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Toward a synthesis of two accounts of discourse structure

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For almost a decade, there has been a debate in the computational discourse community between proponents of theories based on domain-independent rhetorical relations (most notably Rhetorical Structure Theory (Mann and Thompson 1988), henceforth RST) and those who subscribe to theories based on intentionality (most notably that of Grosz and Sidner (1986), henceforth G&S). Besides its inherent intellectual interest, this debate is important because it has divided the discourse community. Researchers interested in generating multisentential utterances, e.g., (McKeown 1985; Hovy 1993; Moore and Paris 1993), have developed algorithms and systems that rely on rhetorical relations, while researchers working in interpretation have focused on inferring the intentions of discourse participants and tracking attentional state. Now, of course, this is an oversimplified view. Some researchers, e.g., (Hobbs 1985) argue that rhetorical or “coherence” relations are needed for interpretation, and others (Moore and Paris 1993) have tried to integrate the two approaches. Still, in large part due to the debate between these two theories, there has been little interaction and cross-fertilization between the two communities.

In this paper, we compare what G&S and RST say about how speakers’ intentions determine a structure of their discourse. We use the term *Intentional Linguistic Structure*, or ILS, as a theory-neutral way of referring to this structure. The definition of ILS comprises one of the major claims in G&S. ILS is not directly addressed in RST, but is implicit in the RST concept of *nuclearity*. We argue that the key to reconciling ILS in the two theories lies in the correspondence between (a) the *dominance* relation between intentions in G&S and (b) the *nucleus:satellite* relation between text spans in RST. Roughly speaking, an RST nucleus expresses a G&S intention I_n , a satellite expresses another intention I_s and, in G&S, I_n dominates I_s . The correspondence between G&S dominance and RST nuclearity helps to clarify the relationship between ILS and informational structure. In particular, the undesirable possibility that RST informational structure could be incompatible with

intentional structure (Moore and Pollack 1992) is explained. Further, we argue that a synthesis of G&S and RST is possible because the correspondence between dominance and nuclearity forms a great deal of common ground and because the remaining claims in the two theories are also consistent.

1 Intentional Linguistic Structure in G&S

G&S is formulated in terms of the interdependence of three distinct structures. Of the three structures, it is the effect of *intentional structure* on *linguistic structure* that concerns us in this paper. This effect is an explicit claim about ILS.

In G&S, the intentional structure consists of the set of the speakers' communicative intentions throughout the discourse, and the relations of *dominance* and *satisfaction-precedence* among these intentions. The speaker tries to realize each intention by saying something; i.e., each intention is the purpose behind one or more of the speaker's utterances. Intentions are thus an extension of the intentions in Grice's (1957) theory of utterance meaning. Speakers intend the intentions behind their utterances to be recognized and for that recognition to be part of what makes their utterances effective. A purpose I_m dominates another purpose I_n when satisfying I_n is part of satisfying I_m . A purpose I_n satisfaction-precedes another purpose I_m when I_n must be satisfied first. The dominance and satisfaction-precedence relations impose a structure on the set of the speaker's intentions, the intentional structure of the discourse, and this in turn determines the linguistic structure.

The linguistic structure of a particular discourse is made up of segments, which are sets of utterances, related by embeddedness and sequential order. A segment DS_n originates with the speaker's intention: it is exactly those utterances that the speaker produces in order to satisfy a communicative intention I_n in the intentional structure. In other words, I_n is the discourse segment purpose (DSP) of DS_n . DS_n is embedded in another segment DS_m just when the purposes of the two segments are in the dominance relation, i.e., I_m dominates I_n . The dominance relation among intentions fully determines the embeddedness relations of the discourse segments that realize them. For example, consider the discourse shown in Figure 1, adapted from Mann and Thompson (1988). The whole discourse is a segment, DS_0 , that attempts to realize I_0 , the speaker's intention for the hearer to adopt the intention of attending the ballet. As part of her plan to achieve I_0 , the

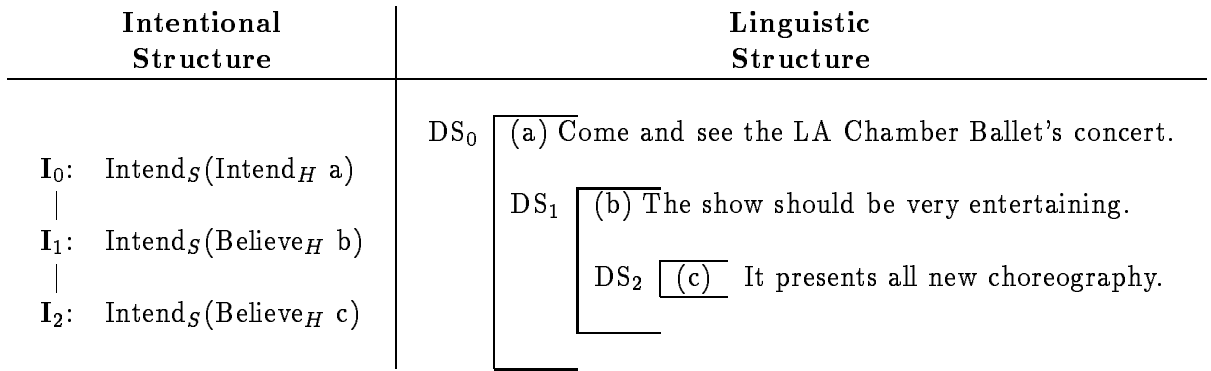


Figure 1: For G&S, dominance in intentional structure determines embedding in linguistic structure.

speaker generates I_1 , the intention for the hearer to adopt the belief that the ballet will be very entertaining. Then, as part of her plan to achieve I_1 , the speaker generates I_2 , the intention that the hearer believe that the show is made up of all new choreography. As shown on the left in Figure 1, I_0 dominates I_1 , which in turn dominates I_2 . Due to these dominance relations, the discourse segment that realizes I_2 is embedded in the discourse segment for I_1 , which is in turn embedded within the discourse segment for I_0 , as shown on the right in the figure. The dominance of intentions directly determines embedding of segments.

When one DSP I_n satisfaction-precedes another I_m , then DS_n precedes DS_m in the discourse. The satisfaction-precedes relation among intentions constrains the order of segments in the discourse, but it does not fully determine it. In the example, none of the intentions satisfaction precedes the others.

A segment may contain individual utterances as well as embedded segments. Because it will be important to the discussion below, we coin the term *core* to refer to those utterances in a segment that do not belong to an embedded segment. In the example, (a) is the core of DS_0 , (b) the core of DS_1 and (c) the core of DS_2 . As will be discussed, a core functions to manifest the purpose of the segment, while the embedded segments serve to help achieve that purpose.

It should be clear that the theory-independent notion of ILS as it was characterized above is exactly the linguistic structure in G&S. ILS is something G&S makes explicit claims about. By choosing to modify the terminology from simply “linguistic structure” to “*intentional* linguistic structure”, we mean to suggest that consideration of something other than speaker intentions–

namely, semantic relations— could determine another kind of structure to the discourse. Clearly, the semantic, or informational, relations among discourse entities can in principle be the determinant of a separate linguistic structure. Whether or not such an informational structure is useful or is related in an interesting way to ILS is a question requiring further research. We discuss the relationship between ILS and possible approaches to informational structure briefly in §4.

2 Intentional Linguistic Structure in RST

In contrast to its explicitness in G&S, ILS is only implicit in RST. In order to identify the implicit claims about ILS, we must first identify the components of an RST analysis that involve a judgement about the relation between intentions underlying text spans.

The range of possible RST text structures is defined by a set of *schemas*, which describe the structural arrangement of *spans*, or text constituents. Schemas are basic structural units or patterns in the application of RST relations. There are five schema patterns, each consisting of two or more spans, a specification of each span as either *nucleus* or *satellite*, and a specification of the RST relation(s) that exist between these spans. In this paper, we focus on the most commonly occurring RST schema, which consists of two text spans (a nucleus and a satellite) and a single RST relation that holds between them. The nucleus is defined as the element that is “more essential to the speaker’s purpose”, while the satellite is functionally dependent on the nucleus and could usually be replaced with a different satellite. As we argue below, this functional distinction between nucleus and satellite is an implicit claim about ILS, and is a crucial notion in understanding the correspondence between RST and G&S.

A schema application describes the structure of a larger span of text in terms of multiple constituent spans. Each of the constituent spans may in turn have a structure of subconstituent spans. Thus, the application of RST schemas in the analysis of a text is recursive, i.e., one schema application may be embedded in another. To be an acceptable RST analysis, there must be one schema application under which the entire text is subsumed and which accounts for all minimal units, usually clauses, of the text. In addition, each minimal unit can appear in exactly one schema application, and the spans constituting each schema application must be adjacent in the text. These constraints guarantee that a correct RST analysis will form a tree structure.

An instantiated schema specifies the RST relation(s) between its constituent spans. Each rela-

tion is defined in terms of a set of constraints on the nucleus, the satellite and the nucleus-satellite combination, as well as a specification of the effect that the speaker is attempting to achieve on the hearer’s beliefs or inclinations. An RST analyst must judge which schema consists of RST relation definitions whose constraints and effects best describe the nucleus and satellite spans in the schema application. Mann and Thompson claimed that, for each two consecutive spans in a coherent discourse, a single RST relation will be primary. For reasons discussed in Section 4.1, we consider only the RST presentational relations, or what Moore and Pollack (1992) call intentional relations, in identifying the ILS claims of RST.

To illustrate how a speaker’s intentions determine discourse structure in this theory, consider the RST analysis of the example discourse from Figure 1. As shown in Figure 2, at the top level, the text is broken down into two spans: (a) and (b-c). The span (b-c) forms a satellite that stands in a *motivation* relation to (a). This span can be further broken down into the two minimal units (b) and (c), where (c) is a satellite that stands in an *evidence* relation to (b)¹.

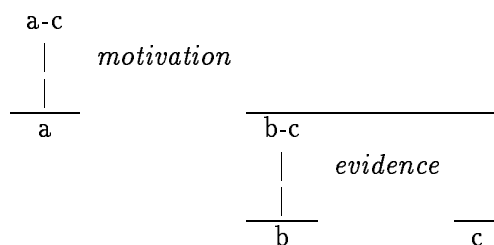


Figure 2: The RST structure assigned to the example discourse in Figure 1

While there is no direct representation of intentions in RST, the asymmetry between a nucleus and its satellite originates with the speaker’s intentions. The nucleus expresses a belief or action that the hearer is intended to adopt. The satellite provides information that is intended to increase the hearer’s belief in or desire to adopt the nucleus. Implicitly, this is a claim that the text is structured by the speaker’s intentions and, more specifically, by the difference between the intention that the hearer adopt a belief or desire expressed in a text span and the intention that a span contribute to this adoption. In the example, the nucleus (a) expresses an action that the speaker intends the hearer to adopt. The satellite (b-c) is intended to facilitate this adoption by providing the hearer

¹Space does not permit the definition of the *motivation* and *evidence* relations to be included here. See Mann and Thompson (1988).

with a motivation for doing the suggested action. In the embedded span, the nucleus (b) expresses a belief that the speaker intends the hearer to adopt and the satellite (c) is intended to facilitate this adoption by providing evidence for the belief.

The second implicit RST claim about ILS is a refinement of the first. The set of intentional relations is a range of ways a speaker can affect the hearer's adoption of a nucleus by including a satellite. That is, not only is there a functional distinction between nucleus and satellites, there is also a classification of satellites according to how they help achieve the hearer's adoption of the nucleus. Translating this into a claim about ILS, text is structured by the ways in which some utterances are intended to help other utterances achieve their purpose.

3 Correspondence between Dominance and Nuclearity

Now we are in a position to compare the explicit claims of G&S about ILS with the implicit ones of RST. Both theories agree that a discourse is structured into a hierarchy of nonoverlapping constituents, segments in G&S and spans in RST. Each subconstituent may in turn be structured in exactly the same way as the larger constituent. Superficially, the similarity ends there because the internal structure of segments and spans is different. In G&S, the internal structure of a segment consists of any number of embedded segments plus what we are calling the core, those utterances that express the discourse segment purpose and do not belong to any embedded segment. In RST, the internal structure of a span consists of a nucleus, which we have characterized as expressing a belief or action the hearer is intended to adopt, a satellite, which is intended to facilitate that adoption, and an intentional relation between the nucleus and satellite.

If we look more closely at the correspondence between dominance and nuclearity, we find that the structure of spans and segments are nearly identical. Specifically, an embedded segment corresponds to a satellite, and the core corresponds to the nucleus. Or, because G&S are not committed to a segment having both a core and embedded segments, a more accurate characterization of the correspondence would be that the nucleus manifests a dominating intention, while a satellite manifests a dominated intention. That is, dominance in G&S corresponds closely to nuclearity in RST. There is a relationship, which we can crudely characterize as that of linguistic manifestation, that links the nucleus to a dominating intention and a satellite to a dominated intention. Exactly

how to derive a communicative intention from an utterance, and vice versa, is one of the main research issues in computational linguistics. Here we simply assume that an utterance conveys either a belief or an action p and thereby makes manifest the speaker's intention that the hearer adopt belief in or an intention to perform p .

The correspondence suggests a mapping between G&S linguistic structure and RST text structure. An embedded segment in G&S will be analyzed as a satellite in RST, and the segment core will be the nucleus. When there are multiple embedded segments in G&S, each subsegment will be analyzed as an RST satellite. In these cases of multiple subsegments, the G&S core and an adjacent subsegment will be analyzed as an RST nucleus and satellite, forming an RST span. This span is then the nucleus of a higher span in which the satellite is an additional G&S subsegment from the same segment. The possibility of a coreless segment creates a complication in this mapping. In G&S, the definition of linguistic structure does not require a segment to contain a core. According to the theory, a segment can be composed entirely of embedded segments. In the RST schemas considered thus far, a span always consists of a nucleus and satellite. A less common schema pattern, known as the *joint* schema, contains multiple spans with no nucleus-satellite distinction among them joined into a single span. Coreless segments in G&S map to these joint schemas in RST.

Building on the correspondence between dominance and nuclearity, we raise two issues in the next sections. First, how do informational relations fit into the discourse structure? Second, what synthesis of the two theories emerges when we recognize the correspondence?

4 Informational structure

Moore and Pollack (1992) argued that RST defines two types of relations: intentional relations which arise from the ways in which consecutive discourse elements participate in the speaker's plan to affect the hearer's mental state, and informational relations between the information conveyed in consecutive elements of a coherent discourse. This is consistent with Mann and Thompson's (1988, p. 256) distinction between "presentational" (intentional) and "subject matter" (informational) relations. However, while Mann and Thompson maintain that for any two consecutive elements of a coherent discourse, one rhetorical relation will be primary (i.e., related by an informational or an intentional relation), Moore and Pollack showed that discourse interpretation and genera-

tion require that intentional and informational analyses exist simultaneously. Thus, in addition to the Intentional Linguistic Structure discussed so far, a discourse may simultaneously have an informational structure, imposed by domain relations among the objects, states and events being discussed.

4.1 Can intentional and informational structure differ in RST?

In addition to their claim that intentional and informational analyses must co-exist, Moore and Pollack presented an example in which the intentional and informational relations can impose a different structure on the discourse. However, it is important to understand that their example shows that the strict application of *RST informational relations* determine a discourse structure that is incompatible with the one determined by *RST intentional relations*. That is, the incompatibility arises because of the way in which RST relations are defined. More precisely, the incompatibility arises because the nucleus and satellite relationships in the intentional analysis of the discourse are inverted in the informational analysis for the particular example given by Moore and Pollack.

Now, in §3, we argued that nuclearity in an RST analysis is an implicit claim about speaker intentions, corresponding to the G&S relation of dominance among intentions. That is, nuclearity rightly belongs in the definitions of intentional relations. However, we argue that informational relations, properly construed, should not distinguish between nucleus and satellite in their definitions. As an example, consider the pair of RST relations *volitional-cause* and *volitional-result*. The *volitional-cause* is defined as one in which the nucleus presents a volitional action and the satellite presents a situation that could have caused the agent to perform the action. The effect of this relation is that the reader “recognizes the situation presented in the satellite as a cause of the volitional action presented in the nucleus.” The *volitional-result* relation is nearly identical except that the cause of the action is the nucleus and the result is the satellite. Why does RST need two relations to capture this? The reason is that the same domain relation, call it *cause-effect*, links a cause and effect regardless of which is the nucleus. For a particular instance of a *cause-effect* in the domain, it is equally plausible for a speaker to mention the effect to facilitate the hearer’s adoption of belief in the cause, or to mention the cause to facilitate the hearer’s adoption of belief in the effect. Moreover, this is precisely what the intentional relations capture. By incorporating the nucleus-satellite distinction in the definitions of RST informational relations, these relations in-

clude an implicit analysis of intentional structure. As a consequence, strict application of the RST informational relations can result in a different structure than the intentional relations, and this is the source of the problem noted by Moore and Pollack. Because nuclearity can only be determined by consideration of intentions, and intentional and informational analyses of a discourse must co-exist, we argue that the solution to the problem is to properly relegate information about nuclearity (intention dominance) to the intentional analysis, and remove it from definitions of informational relations. In this way, these two determinants of discourse structure cannot conflict. In addition, note that this is preferable to adding additional informational relations to allow either relatum to be the nucleus (as was done in the *volitional-cause* and *volitional-result* case) because this obscures the fact that relations such as *volitional-cause* and *volitional-result* appeal to the same underlying domain relation.

4.2 Relationship between ILS and informational structure

Once we recognize that an informational analysis is needed simultaneously with ILS and that the informational analysis should be determined by domain relations without reference to how the relations are employed by the speaker, exactly how to determine informational structure becomes an underconstrained question. Should all domain relations across utterances be analyzed in the informational structure? What patterns of informational relations are employed in realizing various kinds of intentions, and what analysis provides a reliable means for identifying such patterns? Final answers to these questions require further research. Because constraints may be needed in order to make progress on these issues, we point out two approaches to constraining the definition of informational structure. In Section 5.2 we suggest that RST informational relations provide a version of one of these approaches.

The most inclusive definition of informational structure would contain all the domain relations between the things being talked about. Included would be causal relations of various sorts, set relations, relations underlying bridging inferences (Clark and Haviland 1977), and the relation of identity between domain objects underlying coreference of noun phrases across utterances. By this definition, informational structure is a complex network of domain relations that is defined independently of the intentional structure. An analysis that keeps track of all domain relations in a discourse is an overwhelming task that is often infeasible. One approach to constraining

informational structure is to define it as parasitic on intentional structure. The informational structure would contain an accompanying informational relation for each intentional relation. A second approach to constraining informational structure is to define it as a network of domain relations with type restrictions on the relata. The informational structure would contain only the relations among situations, events and actions, the types of entities referred to by clauses.

5 A partial synthesis

The discussion in Section 3 suggests that RST and G&S share a large amount of common ground. That is, many of the claims in the two theories, although formulated differently, are essentially equivalent. To begin this section, we state the common ground that emerges from relating dominance and nuclearity. Then we briefly review the claims of each theory that are outside this common ground. Each theory has some consistent ground, additional claims that concern issues simply not addressed by the other theory. The actual contentious ground, claims made by one theory that are incompatible with the other, is quite small.

5.1 Common ground

Building on the correspondence between dominance and nuclearity, a partial synthesis of G&S and RST would be roughly the following. A segment/span arises because its speaker is attempting to achieve a communicative purpose. Such purposes have the feature that they are achieved in part by being recognized by hearers. Thus, the plan for achieving the purpose typically has two distinct parts: (1) one or more utterances that serve to make the purpose manifest by expressing a belief or action for the hearer to adopt (the core/nucleus) and (2) a set of subparts that contribute to achieving the purpose by manifesting subpurposes dominated by that purpose (the embedded segments/satellites).

Note that this synthesis encompasses the ILS claims of both theories regarding the example discourse. DS_0 is a segment/span designed to achieve the purpose I_0 . The plan for achieving I_0 is to first manifest I_0 by expressing the action in (a), the core/nucleus, and then to contribute to the achievement of I_0 by providing the motivation in (b-c), the embedded segment/satellite. In turn, DS_1 is a segment/span designed to achieve the purpose I_1 by first manifesting I_1 in the expression of

the core/nucleus (b) and then providing evidence in the embedded segment/satellite (c). Finally, I_2 is made manifest by (c), though no additional contribution to achieving this intention is provided.

5.2 Consistent ground

RST and G&S each makes claims about issues not addressed by the other theory. We review these claims briefly in order to establish that they are consistent. First, the two theories offer different but consistent perspectives on the ordering of segments/spans. In G&S, intentions may be related by satisfaction-precedence in addition to dominance. One intention satisfaction-precedes another when it must be realized before the other. This relation between intentions partially constrains the order of what is said and thus introduces a distinction between necessary order, originating with a satisfaction-precedence relation of the underlying intentions, and artifactual order, additional ordering that must be imposed to produce linearized text. Note that the relative ordering between a core and embedded segments always arises as part of artifactual ordering because the underlying intentions cannot be related by satisfaction-precedence. In RST, because the underlying intentions are not analyzed explicitly, the distinction between necessary and artifactual order is not available. Instead, the relative ordering of core/nucleus and embedded segment/satellite is highlighted. It is claimed that many relations have a typical ordering of their nucleus and satellite. The two theories address different aspects of ordering without suggesting any points of contention.

Second, in addition to intentional and linguistic structure, G&S posits an attentional structure. This component determines which discourse entities will be most salient and thereby imposes constraints on available referents for pronouns and reduced definite NPs. This is an important issue, but one that RST simply does not make claims about.

Finally, while G&S recognize that informational structure is a cue to recognition of intentional structure, the theory does not provide detail. RST does provide an analysis of informational relations. Section 4.1 claimed that these relations should not include any reference to nuclearity, a modification to the original RST. Without nuclearity, informational relations are simply domain relations that the hearer is intended to recognize. Section 4.2 points out two approaches to defining a constrained informational structure. If we pursue an informational analysis that is parasitic on the intentional structure, then the set of modified RST informational relations are a good candidate for the relations to use.

5.3 Contentious ground

The claims of G&S and RST discussed so far have been, we argued, either equivalent or compatible. We now turn to a point of contention between the two theories. There are distinctions among the RST intentional relations that, in G&S, would be subtypes of the dominance relation among intentions. However, G&S specifies that the only relations among intentions affecting discourse structure are dominance and satisfaction-precedence. Should the various RST intentional relations be incorporated into a synthesized theory? Here we suggest that, because the relations have a different significance for speaker and hearer, the answer depends on the application of the theory.

Consider the RST distinction between motivation and enablement relations as an example. When a speaker intends that a hearer adopt the intention to do some act, she manifests this intention by, for example, a command to do the act. At least two different problems may prevent the hearer's compliance, giving rise to the satellites in motivation and enablement relations. For motivation, the satellite supplies information in order to increase the hearer's desire to comply. The speaker reasons that, without the satellite information, the hearer will be less likely to want to do the suggested action. For enablement, the satellite supplies information in order to increase the hearer's ability to comply. In this case, the speaker reasons that, without the satellite information, the hearer will be less likely to be able to do the suggested action. The distinction between the two relations arises from the speaker's reasoning about what should be said in addition to the nucleus in order for the span to have the desired effect, the hearer's adoption of an intention to act and eventual performance of the act.

From the point of view of the hearer, the distinction is not significant. In the discourse of Figure 1, the speaker motivates the hearer to attend the ballet by mentioning that the show will be entertaining. It is not necessary, however, for the hearer to recognize that the speaker intended the comment about entertainment to have this effect. Rather, the hearer (1) must recognize the informational link of identity between the show mentioned in (b) and the concert in (a) and (2) must accept the speaker's judgement of an entertaining show. If these conditions obtain, the hearer will be more likely to attend the ballet. Alternatively, if the speaker provides the enablement satellite *The show begins at 8pm.*, the hearer (1) must recognize the same informational link as before and (2) must believe the statement. If these conditions obtain, the hearer will be better able to attend the ballet. The effect is achieved whether or not the hearer recognizes the speaker is trying to

achieve it.

Since the distinction among intentional relations has significance for the speaker but not the hearer, we suggest the distinction has more application for generation than for interpretation. The intentional relations help define a set of reasoning tasks involved in generation of multisentential text. In suggesting an action to the hearer, a system can reason about possible difficulties in getting the act adopted. Consideration of how likely the hearer is to adopt the action or to be able to perform it can help determine whether motivating or enabling information is needed. Similarly, in suggesting a belief to the hearer, a system can reason about possible difficulties in order to determine the most effective way to elaborate the presentation of the belief.

6 Conclusion

In this paper, we have argued that the two most prevalent theories of discourse structure in computational linguistics, G&S and RST, are not incompatible, but in fact have considerable common ground. The key to the basic similarity between these two theories is understanding the correspondence between the notions of dominance in G&S and nuclearity in RST. Understanding this correspondence between the theories will enable computational models that effectively synthesize the contributions of the theories, and thereby are useful both for interpretation and generation of discourse.

References

- Clark, H.H. and Haviland, S.E. 1977. Comprehension and the given-new contract. In Freedle, R.O., Ed., *Discourse Production and Comprehension*. Lawrence Erlbaum Associates, Hillsdale, NJ.
- Grice, H. Paul 1957. Meaning. *Philosophical Review* 68:377–388.
- Grosz, Barbara J. and Sidner, Candace L. 1986. Attention, intention, and the structure of discourse. *Computational Linguistics* 12(3):175–204.
- Hobbs, Jerry R. 1985. On the coherence and structure of discourse. Technical Report CSLI-85-37, Center for the Study of Language and Information, Leland Stanford Junior University, Stanford, California.

- Hovy, Eduard H. 1993. Automated discourse generation using discourse structure relations. *Artificial Intelligence* 63(1-2):341–385.
- Mann, William C. and Thompson, Sandra A. 1988. Rhetorical Structure Theory: Towards a functional theory of text organization. *Text* 8(3):243–281.
- McKeown, Kathleen R. 1985. *Text Generation: Using Discourse Strategies and Focus Constraints to Generate Natural Language Text*. Cambridge University Press, Cambridge, England.
- Moore, Johanna D. and Paris, Cécile L. 1993. Planning text for advisory dialogues: Capturing intentional and rhetorical information. *Computational Linguistics* 19(4):651–695.
- Moore, Johanna D. and Pollack, Martha E. 1992. A problem for RST: The need for multi-level discourse analysis. *Computational Linguistics* 18(4):537–544.