Phrases as Carriers of Coherence Relations

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Abstract

Coherence relations have mainly been studied as a mechanism for the representation of text structure based on the analysis of clauses and larger text fragments. A closer look at textual data reveals, however, that adjuncts, typically cued by prepositions, also have a coherence establishing function. We discuss empirical evidence for this claim, and outline a framework that integrates the semantic interpretation and recognition of coherence relations covert in prepositional phrases.

Introduction

Single sentences encode one or more propositions, the semantic content of an utterance. When sentences are grouped together to form a text, this does not just constitute a bag of such propositions. Rather texts are characterized by the property of being coherent.

The glue out of which coherent texts are made is typically attributed to so-called *coherence relations*. Basically, these relations link low-level propositions by causal connections, motivational links (e.g., relating a goal to a sequence of actions intended to accomplish that goal), property descriptions, and argumentative roles. This linkage between several propositions is crucial not only for simple fact retrieval from memory but also for other high-level cognitive tasks. Hence, making coherence relations available lies at the heart of any cognitively plausible approach to modeling human text comprehension and automatic text understanding, as well.

Given the importance of coherence relations for adequate text understanding, the question arises how these relations can be determined by explicit criteria and how this may be achieved by automated systems. The currently dominating approach derives coherence relations directly from particular cue words (i.e., sentence connectives such as *'because'*, *'alternatively'*, etc. [Knott and Dale, 1994, Marcu, 1998]).

In line with one of the most prominent approaches to coherence, Rhetorical Structure Theory [Mann and Thompson, 1988], such approaches typically take clauses as the elementary coherence bearing units, ignoring the role of more smaller units, i.e., phrases. We will argue that such *inter*clausal coherence analysis should be complemented by an analysis of *intra*clausal coherence, in order to obtain more accurate results, both with respect to completeness as well as with respect to correctness of the analyses performed.

When *phrases* are considered as the origin or target of coherence relations, it becomes evident that intraclausal coherence relations are explicitly cued (by prepositions or adverbs), but they also depend on implicit inferences at the semantic level, with references to the underlying commonsense or domain knowledge. While this finding coincides with commonly held views in the cognitive science community [Black, 1985, Meyer, 1985], usually no concrete specifications are supplied for how to compute coherence relations under these assumptions. In this paper, we will first present empirically supported arguments for phrases as the smallest units of coherence analysis, and then discuss explicit nonlexical, i.e., inferential criteria for deriving coherence relations from them.

Arguing for Phrases as Discourse Units

Intraclausal Coherence Phenomena

The main claim we make is that coherence relations not only have to be addressed at the *inter*clausal but also at the *intra*clausal level of discourse analysis. Unless this finer grain size for discourse units is chosen, we will argue in the following that some coherence relations will not be identified at all, or some of them will be identified but are invalid. Accordingly, we will treat at least some phrase types, *viz.* prepositional and adverbial phrases, as discourse units. Consider the following example:[1]

(1) a. *Mit dem P6LXZ-A wird Elitegroup aber kaum neue Kunden gewinnen.*
[With the P6LXZ-A – Elitegroup will hardly attract new customers.]

   b. *Mit einem PCI-Slot bietet das Motherboard zu wenig Platz für Erweiterungen.*
[With one PCI slot – the motherboard provides not enough space for extensions.]

A straightforward coherence analysis with relations from Rhetorical Structure Theory [Mann and Thompson, 1988][2] takes (1-b) as a single unit and links it to (1-a), probably via an

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[1] In the translations, important phrases keep the syntactic position of the original German sentences and are therefore separated with dashes.

[2] Relations referring to Rhetorical Structure Theory (henceforth referred to as RST) will appear *emphasized* and *Capitalized*.

Evidence	The Satellite, the not so important unit, provides evidence for the situation in the important unit, the Nucleus.
Explanation	The Satellite, which is typically independent of the will of an animate object, explains the Nucleus.
Cause	The situation in the Satellite causes the situation in the Nucleus.
Interpretation	The situation presented in the Satellite interprets (presents a different perspective on) the Nucleus and constitutes the opinion of the writer of the situation in the Satellite.
Means	The Satellite explains the means by which the Nucleus was done.

Table 1: Relations from Rhetorical Structure Theory.

Evidence relation, see Table 1.[3] Paraphrasing sentence (1-b) reveals, however, a plausible decomposition into two basic discourse units:

(2) a. *The motherboard has but one PCI slot,*
    b. *so it does not provide enough space for extensions.*

Obviously, (2-a) gives an *Explanation* for (2-b).[4] From a methodological point of view it cannot be justified to analyze Sentence (2) as being composed of two elementary units, while the prepositional phrase *"with one PCI slot"* should be an indistinguishable part of the whole Sentence (1-b).

Besides *missing* essential coherence relations by not looking at phrases as discourse units, we also have indications that even *wrong* analyses may result. Consider the following sentences:

(3) a. *Floptical Disks lassen sich nicht wie Festplatten ansprechen.*
    [Floptical disks cannot be addressed in the same way as ordinary hard disks.]
    b. *Diese Beschränkung ist aufgrund technischer Unterschiede notwendig.*
    [This restriction is – because of technical particularities – necessary.]

One might argue, granting the interpretative force of *'because of'*, that (3-b) gives a *Cause* for (3-a). On a closer look, however, this seems to be mistaken, because (3-b) can be said to *Interpret* (3-a). Its main assertions consist of an assessment of (3-a) as being a *"restriction"* and as being *"necessary"*. Obviously, the embedded prepositional phrase (*"because of . . . "*) specifies just the *Cause* for the necessity of the restriction, and is not related to sentence (3-a).

Criteria for Phrases as Discourse Units

Given that, on the one hand, at least some phrases should be analyzed as discourse units in their own right and that, on the other hand, certainly not all of them figure as discourse units, the question arises which criteria should be set up in order to single out true candidates for discourse units from spurious

ones. While [Grote et al., 1997] recognize that "prepositional phrases are the most compact form" to establish a coherence relation, [Marcu et al., 1999] are among the first who propose to consider those phrases as elementary discourse units that "are unequivocally the nucleus or the satellite of a rhetorical relation that adds some significant information to the text." However, the restrictions provided by this criterion proved to be too liberal for the choice of possible candidates.

Focusing on the role of prepositional phrases (PPs) in our paper, we propose a mix of two criteria. First, the syntactic criterion requires only those PPs to be candidates for discourse units, which are not syntactically mandatory *complements* of a governing syntactic head, for which we assume a subcategorization frame or a valency list. Phrases which do not match such a schema of their governing syntactic head are syntactic elements we refer to as *adjuncts*.

For example, the PP starting Sentence (1-b), *"with one PCI slot"*, figures as an adjunct. It gives optional information, since the remainder still forms a complete grammatical sentence, *"the motherboard provides not enough space for extensions"*. This stands in contrast to example (4), which contains a true complement:

(4) *We have to stop pointing our fingers at these kids, he said.*

In Sentence (4), neither should the PP *"at these kids"* be treated as a discourse unit, nor should any other mandatory phrase, such as the subject *"we"*.

At the semantic level we formulate the second major criterion. It is based on the assumption that semantic specifications of lexemes, independent of the specific semantic theory one subscribes to, are confined to "typical" properties, e.g., events are characterized by agents, patients, instruments, locations, time frames, etc. Since any straightforward semantic interpretation must account for these attributes, they should not be part of analyses targeting on coherence relations. Whenever nontypical, unpredictable information pieces have to be accounted for, coherence relations may capture their value-adding semantics. Therefore, only those PPs should be considered as discourse units

- whose straightforward semantic interpretation is precluded because they refer to nontypical properties;

- or whose semantic interpretation partially refers to typical properties, but the intended meaning is not fully covered by them; only additional computations – inferences taking the preliminary semantic interpretation as a starting point – completely account for the intended meaning.

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[3] In order to avoid a lengthy introduction to RST, the definitions are taken from the manual coming with the tool that we used for our analyses [Marcu et al., 1999]. It makes available an extension of the original RST relations [Mann and Thompson, 1988].

[4] This analysis reflects the impact of the cue word *"so"* in (2-b). More generally, whenever an implicit coherence relation can be made explicit by a paraphrase incorporating a specific cue word, then this coherence relation is always assumed to hold [Martin, 1992, p.184].

We will illustrate the main criteria which determine whether a PP should be treated as a discourse unit or not by contrasting the sample sentences (1-a) and (1-b). In Sentence (1-a), the PP specifies an instrument for attracting new customers. As it seems entirely reasonable to consider "instrument" as a typical property of "attraction" events, this example should straightforwardly be dealt with by standard semantic interpretation — the conceptual correlate of *P6LXZ-A* will be assigned as the value of a corresponding "instrument" attribute. In particular, this analysis need not take recourse to any notion of coherence relation, although the proponents of RST might consider a *Means* relation as being appropriate.

This typicality consideration does not carry over to an "explanation" of events, which is our interpretation of *"with one PCI slot"* from Sentence (1-b). Rather than being missed at the representational level, accounting for this information adds valuable, 'heavy' knowledge. Such a relation, however, can only be computed by additional inferences relating to the underlying domain knowledge base.

From Prepositional Phrases to Coherence Relations

We now briefly sketch a coherence analysis based on the considerations discussed in the previous section. To make this discussion more concrete, it is embedded in the framework of SYNDIKATE, a text analysis system under development in our lab [Hahn and Romacker, 1999b]. After being submitted to a syntactic analysis the dependency graph for Sentence (1-b) (cf. Figure 1) contains a prepositional adjunct (ppadj) subgraph which holds the phrase *"Mit einem PCI-Slot"*. (This analysis results from the valency specification for the main verb *"bietet"*.) In order to compute a semantic interpretation for Sentence (1-b) (assuming the framework of description logics [Woods and Schmolze, 1992]), the conceptual correlates of its content words are checked for role compatibility.

In this case, the major interpretation constraints derive from the main verb *"bietet" (provide)* which is represented as the concept PROVIDE (cf. Figure 2). It has three major conceptual roles, PROVIDE-PATIENT, PROVIDE-CO-PATIENT, and INSTRUMENT. The PROVIDE-PATIENT and PROVIDE-CO-PATIENT roles can be filled by some instance of MOTHERBOARD and SIZE, respectively, in the semantic interpretation phase. This causes conceptual interpretation processes to be triggered linking SIZE and MOTHERBOARD (cf. Figure 2) via the role SIZE-OF.
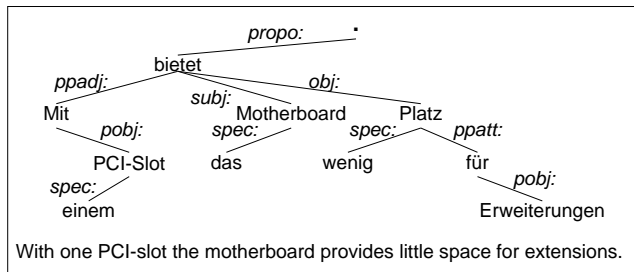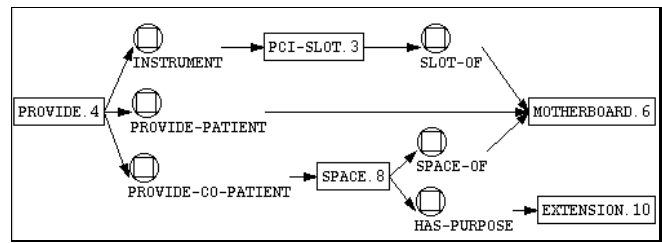

Figure 2: Semantic Interpretation for (1-b)

Focusing on the analysis of the PP, each preposition specifies *semantic constraints*, see [Hahn and Romacker, 1999a]. In the case of *"mit" (with)* they allow an interpretation of the dependency relation ppadj in terms of the conceptual INSTRUMENT role, so the corresponding role of SHOW-FEATURE is filled with PCI-SLOT during semantic interpretation. Conceptual interpretation, in addition, triggers the computation of a specialization of the PART-OF relation (SLOT-OF) between PCI-SLOT and MOTHERBOARD.

At this stage, we check whether the preposition might give rise to the computation of coherence relations. Corresponding *discourse constraints* of a preposition specify a set of possible coherence relations it may signal. These constraints were determined empirically, see Section (4). The constraints of permitted coherence relations are checked, taking the already computed semantic interpretation as a starting point. For *"mit" (with)* an *Explanation* may be signaled whenever the filler of the INSTRUMENT role stands in a PART-OF relation to the PROVIDE-PATIENT. As SLOT-OF is one of the subroles of the PART-OF relation, an *Explanation* relation is established.

Figure 2 also shows a PURPOSE relation linking instances of PHYSICAL-SIZE and EXTENSION that is due to semantic interpretation, in line with considerations which will be presented in the next section.

Evaluation of Coherence Data

The basic claim we try to back up by empirical analysis is that focusing on intraclausal coherence leads to more adaquate analyses, with respect to both completeness and correctness. In the following we will set out to validate the principal assumptions and criteria and not their implementation. For this task it is necessary to a) closely consider how many and which PPs can be seen as discourse units in their own right (i.e., checking the proposed criteria), b) how many of them have been missed in mainly clause-based analyses, and c) how many of these analyses could be judged as incorrect (similar to example (3)).

Distribution of Prepositional Phrases in the Corpora

The textual data for our study were taken from two sources – a German-language corpus of test reports from the information technology domain (31 texts, with approximately 7,700 text tokens), and a small set of English texts from the MUC corpus [MUC-6, 1995] (9 texts, with approximately 5,100 text tokens) for comparison purposes.

Figure 1: Dependency Analysis for (1-b)

For our empirical study we used RSTTOOL, a workbench for annotating texts in terms of their underlying coherence relations. The tool makes available an extension of the set of original RST relations. Both the tool and the English texts were kindly supplied by D. Marcu, see [Marcu et al., 1999].

The English texts were already analyzed and contained 795 discourse units connected by 379 relations. We re-analyzed these texts only with regard to prepositional phrases, modifying the original discourse analyses where appropriate. As the German texts were all analyzed with such a focus, we provide the distribution of units and relations in the next subsection.

Our analyses were performed in joint work by one of the authors and one student. During the discourse annotations, for each new clause to be segmented and related, we first determined the syntactic role of prepositional phrases, i.e. whether an identified PP should be seen as an adjunct or mandatory complement of its governing head. Next, when a coherence relation was unequivocally identifiable, the PP was taken as an elementary discourse unit and related with the coherence relation. As a result, we determined for each preposition the set of coherence relations it may give rise to.[5] Otherwise, we just recorded its likeliest interpretation. Obviously, the annotators needed to know about the hypothesis that (prepositional) phrases might trigger coherence relations. Therefore, the data presented below needs to be validated further.

Overall, we determined a total of 611 PPs in the German and 501 PPs in the English corpus. Table 2 lists their syntactic distribution, distinguishing between adjuncts and complements. The leftmost column indicates the syntactic head of the PP, either a nominal or verbal phrase, or an adjective/adverb.

	Adjuncts		Complements	
	German	English	German	English
NP	192	98	60	154
VP	176	128	159	109
Adj	10	5	14	7

Table 2: Syntactic Distribution of PPs in the Corpora

Distinguishing certain and dubious judgements, Table 3 shows the distribution of PPs that were solely analyzed by semantic interpretation, i.e., either no coherence relation could be determined or a semantic interpretation seemed entirely sufficient. We found that in those cases in which a *Means* or *Manner* relation might be used, the interpretation of the PPs just amounted to the assignment of values to reasonable and typical properties, see Example (1-a). Hence we felt that these cases should be dealt with by proper semantic interpretation and not be counted as coherence relations at all, just like locative/spatial and temporal information.

With regard to *Attribute/Restriction*, we found that many PPs that are adjuncts of NPs can be interpreted as specifying

attributes (such as *"the Matrox Millenium graphics card with 4 MByte SDRAM"*) or as stating restrictions for the interpretation of the NP (such as *"a computer with a Pentium is fast enough"*, where the PP picks a specific set of *"computers"*).

Interpretation	German		English	
	Cert.	Dub.	Cert.	Dub.
Locative/Spatial	37	16	25	0
Temporal	16	0	31	1
Means	44	3	4	0
Manner	22	0	4	1
Attribute/Restriction	205	0	226	0
Others	181	1	167	0

Table 3: PPs Not Considered as Discourse Units

Those cases that could neither be addressed by one of the given categories nor be treated as discourse units are listed as *Others*. Mostly these are cases in which the PP is a mandatory complement whose preposition has an almost idiomatic, at least a highly collocational status, see example (4). These phenomena are more adequately dealt with by lexicalized encodings covering the particular reading of the preposition rather than being treated by the general interpretation mechanism for prepositions.

PPs as Discourse Units in the Corpora

Table 4 summarizes the interpretation of PPs in terms of true coherence relations. For the German texts, we found 66 cases for which coherence relations were unequivocally identifiable, plus 20 dubious cases. In 63 cases, the prepositonal phrase appears in the middle of a clause. In this case, two units result from the remainder of the clause that need to be related by an artifical *Same-Unit* relation. Overall, the 66 identified PPs are responsible for 129 relations, including 63 *Same-Unit* relations. For the German texts, a total of 1713 units connected by 869 relations were identified. This means that 14.8% of coherence relations were of the intra-clausal type.

Our re-analyses of the English texts consisted only of additions and modifications of coherence relations due to PPs. This results in 884 units connected by 421 relations. Overall, 40 PPs give unequivocally rise to 51 coherence relations, plus 2 dubious cases. The 40 certain cases of coherence bearing PPs account for 12.1% of the coherence relations.

From those 40 PPs we considered as discourse units in the English texts, only 3 phrases were also analyzed by Marcu. This indicates that the common focus on clauses and larger fragments tends to provoke a certain analytical bias, just as we expected. So, the completeness of coherence analysis seems to benefit from the focus on adjuncts.

With regard to the syntactic criterion, almost all certain cases of discourse units (61 out of 66 in the German texts, 39 out of 40 in the English texts) are due to PPs that we judged as being adjuncts. In contradistinction, most of the dubious cases (15 of 20 for the German texts, 0 out of 2 for the English texts) coincide with the PP in a syntactically mandatory

Relation	German Adjuncts		Complements		English Adjuncts		Complements	
	Certain	Dubious	Certain	Dubious	Certain	Dubious	Certain	Dubious
Analogy	0	0	0	0	1	0	0	0
Attribution	5	0	0	0	1	0	0	0
Background	0	0	0	0	3	0	0	0
Cause	0	0	0	0	2	0	0	0
Circumstance	5	0	0	1	11	0	0	0
Condition	25	1	1	5	8	0	0	0
Consequence	0	0	0	0	2	2	0	0
Elaboration	0	0	0	0	2	0	0	0
Evaluation	0	0	0	0	1	0	0	0
Explanation	6	0	1	0	1	0	0	0
Purpose	20	4	3	9	5	0	0	0
Reason	0	0	0	0	2	0	1	0
Σ	61	5	5	15	39	2	1	0

Table 4: Prepositional Phrases Treated as Discourse Units

position. So the distinction between adjuncts and complements can be seen as a valid indicator for phrases that can be analyzed as discourse units.

With regard to the second criterion, it is necessary to explain the dubious cases. These often coincide with syntactically mandatory complements. As a result, it is often not clear whether the PP should be analysed semantically, although an interpretation in terms of a coherence relation would be possible. As an example, consider the next example, in which the prepositional phrase could be analysed as stating a *Purpose* for the graphics card.

(5) *Für die nächste Generation an Spielen sind Grafikkarten wie die Spea V7 nötig.*
[For the next generation of games – graphics cards such as the Spea V7 are required.]

In contradistinction, for those PPs we unequivocally considered as discourse units, an interpretation solely in semantic terms is usually hard to imagine, see Example (1).

Commenting on the correctness of the original English analyses, we found no cases of errors caused by overlooked PPs, contrary to our expectation. This may be explained by the fact that those cases in German are mainly triggered when the phrase occurs inside a clause – e.g., example (3-b). We found no corresponding example in the English data.

Finally, commenting on the quantitative distribution of coherence relations in Table 4, the large number of *Condition* and *Purpose* relations might largely be attributed to the chosen domain (information-technology). In this domain, judgements are often valid only under certain assumptions and conditions. Also, nearly all actions serve some purpose and are evaluated against it. One might be challenged then to treat *Condition* and *Purpose* as "typical" in this domain; hence they should probably even be treated by the standard semantic interpretation (as already assumed in Figure 2).[6]

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[6]See [Linden and Martin, 1995] for an account of the *Purpose*

Related Work

The notion of coherence relations is dealt with by a variety of approaches — structural ones in which linear text fragments are bracketed and organized in discourse trees by rhetorical relations [Mann and Thompson, 1988], logical ones in which metapredicates provide the inferential basis for linking basic predicate-argument structures [Lascarides et al., 1992], psychological ones in which the level of micropropositions is clustered in terms of conceptually coherent macropropositions [Kintsch and Dijk, 1978, Black, 1985]. Since none of these approaches incorporate syntactic considerations into their analyses (a syntactic analysis is assumed to deliver appropriate text chunks or propositions), they are unable to account for coherence relations encoded via PPs.

There are a few attempts to incorporate the role of cue words in computational approaches to determine coherence relations. These are based on the RST framework [Marcu, 1998], logical interpretations [Hobbs et al., 1993], or extensions of sentence grammars [Webber et al., 1999]. But in these approaches, the level of intraclausal analysis is not an issue. A recent study mentions the role of PPs as carriers of coherence relations [Grote et al., 1997], but only for the purposes of text generation.

Our distinction between semantic and discourse constraints looks similar to the semantic/pragmatic distinction found in [Sanders et al., 1992, Knott and Dale, 1994]. Their distinction, however, addresses the intended effects coherence cues have on the reader, while in our work discourse constraints establish interpretations beyond 'typicality' limits.

Another distinction relates to the role of empirical arguments related to coherence relations. Our study deals with the *quantitative distribution* of a set of coherence relations as encoded by various PPs, while in [Sanders et al., 1992] the *plausibility* of certain coherence relations fulfilling a set of

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relation in instructional texts that also acknowledges the role of intraclausal coherence.

criteria is judged by a number of subjects.

Conclusion

We have presented an approach in which the computation of coherence relations is made dependent on the semantic interpretation of a particular class of prepositional phrases, *viz.* adjuncts. The notoriously difficult distinction between complements and adjuncts has been resolved in a pragmatic way such that the syntactic notion of complements is associated with typicality considerations at the semantic level, and, similarly, adjuncts are associated with nontypical properties.

Text interpretation then proceeds via a two-step procedure. First, proper semantic interpretation is concerned with matching parsed utterances to (conceptual) representations in the lexicon. If a match is found (i.e., complements refer to typical properties/relations), one checks, in addition, whether inferential criteria for coherence relations are fulfilled. If no match can be found, an adjunct has been determined which, by definition, constitutes a possible discourse unit and has to be checked for more specific criteria for coherence relations.

One focus of our paper was on finding empirical evidence for the claim that PPs are important at all for coherence analysis. Indeed, we have detected a significant subset of coherence relations encoded as PPs (for the English data roughly 12%, for the German data 15%). These would have been lost if a cue-phrase-only approach were followed, since prepositions cannot be considered reliable predictors of (specific) coherence relations. They would, however, also have been lost with an inference-only approach, since each preposition may signal only some coherence relations. Therefore, they do not seem to be derivable from conceptual representations alone.

Given that this argument is valid, the computation of coherence relations must incorporate both the syntactic and semantic level, as well as inference rules which determine those knowledge structures which have to be superimposed by coherence relations.

References

[Black, 1985] Black, J. (1985). An exposition on understanding expository text. In Britton, B. and Black, J., editors, *Understanding Expository Text*, pages 249–267. Hillsdale, NJ: L. Erlbaum.

[Grote et al., 1997] Grote, B., Lenke, N., and Stede, M. (1997). Ma(r)king concessions in English and German. *Discourse Processes*, 24(1):87–118.

[Hahn and Romacker, 1999a] Hahn, U. and Romacker, M. (1999a). Incrementality and locality of language comprehension. In *Proc. Cognitive Science 99*, pages 202–207.

[Hahn and Romacker, 1999b] Hahn, U. and Romacker, M. (1999b). SYNDIKATE – generating text knowledge bases from natural language texts. In *IEEE SMC'99*, volume 5, pages V–918–V–923. IEEE Press.

[Hobbs et al., 1993] Hobbs, J., Stickel, M., Appelt, D., and Martin, P. (1993). Interpretation as abduction. *Artificial Intelligence*, 63(1/2):69–142.

[Kintsch and Dijk, 1978] Kintsch, W. and Dijk, T. (1978). Toward a model of text comprehension and production. *Psychological Rev.*, 85:363–394.

[Knott and Dale, 1994] Knott, A. and Dale, R. (1994). Using linguistic phenomena to motivate a set of coherence relations. *Discourse Processes*, 18(1):35–62.

[Lascarides et al., 1992] Lascarides, A., Asher, N., and Oberlander, J. (1992). Inferring discourse relations in context. In *Proc. ACL'92*, pages 1–8.

[Linden and Martin, 1995] Linden, K. V. and Martin, J. H. (1995). Expressing rhetorical relations in instructional texts: A case study of the purpose relation. *Computational Linguistics*, 21(1):29–59.

[Mann and Thompson, 1988] Mann, W. and Thompson, S. (1988). Rhetorical Structure Theory: toward a functional theory of text organization. *Text*, 8(3):243–281.

[Marcu, 1998] Marcu, D. (1998). *The Rhetorical Parsing, Summarization and Generation of Natural Language Texts*. PhD thesis, U Toronto.

[Marcu et al., 1999] Marcu, D., Amorrortu, E., and Romera, M. (1999). Experiments in constructing a corpus of discourse trees. In *Proc. ACL'99 Workshop 'Standards and Tools for Discourse Tagging'*, pages 48–57.

[Martin, 1992] Martin, J. (1992). *English Text*. Philadelphia: J. Benjamins.

[Meyer, 1985] Meyer, B. (1985). Prose analysis: purposes, procedures, and problems. In Britton, B. and Black, J., editors, *Understanding Expository Text*, pages 11–64. Hillsdale, NJ: L. Erlbaum.

[MUC-6, 1995] MUC-6 (1995). *Proceedings of the 6th Message Understanding Conference*. Columbia, Maryland, November 6-8, 1995. San Mateo, CA: Morgan Kaufmann.

[Sanders et al., 1992] Sanders, T., Spooren, W., and Noordman, L. (1992). Towards a taxonomy of coherence relations. *Discourse Processes*, 15:1–35.

[Webber et al., 1999] Webber, B., Knott, A., Stone, M., and Joshi, A. (1999). Discourse relations: A structural and presuppositional account using lexicalised TAG. In *Proc. ACL'99*.

[Woods and Schmolze, 1992] Woods, W. and Schmolze, J. (1992). The KL-ONE family. *Computers & Mathematics with Applications*, 23(2/5):133–177.