS
            +NOM   +DAT   +ACC
       Then had   the doctor the man   the pill given

(16) Dann hatte der Doktor die Pille dem Mann gegeben
            −FOCUS   +FOCUS +FOCUS
            +NOM   +ACC   +DAT
       Then had   the doctor the pill the man   given

(17)?? Dann hatte der Doktor die Pille dem Mann gegeben
            −FOCUS   +FOCUS −FOCUS
            +NOM   +ACC   +DAT
       Then had   the doctor the pill the man   given

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[9]The widely used notation for noninstantiated LP rules and the feature instantiation principles could be regarded as meta-metagrammatical devices that inductively define a part of the metagrammar.

[10]Remember that, in an $\bar{X}$-syntax, syntactic categories abbreviate feature sets $NP = \{+N, -V, +2BAR\}$. The definition can easily be extended to work on feature trees instead of feature sets.

[11]In principle, there is nothing in the original ID/LP definition either that would prevent the grammar writer from abbreviating a set of LP rules by (12). It is not quite clear, however, which set of LP rules is abbreviated by (12).

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In (17) the sub-LP-rules +DAT < +ACC and −FOCUS < +FOCUS are violated. No other sub-LP-rule legitimizes these violations and therefore the sentence is bad.

This agrees with the findings of Lenerz (1977), who tested a large number of sample sentences in order to determine the interaction of the unmarked syntactic order and the ordering preferences introduced by discourse roles. There are too many possible feature instantiations and permutations of the three noun phrases to permit making grammaticality predictions here for a larger sample of ordering variants. So far I have not discovered any empirical deficiencies in the proposed analysis.

5. Implications for Implementations

The theory of GPSG, as described by its creators and as outlined in this paper, cannot be used directly for implementation. The number of rules generated by the metagrammar is just too large. The Hewlett-Packard system (Gawron et al., 1982) as well as Henry Thompson's program, which are both based on a pre-ID/LP version of GPSG, use metarules as metagrammatical devices, but with feature instantiation built into the processor. Agreement checks, however, which correspond to the work of the metagrammatical feature instantiation principles, are done at parse time. As Berwick and Weinberg (1982) have pointed out, the context-freeness of a grammar might not accomplish much when the number of rules explodes. The more components of the metagrammar that can be built into the processor (or used by it as additional rule sets at parse time), the smaller the resulting grammar will be. The task is to search for parsing algorithms that incorporate the work of the metagrammar into context-free phrase structure parsing without completely losing the parsing time advantages of the latter. Most PSG parsers do feature handling at parse time. Recently, Shieber (forthcoming) has extended the Earley algorithm (Earley 1970) to incorporate the linearization process without a concomitant loss in parsing efficiency. The redefinition of the LP component proposed in this paper can be integrated easily and efficiently into Shieber's extension.

If the parser uses the disjunctive LP rules to accept all ordering variants that are well-formed with respect to a discourse, there still remains the question of how the generator chooses among the disjuncts in the LP rule. It would be very surprising if the different orderings that can be obtained by choosing one LP rule disjunct over another did in fact occur with equal frequency. Although there are no clear results that might provide an answer to this question, there are indications that certain disjuncts "win out" more often than others. However, this choice is purely stylistic. A system that is supposed to produce high-quality output might contain a stylistic selection mechanism that avoids repetitions or chooses among variants according to the type of text or dialogue.

6. Conclusion

The proposed analysis of partially free word order in German makes the accurate predictions about the gram-

maticality of ordering variants, including their appropriateness with respect to a given discourse. The ID/LP format, which has the mechanisms to handle free word order, has been extended to account for the interaction of syntax and pragmatics, as well as for the mutually competing ordering principles. The modifications are compatible with efficient implementation models. The redefined LP component can be used for the implementation of stylistic choice.

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