

Discourse and Information Structure

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This volume presents a collection of papers that address the interactions between discourse structure and information structure from a variety of perspectives. Their common goal is to improve our understanding of how utterance-internal semantic devices that make up information structure, and utterance-external semantic devices that make up discourse structure, interact to refer to and update a dynamically evolving representation of discourse context.

The papers collected in this volume have evolved from presentations at the *Workshop on Information Structure, Discourse Structure and Discourse Semantics* during the 13th European Summer School in Logic, Language and Information (ESSLLI) in Helsinki August 2001. The workshop set as its goal to bring together researchers interested in the interactions between discourse structure and information structure, with the aim to encourage progress towards an explanatory account of how sentence-level semantic devices that make up information structure symbiotically serve the needs of discourse cohesion and coherence. 8 out of an original 24 submitted and refereed papers and 2 invited talks were presented at the workshop. The authors of the workshop presentations and 3 further reserve papers were then invited to revise their papers, taking into account the feedback from discussions at the workshop, and resubmit them for this volume. We received 8 submissions, which were again refereed, and from which we had space to include 6. The intention was to assemble a coherent set of papers addressing a variety of closely related issues from different though related perspectives.

By *discourse*, we mean a coherent multi-utterance dialogue or monologue text. Discourse is more than a sequence of propositions, just as sentences are more than sequences of words. In discourse, both explicit and implicit devices signify links between utterances, between groups of utterances, and between elements within them, and in turn, carry additional elements of discourse semantics. We are thus taking *discourse structure* (DS) broadly, to cover all aspects of the internal organizational structure of a discourse. Discourse structure thus subsumes notions such as segmentation, relations between segments (in-



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formational and intentional), anaphoric relations, modal subordination, discourse topic, thematic progression, etc.

Information structure (IS) is also construed broadly here as comprising the utterance-internal structural and semantic properties reflecting the relation of an utterance to the discourse context, in terms of the discourse status of its content, the actual and attributed attentional states of the discourse participants, and the participants' prior and changing attitudes (knowledge, beliefs, intentions, expectations, etc.). This broad view of IS is meant to subsume the various dichotomies such as topic/comment, topic/focus, ground/focus, theme/rheme on the one hand, and given/new, background/focus, background/kontrast etc. on the other hand. (Section 1 presents IS terminologies in more detail.)

We believe it useful to think of the relation between DS and IS in terms of some extension to Grosz and Sidner's (1986) computational model. Specifically, IS seems to belong in the "Linguistic Structure", its discourse semantics seem related to the "Attentional State", and other rhetorical and illocutionary aspects of IS, to the "Intentional Structure". The notion of a center of attention (Grosz et al., 1995; Walker et al., 1998) also seems tightly related to the IS notion of theme.

Understanding IS in light of DS and vice versa is justified on more than just theoretical grounds: experience with applications such as translating telephony and interactive query-answering, as well as written text analysis and generation, makes it painfully clear that a theory relating IS and DS is essential for accurate natural language processing. Formal accounts addressing these issues have started to emerge, and some have been embodied in computational models of discourse processing involving intonation (Hirschberg, 1993; Nakatani et al., 1995; Monaghan, 1994; Prevost, 1995; Kruijff-Korbayová et al., 2003) or other aspects of IS realization, such as word order (Hoffman, 1995; Hoffman, 1996; Komagata, 1999; Kruijff-Korbayová et al., 2002). Further theoretical development as well as adaptation into practical systems will require expertise from linguistics, logic and computation. We hope to stimulate such symbiosis with the present volume.

While the phenomena involved in discourse and information structure are themselves complex and not yet fully understood, progress in studying their interaction is made even more difficult by proliferating terminologies, especially in the area of information structure. Before turning to the contents of this volume, we first try to establish some basic distinctions and definitions within which we believe all the theoretical positions represented in this volume can be compared and/or reconciled, and their often close relationships to each other be understood (Section 1). Based on what we hope is an uncontentious systematization of the terminology, we attempt an overview of this

volume, and discuss some relationships between the included papers, and the questions they address (Section 2).

1. Two Dimensions of Information Structure

The terminology describing Information Structure and its semantics is at the same time diverse, and under-formalized. Yet it seems that all definitions have some elements in common. They all draw at least one of these distinctions: (i) a “topic/comment” or “theme/rheme” distinction between the part of the utterance that relates it to the discourse purpose, and the part that advances the discourse; (ii) a “background/kontrast” or “given/new” distinction, between parts of the utterance—actually, words—which contribute to distinguishing its actual content from alternatives the context makes available.

There are differences among the theories of course. Some, like (Halliday, 1967), view the two distinctions as orthogonal, applying at independent levels of structure. Others, both in the Prague School tradition (Mathesius, 1929; Firbas, 1964; Sgall, 1967) and in the Bolingerian tradition (Bolinger, 1965), view them as different aspects of a single level of structure, e.g., (Sgall et al., 1986), (Vallduví, 1990), (Steedman, 2000) or Komagata, McCoy, and Polanyi et al. in this volume. An important issue that further differentiates the Bolingerian theories is that of whether pitch accent corresponds to a single contrastive notion applying to both theme and rheme, i.e., what (Steedman, 1991) calls “focus” and (Vallduví and Vilkuna, 1998) call “kontrast”, or whether “contrastive focus” is a distinct notion, applying to explicitly mentioned entities and associated with topic or theme alone.

Another issue where theories differ is recursivity of IS partitioning. That is, whether IS is a partitioning at the sentence level, clause level or possibly even lower ranks of syntactic structure.¹ Various authors allow various degrees of mild recursivity, e.g., for coordinated and some cases of subordinated clauses within complex sentences (Vallduví and Zacharski, 1994; Koptová, 1995; Hajičová et al., 1998; Kruijff-Korbayová and Webber, 2001). But there are also extreme positions, not allowing any recursivity (Vallduví, 1990; Sgall et al., 1986; Steedman, 2000) or allowing unlimited recursivity (Partee, 1995).

Many questions concerning the IS partitioning, and its realization in different languages await fuller empirical and corpus based studies.

¹ Some, including Komagata in this volume, argue for utterance as the unit of IS. But more research is needed to clarify what structural units can constitute separate utterances.

The following example illustrates the two dimensions of IS in action. We follow (Vallduví and Vilkuna, 1998) in distinguishing between theme/rheme and background/kontrast as the two dimensions of IS.

Q: I know that THIS car is a PORSCHE.

But what is the make of your OTHER car?

A: (My OTHER car) (is ALSO a Porsche)

L + H* LH% H* LL%

$\underbrace{\hspace{10em}}$
 $\underbrace{\hspace{10em}}$
 $\underbrace{\hspace{10em}}$

Background
Kontrast
Background
Kontrast
Background

$\underbrace{\hspace{10em}}$
 $\underbrace{\hspace{10em}}$

Theme
Rheme

For English, we follow (Steedman, 1991) in claiming that Information Structure is indicated by Intonation Structure, and that the pitch contour described as L+H* LH% in the notation of (Pierrehumbert, 1980) is one of the “theme tunes” that identify the intonational phrase *Mary admires* as the topic or theme of this utterance, while H* LL% is a “rheme tune”. Within both the theme and the rheme, the presence of one or more pitch accents identifies words which contribute to distinguishing that theme and/or that rheme from other themes and rhemes that the context affords. We follow (Bolinger, 1965) and (Lambrecht, 1994) in viewing the role of accent in English as a single undifferentiated contrastive meaning applying to both informational components, adopting the term *kontrast* introduced in (Vallduví and Vilkuna, 1998) and used by McCoy in the present volume to distinguish this narrow accent-related sense of the term from any other.

This use of the terms theme and rheme stems from Firbas and Bolinger, rather than Halliday; the theme/rheme dichotomy in Vallduví and Vilkuna’s, Steedman’s, Firbas’ and Bolinger’s analyses is straightforwardly comparable to the topic/focus dichotomy in the recent Prague School works (Sgall et al., 1986; Hajičová et al., 1998; Kruijff, 2001). The ground/focus dichotomy employed in (Vallduví, 1990) also more or less aligns with theme/rheme and topic/focus. However, Vallduví analyzes IS at the level of surface syntactic constituents, whereas the Prague School exponents and Steedman ascribe IS partitioning at some level of semantic representation, i.e., logical form or linguistic meaning. (For Steedman, IS is also directly represented at the level of syntactic derivation and, in English, intonation structure.)

The background/kontrast distinction is closely related to the Hallidean given/new dichotomy and the background/focus distinction of (Dahl, 1969). Background/kontrast partitioning can occur within both rheme and theme. Kontrast within rheme corresponds to what the Praguians call “focus proper”, whereas kontrast within theme corresponds to “contrastive Topic” in the most recent Praguian works

(Hajičová et al., 1998).² In the earlier information packaging terminology of (Vallduví, 1990), *kontrast* within *rheme* does not have any particular label, while *kontrast* within *theme* is comparable to *link* as part of *ground*, and *background* within *theme* is comparable to *tail* as part of *ground*.

There are further similarities between the various approaches to IS: while some of the theories leave the associated discourse semantics at an intuitive level, the theories which do address formal semantic issues all tend to use some version of “update” semantics of the *Kampo-Heimian* synthesis (Kamp, 1984; Heim, 1982) or *Alternative Semantics* (Rooth, 1985; Büring, 1995; Steedman, 2000), e.g., (Vallduví, 1990; Kruijff-Korbayová, 1998; Hendriks, 1998). For example, (Steedman, 2000) views context as an updatable database including two Roothian alternative sets, respectively called the “*Theme Alternative Set*” and the “*Rheme Alternative Set*” (corresponding also to what is called *membership set(s)* in (Vallduví and Vilkuna, 1998), and used in McCoy’s analysis in the present volume).

The diagram in Figure 1 summarizes this account of the influences and terminological dependencies in theories of Information Structure and the associated Discourse Structure. We venture to suggest that the terminology of (Vallduví and Vilkuna, 1998), as embodied in the twin dichotomies of *theme/rheme* and *background/kontrast* discussed above, provides a clear and unambiguous expression of the basic ideas that unite all these approaches.

2. Overview of this Volume

The papers in this volume can be seen as addressing two broad issues, each of which decomposes into a number of subsidiary questions

The unit of IS, and the role of IS-partitioning in discourse.

Several papers claim or are compatible with the view that basic IS units are also basic units of DS. There appears to be further agreement that Intonation Structure in English is identical to an underspecified form of DS, and in particular that intonational phrases correspond to information units. On the other hand, it is also quite clear, that themes and rhemes can be discontinuous within a single utterance.

Nobo Komagata examines alternative analyses of IS partitioning in complex sentences proposed in the literature. Using test methodologies

² The Praguian distinction between contextually bound and non-bound elements is not so straightforwardly alignable with *background/kontrast*, although it is usually, but perhaps inaccurately, also compared with Hallidean *given/new*.

including intonation, syntax and morphology, to access evidence from various languages including English, German and Japanese, he supports the view that IS is a non-recursive, matrix-level partitioning of an utterance. Whereas coordinated clauses in a complex sentence often constitute separate utterances, subordinate clauses usually are part of the matrix-clause utterance. But there are also cases of subordinate-like clauses functioning as separate utterances, having their own IS partitioning. Komagata argues for an incremental utterance-by-utterance model of discourse interpretation, where the IS of an utterance updates the DS constructed up to that point, resulting in a new DS.

Livia Polanyi, Martin van den Berg and David Ahn advance the view that IS plays an important role in co-determining how subsequent utterances (or: basic discourse units) relate to one another in terms of their attachment to an incrementally constructed discourse tree. They distinguish two essential types of relating subsequent IS-partitions, theme-theme chaining and theme-rheme chaining. They work out a detailed analysis of IS and DS interaction on a sample expository text, arguing that IS and DS are mutually co-constraining. Their proposal is not dependent on any particular approach to representing discourse context, and would be compatible with either an account based on Discourse Representation Theory or one using Alternative Semantics.

Katherine Forbes, Eleni Miltsakaki, Rashmi Prasad, Anoop Sarkar, Aravind Joshi and Bonnie Webber also argue for various aspects of sentence- and discourse-level processing in lockstep with one another. They present an implemented system for discourse parsing based on a lexicalized Tree-Adjoining Grammar for discourse. This approach allows elements to be lexicalized both with respect to sentence and discourse, and thus represent in the same way their contributions to both, as well as inter-relations between them. Although the current system does not directly address interactions between IS and DS, the approach allows for modeling such projections.

The semantics of IS and discourse context management.

Many discourse phenomena discussed in this volume appear to depend at least in part on IS representations in the context. This includes at least the meaning of discourse markers, anaphora and presupposition. While different authors employ different flavors of semantics, representing context as collections of alternative sets, filecards or discourse representation structures, they all work with context representations having a complex structure. The systems appear to differ mainly in notation, but be in some sense equivalent.

Svetlana McCoy examines the distribution of three Russian particles used as contrast-markers. She explains the regularities in their distribu-

tion in terms of the type of alternative set involved in the interpretation, the cognitive status of the kontrasted entities, and the intended context update function (e.g., an operation of adding or replacing contextual alternatives). There is a tight relationship between McCoy's and Komagata's analyses: both argue for extending the repertoire of the so-called "association-with-focus" phenomena (Rooth, 1992) and for deepening the formal semantic analyses towards the interaction between IS and DS. A consequence of Komagata's argument is that some phenomena attributed in the literature to theme/rheme partitioning, should be reworked in terms of the background/kontrast partitioning. This in turn influences our view of context management and the notion of context update potential as the meaning of an utterance.

Jeanette Gundel, Michael Hegarty and Kaja Borthen investigate pronominal reference to abstract entities introduced into the discourse model by clauses. They explain the difference between personal vs. demonstrative pronoun reference in terms of a difference in cognitive status of the underlying discourse entity, i.e., whether it is "in focus" or only "activated": While hearer-new abstract entities get the status of being activated by their mention in a clause, a status not sufficient for personal pronounreference, hearer-old abstract entities can get the in-focus status, and thus can be referred to by a personal pronoun.

Also *Jennifer Spenader* investigates reference to abstract entities. In her case, they are those referred to in the complements of factive verbs, both clausal and pronominal ones. Formal semantics treats factive verbs as presupposing their complements. Spenader's empirical study of factive verbs in spoken English has revealed that an overwhelming majority of clausal complements express hearer-new information, requiring the presupposition to be accommodated, as opposed to hearer-old information, in which case the presupposition could be bound. This appears unexpected against the background of the standard view of presupposition accommodation as a repair strategy. Spenader discusses some implications that her findings have for a general theory relating presupposition, anaphora and accommodation.

These papers note correlations between IS and the cognitive status of discourse entities referred to. McCoy stays neutral, as she correlates cognitive status with the notion of kontrast, which can occur in both theme and rheme. Gundel et al. point out that entities referred to in the theme (topic) of an utterance may be new to the discourse, but should be familiar to the addressee (discourse-new vs. hearer-old in terms of (Prince, 1981)). Spenader even suggests that the hearer-new status of the clausal complement tends to correlate with it being rhematic (belonging to the focus in Vallduví's terminology), while the hearer-old status correlates with it being thematic (belonging to the ground).

Such correlations are not commonly part of IS theories. The latter often stress that the speaker has a considerable degree of freedom to choose an IS-partitioning that suits her communicative purpose; hearer-new entities thus can belong to theme(s), while hearer-old entities can belong to rheme(s). Clearly, more empirical investigations are needed.

The question of how to reliably identify IS in naturally occurring discourse remains problematic, but some tests emerge as agreed methodology, including systematically altering intonation, word order and other parameters, or looking at the effect of IS-dependent discourse markers.

In addition to the submitted papers, *Robin Cooper* as one of the active ESSLLI'01 workshop participants, agreed to draw his conclusions from some of the contributions, in the form of an afterword to this volume. He relates IS and DS to notions like Question Under Discussion (QUD, (Ginzburg, 1996)), question accommodation and question reraising, which have been found useful for dialogue modeling in the information state update approach. Dialogue applications can serve to test various claims about IS and DS interaction. This comparison shows that there is still more to be gained from overcoming terminological differences, and bringing diverse perspectives together.

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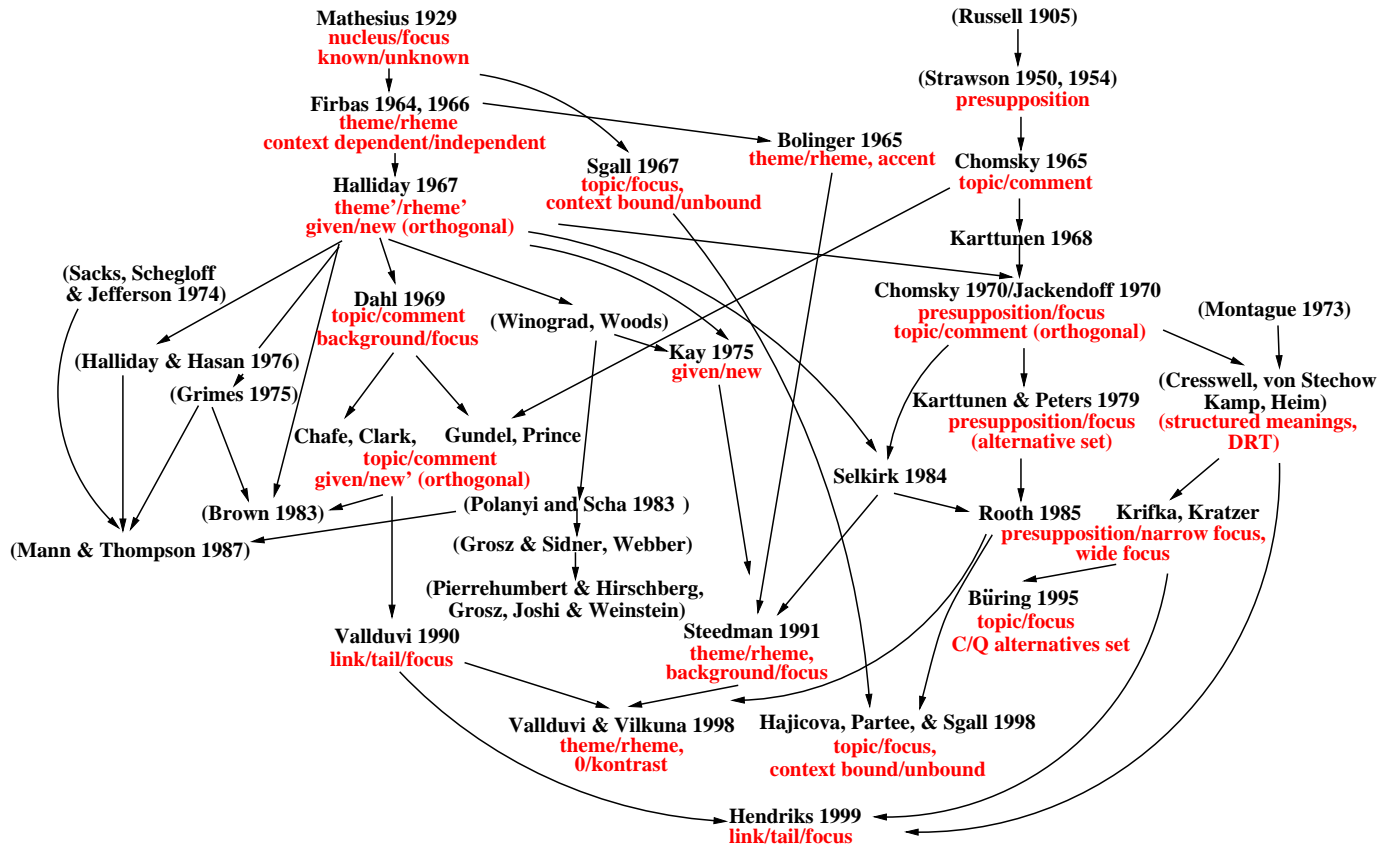


Figure 1. Information Structure Terminologies and their Dependencies