Summary

In this paper, we show that Reiteration and Collocation relations as introduced by Halliday and Hasan may function as lexically biased discourse structure relations and that these relations are well represented by sequences of Mek&'s Lexical Functions (LFs). We propose to use LF sequences for the final determination and realization of discourse organization during lexical choice in text generation.

1 LEXICAL PHENOMENA IN DISCOURSE

1.1 The Problem

In text generation, the task of content selection and discourse organization, i.e., text planning, has often been opposed to the task of linguistic realization of the information selected and organized by the text planning process (cf., e.g., McKeown and Swartout, 1987). However, discourse organization is not possible without taking into account linguistic means that are available to express a particular meaning (cf., e.g., Meteer, 1992; Rubinoff, 1992). Especially the failure to integrate lexical choice into the planning process may lead to monotonous, awkward, or even ungrammatical text (note that when used separately, the clauses in (1a) and (2a) are fully acceptable):

(1) a. *Alle bewahrten Ruhe; nur Hans konnte keine Ruhe (sie nicht) bewahren* lit. 'All kept calmness; only Hans could not keep calmness/ it'.

vs.

b. Alle bewahrten Ruhe; nur Hans konnte nicht ruhig bleiben lit. 'All kept calmness; only Hans could not keep calm'.

(2) a. Der langegeplante Ausflug fand am Sonntag statt; wir unternehmen ihn mit der ganzen Familie lit. 'The long-planned trip took place on Sunday; we undertook it with the entire family'.

vs.

b. Der langegeplante Ausflug fand am Sonntag statt; die ganze Familie nahm dann teil lit. 'The long-planned trip took place on Sunday; the entire family took part in it'.

These examples show that lexical constraints are of a special relevance to discourse organization if related discourse segments communicate information on the same or related object, event, process, etc. While in the past, considerable work has been done on the realization of anaphoric links between related entities via referring expressions (cf., e.g., Tutin and Kittredge, 1992; Dale, 1989; Reiter, 1991), only a few proposals emphasize the relevance of lexical means for the realization of discourse structure relations such as CONTRAST in (1b) and ELABORATION in (2b) and (3b).

It is important to note that the actual realization of a discourse relation may vary with the semantics of the lexemes involved. For example, in (4), the second clause is an INTERPRETATION or CONSEQUENCE of the first, despite the analogous syntactic construction in (5), the second clause is a JUSTIFICATION or an EXPLANATION of the first, rather than an INTERPRETATION or CONSEQUENCE.

(4) *Hans machte eine Entdeckung; diese Entdeckung war wirklich lit. 'Hans made a discovery; this discovery was real'.

vs.

(5) *Hans machte eine Entdeckung; diese Entdeckung war eine Entdeckung im wahrsten Sinne des Wortes lit. 'Hans made a discovery; this discovery was a discovery in the real sense of the word'.

1.2 The Proposal

Such relations as those between *Ruhe bewahren* '[to] keep calmness' and *ruhig bleiben* '[to] keep calm' (in 1); between *Ausflug findet statt* 'trip takes place' and *Ausflug teilnehmen* '[to] take part in the trip' (in 2); and between *Entdeckung* 'discovery' and *im wahrsten Sinne des Wortes* 'in the real sense of the word' (in 3) have been introduced by (Halliday and Hasan, 1976) as Reiteration and Collocation relations.

In this paper, we use the names of discourse structure relations as they are known from the Rhetorical Structure Theory (Mann and Thompson, 1987).

Although preferably used so far to describe discourse links between information segments realized by nouns, Reiteration and Collocation relations may well hold between segments which are realized by other parts of speech and even by multiple word expressions.
Reiteration stands for a strict repetition of a lexical expression in related discourse segments; for a substitution of a lexical expression by a synonym, or for a substitution by a superordinate. Consider the following examples, which illustrate the three different reiteration relations (strict repetition in (7a), synonymy in (7b), and superordination in (7c)):

(6) Last year, Monica flew to Italy.
(7) a. while Daniaela flew to Norway.
    b. while Daniela took the plane to Norway.
    c. while Daniela travelled to Norway.

Further substitution relations such as metaphoric repetition (7d), negated antonymy (7e), etc. can be added:

(7) d. while Daniela wasted away to Norway.
    e. Daniela also did not stay at home.

Collocation stands for 'any recognizable lexicosemantic relation' between lexical expressions in related discourse segments. Examples of collocation relations are attribution (7f), partition (7g), means (7h), etc.:

(7) f. it was a very pleasant journey.
    g. making a stop over in Munich.
    h. it was one of those big aircrafts.

As our examples show, reiteration and collocation relations help to ensure not only cohesion, but also coherence in texts. Therefore, a text generator has to provide an organization of lexical resources that tailors these relations to reiteration and collocation relations. This presupposes, on the one hand, a precise picture of which reiteration and collocation relations are available in language and how they are realizable; and, on the other hand, a fine-grained discourse model that contains these relations.

To make allowance for the global discourse organization, which is performed independently from lexical resources, we suggest a two level task implementation, with the first level realized by a Rhetorical Structure Theory (RST) (Mann and Thompson, 1987) style text planner and the second level - by a separate lexical choice module. Then, the discourse organization of a text is done in two steps: in the first step, the text planner predetermines the discourse structure relations; in the second step, the lexical choice module provides, in accordance with linguistic constraints, the final determination and the realization of these discourse structure relations.

The present paper reports an attempt to define lexically biased discourse structure relations used in a partially implemented lexical choice module. Due to the lack of space, we do not discuss the module itself; it is described in detail in (Wanner, 1992, 1994). Here, we demonstrate how discourse organization for text generation can be refined by lexically biased discourse structure relations and how these relations are related to global discourse relations specified in the output of an RST style text planner.

In contrast to the most discourse models (cf., e.g., McKeown, 1985; Grosz and Sidner, 1986; Mann and Thompson, 1987), which take the clause as the minimal discourse segment, we consider as discourse segments “perspectives” (cf. McCoy, 1989) — specific views taken on a semantic entity (an object, an event, etc.). A perspective is a wording which is tailored to the lexical repertoire of an entity; it is realizable as a clause, a phrase, or as a single lexeme. Each of the clauses in the examples above can be considered as a realization of a single perspective; and the reiteration and collocation relations that hold between the clauses — as well-defined perspective pairs.

In our model, a single perspective is represented as a composition of Mel'čuk’s Lexical Functions (hereafter LFs) (Mel’čuk and Polguère, 1987); perspective pairs are represented as LF sequences.

The following distinctive features characterize our model:

- it makes sure that all relations defined are expressible in language,
- it allows for a realization of lexical relations as subcultural relations between discourse segments,
- it is sensitive to lexical and syntactic variations for the realization of discourse structure relations.

2 LEXICAL FUNCTIONS IN DISCOURSE

2.1 The Basics

Formally speaking, an LF f is a standard semantico-lexical relation which holds between a lexeme l(f) (the keyword of f) and a set of lexemes f[l,] (the value of f). Examples of LFs are:

- Syn: 'synonym'
- Anti: 'antonym'
- Gener: 'hyperonym'
- Figur: 'metaphor'
- Conv: 'conversion'
- Syn: 'synonymy'
- Anti: 'antonymy'
- Gener: 'hyperonymy'
- Figur: 'metaphor, rep.'
- Conv: 'conversion'

Hereafter, the following distinctive features characterize the following features:

- Syn(bible) = God’s Book
- Anti(victory) = defeat
- Gener(lamb) = meat
- Figur(fog) = wall
- Conv(to include) = [to] belong
- So: 'situation'
- Sa(to teach) = teaching
- A0: 'agent'
- S1(lie) = liar
- A1: 'time'
- V1(Deal) = deal
- Vn: 'action'
- Vn(deal) = [to] deal
- Magn: 'intense(ly)'
- Magn(belong) = real, stunning
- Ops: 'perform'
- Ops(cry) = [to] let out (a cry)
- Incep: 'beginning'
- Incep(to sleep) = [to] fall asleep
- Fin: 'end'
- Fin(to sleep) = [to] wake up
- Caus: 'causation'
- Caus(to sleep) = [to] put to sleep
- Manif: 'manifestation'
- Manif(happy) = [to] beam with joy

Mel’čuk distinguishes about sixty simple LFs of the above kind. Simple LFs can further be combined with...
Moreover, the existence of LF $A$ LF in a language does not mean that LF $A$ LF is also available. Therefore, in LF sequences, one argument is the 'hub' - the point of departure (or the expanded LF) and the other argument is the 'hub expander'. How a specific LF can be expanded, i.e., which LF sequences are possible, depends individually on this LF, and on which LFS are further available for the entity the LFS are applied to. Compare, e.g., the LF sequences that instantiate the negated antonymy reiteration for $V_0$ (forgetting) and the two, which instantiate the same relation for $V_0$ (lie):

Forgetting (the $V_0$ clause is in all examples realized as $I$ forget; to abbreviate, we write '...') instead:

\[
\begin{align*}
V_0 & \text{ NOT Conv2l Anti}V_0 \quad \ldots ; \text{it does not} \\
V_0 & \text{ A (Magn o) NOT Anti}V_0 \quad \ldots ; \text{can (absolutely)} \\
V_0 & \text{ (Magn o) Ven} Oper_1 \text{ A Anti}S_0 \quad \ldots ; \text{not think of it (now).} \\
V_0 & \text{ (Magn o) NOT AntiSyn} \quad \ldots ; \text{(absolutely) no idea.}
\end{align*}
\]

LIE ('...' stands here for 'he is lying'):

\[
\begin{align*}
V_0 & \text{ NOT Oper} \text{ o } S_0 \text{ Anti}V_0 \quad \ldots ; \text{(simply) does not} \\
V_0 & \text{ A Gener}V_0 \text{ NOT Anti}V_0 \quad \ldots ; \text{tell the truth.} \\
V_0 & \text{ A Oper_1} \text{ o } \text{Anti}V_0 \quad \ldots ; \text{what he says is not true.}
\end{align*}
\]

Apart from the reiteration or collocation relation it stands for, an LF sequence is further characterized by its possible syntactic realizations and its functional content.

### 2.2 Syntactic Realizations of LF Sequences

As a rule, an LF sequence is realizable by several different syntactic constructions. How these constructions can look like is predetermined by each LF sequence individually (and by the information to be communicated). For example, $\text{Oper}_1$ $\text{A Oper}_1$ (more precisely, strict repetition) is in general realizable only as a paratactic complex clause; cf. Have a look at it; please have a look. In contrast, for example, $\text{Oper}_1$ $\text{A Magn o S}_0$ is realizable when applied to, e.g., decision — by all syntactic constructions possible, cf.:

\[
\begin{align*}
(8) & \quad \text{a. John made a decision; this decision} \quad \text{was important to him (paratactic complex clause);} \\
& \quad \text{b. John made a decision, which was important} \quad \text{to him (hypotactic complex clause);} \\
& \quad \text{c. The decision, which John made, was important} \quad \text{to him (embedded clause);} \\
& \quad \text{d. John made an important decision} \quad \text{(simple clause);} \\
& \quad \text{e. John's recently made important decision} \quad \text{(phrase).}
\end{align*}
\]

The relevance of syntactic variations for the realization of discourse structure relations is well known, cf., e.g., (Hovy, 1993).
2.3 Functional Content of LF Sequences

Semantics, lexis, and syntax of LF sequences do not provide sufficient criteria for the choice of one sequence over all other comparable ones. These criteria must be provided by the functional content we associate with each sequence (or reiteration and collocation relation, respectively). The functional content of the reiteration and collocation relations listed in Table 1 is presented in Table 2.5

| strict repetition | insisting restatement |
|--------------------|-----------------------|
| synonymy           | clarifying restatement |
| superordination    | generalizing restatement, clarifying restatement, class-referencing |
| metaphor replication | illustrative restatement, picturesque restatement, intensifying restatement |
| negated antonymy   | contrasting restatement |
| conversion         | clarifying restatement, constituent enhancement, perspective shifting |
| process-actor      | identification, actor-introduction |
| cause-process      | processual enhancement, causal enhancement, cause introduction |
| initialization-process | processual extension, beginning extension |
| attribution         | attributive refinement |
| manifestation       | predicative refinement, manifestation enhancement |

Table 2: Functional content of some reiteration and collocation relations

3 TOWARDS LEXICALLY BIASED DISCOURSE RELATIONS

Due to their functional content, LF sequences serve as instantiations of individual discourse structure relations. In our work, we suggest that these individual discourse structure relations can be organized coherently in terms of the functions and semantic distinctions they represent. In accordance with the claim that the availability of specific LF sequences is dependent on the entities the LFs are applied to, we further suggest that this organization must be done individually for each predicative entity (cf. Wanner, 1994).

Based on this, we define taxonomies (one for each predicative entity) which have been inspired by Halliday’s proposal for grouping interclausal logico-semantic relations (cf. Halliday, 1985). How such an organization can be realized efficiently using inheritance techniques is described in (Wanner, 1992).

Although our model is not restricted to interclausal relations, two features of Halliday’s proposal are valuable to us: (i) that a logico-semantic relation ‘expands’ one wording by another one rather than connecting two given wordings and (ii) that a logico-semantic relation can be further decomposed with respect to its: 1. semantics, 2. syntactic realization, 3. communicative structure, and 4. with respect to the speaker’s intention, which motivates the selection of this relation during the text production process.

In what follows, we discuss first the general taxonomy of our ‘expanding’ discourse structure relations for processes and then the decomposition of the relations along these four dimensions. Following the conventions in RST, we call the expanded part ‘nucleus’ and the expanding one ‘satellite’.

3.1 Taxonomy of Lexical Discourse Relations

A taxonomy of lexical discourse structure relations is to be understood as a hierarchy of alternative choices of increasingly delicate relations. The most delicate relations are LF sequences represented by their functional content. The top level of the taxonomy represents, thus, the most global types of expansion. In accordance with (Halliday, 1985), these are ELABORATION, EXTENSION, and ENHANCEMENT. ELABORATION subsumes all those expansions which ensure a deeper understanding of the meaning communicated by the nucleus wording. A deeper understanding of the nucleus wording is ensured by restating, refusing, or clarifying it (the next level of ELABORATION in the taxonomy). For example, all reiteration relations are of the ELABORATION type.

The EXTENSION expansions extend the meaning communicated by the nucleus wording. This can be done by introducing a new constituent that is related to what has been said in the nucleus, by adding a new action of the known constituents, etc. BEGINNING EXTENSION is, e.g., an EXTENSION.

The ENHANCEMENT expansions qualify the meaning communicated by the nucleus wording by adding a reference of causation, time, location, manner, mode, etc. An example of ENHANCEMENT is CAUSAL ENHANCEMENT.

Figure 1 shows in more detail the ELABORATION fragment of the taxonomy in network form. According to this figure, RESTATEMENT can be realized as a CONTRASTIVE, a GENERALIZED, or as a REPEATING RESTATEMENT, respectively. As shown in Table 2, CONTRASTIVE RESTATEMENT corresponds to the reiteration NEGATED ANTONYMY, GENERALIZING RESTATEMENT to SUPERORDINATION, respectively. REPEATING RESTATEMENT is further INSISTING, CLARIFYING, ILLUSTRATIVE, PICTORESQUE, etc. (see again Table 2 for corresponding reiteration relations).

5This is not to say that these functions are the only ones that are possible.
3.2 Decomposition of Lexical Discourse Structure Relations

As presented in Figure 1, the relations are still too global to be useful for lexical choice. Consider, e.g., ATTFIUBUTION -- a subtype of the REFINEMENT relation; it allows for various decompositions with respect to all four dimensions mentioned above:

- **Semantics**: thus, ATTFIUBUTION can mean ATTFIUBUTION, e.g., of a process, of one of the participants of this process, or of one of the circumstances of this process; if ATTFIUBUTION of a participant (let’s say the ACTOR) is meant, it is still undetermined what kind of attribution this is (e.g., a one which enables the actor to engage in the process, a one which prevents him from engaging in this process, etc.).

- **Syntactic realization**: how the various ATTFIUBUTIONs can be realized syntactically depends on the semantic and lexical properties of the information to be communicated. For example, Monica flew to Italy; it was a very pleasant journey is also realizable as a subordinated clause (Monica flew to Italy, which was very pleasant); as a simple clause (Monica had a very pleasant journey to Italy); and as a phrase (Monica’s pleasant journey to Italy).

- **Communicative structure**: the communicative structure of ATTFIUBUTION varies depending on the order in which nucleus and satellite are realized. Cf., e.g.: Monica flew to Italy; it was a very pleasant journey vs. It was very pleasant, Monica’s journey to Italy.

- **Speaker’s intention**: selecting the ATTFIUBUTION relation the speaker is assumed to intend,

---

Figure 2: The text plan for the text with the meaning “The man is lying; the consequence of this is that this man is a liar”

- e.g., a justification of what has been communicated in the nucleus as in John failed the exam; it was very difficult; a consequence of it John has been shot -- he is dead, etc.

The increasingly delicate specifications achieved by decomposition are also represented hierarchically in network form; one network for each dimension.

4 GETTING THE RELATIONS ACROSS

The lexical choice process, which makes use of the discussed discourse structure relation taxonomies, and the representation of lexical resources are described in detail in (Wanner, 1992, 1994). Here we focus on the interface between the first level text planning and the lexical choice module; and on the output as produced by the lexical choice module.

The computational framework in which our model has partially been implemented, is the systemic text generator KOMET (Bateman et al., 1991). One source of constraints for the first level text organization comes in KOMET from an RST-based planner.6 The output of this planner is a collection of case frames with RST relations holding between them as shown in Figure 2.

Starting from a text plan of this kind, the lexical choice module traverses a multilayered collection of networks (one of these layers is given by a taxonomy of lexical discourse structure relations discussed). During the traversal, the text plan is transformed into a lexicalized Partial Grammatical Structure (PGS),7 it is called ‘partial’ because it contains precisely that amount of grammatical information which is necessary

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6Recent developments of this planner are described in (Hovy et al., 1992).

7A PGS corresponds, roughly speaking, to the Partial Surface Functional Description (PSFD) specification of the COMET system (McKown et al., 1990).
for lexical choice. The PGS is passed to the grammar (a systemic grammar of German; cf. Teich, 1992) for final syntactic realization. Figure 3 shows a sample PGS encoded as a *Typed Features Structure* (cf. Hatemman et al., 1992).

The first and the most important task in tailoring the text plan to linguistic resources is to find a lexically biased discourse structure relation for the RST relation specified in the text plan. The search is done in accordance with the functional content, the intention of the speaker, and the contents of the arguments of the RST relation. If the RST relation connects unrelated case frames\(^6\) (as, e.g., EVIDENCE in *In winter, the days are short. It is getting light late and early dark.*), these case frames are realized independently without being connected by a lexical discourse structure relation. If the case frames are related, the following three variations are possible:

(i) An RST relation instantiation coincides with a lexical discourse structure relation; as, e.g., the instantiation of RESTATEMENT in the following rudimentary text plan coincides with our RESTATEMENT:

\[
\begin{align*}
(9)\text{a}. & \hspace{1cm} \text{Gaul is entirely occupied by the Romans; well, not entirely} \ldots \text{one small village still holds out.} \\
(9)\text{b}. & \hspace{1cm} \text{Gaul is almost entirely occupied by the Romans; but one small village still holds out.}
\end{align*}
\]

In this case, the taxonomy of lexical discourse structure relations is entered at a relatively general level (in the worst case at TOP).

(ii) An RST relation is not captured by our taxonomy (as, e.g., CONCESSION). Then, the corresponding case frames are treated as unrelated (see above).

5 RELATED WORK

Our proposal for the description of lexically biased discourse structure relations resembles Danlos' work (Danlos, 1987), who presented acceptable clause pattern sequences explicitly in a *Discourse Grammar*. The basic difference between Danlos' work and ours is that in the *Discourse Grammar*, clause pattern sequences are represented as concrete valency schemata while in our model they are represented as functional distinctions that encode sequences of IFS. As a result, we do not face the problem of being restricted to a concrete small domain as Danlos does.

Meteer's text planner (Meteer, 1992) is another proposal for the realization of lexically biased discourse structure relations. But while we argue that lexically biased discourse structure relations are to be realized by a functionally motivated lexical choice model, Meteer suggests a single structurally motivated model for text planning, which also subsumes lexical choice. This is different from, e.g., (Rubinov, 1992), who ensures the expressibility of discourse structure relations provided by a conventional text planner by annotating linguistic structures.

Elhadad's proposal (Elhadad, 1992) to use *Topoi* (inference rules that encode relations between propositions incorporating lexical material) as discourse structure relations is aimed at exploiting lexical phenomena for discourse organization. Elhadad focuses, however, on the 'argumentative potential' of lexical items rather than on lexically biased discourse structure relations.

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\(^6\)Case frames are considered to be unrelated if between them or one of their roles no identity, is-a, cause, location, etc. relation holds.
6 CONCLUSIONS AND FUTURE WORK

In this paper, we argued that it is useful to distinguish between two levels of discourse organization: a global discourse organization, which is not affected by linguistic means; and a finer discourse organization, which is built up in accordance with the linguistic material that is available for the meaning communicated.

We have shown that repetition and collocation relations may function as discourse structure relations and that these relations are well represented by Lexical Function sequences. We presented a taxonomy of lexically biased discourse structure relations, which is related to Halliday's proposal for grouping inter-clausal logico-semantic relations and suggested to use this taxonomy in a lexical choice module.

One of the open problems we face is how sufficiently detailed contextual constraints can be acquired in order to guide the choice of one discourse structure relation over others. This will certainly be one of the topics we will have to address in the future.

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References

Bateman, J. A. et al. (1991). Towards an Architecture for Situated Text Generation. In ICCICL, Penang, Malaysia.

Bateman, J. A. et al. (1992). The Nondirectional Representation of Systemic Functional Grammars and Semantics as Typed Feature Structures. In Proceedings of COLING-92, volume III, pages 916 - 929.

Dale, R. (1989). Generating Referring Expressions in a Domain of Objects and Processes. PhD thesis, University of Edinburgh.

Danks, L. (1987). The Linguistic Basis of Text Generation. Cambridge: Cambridge University Press.

Elbadal, M. (1992). Generating Coherent Argumentative Paragraphs. In Proceedings of COLING '92, volume II, pages 638 - 644.

Grosz, B. J. and L. Sidner (1986). Attention, Intention and the Structure of Discourse. In Computational Linguistics Journal, 12(3):175-204.

Halliday, M. A. K. and R. Hasan (1976). Cohesion in English. London: Longman.

Halliday, M. A. K. (1985). An Introduction to Functional Grammar. London: Edward Arnold.

Hovy, E. H. (1993). Automated Discourse Generation Using Discourse Structure Relations. In Artificial Intelligence, 63(1-2):341-386.

Hovy, E. et al. (1992). Employing Knowledge Resources in a New Text Planner Architecture. In Proceedings of the 6th Natural Language Generation Workshop, Trento, Italy.

Jordanskaja, L. N. et al. (1991). Lexical Selection and Paraphrase in a Meaning-Text Generation Model. In C. L. Paris et al. (editors), Natural Language Generation in Artificial Intelligence and Computational Linguistics. Dordrecht: Kluwer Academic Publishers.

Mann, W. C. and S. A. Thompson (1987). Rhetorical Structure Theory: A Theory of Text Organization. In L. Polanyi (editor), The Structure of Discourse. Norwood, New Jersey: Ablex Publishing Corporation.

McGoy, K. F. (1989). Generating Context Sensitive Responses to Object-related Misconceptions. In Artificial Intelligence, 41:157-195.

McKown, K. R. and W. R. Swartout (1987). Language Generation and Explanation. In Annual Reviews in Computer Science.

McKown, K. R., et al. (1991). Natural Language Generation in COMET. In R. Dale, et al. (editors), Current Research in Natural Language Generation. London: Academic Press.

McKown, K. R. (1985). Text Generation: Using Discourse Strategies and Focus Constraints to Generate Natural Language Text. Cambridge: Cambridge University Press.

Med'nik, I. A. and A. Polguère (1987). A Formal Lexicon in the Meaning-Text Theory (or How to Do Lexica with Words). In Computational Linguistics, 13(4):276-289.

Metee, M. W. (1992). Expressibility and the Problem of Efficient Text Planning. London: Pinter Publishers.

Reiter, E. (1991). A New Model of Lexical Choice for Nouns. In Computational Intelligence, 7(4).

Rubinoff, R. (1992). Integrating Textplanning and Linguistic Choice by Annotating Linguistic Structures. In Proceedings of the 6th Natural Language Generation Workshop, Trento, Italy.

Teich, E. (1992). Konext: Grammar Documentation. Technical report, GMD/Institut für Integrierte Publikations- und Informationssysteme, Darmstadt, Germany.

Tatin, A. and R. Kittredge (1992). Lexical Choice in Context: Generating Procedural Texts. In Proceedings of COLING '92, volume II, pages 763 - 769.

Wanner, L. and J. A. Bateman (1990). Lexical Cooccurrence Relations in Text Generation. In Proceedings of the 5th Natural Language Generation Workshop, Dartmouth, PA.

Wanner, L. (1992). Lexical Choice and the Organization of Lexical Resources in Text Generation. In Proceedings of the European Conference on Artificial Intelligence, Vienna, Austria.

Wanner, L. (1994). Building Another Bridge over the Generation Gap. In Proceedings of the 7th Natural Language Generation Workshop, Keenebunkport, Maine.
Parsing
