Chapter 18

Embedding in discourse

Elena Karagjosova
Freie Universität Berlin

Torgrim Solstad
Universität Bielefeld

The chapter addresses the question of what constitutes embedding in discourse and argues that discourse-structural subordination is a case in point. The concept of discourse-structural subordination is discussed both from the viewpoint of different theories applying the notion of "rhetorical" or "discourse relations", as well as in goal-driven approaches to discourse structure. The chapter also provides an overview of how discourse-structural embedding is realized in language with an emphasis on the relationship between discourse-structural and syntactic subordination. Finally, the notion of discourse subordination is revisited from the viewpoint of the semantic and pragmatic processes that may lead to the establishment of a subordinating relation between discourse segments.

1 Introduction

This chapter addresses the question of whether the notion of embedding is relevant in discourse structure and, if so, what constitutes embedding in discourse. We will argue that *discourse-structural subordination* is a case in point, discussing this concept both from the viewpoint of different theories applying the notion of rhetorical or discourse relations, as well as in goal-driven approaches to discourse structure. Furthermore, we will provide an overview of how discourse-structural embedding is realized in language, with an emphasis on the relationship between discourse-structural and syntactic subordination. Finally, we will revisit the notion of discourse subordination from the viewpoint of the semantic and pragmatic processes that may be taken to lead to the establishment of a subordinating relation between discourse segments.

Elena Karagjosova and Torgrim Solstad. Embedding in discourse. To appear in: Benz, Anton, Frey, Werner, Gärtner, Hans-Martin, Krifka, Manfred, Schenner, Mathias & Żygis, Marzena (eds.), Handbook of clausal embedding. Berlin: Language Science Press. [preliminary page numbering]

The chapter is structured as follows. In Section 2 we first introduce the notions of rhetorical/discourse relations and the distinction between coordinating and subordinating discourse relations before providing an overview of theories of discourse structure that contribute an implicit or explicit notion of discourse-structural subordination. Section 3 discusses parallels and mismatches between embedding in syntax and discourse, while Section 4 is devoted to semantic and pragmatic mechanisms that establish subordination in discourse. Section 5 provides a summary and points at further related issues.

2 Discourse-structural subordination

While there is no widely accepted definition of discourse-structural subordination, one of the most prominent concepts related to subordination in discourse is the notion of subordinating discourse relations. In what follows, we first introduce the distinction between subordinating and coordinating discourse relations, tracking down its deployment throughout some of the most prominent theories of discourse that utilize the notion of rhetorical or discourse relations. We do this in an attempt to pin down the exact notion of discourse subordination that these theories implicitly or explicitly provide. We then explore the view of discourse subordination that emerges from a second set of theories of discourse structure that regard discourse goals or questions under discussion as the central organizing principle in discourse. The section ends with a summary and a discussion of more recent work providing comparison or integration of the two sets of approaches to discourse structure.

2.1 Subordinating vs. coordinating discourse relations

In one of the first influential approaches to the study of discourse, Rhetorical Structure Theory (RST; Mann & Thompson 1988), *discourse* (or *rhetorical*, *coherence*) *relations*[1] are defined on the basis of the following definition of discourse coherence (Mann, RST website, http://www.sfu.ca/rst/):

> ... For every part of a coherent text, there is some function, some plausible reason for its presence, evident to readers, and furthermore, there is no

[1]The use of these terms varies across theoretical approaches. While RST uses the notion of "rhetorical relations", Hobbs (1985) speaks of "coherence relations", and later work like Asher & Lascarides (2003) and Asher & Vieu (2005) uses the term "discourse relations". Throughout this chapter, we will use "discourse relations" as a general term for the purpose of discussing general issues, and "rhetorical relations" and "coherence relations" when we deal with the respective theory.

sense that some parts are somehow missing. RST focuses on the first part—an evident role for every part.

A rhetorical relation is thus a pragmatic function that an utterance or a larger part of a text fulfills with respect to another. For instance, Elaboration holds between two discourse units that describe the same state of affairs at different levels of abstraction (e.g. Hobbs 1979, 1985, Kehler 2002), see (1) (Hobbs 1985: 18). Parallel holds between discourse units in virtue of the similarity or uniformity of their content along some relevant dimension (Hobbs 1985, Kehler 2002, Asher & Lascarides 2003), as in (2) (Hobbs 1985: 15), where the similarity condition is satisfied by the predication of the same action, *setting*, of the two data structures ("stack A" and "link variable P"). Contrast connects discourse units whose content is "opposite" or "contradictory" in some respect, and is typically marked by the connective *but*, see (3) (Lakoff 1971: 133).[2]

(1) Elaboration:
Go down First Street.
Just follow First Street three blocks to A Street.

(2) Parallel:
Set stack A empty and
set link variable P to T.

(3) Contrast: John is tall, but Bill is short.

The theory of Hobbs (1985: 25) was one of the first in which what he called *coherence relations* were divided into two categories of relations, coordinating and subordinating. However, Hobbs did not relate these notions to discourse-structural embedding. Rather, such a distinction is suggested as an approach to the problem of identifying the content of larger discourse segments composed of single clauses: when two segments are linked by some relation, they compose to a single unit which is then linked to a new discourse unit by means of a discourse relation. Hobbs contends that in order to be able to apply his definitions of coherence relations to discourse units larger than a single clause, one needs to be able to say "what is asserted by those segments" in terms of a joint, overall content, a "kind of summary" or "discourse topic" (ibid.: 25). This requirement follows from

[2] For a more comprehensive list and informal definitions of coherence relations, see, for instance, Zeevat (2011), Jasinskaja & Karagjosova (2020), as well as the catalogue of relations on the RST-website (https://www.sfu.ca/rst/01intro/definitions.html) and the glossary of SDRT-relations in Asher & Lascarides (2003: 459–471).

the way Hobbs defines coherence relations in terms of inferences drawn by the listener on the basis of the content of the segments and the knowledge of speaker and hearer. Without computing a joint assertion for a composed discourse unit, there is no way in which a unit can be attached to it by means of a coherence relation. The difference between coordinating and subordinating relations is then described as follows. "To recognize a coordinating relation, one must generally discover some common proposition inferrable from each segment" (ibid.). When one of the two segments is subordinated to the other, however, "the assertion of the composed segment is the assertion of the dominant segment" (ibid.). According to Hobbs, in a Contrast relation S_0, *but* S_1, where S_0 and S_1 are discourse segments, one (usually the second) segment is informationally more dominant with respect to the overall discourse topic of S_0 and S_1. Thus, in spite of the structural parallelism displayed in (3), applying Hobbs' informational dominance criterion would lead to characterizing the relation between S_0 and S_1 as subordinating. An Explanation relation S_0, *because* S_1 receives a similar treatment, based on the argument that the first segment determines the content (discourse topic) of the entire complex segment (ibid.). In contrast, an Elaboration relation is coordinating according to Hobbs, since the two segments contribute a common proposition as the assertion of the composed segment (ibid.). For instance, the common proposition for (1) would be that the addressee should go three blocks down First Street until she reaches A Street. Similarly, Parallel involves the inference of a common proposition which counts as the assertion of the composed segment. Thus, from each of the clauses in (2) one can infer that a data structure is being set to a value (ibid: 15). From this point of view, subordination is defined in terms of informational dominance, and relations like Contrast, Explanation and Violated expectation count as subordinating, and Elaboration and Parallel as coordinating.

At the same time, Hobbs (1985) provides a classification of coherence relations based on four aspects of the discourse situation – (i) relations reflecting real world coherence between events (such as Cause), (ii) relations connecting discourse segments to conversational goals (Evaluation), (iii) relations connecting segments to the listener's prior knowledge (Background, Explanation), and (iv) inferential relations between discourse segments (including Parallel, Elaboration, Contrast and Violated expectation). This classification cuts across the above-mentioned coordination/subordination distinction. Thus, Hobbs' fourth class, which he calls "expansion relations", involves relations that "expand the discourse in place", "rather than carrying it forward and filling the background" the way relations like Cause, Explanation and Background do. Thus, whereas some expansion relations like Parallel and Elaboration are coordinating, others,

such as Contrast and Violated expectation, are categorized as subordinating, just like non-expansion relations like Background and Explanation. Hobbs' distinction between expansion relations and relations that carry the discourse forward comes closer to a structural definition of/view of discourse subordination, and, together with his subordination/coordination distinction, has significantly influenced subsequent work on the notion of subordination in discourse that we discuss below.

Let us however first turn to the rather functionally motivated division between two types of relations that is put forward in Rhetorical Structure Theory (RST; Mann & Thompson 1983, 1987, 1988). In general, RST is characterized by Mann & Thompson (1988: 243) as a "theory of text organization" that "identifies hierarchical structure in text" in describing "the relations between text parts in functional terms", with the aim of providing a "general way to describe the relations among clauses in a text" (ibid.: 244). More specifically, RST views discourse as being structured along *rhetorical relations* between non-overlapping text spans, where a text span is a contiguous linear interval of text, that is, a clause or a portion of text with an RST structure. Only one single relation may hold between two text spans. Relations are defined in terms of the writer's intentions and the effect that text spans are intended to achieve with respect to the reader's attitudes (knowledge, beliefs, desires) on the subject matter described by the text spans, which in many respects is comparable to Hobbs' inferential view of discourse coherence. In contrast to Hobbs, however, segments in RST are linked to a larger segment without the requirement of computing a common semantic core of the segments constituting the larger segment. Furthermore, within a particular RST relation, a text span serves as either a Nucleus or a Satellite. This distinction is based on the observation that the relations are mostly asymmetric. For instance, in an Evidence relation, if it holds that A is evidence for B, it does not hold that B is evidence for A (ibid.: 266). Nuclearity is taken to be a central principle of the hierarchically organized discourse structure that is represented as an RST-tree, as well as a central notion for a theory of text structure (ibid.: 268). It is defined in functional terms: the Nuclei are comprehensible without the Satellite, are not replaceable and more essential to the writer's purpose, whereas Satellites are incomprehensible without the Nucleus and replaceable by other material. In addition, whereas a Satellite supports the purpose of the Nucleus, it is not strictly necessary for the coherence of the text. Thus if "we delete all units that function as nuclei anywhere in the text, the result should be incoherent and the central message difficult or impossible to comprehend" (Mann & Thompson 1987: 32). On the other hand, deleting units that only function as Satellites in a text should

not have an effect on its coherence, and the result is a synopsis of the original text.[3]

Based on the distinction between Nucleus and Satellite, two principally different types of relations are assumed. While most relations are of the type Nucleus-Satellite, a few relations are Multinuclear, with no Satellite. This is illustrated in Figure 1, where the diagram to the left represents the Nucleus-Satellite relation Circumstance and the diagram to the right represents the Contrast relation. Graphically, the Nucleus is represented by a vertical (or oblique) line, and the arrow visualizes the relation. In a Circumstance relation, the Satellite unit "sets a framework, for instance, a temporal or spatial framework, within which to interpret the nucleus" (ibid.: 48), as in (4) (Mann & Thompson 1987: 48), where the Satellite in (4b) provides the temporal framework within which the Nucleus in (4a) should be interpreted. On the other hand, a multinuclear Contrast relation connects two Nuclei, each of which has an independent standing in discourse, see (3).

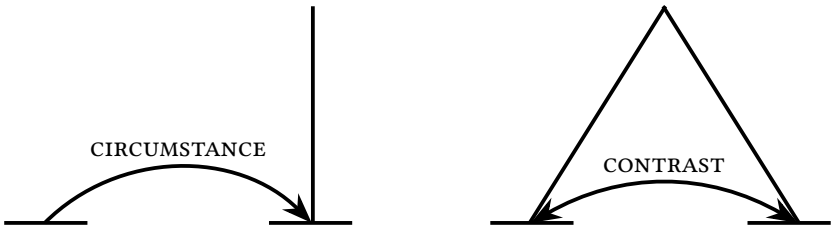

Figure 1: Nucleus-Satellite (left) and Multinuclear (right) RST-structure

(4) a. Probably the most extreme case of Visitors Fever I have ever witnessed was a few summers ago …
b. …when I visited relatives in the Midwest.

The notion of nuclearity in RST is thus one way of looking at discourse subordination or embedding in discourse: a Satellite is a subordinated text span that is embedded into a Nucleus-span. As a matter of fact, Mann and Thompson draw

[3] Marcu (1997, 2000) uses this functional distinction between Nucleus and Satellite units for the task of automatic text summarization. As an anonymous reviewer noted, however, one should obviously only delete atomic Satellite units in order to get a synopsis of a text. Deleting a larger Satellite unit in an RST-tree will also involve the deletion of all nuclear units that are part of the complex Satellite.

an explicit link between nuclearity and syntactic embedding, stating that nuclearity is grammaticalized in hypotaxis (Mann & Thompson 1988: 270), as examples like (4) suggest, where the main clause represents the Nucleus and the subordinate one the Satellite. However, as Matthiessen & Thompson (1988: 290) argue, nuclearity and hypotaxis are clearly distinct notions, as there are many Nucleus-Satellite relations which do not involve hypotaxis, instead being realized by mere juxtaposition of clauses, see for instance (1).

Comparing the notion of nuclearity with Hobbs' subordinating coherence relations (and his class of expanding coherence relations), the two seem to be orthogonal. Since a Nucleus is comprehensible without a Satellite, the Nucleus must represent the informationally dominant text unit. Nevertheless, while Hobbs classifies Contrast as a subordinating relation in which one of the spans is informationally subordinate and thus not contributing to the overall content of the discourse units connected by it, Contrast is a multinuclear relation in RST, where both spans are essential to the writer's purpose and to the overall "message" of the complex discourse unit. Similarly, whereas RST conceives of Elaboration as a Nuclear-Satellite relation where the elaborating Satellite does not contribute to a summary of the overall discourse content, Hobbs views it as a coordinating relation, since both segments would contribute their joint content to the overall content of the complex unit. Other relations like Violated expectation and Background, which Hobbs considers subordinating, are of the Nucleus-Satellite type in RST. Finally, whereas Hobbs' expansion relations Parallel[4] and Contrast are multinuclear in RST, others, like Explanation and Violated expectation, are Nucleus-Satellite relations in RST.

A distinction between two kinds of relations between discourse units, coordinating and subordinating, is also employed within the Linguistic Discourse Model (LDM) (Polanyi 1988). At the same time, LDM offers a concept of subordination in discourse that is broader than the distinction between Nucleus and Satellite in RST (cf. also Blühdorn 2008) or Hobbs' notion of subordinating relations, as LDM views discourse structure as emerging from both structural and semantic relationships between units of discourse. Thus, a central premise on which LDM is based is the view of discourse structure as resulting from the process of "recursive sequencing and embedding of discourse units of various types" (Polanyi 1988: 603). The hierarchical structure that results from this process has the form of a Discourse Parse Tree built up "on a left to right clause by clause basis" (ibid.). The basic unit of discourse formation in LDM is the *discourse constituent unit* (henceforth, DCU), which in turn is composed by clauses (where

[4]The Parallel relation corresponds roughly to the original RST concept of a Joint, or, in later RST developments, to the relations List and Conjunction, see Stede et al. (2017).

an individual clause is considered an elemental DCU). Four main types of DCUs are distinguished, partly drawing upon Hobbs' dichotomy between relations that locally expand the discourse and those that carry it forward, at the same time relating the former to the notion of structural subordination. Thus, Sequences are formed by conjoining arbitrarily many constituent elements of the same type, where the elements are considered to be coordinated with each other, with subtypes like List and Narrative.[5] Expansions, on the other hand, are described as DCUs composed of a unit and an immediately following unit that in some way expands the content of the former unit. Here, Polanyi draws on Hobbs' class of expansion relations. However, she treats the expanding units uniformly as units that are subordinated to the unit they expand in terms of structural dominance in the Discourse Parse Tree. Polanyi (1988: 609) explicitly adopts Hobbs' definition of his (expansion but coordinating) Elaboration relation to formalize this type of unit. Thus, subordination in LDM is on the one hand defined in semantic terms as subordinated DCUs that expand the propositional content of the immediately preceding clause in discourse. On the other hand, it is also defined in terms of structural attachment: When processing discourse and building the Discourse Parse Tree on a left-to-right clause-by-clause basis, phenomena like elaborations, digressions and interruptions that interrupt the completion of an ongoing discourse unit are treated as subordinated or embedded. This sets them apart from units that "continue the development of an ongoing unit", as in the case of stories or proposals for a course of action (ibid.: 611). This distinction is implemented in terms of differently labelled nodes indicating that a coordination or subordination relation obtains between an incoming unit and an accessible node in the tree. In Figure 2, the left hand structure represents a "coordination node" C with two clauses *a* and *b* that are coordinated with each other. In the "subordination node" S on the right hand, however, the *a* clause is superordinate to or embeds the *b* clause.

The structural attachment of new information in discourse is governed by what later became known as the Right Frontier Constraint (Asher & Lascarides 2003), postulating that only the nodes at the right frontier of the discourse tree are accessible for attachment of new discourse units, see Figure 3 which shows the accessible ("open") and inaccessible ("closed") nodes in the Discourse Parse Tree. The "right frontier" metaphor is based on the way discourse structure is represented in LDM as a graph constructed from left to right as discourse is

[5]Note that the List relation corresponds to Hobbs' coordinating Parallel relation, which however belongs to his class of expansion relations. These LDM units are moreover described in terms similar to corresponding coordinating SDRT relations such as List and Narration, see the paragraph on SDRT below.

Figure 2: Coordinated and subordinated structures in a Discourse Parse Tree (Polanyi 1988: 612)

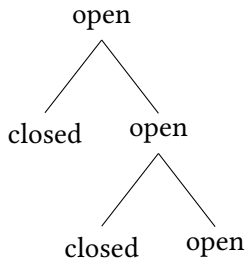

Figure 3: Open and closed nodes in a Discourse Parse Tree (Polanyi 1988: 613)

processed incrementally clause by clause (Polanyi 1988).[6] On the other hand, the decision whether to attach new units in terms of subordination or coordination is made on the basis of computing the semantic content of the units (ibid.: 617), a process which is not further specified but which involves inferences from world knowledge and linguistic knowledge.[7]

Subordination in terms of structural attachment is most prominently dealt with in the framework of Segmented Discourse Representation Theory (SDRT; Asher 1993, Asher & Lascarides 2003, Lascarides & Asher 2007), a formal theory of the representation and interpretation of discourse that accounts for the hierarchical organization of discourse, relying on the concept of discourse relations between text spans. Just like in RST, each text segment in SDRT is connected to another via discourse relations with no overlap between text segments. Unlike RST, however, SDRT does not address speakers' intentions. Instead, discourse relations are defined in terms of their semantic effects on the interpretation of

[6] Cf. Polanyi (1988: 613): "A new constituent is attached to the Discourse Parse Tree as the rightmost constituent at a structurally accessible existing level in the Tree."

[7] This process is described in terms similar to the process involved in recognizing coherence relations described in Hobbs (1985) and the processing of utterance content in Asher & Lascarides (2003), as well as the derivation of a particular relation (dominance or satisfaction-precedence) holding between two DSPs in Grosz & Sidner's model, see the paragraph below as well as Section 2.2.1.

discourse. Thus, the relation Explanation between a segment π_2 and its predecessor π_1 is defined in terms of its indicating that the event described by π_2 causes the one described by π_1. Discourse relations are derived from the utterance content (e.g. lexical semantics, connectives) and (non-linguistic) domain knowledge by means of commonsense reasoning defined in terms of a so-called glue logic.[8] More than one relation can obtain between two segments, and one text segment can relate to more than one other text segment. Similar to the structure of discourse envisaged by Hobbs, SDRT allows complex discourse units that can function as a single complex node in a relation to another node, where in order to be able to infer a particular discourse relation, the common content of the two units within the complex node needs to be computed. How this is done is, however, an issue that, to our knowledge, has not been explicitly addressed in the SDRT literature, while Hobbs (1985: 26) envisages "rules for assigning assertions to larger segments of discourse" like the ones mentioned for examples (1)-(3) above.[9] In SDRT, discourse relations are classified into two categories, coordinating or subordinating, based on criteria like the availability of structural attachment points and anaphoric accessibility. This distinction is based on the observation that the hierarchical structure imposed by discourse relations constrains the interpretation of anaphora by restricting the parts of discourse to which new information is attached (Asher & Lascarides 2003: 146, see also Section 3.1.2), thus offering a similar structural notion of discourse subordination as in Polanyi (1988). Thus, Asher (1993) and Asher & Lascarides (2003) assume that discourse relations like Elaboration, Explanation and Source induce subordination in discourse segmentation and are therefore regarded as subordinating, whereas Parallel, Contrast, Narration and Result induce coordination and count as coordinating.

Subordination is at the same time defined in semantic terms: "[α subordinates β] iff the main eventuality described in β is a subsort of the main eventuality described in α or the proposition associated with β defeasibly implies that associated with α." (Asher & Vieu 2005: 597). Semantically, subordinated discourse units are assumed to provide a more detailed description of some aspect of the superordinated unit, thus introducing a "new level of detail in discourse" (Asher

[8] Glue logic may be briefly characterized as a logic for constructing the logical forms of discourse, supplemented by a separate logic for representing and interpreting the logical forms called the logic of information content, see Lascarides & Asher (2007).

[9] Note that in SDRT, a notion of discourse topic plays a role for some relations such as Narration and Background: They require a common topic summarizing the content of the two related constituents, cf. Asher & Lascarides (2003: 164), where Narration is argued to hold between two discourse units only if there is some information that summarizes the two units such that it is a topic for the two, and where topic is defined as a subordinating relation, rendering at the same time the two units as subordinated to their common topic.

& Lascarides 2003: 8). In this regard, SDRT draws on Hobbs's (1985: 14) class of expansion relations.[10]

In their attempt to sharpen the distinction between coordinating and subordinating discourse relations, Asher & Vieu (2005) argue that a discourse relation is not coordinating or subordinating by virtue of its semantic content but rather in terms of how it is "presented in the discourse", that is, the two notions are a feature of the structure of the discourse representation (ibid.: 594, 606). Thus, although Result is coordinating by default, this default can be overridden in specific contexts, whereby it may come out as a subordinating relation. Based on such observations, they argue for the need of a systematic way of distinguishing between coordinating and subordinating discourse relations, suggesting the following general test (next to 3 more specific ones) that can help categorize relations in terms of this distinction (where $\langle \alpha, \beta, \gamma \rangle$ are discourse units and $R_1(\alpha, \beta)$ is a discourse relation already established between α and β) (Asher & Vieu 2005: 600):

(5) If you can attach some γ to α, then R_1 is subordinating. If you can attach only to β, R_1 is coordinating.

Based on this test, the difference between a coordinating relation like Parallel and a subordinating relation like Source can be captured in terms of different attachment possibilities of a new discourse unit to an existing unit. Thus in (6), the new unit (6c) cannot be attached to (6a), which indicates that the Parallel relation between segments (6a) and (6b) is coordinating, whereas in (7), (7c) can be attached to (7a), which makes the relation Source between (7a) and (7b) subordinating.

(6) Parallel, a coordinating relation: cf. Figure 4

a. John broke the vase.
b. Bill broke the mirror.
c. This is unfortunate.

(7) Source, a subordinating relation: cf. Figure 5

a. John broke the vase.
b. Bill told me that.
c. This is unfortunate.

[10] Note, however, that Hobbs includes in this class both relations like Parallel and Contrast, which in SDRT are considered coordinating, and Elaboration, which counts as the prototypical example for a subordinating relation in SDRT.

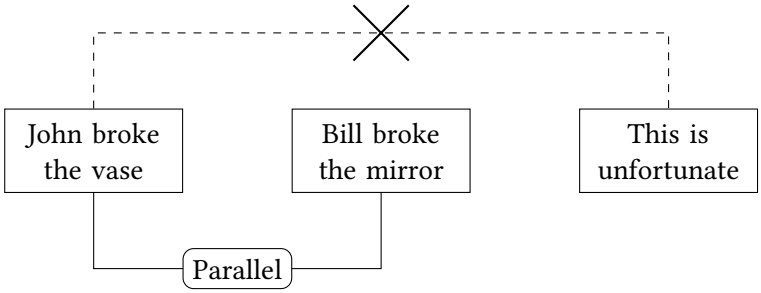

Figure 4: Parallel, a coordinating relation

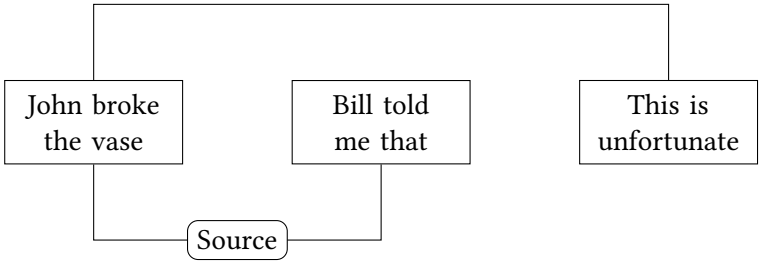

Figure 5: Source, a subordinating relation

The test in (5) is based on the "Right Frontier Constraint" first formulated in Polanyi (1988) and refined in SDRT. As argued in Asher & Vieu (2005: 593), this constraint in its original form does not make enough elements available for attachment, attributing this drawback to the lack of distinction between different types of discourse relations, i.e. relations that are defined as either subordinating or coordinating. As a matter of fact, we saw that Polanyi makes a similar distinction between coordination and subordination, structurally implemented in terms of coordination and subordination nodes in the discourse tree (labelled C and S, respectively, cf. discussion above), indicating that a coordination or subordination relation obtains between an incoming unit and an accessible node in the discourse tree. However, the way the discourse tree is constructed does not allow for the right attachment points, as Asher & Vieu (2005) argue. Thus, in (7), (7c) could not be attached to (7a) in Polanyi's discourse tree, since (7a) would represent a closed node, see the left hand structure in Figure 6. Instead, the correct hierarchical representation of discourse structure would distinguish graphically between coordinating and subordinating relations, as in the right hand structure in Figure 6, Asher and Vieu argue. In such structures, coordinating relations are depicted by horizontal and subordinating relations by vertical arrows between

Figure 6: Two structures for example (7): Polanyi's (1988) discourse tree on the left and Asher and Vieu's (2005) discourse graph on the right.

nodes. Consequently, discourse structure is represented in form of directed two-dimensional graphs rather than trees. In the right hand structure in Figure 6, the subordinating relation between (7a) and (7b) is represented graphically in terms of a vertical arrow, leaving the *a*-node still accessible for the attachment of unit *c*.[11] Hence, the right frontier in Asher & Vieu (2005) consists of the last processed node and all the nodes to which it is connected by a subordinating relation, which would be nodes (7a) and (7b) in the right hand structure in Figure 6. As already mentioned, the right frontier constraint not only governs the way new material is attached to existing discourse but also captures the influence of discourse subordination on anaphoric reference in terms of the "look-left-one-step-only-or-look-up rule" (Asher & Vieu 2005), predicting that subordination works against recency in anaphora resolution. Thus, the propositional anaphor *this* in (6) cannot be resolved to the proposition expressed by the segment in (6a) since the corresponding discourse segment is not at the right frontier and thus not available for attachment of the new material, in contrast to (7) where the segment corresponding to (7b) is subordinated to the one in (7a) and (7a) is thus accessible for the resolution of the propositional anaphor.

[11]Note that the adequacy of the Right Frontier Constraint and the tree-like reperesentation of discourse has been challenged in work by Wolf & Gibson (2004), who argue that discourse involves a lot of crossed dependencies and nodes with multiple parents. This view, however, is questioned in Egg & Redeker (2010), who show that many of the cases discussed by Wolf & Gibson are due to particular theoretical choices rather than to the actual structure of discourse. At the same time, in comparing RST and SDRT, Danlos (2008) reaches the conclusion that none of these frameworks displays a "strong generative capacity": None of them allows the representation of all the discourse structures corresponding to felicitous discourses, while also excluding those corresponding to infelicitous ones. Behrens & Fabricius-Hansen (2010) argue at the same time that a SDRT-relation like Background seems to be both subordinating and coordinating when different criteria are applied: subordinating according to the RFC but coordinating with respect to the topic criterion, cf. also fn. 9.

2.2 Discourse-structural subordination in goal and question based approaches to discourse

A different view of discourse structure and discourse subordination is provided in goal- and question-based approaches to discourse. Below, we will briefly review the most influential approaches to discourse structure that (implicitly or explicitly) provide a notion of discourse subordination based on the notions of goals and questions in discourse.

2.2.1 Grosz & Sidner (1986)

In the discourse model proposed in Grosz & Sidner (1986), discourse structure is based on intentions (as opposed to the discourse relations in RST and SDRT). Discourse consists of three distinct, but interacting components, dealing with different aspects of the utterances made in discourse:

1. *Linguistic structure:* consists of the actual utterances comprising a discourse, aggregated into discourse segments (DS), and an embedding relationship that can hold between segments. This relationship is only a "surface reflection" of relationships on the deeper level of intentional structure.

2. *Intentional structure:* consists of discourse segment purposes (DSP) that specify how the individual segments contribute to the overall purpose of the discourse, defined as the intention underlying the engagement in a particular discourse with a particular content. Examples include the intention that some agent intend to perform some physical activity, or the intention that some agent come to believe some facts.

3. *Attentional state:* comprised of a set of focus spaces containing information about objects, relations, properties and intentions that are salient at each point of the discourse and thus crucial for the processing of subsequent utterances. A focus space is associated with each discourse segment. Changes in attentional state are modeled by a set of transition rules, implemented in terms of push and pop operations defined on a focus space stack.

In Grosz & Sidner (1986), embedding in discourse relates to the intentional structure. The model envisages only two relations between discourse segments, dominance and satisfaction-precedence, which are structural relations holding between Discourse Segment Purposes (DSP). Satisfaction-precedence corresponds to linear precedence in parsing at sentence level (ibid.: 204). A DSP1

satisfaction-precedes a DSP2 whenever DSP1 must be satisfied before DSP2. On the other hand, when an action satisfying one intention DSP1 is intended as part of satisfying some other intention DSP2, DSP1 contributes to DSP2, and DSP2 dominates DSP1. The dominance relation thus induces a partial ordering on DSPs, called the *dominance hierarchy*. This hierarchy provides a record of the discourse purposes of all segments and their dominance (and relevant satisfaction-precedence) relations (ibid.: 180).[12] Both dominance and satisfaction-precedence relations depend on domain knowledge, but may be reflected by the linguistic structure (e.g. in terms of cue phrases like *first … then, moreover* etc.).

Figure 7 shows how the three components interact for a (slightly modified) fragment of a discourse from Grosz & Sidner (1986: 183) in which an author discusses the influence of movies on young people, see (8):

(8)

DS1: 1. Parents ought not to permit their children to attend a movie picture show often or without being quite certain of the show they permit them to see.

  DS2: 2. No one can deny, of course, that great educational and ethical gains may be made through the movies [...]

  DS3: 3. But the important fact to be determined is the total result of continuous and indiscriminate attendance on shows of this kind.

  4. Can it be other than harmful?

The linguistic structure is graphically represented in terms of left square brackets and indentation of the embedded units. The individual discourse segments DS1 and DS2 give rise to their respective focus spaces, FS1 and FS2, which in turn are parts of a stack structure containing the focus spaces of the relevant segments. The stack of focus spaces thus represents the attentional state at the given stage of the discourse. Each focus space contains the salient entities (objects, their properties and relations between them) of the respective segment,

[12] Grosz & Sidner (1986: 193) argue that embedding occurs only in the attentional structure. However, the stack relationships arise from the ways in which the DSs relate, and information about these relationships is represented in the dominance hierarchy (ibid.: 180). See also Moser & Moore (1996: 411), who observe that the relation of dominance between DSPs determines "the embeddedness relation of the discourse segments that realize them", since segments are produced in order to satisfy certain intentions.

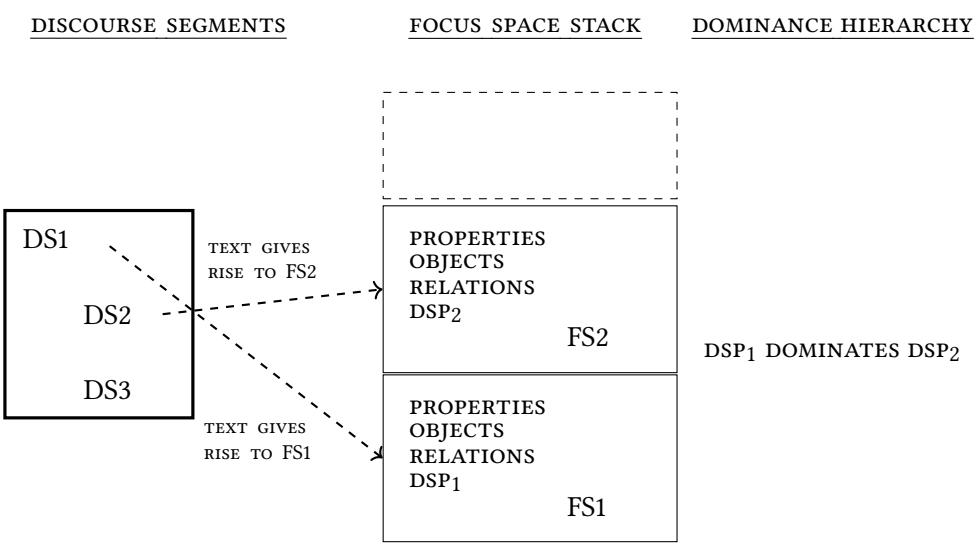

Figure 7: A snapshot of a stage in discourse processing (cf. Grosz & Sidner 1986: 181)

including its discourse segment purpose DSP. When DS2 is being processed, its focus space FS2 is stacked on top of FS1 because the associated DSP1 dominates DSP2, i.e. satisfying DSP2 (intend the reader to believe that the writer is aware of the gains of watching movies) contributes to satisfying DSP1 (intend the reader to believe that it is not harmless for children to watch movies often or without parental control). When DSP2 is satisfied, FS2 is popped off the stack. Then DS3 is being processed, and its focus space FS3 is pushed onto the stack, since also this new segment contributes to DSP1 (where DSP3=intend the reader to believe that continuous and indiscriminate attendance of movies is harmful). After satisfying DSP3, FS3 is popped off the stack, and the focus space of the superordinating DS1 is processed. The dominance relation between DSP1 and DSP2 and between DSP1 and DSP3 represents the intentional structure of the current discourse. When the discourse is completed, the focus stack is empty, and the intentional structure (the dominance hierarchy) will be fully constructed (Grosz & Sidner 1986: 180).

The hierarchical relationship between focus spaces influences furthermore the interpretation of linguistic expressions occurring in the discourse segments in terms of e.g. reference resolution, where an entity belonging to the linguistic structure of a segment DS1 (and represented in its FS1) is less salient and thus less available for anaphoric resolution of a pronoun in a subsequent segment DS2,

due to the fact that FS1 is not processed until FS2 is processed and popped off the stack. This effect of segmentation on the use of referring expressions becomes evident when we consider that the pronoun *it* in sentence 4 of the discourse in (8) is used within the same DS to refer to the NP *continuous and indiscriminate attendance on shows of this kind*, while a generic NP like *shows of this kind* is used in DS3 – instead of a pronoun – to refer to the NP *the movies* in the preceding DS2. Notably, SDRT would predict the same anaphoric attachment site for the pronoun *it* in sentence 4, where, however, sentences 3 and 4 would be segmented into separate discourse units: While a relation of Contrast holds between 2 and 3, 4 can only be attached to 3, which represents the right frontier of (this portion) of the discourse. On the other hand, the right frontier constraint in SDRT would not exclude the use of a pronoun like *them* in 3 to refer to the NP *the movies* instead of the generic NP *shows of this kind*, as 3 represents an available attachment site for 4.

The three components of discourse structure provide the discourse participants with the necessary information needed to figure out how a new utterance in discourse is to be integrated in terms of both content and purpose (and also serves as a basis for certain expectations on what new utterances will follow and how to accommodate them). Intentions thus play a primary role in explaining discourse structure, defining discourse coherence.

Comparing their model to theories of discourse coherence such as Hobbs (1985) and Mann & Thompson (1988), Grosz & Sidner (1986: 202) argue that although intentions underlie most of the coherence relations these theories assume, they are unable to account for the vast diversity of intentions that underlie discourse and the relationships between them. Nevertheless, Moser & Moore (1996) propose a synthesis of RST and Grosz & Sidner's model, arguing that both theories make similar claims about the role of speaker's intentions in determining the structure of discourse, even though intentional structure is only implicitly contained in the functional distinction between Nucleus and Satellite in RST. In particular, Moser & Moore (1996: 413) argue that nuclearity in RST and the dominance relation between intentions in Grosz & Sidner (1986) correspond to each other, as "the asymmetry between nucleus and satellite originates with the speaker's intentions": "the nucleus expresses a belief or action that the hearer is intended to adopt", whereas the satellite provides information that is intended to facilitate adopting this intention. Thus in either model, text is structured depending on how spans/segments are intended to support other spans/segments in achieving their purpose (ibid.).

2.2.2 Questions under Discussion

The concept of Questions under Discussion (QUD) has been introduced in various frameworks with somewhat varying aims and underlying assumptions. The central idea on which these approaches are based is that sentences in discourse address an explicit or implicit question, either by representing an answer to it or by giving rise to a sub-question that can help answer the superordinated question, cf. also Benz & Jasinskaja (2017: 177).

The first to suggest that texts are structured around an explicit or implicit "question which the text in its entirety is produced to answer" were von Stutterheim & Klein (1989: 41). They call the implicit question that an utterance answers the *quaestio* and argue that a quaestio may be derived from the general context in which the utterance is made or from a higher quaestio which the entire text is intended to answer. Thus, a question like "What happened to you last week?" may be subdivided into several sub-questions corresponding to the sub-events happening within the time span of the entire event (Q1: *What happened to you at t1? ... at t2?*), thus representing the "backbone" of the narrative. Notably, such questions partition the text into a "main structure" – "those utterances in the text which directly contribute to answering the question", and a "side structure"– those parts of the text that provide additional (but not necessarily unimportant) material (ibid.: 40). In this approach, a notion of discourse subordination is involved in both the distinction between questions and subquestions and the distinction between main structure and side structure, the latter being reminiscent of the distinction between Nucleus and Satellite in RST, where a Satellite represents information that is not essential for the coherence of the discourse and may be omitted or replaced by other material.

In van Kuppevelt (1995), the distinction between different structural levels of discourse is further elaborated and related to the notions of foreground and background in discourse. The foreground is made up of the events forming the storyline in narratives, where the order of presentation matches the temporal order, while the background contains material consisting of attached elaborations that lack such temporal properties. According to van Kuppevelt, topicality represents the basic organizing principle of discourse (ibid.: 812). Topic (and subtopic) is defined as every contextually induced explicit or implicit (sub)question that is answered in discourse. Such a question represents "a set of possible extensional values" consisting of entities evoked in the discourse, one of which is selected by the answer to the question, the comment. As a result, discourse is seen as structured around a topic-comment hierarchy and discourse structure as the result of the contextual induction of explicit and/or implicit (sub)topic-forming questions

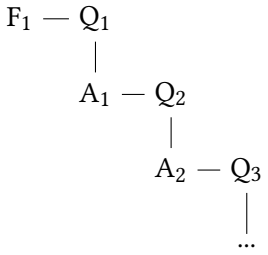

Figure 8: A question–answer structure in van Kuppevelt (1995: 818); F=Feeder, Q=Question, A=Answer

(ibid.: 813). More specifically, subquestions are contextually induced in a recursive fashion: "when a topic-constituting question has been answered unsatisfactorily, it gives rise to a further subquestion that, if also answered unsatisfactorily, gives rise to a further subquestion, and so on recursively, until the original, topic-constituting question has been answered satisfactorily" (ibid.: 816), cf. Figure 8, where F is a "feeder", i.e. an utterance that triggers such a recursive process of subquestioning.[13] This is the structure representing for instance the question-answer discourse structure in (9) (adapted from van Kuppevelt 1995: 815), where Q_1 is triggered by the opening sentence F_1 which serves as a feeder, and the subsequent questions are triggered by indeterminacies contained in the respective answers A_1 and A_2 respectively:[14]

(9) F_1 A: Last Tuesday our company got a new president.
Q_1 B: Who is it?
A_1 A: It is the former manager of a successful software house.
Q_2 B: Which software house?
A_2 A: The one where your friend works.
Q_3 B: Which friend?
...

Based on this, van Kuppevelt distinguishes three structural levels in discourse, corresponding to three different types of topic-forming questions: (i) a main

[13] Even a non-linguistic "event" can have this function. More specifically, a linguistic feeder F_n is defined as "a topicless unit of discourse or one the topic of which is no longer prominent at the moment of questioning" which provides a set of indeterminacies that is contextually unrestricted by preceding questions (ibid.: 814).

[14] Note that an answer to a question may also serve as a feeder. It may, for instance, introduce an indeterminacy that does not contribute to answering the original topic-constituting question, but leads to the introduction of a new topic, resulting in a topic shift or topic digression (ibid.: 821).

structure, representing an answer to the "leading topic-forming question" (which also defines the global discourse topic, e.g. A_1 in (9)), (ii) a substructure ("subordinated" structure) resulting from subquestions and contributing directly or indirectly (in terms of e.g. justifications) to an answer to the main topic-forming question (e.g. A_2 in (9)), and (iii) a side structure, which corresponds to topic digression (ibid.: 822) and which arises when for instance in (9), A_2 would give rise to the alternative Q_3 "By the way, did you hear that Peter got married yesterday?".[15] In addition, a functional distinction is made between two types of subquestions in the substructure: those that are contextually induced as the result of a preceding unsatisfactory answer because the answer is (a) quantitatively unsatisfactory (in terms of completeness, as in "Which members of the gang have been arrested? Unfortunately not the leader", ibid.: 817) or (b) qualitatively unsatisfactory (not specific enough or not accepted by the addressee and calling for support, justification, motivation, evidence, e.g. A_1 and A_2 in (9) which are not specific enough to answer the question Q_1). The "quantitative elaborations" constitute a goal-satisfying part of the answer to the main question, whereas the "qualitative elaborations" form the goal-subservient parts of it, that is, the parts that can be deleted while preserving the goal of the question and the coherence of the text that forms an answer to it. Discourse subordination in van Kuppevelt's model is thus explicitly related to the process of subquestioning, where subquestions are not autonomous but "subservient to the program associated with a preceding topic-constituting question". On the other hand, the distinction between goal-satisfying and goal-subservient substructures is reminiscent of the Nucleus-Satellite distinction in RST and the notion of subordination provided by it.

Roberts' (1996) formal model of discourse and information structure is probably the most influential QUD-based model of discourse.[16] It relies on the assumption (originally suggested in Stalnaker 1978) that the primary goal of every discourse is in general to share information about "the way things are". Roberts suggests that this goal can be formulated in terms of a question like *What is the way things are?*. This question is answered by breaking it down into a number of subquestions that are logically related and addressed one by one, along a strategy of inquiry that the speaker develops towards answering the "big question". The strategy represents a hierarchy of questions under discussion (QUDs) that are subsequently answered and that reflect the hierarchical structure of discourse. The set of QUDs at a given point in a discourse is modelled by the QUD-stack, a

[15] Note that the question of the topic digression is not a subquestion of the topic-constituting question but achieves a topic shift (ibid.: 822).

[16] Equally influential in research on dialogue semantics and computational modeling of dialogue is the QUD-based model developed in Ginzburg (1996).

push-down store (similar to Grosz & Sidner's 1986 stack structure containing the discourse segments' focus spaces) representing the ordered set of all as yet unanswered questions. The question on top of the stack represents the immediate QUD. Higher questions on the stack are subquestions of the lower ones. When a question is pursued by asking a subquestion, the subquestion is added to the stack, such that the stack partly reflects a strategy of questions (since a strategy to answer a question involves conducting the set of subinquiries). When a question is answered, it is popped off the stack. A superquestion is answered when enough subquestions are answered. Consider the example in (10), which represents a discourse that realizes a strategy to answer question "Who ate what?" by means of the set of subquestions {a, a_i, a_{ii}, b, b_i, b_{ii}} (Roberts 1996: 16).

(10) Who ate what?
   a. What did Hilary eat?
      i. Did Hilary eat bagels?
         Ans(a_i) = yes
      ii. Did Hilary eat tofu?
         Ans(a_{ii}) = yes
   b. What did Robin eat?
      i. Did Robin eat bagels?
         Ans(b_i) = yes
      ii. Did Robin eat tofu?
         Ans(b_{ii}) = yes

Roberts' QUD-theory can thus be seen as a specific implementation of Grosz & Sidner (1986) where conversational goals and strategies to achieve these are seen as the central organizing principle of discourse and where questions correspond to goals and the subquestion relation to Grosz & Sidner's (1986) dominance relation. In contrast to Grosz & Sidner, however, Roberts provides a formal definition of subordination, capturing the subquestion relation in terms of entailment: a question q_1 entails another q_2 iff every proposition that answers q_1 answers q_2 as well (Roberts 1996: 7). In contrast to van Kuppevelt, where the questioning process is triggered by indeterminacies (contextually determined or linguistically provided by feeders or by unsatisfactorily answered subquestions of the topic-constituting question), the strategy of inquiry that the speaker develops is determined on the basis of the information structure of the discourse in which the utterances occur. Following Carlson's (1983) insight that questions that are

implicit can be retrieved/inferred from context, Roberts thus claims that intonational focus presupposes that an assertion is a congruent answer to the QUD at the time of its utterance (ibid.: 33), relating the information structure of individual utterances to their role in discourse. While the questioning process in van Kuppevelt functions in a top-down fashion, being triggered by indeterminacies related to the current utterance in discourse that give rise to the question the following utterance provides an answer to, a QUD is reconstructed in a bottom-up fashion from the information structure of the utterance that provides an answer to this question.

2.2.3 Jasinskaja & Karagjosova (2020)

In their attempt to capture the notion of subordination in discourse in more precise terms, Jasinskaja & Karagjosova (2020) suggest a goal-based definition of discourse subordination in which discourse structure is defined in terms of relationships between communicative goals. In line with Grosz & Sidner (1986), Roberts (1996) and work by Farkas & Bruce (2010), Jasinskaja & Karagjosova (2020) assume that typical communicative goals are to make the addressee answer a question, believe some proposition (or accept it to a degree sufficient for the purposes of the exchange, i.e. make that proposition part of the common ground, Stalnaker 2002), or make the addressee perform (or commit to performing) some action. Accordingly, they define discourse subordination in terms of super- and subordinated discourse goals (Jasinskaja & Karagjosova 2020).[17]

(11) **Subordination in discourse**: In a sequence of discourse units $\langle U_1, U_2 \rangle$, U_2 is subordinate to U_1 whenever the communicative goal of U_1 cannot be reached before the communicative goal of U_2 is reached.

This definition states that the speaker first attempts to reach the goal associated with U_1, which, however, cannot be reached before that of U_2. Having started working towards the goal of U_1, the speaker needs to interrupt this process, deal with U_2 instead, and, in or after doing so, reach the primary goal of U_1. The idea of interruption is argued to be essential to discourse subordination, since it explains

[17] Note that RST employs a similar notion of functional goals in terms of particular effects of rhetorical relations on the addressee's knowledge, beliefs and desires, as part of the definitions of the individual rhetorical relations. Thus, the effect of the Elaboration relation is specified as the addressee (i) recognizing the situation referred to in the Satellite as providing additional detail for the Nucleus and (ii) identifying the element for which detail is provided (Mann & Thompson 1988: 273). However, these effects are not given an account in RST in discourse-structural terms.

why U_1 has to be kept in memory while U_2 is processed in order to be able to eventually go back to U_1 after processing U_2.[18] This reflects the way Grosz & Sidner's focus stack model applies to the notion of subordination and explains why subordination works against recency as in Asher & Vieu's (2005) version of the Right Frontier Constraint (see also Section 2.1 and the discussion of examples (6) and (7)). The influence of discourse-structural subordination on anaphoric reference captured by the Right Frontier Constraint is viewed in Jasinskaja & Karagjosova (2020) as a structural reformulation of the idea formulated by Grosz & Sidner (1986) that the processing of discourse requires keeping track of a stack of focus spaces (cf. Section 2.2.1). In a certain class of cases which correspond to subordinating discourse relations, the focus space of the subordinate unit is pushed onto the stack while the focus space of the subordinating unit also stays there until the subordinate unit is processed. Thus in (7), repeated below as (12), the subordinate unit (12b) would be pushed onto the stack after the subordinating unit (12a) and processed before (12a), since (12b) plays a role in reaching the communicative goal of (12a), e.g., convincing the addressee that John broke the vase, by providing the source of the information given in (12a). Once the processing of the subordinate unit is complete, its focus space is popped off the stack so the focus space of the subordinating unit becomes topmost again and available for various operations such as anaphoric reference. This accounts for the resolution of the propositional anaphor *this* in (12c) to (12a), instead of (12b) which is popped off the stack and no longer available as an antecedent for pronoun resolution.

(12) a. John broke the vase.
b. Bill told me that.
c. This is unfortunate.

In the case of coordination like (6), the focus spaces are processed on a "first come, first served" basis, that is, previously processed units are not kept in memory, so there is no way to go back and access the entities associated with those units.

[18] Note that this notion of interruption is not to be equated with the notion of interruptions in discourse employed in Grosz & Sidner (1986) and defined as "pieces of discourse that break the flow of preceding discourse". Interrupting discourse units in Grosz & Sidner's sense correspond to van Kuppevelt's digressions which belong to the side structure of discourse. Cf. also Section 4.3.

2.3 Subordination in theories of discourse structure: summary and further developments

To sum up, subordination in discourse can be viewed in terms of (i) functional asymmetry between text spans (Nucleus vs. Satellite in RST, goal-satisfying vs. goal-subservient parts of discourse in van Kuppevelt, informational dominance in Hobbs), (ii) structural attachment (LDM, SDRT), (iii) a semantic relation between a subordinated unit and its superordinated unit (defeasible implication, SDRT) or between questions addressed by utterances in discourse (entailment, Roberts), and (iv) in terms of a structural relation of dominance between intentions or satisfaction of communicative goals (Grosz & Sidner, Jasinskaja & Karagjosova) or between topic-constituting and subtopic-constituting questions (van Kuppevelt).

There have been continual efforts to bring together the different approaches to discourse structure. Thus, the Relational Discourse Analysis developed in Moore & Pollack (1992) and Moser & Moore (1996) is an attempt to merge RST with Grosz & Sidner's theory into a theory of discourse structure in which the intentional structure of discourse is linked to its rhetorical structure in terms of defining a set of intentional relations (such as convince, enable, concede) next to informational relations (such as cause–effect). In more recent research, special attention has been given to the combination of approaches underlying theories of discourse relations and question-based theories of discourse. Thus, Jasinskaja & Zeevat (2008) and Jasinskaja (2010) have argued that additive and contrastive markers such as *and* and *but*, which mark discourse relations such as Narration and Contrast, also convey information about the QUDs addressed by the clauses they connect. Karagjosova (2011) explored the interplay between discourse relations and QUDs in capturing the meaning of the German connective *nämlich* ('namely'). An interesting link between discourse relations and her QUD-model of information structure is already suggested by Roberts (1996: 62–63), who notes that particular types of RST-relations can be characterized as types of strategies and that discourse relations in general can be characterized in terms of questions and answers, suggesting that one could use a *Why*-question and its answer to characterize Explanation. At the same time, Roberts points at some differences between the two concepts, noting that the goal of discourse is only partly to offer more information by addressing a hierarchy of questions, the other part being to "achieve consensus about the value of the information contributed", a task that is accomplished by discourse relations intended to convince the hearer to accept the information offered and add it to the common ground by showing, for instance, how this information explains other known facts (ibid.). This

distinction between two kinds of goals of discourse is reminiscent of the two different functions that Mann & Thompson (1988) ascribe to Nucleus and Satellite units in discourse, as well as of van Kuppevelt's distinction between main structure and (qualitative) goal-subservient structure as two different hierarchical levels of discourse. Comparing QUD-models like van Kuppevelt's with discourse relation based models like SDRT, Karagjosova (2013) argues that the two approaches deal with two distinct dimensions of discourse structure, showing that a discourse consisting of two units related by Elaboration may give rise to two different question-answer structures depending on the way in which the topic-constituting question is defined. Benz & Jasinskaja (2017) observe that a straightforward link between rhetorical structure and QUD-theories of discourse structure is contained in Mann and Thompson's definition of discourse relations cited in Section 2.1: While discourse relations capture one aspect of discourse coherence – "an evident role of every part", QUDs capture the second –"no sense that a part is missing". This is illustrated in (13), where the intuition that the discourse is incomplete as it stands cannot be accounted for in terms of discourse relations, since the discourse is incoherent in spite of the fact that the two sentences are related by Elaboration. The incompleteness of the discourse can however be captured by a notion of a purpose or goal of a discourse, conceptualized as a QUD like "Which two things did the speaker do?" triggered by (13a), and requiring that the discourse is completed only when the question is fully answered in terms of providing information on "two things", see (14) (ibid.: 183).[19] Benz & Jasinskaja (2017) take this as a strong argument for the contribution of the notion of QUDs to a general theory of discourse coherence that goes beyond discourse relations.

(13) a. I did two things on my seventy-fifth birthday.
b. I visited my wife's grave.

(14) Then I joined the army.

At the same time, it has been argued in Hunter & Abrusán (2017) that Roberts' definition of subordination in terms of question entailment is too rigid to account for the rhetorical structure of discourse, this being one of the reasons why the

[19] Remember that according to van Kuppevelt, assertions in discourse not only answer questions but also raise questions themselves, an idea implemented in terms of the so-called feeders. Onea (2016) develops this idea further, arguing that certain linguistic expressions, such as indefinite expressions and nominal appositives, systematically license "potential questions" in discourse which play an additional role in explicating discourse structure next to Robert's QUDs.

two structures cannot be mapped directly to one another without loss of information. An attempt to loosen this constraint is presented in Riester (2019) and Riester et al. (2018), where QUDs are integrated into a theory of discourse and information structure represented by means of discourse trees, combining features from Roberts' QUD theory, SDRT and van Kuppevelt's model of discourse. In Riester's QUD trees, subordinating discourse relations are represented by questions – *Why*-questions for Explanation, *What-about*-questions for Elaboration, whereas coordinating discourse relations such as Narration are captured as a series of parallel questions about different times, thus constituting a temporal progression in the spirit of Klein & von Stutterheim (1992). The entailment relation between QUDs is loosened by allowing subordinated units of discourse to answer questions that are not entailed subquestions but are triggered by unsatisfactory answers to subquestions in a top-down fashion, adopting van Kuppevelt's notion of feeders as answers introducing topic-forming questions that do not belong to the main structure (cf. Figure 8). Further research on this topic is needed to fully explore the possibilities of developing an integrated theory of discourse structure that adequately captures the various notions of subordination in discourse.

3 Embedding in syntax and discourse

In this section, we proceed to discuss the relation between syntactic embedding (or lack thereof) and discourse-structural subordination and coordination. In doing so, we will largely assume the notion of discourse-structural subordination which underlies theories employing the concept of discourse relations, such as RST and SDRT, and which is presupposed in most current research on the topic. The two frameworks diverge in the criteria underlying the distinction between coordination and subordination in SDRT and between mono- and multinuclear relations in RST. Still, there is a rough correspondence in the way central subordinating relations like Elaboration and Background on the one hand and coordinating relations such as Narration/Sequence and Contrast are categorized with respect to the hierarchical structure of discourse (for a consensus list of discourse relations, cf. e.g. Jasinskaja & Karagjosova 2020).

Subordinating relations such as Explanations may take on a number of different syntactic structures with a varying degree of clausal integration, see (15). In all these cases, the underlined material provides an explanation of the occurrence of the mental state of annoyance, establishing a discourse-structural subordinating relation between two segments:[20]

[20]It should be noted that the status of sentential complements as in (15e) as (independent) discourse segments is debatable, but for the parallelism in interpretation, we include them in our

(15) a. *Adverbial clause:*
Peter annoyed Mary because he sang loudly.
b. *Non-restrictive relative clause:*
Peter, who sang loudly, annoyed Mary.
c. *Gerund:*
Singing loudly, Peter annoyed Mary.
d. *Independent sentence (without explicit marker):*
Peter annoyed Mary. He sang loudly.
e. *Sentential complement:*
It annoyed Mary that Peter sang loudly.

There is a certain tendency for subordinate clauses to go along with discourse-structural subordination. Thus, Matthiessen & Thompson (1988: 308) argued that subordinate clausal syntax (hypotaxis) is a grammaticalization of the relationship of discourse subordination. Their counts based on a small corpus of 18 short texts revealed that a subordinate clause realized a subordinating discourse relation in 45 out of 48 cases, whereas only 3 (= 6%) subordinate clauses realized a coordinating discourse relation.[21] In Loock's (2007) study of 450 English non-restrictive relative clauses (NRRC) collected from texts of four different genres, only 20 (= 4.4%) were continuative (i.e., discourse-structurally coordinated).[22]

The opposite clearly does not hold. First, subordinating discourse relations may span across sentence boundaries, as shown by (15d), partly because there are other, more conventional means of encoding subordinating relations that do not involve syntactic subordination (such as connectives). What is more, some cases of syntactic subordination raise the interesting question of what should count as a discourse segment, see the sentential complement in (15e). In the following, we will first discuss parallels between syntactic and discourse-structural embedding (Section 3.1) before we turn to what may be viewed to be mismatches between the two domains (Section 3.2).

discussion. See sub-section "Complementation" in Section 3.1 for further discussion.

[21] Matthiessen & Thompson (1988) base their analysis on RST (Mann & Thompson 1988) and operate with the notions of 'nucleus-satellite relation' and 'hypotaxis', which are not identical but closely correspond to the notions of discourse-structural subordination and subordinate clause, respectively, cf. also Section 3.1 for further details on the distinction between syntactic embedding and hypotaxis.

[22] See also Jasinskaja & Poschmann (2018), who argue that there is a statistical tendency for an alignment between hierarchical structures in syntax and discourse.

3.1 Parallels between syntactic and discourse structure

In this section, we first investigate the correspondences between syntactically non-embedding structures and discourse-structural coordination on the one hand, and syntactically embedding structures (in terms of adjunction and complementation) and subordinating discourse structures on the other. We then proceed to discuss some parallels between discourse prominence and syntactic subordination.

3.1.1 Syntactic relations between clauses and their discourse-structural counterparts

3.1.1.1 Coordination

There are many cases in which discourse-structural coordination corresponds to clausal coordination (see Chapter 5 Coordination). In general, syntactic coordination, or conjunction, holds between syntactic units that have the same status or play the same role in a given syntactic context (cf. e.g. Fabricius-Hansen & Ramm 2008: 5 and the literature cited there). It is usually taken to be a symmetric relation in the sense that if unit A is coordinated with unit B, then B is also coordinated with A. However, various cases of asymmetric coordination are reported in the literature, such as *and*-constructions performing "subordinate conjoining" (Lang 1984) or "No Backward Anaphoricity" (ibid.), that is, the fact that the first conjunct is an accessible anaphoric antecedent for anaphoric elements in the second conjunct, but not the other way around.[23] Clausal coordination is signalled by coordinating conjunctions, prototypically *and*, *but* and *or*, thus representing a syndetic variety of paratactic clause combining (Fabricius-Hansen & Ramm 2008: 6).[24] The same coordinating conjunctions are also typical markers of coordinating relations such as Parallel (16), Narration (17), Contrast (18) (Lakoff 1971: 133) or Alternation (19) (Asher & Lascarides 2003: 169).

(16) Mary plays football and John plays tennis.

(17) Max fell and John helped him up.

(18) John is tall, but Bill is short.

[23] Some researchers even assume a subordination-coordination continuum (cf. e.g., Kortmann 1997: 56).

[24] Malchukov (2004) and Mauri (2008) offer an account of the particular semantics (functions, uses) of various coordination markers within the semantic map approach: adversative, contrastive, additive, disjunctive, etc. conjunctions, converbs (non-finite verb forms expressing adverbial subordination), etc.

(19) Either Jane likes football or she has a crush on David Beckham.

On the other hand, coordinating discourse relations need not be syntactically realized in terms of syndetic clause combination but may take the form of asyndetic clause combination or mere juxtaposition of independent clauses in discourse, as in the Narration-example (20) (Asher & Lascarides 2003: 6) below. Moreover, coordinating discourse relations may be (additionally) marked by adverbs and particles. Thus, typical markers of the Parallel relation are the particles *also* and *too* that may be used in syndetic or asyndetic parataxis/clause combining or mere juxtaposition, as in the Parallel-example (21).

(20) Max fell. John helped him up.

(21) Mary drives a Toyota $\left\{ \begin{array}{c} . \\ , \\ \text{and} \end{array} \right\}$ John also drives a Toyota.

3.1.1.2 Adjunction

Discourse-structural subordination corresponds roughly to clause combining in terms of adjoined, primarily adverbial clauses, a relation also known as adverbial subordination (see Chapter 3 Adverbial clauses).

Adverbial clauses are viewed in Sæbø (2011) as subordinate clauses that modify their superordinate clauses at various syntactic phrasal levels (e.g., verb phrase, tense phrase, mood phrase) and in various dimensions (such as times and worlds). They are mostly marked by a subordinator. As a matter of fact, there is a controversy as to the extent to which adverbial clauses are syntactically subordinated or embedded into a main (matrix) clause. Thus, Matthiessen & Thompson (1988) argue for a distinction between clausal (syntactic) embedding where one clause is a constituent part of another, and clause combination based on some circumstantial, that is, temporal, conditional or other relation and syntactically realized as either parataxis or hypotaxis. They argue further that adverbial subordination, as well as non-restrictive relative clauses, represent a case of clause combination rather than clausal embedding, thus arguing against grouping embedding and hypotaxis together as 'subordination'.[25] Based on this distinction between embedded and hypotactic adverbial clauses, Matthiessen and Thompson view hypotaxis as a grammaticalization of the hierarchical organization of discourse, in terms of

[25] One argument for this involves the fact that adverbial clauses may be syntactically embedded within a noun phrase, as in [$_{NP}$ the happy days [before the Magistrate had been invited]] (Matthiessen & Thompson 1988: 279).

a special case of the mono-nuclear relation in RST. Others, like Fabricius-Hansen & Ramm (2008: 15), equate hypotaxis with subordination in the general sense of "subordinate clauses that are not embedded" and parataxis with explicitly marked coordination and mere juxtaposition of mutually independent clauses.[26]

In adverbial hypotaxis, the circumstantial relation to the clause that an adverbial clause is adjoined to is marked by a corresponding adverbial subordinator. An extensive typology of adverbial subordinators such as *because*, *if* and *while* in the languages of Europe is presented in Kortmann (1997). The same items that serve as subordinators at the syntactic level also function as markers of subordinating relations such as Explanation (*because*), Flashback (*after*) or Background (*while*), see also Zeevat (2011) who provides a list of grammaticalized English cues for RST relations. Among them are markers of Nucleus-Satellite relations such as *because, since* for Evidence, Justify, Motivation and Non-volitional Cause, *but* and *though* for Concession, *if* for Condition and *namely* for Elaboration.

Next to adverbial subordination, there is a further case of syntactic adjunction that is relevant to the notion of subordination in syntax and discourse. In their study of the semantics of non-restrictive relative clauses (NRRCs; see also Chapter 4 Relative clauses), Jasinskaja & Poschmann (2018) and Jasinskaja & Poschmann (2020) observe that NRRCs tend to realize subordinating discourse relations since they are syntactically subordinate, and are therefore interpreted globally (i.e., as independent sentences, outside the scope of semantic operators in the embedding sentence). Thus in (22), adapted from Jasinskaja & Poschmann (2020), the NRRC constitutes an Explanation and the content of the NRRC is entailed by the discourse, showing that it is outside the scope of the conditional operator. However, they contend, an NRRC may also be interpreted locally if the discourse relation it establishes to its host is coordinating (e.g., Narration, Parallel, Contrast). See (23), where the NRRC establishes a Narration relation to its host, and the content of the NRRC is not entailed by the discourse since it is within the scope of the conditional operator in the main clause.[27]

[26] See, however, the distinction between core and peripheral adverbial clauses suggested in Haegeman (2002, 2004, 2006) and discussed in Frey (2011) for German. See also the detailed discussion of correspondences between various degrees of clausal integration and the Sweetser (1990) sub-types of explanatory (and concessive) relations in Frey (2020).

[27] Jasinskaja & Poschmann (2020) draw on earlier work by Schlenker (2013), who first observed that the two readings are related to two different discourse relations, however without elaborating on the nature of the difference.

(22) If Peter praised John,
who designed the new prototype, ⇝ John designed the new prototype
he would be doing the right thing.

(23) If Peter praised John,
who then was delighted, ↛ John was delighted
he would be doing the right thing.

Finally, participial and converb clauses also represent a relevant case of syntactic adjunction which at the level of discourse translates into discourse-structural subordination in terms of correspondence to subordinating discourse relations (cf. e.g. Behrens et al. 2012). As noted by Sæbø (2011) (citing Kortmann 1995, König 1995), although present (gerund) or past participial clauses in English allow in general for a wide range of interpretations, there is a clear tendency to interpret these clauses as expressing certain discourse relations, based on the lexical content and the context of utterance. Thus in (24) (Sæbø 2011: 1436), the converb clause *wriggling and writhing* is taken to elaborate on the matrix clause, as the adjunct events represent subevents of the main event (Behrens 1998, cf. also König 1995, according to whom the two converbs and the main verb describe different aspects of the same event).

(24) The trout struggled, wriggling and writhing.

In particular, preposed *-ing* adjuncts may under given circumstances convey largely the same relations as conditional *if*-clauses (25), causal *because*-clauses (26) or temporal *when/while*-clauses (27) (Sæbø 2011: 1437):[28]

(25) Driving slowly through Thorpe, you will see signs for Dovedale on the way.

(26) Having confessed to having sex with the girl, the man was sentenced to one year on an abandoned island.

(27) Reaching the coast, they pick up the scent of their home river.

3.1.1.3 Complementation

It is less clear that there is a discourse-structural counterpart to complementation (see Chapter 2 Argument clauses). Traditionally, complement clauses are consid-

[28] See also Behrens et al. (2012) on further structures competing with non-finite co-eventive adjuncts.

ered to be part of the discourse unit of the corresponding main clause. Thus, Mann & Thompson (1988: 248) state that discourse units should have "independent functional integrity".[29] However, there are some interesting exceptions to this (see for instance the discussion in Schilperoord & Verhagen 1998 and Hoek 2018). In particular, Carlson & Marcu (2001) observe that what they characterize as *attribution verbs* (such as *say, tell, state*) may establish a discourse relation they call Attribution between the matrix and subordinate clause, if the latter is finite, cf. (28) (Carlson & Marcu 2001: 8), where the clause containing the attribution verb *say* represents the Satellite in an Attribution relation to the second clause representing the Nucleus.

(28) [Mercedes officials said] [they expect flat sales next year]

Also in SDRT, a subordinating Attribution relation is assumed to hold between a communicative act and the agent of the act (Reese et al. 2007; cf. also Hunter & Asher 2016 and Bimpikou et al. 2021 on the discourse structure of reports in discourse). In Carlson & Marcu (2001: 9), the class of attribution verbs consists of speech verbs and various cognitive predicates like *think*, *predict*, and *fear*. While we are not aware of any principled discussion of this feature of certain verb classes in the literature, we think that for some of these cognitive predicates, a more specific (subordinating) discourse relation than Attribution is established.[30] In particular, we believe it is reasonable to assume that – as clause-embedding predicates – psychological predicates such as *annoy* or *fear* involve a subordinating Explanation relation between the matrix clause and an embedded *that* clause.[31]

The subject of much research on the syntax-semantics interface, psychological predicates select for an Experiencer and a Stimulus argument, where the Stimulus argument can alternate between a DP and a CP argument (for empirical evidence in English and German, see for instance Salkoff 2002, Engelberg 2018). The mental state of the Experiencer is causally dependent on the Stimulus (Bott

[29] See also the notion of "conceptual dependency" in (Schilperoord & Verhagen 1998).

[30] See, however, work by Danlos (2006) on what she calls "discourse verbs" such as *cause* and *precede*, which take eventualities/facts as arguments and express particular discourse relations as part of their semantics, thus entering into competition with the corresponding discourse connectives *as a result* and *next*.

[31] As pointed out by a reviewer, treating the relation that sentential complements in these cases establish to the main clause as a discourse relation requires redefining what counts as a discourse segment, suggesting an alternative treatment of the connection inferred between a matrix event and its complement in terms of (a kind of) implicature. Clarifying the exact status of the relation between matrix clauses and embedded clauses goes beyond the scope of the present chapter, however.

& Solstad 2021, Kutscher 2009, Solstad & Bott 2022). Thus, the annoyance of the Experiencer (*us*) in (29) (Salkoff 2002: 105) is caused by Jim's late arrival.

(29) That Jim arrived late annoyed us.

Evidence for the explanatory nature of stimulus specifications has been provided by Bott & Solstad (2014, 2021), Kehler et al. (2008), Solstad & Bott (2022). Thus, when participants are asked to provide continuations for simple prompts like *Jim annoyed Jane*, they show a strong tendency (≈ 60%) to provide explanations (e.g., *He was late*). These explanations are of the same type as those provided after *because* prompts (*Jim annoyed Jane because …*), see Bott & Solstad (2014), Solstad & Bott (2022).

While not concerned with the syntactic status of subordinated clauses or the relation between syntactic and discourse-structural subordination in particular, Asher & Lascarides (2003: 267 ff.) argued that Stimulus-Experiencer verbs like *annoy* evoke the interpretation of an Explanation relation in (30) (adapted from Asher & Lascarides 2003: 252, 269):

(30) Fred annoyed Mary. He ate soup last night.

We will return to the role of psychological predicates in establishing discourse coherence in Section 4, where we discuss semantic and pragmatic processes involved in discourse-structural embedding.

3.1.2 Discourse prominence

There is a similar effect of subordinating discourse relations and subordinate clauses on discourse prominence (von Heusinger & Schumacher 2019) in terms of accessibility for anaphora. As we saw in Section 2.1, anaphoric reference follows largely the same principles as discourse attachment: In searching for an antecedent for an anaphoric expression, we are allowed to "look left one step only or look up" (Asher & Vieu 2005). For example, the 1st and the 2nd sentence in (31) are connected by a coordinating relation Parallel. Therefore, only the 2nd sentence is on the right frontier and the pronoun *he* in the following sentence is preferably resolved to a referent mentioned in the 2nd sentence, i.e. Bill. In contrast, in (32) the second sentence provides evidence for the 1st by reference to an authoritative source. Evidence is a subtype of Explanation, i.e. a subordinating relation. Both sentences in (32) are therefore on the right frontier, so the following sentence could continue giving the evidence, in which case the pronoun *he* could refer either to Bill or to John; alternatively, it could continue telling the story about John, in which case *he* would refer to John.

(31) Parallel:
John broke the vase. Bill broke the mirror. He_{Bill} ...

(32) Explanation (Evidence):
John broke the vase. Bill told me that. $\text{He}_{\not John/Bill}$ ...

There is evidence that syntactic subordination has a similar effect on anaphoric resolution as discourse subordination. Experimental studies like Frazier & Clifton (2005) and Cooreman & Sanford (1996) show that a pronoun is less likely to refer to an antecedent in a subordinate clause than to one in a main clause, regardless of the recency status of the subordinate clause. Thus in (33a), the pronoun *she* is more likely to be resolved to the subject of the main clause rather than to that of the subordinate clause, whereas in (33c), *she* can only be resolved to the subject of the main clause (cf. Jasinskaja & Poschmann 2018: 448).

(33) a. Mary left before Sue arrived. $\text{She}_{\text{Mary>Sue}}$ ... main-subordinate
b. Mary left. Then Sue arrived. She_{Sue} ... main-main
c. After Mary left, Sue arrived. She_{Sue} ... subordinate-main

3.2 Mismatches between syntactic and discourse structure

Although the previous section pointed at a number of parallels between syntactic embedding and discourse-structural subordination, it is evident that discourse-structural subordination cannot be identified with syntactic subordination, that is, that discourse-structurally subordinate discourse material need not be realized in a subordinate clause, and a subordinate clause does not always encode a relation of discourse subordination. For detailed discussion of the non-equivalence of these notions see in particular Blühdorn (2008).

Example (7) above is an instance of discourse-structural subordination without syntactic subordination: The subordinating discourse relation Source holds between two independent sentences. On the other hand, syntactically coordinate structures can also realize subordinating discourse relations. For instance, the second conjunct of *and* in (34) (Asher & Vieu 2005) gives an Explanation of the first, and the second disjunct of *or* in (35) is a Reformulation (a special case of Elaboration) of the first disjunct.

(34) Explanation:
Max fell, *and* it was Bill who pushed him.

(35) Reformulation:
The hearer must identify the speech act performed by an utterance, or (in other words), she must identify its illocutionary force.[32]

Conversely, subordinate clauses are syntactically embedded, but can realize coordinating discourse relations. One prominent example is described in Holler (2008) and involves continuative relative clauses, a subclass of non-restrictive relative clauses in German. As argued by Holler, continuative relative clauses like the ones in (36) and (37) are attached to the main clause by means of coordinating, in the SDRT-sense, discourse relations, here Narration and Contrast, signalled by the discourse markers *dann* and *aber* respectively, while ordinary non-restrictive relative clauses like (38) are connected to the main clause by means of subordinating relations (examples from Holler 2008):[33]

(36) Narration:
Oskar traf einen Bauern, den er *dann* nach dem Weg fragte.
'Oskar met a farmer, whom he then asked for the way.'

(37) Contrast:
Oskar machte einen Versuch, der *aber* restlos scheiterte.
'Oskar made an attempt, which however completely failed.'

(38) Elaboration:
Oskar machte diesen Versuch, der nicht scheitern konnte.
'Oskar made an attempt, which could not fail.'

As a matter of fact, the relation signalled by *aber* in (37) is better characterized as Violated expectation or Concession rather than in terms of the general Contrast relation provided by the SDRT inventory of discourse relations. In SDRT, Contrast is by default coordinating, unlike Mann & Thompson (1986), where both a multi-nuclear Contrast relation and two Nucleus-Satellite relations Antithesis and Concession are assumed. Similarly, Hobbs (1985) views both his Contrast and Violated expectation relation as subordinating, while the latter belongs to the class of expansion relations. Moreover, applying the test in (5) yields the result that the relation holding between the main clause and the relative clause in

[32] This is a modified version of Blackmore's (1993: 109) original Reformulation example "The hearer must identify the speech act performed by an utterance. In other words, she must identify its illocutionary force."

[33] Cf. also Jasinskaja & Poschmann (2018) and Jasinskaja & Poschmann (2020) and the discussion of NRRCs in Section 3.1.1 and Chapter 4 Relative clauses for an overview.

(37) is subordinating: A discourse continuation like *Das nächste Mal wollte er sich besser vorbereiten* ('Next time he wanted to be better prepared.') would naturally attach to the main clause which contains the anaphoric antecedent for the pronoun. Nevertheless, although the interpretation of the data may in some cases be theory-dependent, unambiguous examples like (36) do support the observation of a mismatch between syntactic and discourse structure.[34]

Among adverbial clauses, *whereas*-clauses (39) are syntactically subordinate, but express Parallel or Contrast, which are coordinating discourse relations:

(39) Parallel:
John is tall, *whereas* Bill is small.

On the other hand, clauses syntactically coordinated by means of conjunctions like *but* may involve subordinating (i.e. Nucleus-Satellite) RST-relations like Antithesis and Concession. Similarly, the German coordinating conjunction *denn*, as well as its English counterpart *for*, marks the subordinating relation Explanation.

Finally, a further case of mismatch between syntactic subordination and subordination in discourse is discussed in Riester et al. (2018: 34), who treat (following Simons et al. 2010) embedding matrix verbs of sentential arguments as non-at-issue material (of type evidentials) which does not answer the current QUD, thus belonging to van Kuppevelt's subordinated layer of discourse (cf. Figure 8). See (40) (Riester 2019) where it is the sentential complement that answers the QUD and thus belongs to the main discourse structure.

(40) Q: {What is the current status of the bill?}
Jetzt heißt es, das Kanzleramt hat diese Verordnung gestoppt. 'Now they are saying that the Chancellery has stopped the bill.'

4 Semantic and pragmatic processes leading to the establishment of subordination in discourse

In this section, we will discuss how semantic and pragmatic aspects of the discourse beyond domain or world knowledge (as discussed in Asher & Lascarides 2003) may lead to the establishment of discourse-structural subordination. In doing so, we will revisit some of the issues discussed in Sections 2.2.3 and 3.1.1 from

[34] Note also that examples like this do not pose a problem for SDRT since, as mentioned in Section 2, the test in (5) is motivated by the observation that a relation that is coordinating by default may in some contexts come out a subordinating.

the viewpoint of what motivates the establishment of discourse-structural subordination, both in terms of subordinating discourse relations and in terms of questions and goals. We will first investigate the relationship between discourse expectations triggered by the semantics of certain verbs and the establishment of discourse subordination in terms of subordinating discourse relations. Then we briefly introduce a case where derivational morphology can be taken to establish subordination in discourse in terms of introducing subquestions. Finally, we turn to the role of the pragmatic process of grounding on the establishment of subordination in discourse in the sense of Jasinskaja & Karagjosova (2020).

4.1 Verb semantics and discourse expectations

In the discussion of the sentential complements of psychological verbs (e.g, *annoy*) in Section 3.1.1, it was argued that such clause-embedding predicates establish an Explanation relation between the matrix clause and an embedded (or independent) clause:

(41) a. That John ate soup in the evening annoyed Mary.
b. John annoyed Mary. He ate soup in the evening.

As already mentioned in Section 3.1.1, Asher & Lascarides (2003) argued that Stimulus-Experiencer verbs like *annoy* evoke the interpretation of an Explanation relation in (41b). Moreover, they argue that these verbs are lexically determined to do so. They contended that although the second sentence in (41b) does not constitute a 'plausible' explanation for Mary's annoyance based on domain knowledge, it is still preferably understood to be an explanation exactly due to the semantics of *annoy*. More precisely, Asher & Lascarides attributed this preference to the semantic nature of the Stimulus/subject argument of *annoy*, which, as stated above, introduces the cause of Mary's attitude of annoyance. Asher & Lascarides analysed the subject as being semantically propositional in nature, in the sense that it carries a presupposition that the subject was involved in some eventuality which resulted in the annoyance in the Experiencer argument. The second clause in (41b) is thus interpreted as an Explanation because it may be taken to justify the presupposition that is introduced by *annoy* and left unspecified otherwise. The fact that the Stimulus argument may be realized as a *that* clause is consistent with this analysis (see also Bott & Solstad 2014, 2021).

Asher & Lascarides limited their observations to psychological predicates of the Stimulus-Experiencer type. However, Bott & Solstad (2014, 2021) and Solstad & Bott (2022) argued that Experiencer-Stimulus predicates such as *fear* can be

given a similar analysis (see also Cheung & Larson 2015) and provided experimental evidence that leaving what Asher & Lascarides characterize as a presupposition unverified (in Bott & Solstad's 2014, 2021 analysis an underspecified propositional argument) evokes the expectation of an explanation. Thus, as mentioned above, when asked to provide a written continuation for prompts such as *John annoyed Mary* or *John feared Mary*, participants provided around 60% explanations (Bott & Solstad 2014, Kehler et al. 2008, Solstad & Bott 2022), which was around three times as much as the second-most frequent relation, Result (Kehler et al. 2008, Solstad & Bott 2022).

Interestingly, psychological verbs constitute a subclass of *Implicit Causality verbs* (henceforth, IC; Garvey & Caramazza 1974, Brown & Fish 1983, Ferstl et al. 2011), which have been linked to *discourse expectations* in psycholinguistic research (Kehler et al. 2008, Bott & Solstad 2021). As mentioned above, these verbs display interesting coherence patterns in discourse continuation studies (in addition to coreference patterns, which will not concern us here; see, for instance Ferstl et al. 2011, Garnham et al. 2021): Prompted to provide a continuation for, for instance, *John annoyed Mary*, participants produce overwhelmingly more Explanations than other continuations (Kehler et al. 2008, Bott & Solstad 2014, Kehler & Rohde 2019) as opposed to "non-IC verbs" such as ordinary agent-patient verbs. Beyond psychological verbs, similar properties have been observed for another class of IC verbs, so-called Agent-Evocator verbs, which include, among others, a subset of Fillmore's (1969) judgment verbs:

(42) Mary punished Peter. He had stolen the money.

In (42), *punish* presupposes that Peter was involved in some eventuality which Mary considered to be punish-worthy (Fillmore 1969). This eventuality is a cause of Mary's intention to punish Peter (see the analysis of reasons in Solstad 2010). Thus, all IC verbs evoking significantly more explanations may be taken to involve an explanatory relation between underspecified or presuppositional content and the eventuality denoted by the predicate itself. Put differently, the predicates in question come with an explanatory *slot* (Bott & Solstad 2021, Solstad & Bott 2022), which is assumed to be filled by material in discourse. Bott & Solstad (2021) argue that it is precisely the discourse expectations associated with the underspecified, or presupposed, semantic content that leads to the establishment of Explanation relations. As a means to avoid accommodation (Altmann & Steedman 1988, Zeevat 2000), subsequent or preceding discourse will be taken to verify the presupposition, leading to causal inferences, even in far-fetched contexts as in (41).

Since both clause-embedding psychological predicates and the so-called 'agent-evocator' predicates display these preference patterns, the establishment of Explanation relations cannot be attributed to a correlation with syntactic subordination. Admittedly, it is an open question whether only subordinating discourse relations can be subject to discourse expectations or whether for instance Narration and Occasion relations may be expected for specific end-point-oriented predicates, such as transfer-of-possession predicates (Stevenson et al. 1994, Kehler et al. 2008).

4.2 Derivational morphology

Next to verb semantics, there are also cases of word-derivational means leading to the establishment of subordination in discourse. One such case is described in Salfner (2018), who argues that the German suffix *-mäßig* ('pertaining to'/'in terms of'/'concerning') is used to mark delimitators (cf. Krifka 2008), which signal that only a discourse subquestion will be addressed by the speaker. For instance, the last utterance in (43) (Salfner 2018: 232), which contains the adverb *hardwaremäßig* ('with regard to the hardware'), does not fully answer any of the possible questions in (43a–43c). Rather, it makes salient a set of alternative subquestions to a superordinated QUD and at the same time signals that the rest of the utterance is only going to address the subquestion specified by the *-mäßig*-adverb.

(43) a. Wie ist der Laptop? 'How is the laptop?'
b. Ist der Laptop gut?
'Is the laptop good?'
c. Hat es sich gelohnt, einen so teuren Laptop anzuschaffen?
'Was it worth buying such an expensive laptop?'
d. Hardwaremäßig ist der Laptop super.
'As for the hardware, the laptop is great.'

Moreover, depending on the propositional content of the utterance, a *-mäßig*-adverb may signal that the host utterance represents an answer to the current QUD that is quantitatively and, in some cases, also qualitatively unsatisfying.

4.3 Grounding in communication

We saw in Section 2.2.3 that one way of capturing what it means for a discourse unit to be subordinate to another discourse unit is by stating that the communicative goal of the superordinate unit cannot be reached before the goal of the

subordinated unit is achieved. In defining what it means to achieve a communicative goal, Jasinskaja & Karagjosova (2020) follow Clark & Schaefer (1989), Clark (1996), Traum (1994) and other works that draw upon a notion of *grounding*, i.e. the process by which an addressee signals to the speaker that the communicative goal of the latter has been reached, for instance, by immediately performing the requested action or answering the question asked by the speaker. In particular, they adopt Clark's (1996) idea that grounding proceeds in four stages that correspond to four levels of action in communication, and consider the ultimate goal of an utterance to be reaching grounding at level 4:

1. vocalization by the speaker, which should result in attention from the hearer;
2. presentation of the acoustic signal, which should result in the hearer's identification of the phonological string;
3. the speaker's meaning, which should result in the hearer's understanding;
4. the speaker's proposal, which should result in the hearer's uptake of the proposal.

Based on this notion of grounding in discourse, Jasinskaja & Karagjosova (2020) argue that the primary function of discourse subordination in terms of subordinating discourse relations is to handle encountered or anticipated grounding problems at different levels. Grounding failure at levels 1 and 2 would typically make the speaker simply repeat U_1. Plain repetition is (in Hobbs' view) the trivial case of Elaboration. More interesting cases pertain to level 3 (problems of understanding) and level 4 (disagreement). Two of the more frequent reasons for failures to understand are problems of reference resolution (44) and lexical access (45). Reformulation, which according to Jasinskaja & Karagjosova (2020) is a subordinating relation, is a way to repair for this kind of problem.

(44) It's there.
[Where is 'there'? / It's WHERE?]
Behind the refrigerator.

(45) This piece begins with an anacrusis,
[What is an 'anacrusis'?]
an unaccented note which is not part of the first full bar.

As for handling disagreement, Jasinskaja & Karagjosova (2020) argue that subordinating relations like Evidence or Motivation address actual or potential disagreements: A piece of information can be made easier to believe by pointing to observable Evidence (46) or by reference to an authoritative source, while Motivation is needed if the hearer might refuse to fulfil a request or answer a question.

(46) John must have been here recently.
[Why do you think so?]
There are his footprints.

In all these cases, the discourse flow is "interrupted" because there is a problem that needs to be solved before the speaker can continue. It is in this sense that Jasinskaja & Karagjosova (2020) understand discourse subordination as motivated by the pragmatic process of grounding and involving interruption of a communicative plan to handle a communicative problem. This notion of interruption corresponds to Polanyi's view of subordinated discourse units as interrupting the completion of an ongoing unit of discourse, rather than to the "true" interruptions in Grosz & Sidner (1986) and topic digressions discussed in van Kuppevelt (1995). On the other hand, the pragmatic notion of subordination proposed in (11) also captures van Kuppevelt's notion of "satisfaction" involved in the question-triggering mechanism described in Section 2.2.2, where a topic-constituting question that has been answered unsatisfactorily gives rise to further subquestions until the original question has been answered. Reformulated in terms of (11), this subquestioning procedure is repeated until there are no potential grounding problems left that need to be dealt with in order to fully answer the main question.

5 Summary and outlook

In this chapter, we argued that subordination in discourse is a notion comparable to the syntactic phenomenon of clausal embedding. Although there is no uniform notion of embedding in discourse, we identified and discussed various concepts that have been proposed so far to capture different aspects of the hierarchical structure of discourse. As we attempted to show, the notions of subordination offered in the theories we discussed are both comparable and compatible with one another, and we believe that the attempt to integrate them into a unified approach to discourse structure will constitute a considerable and hopefully fruitful effort in future research in the field. Especially when it comes to the task of

annotating discourse, several promising research projects which attempt to analyse discourse in terms of both QUD-structure, topical organization and (RST or SDRT) discourse relations are currently under way, cf. Riester et al. (2021), Scheffler (2021), and Hesse et al. (2020). Based on the various notions of subordination in discourse, we furthermore identified and discussed various correspondences and mismatches between syntactic embedding and discourse subordination.

While syntactic relations may be one way of realizing subordination in discourse, we showed that various semantic and pragmatic phenomena may also lead to the establishment of discourse subordination, such as verb semantics, derivational morphology and grounding in communication. There are further non-syntactic ways of expressing discourse-structural subordination or coordination that we did not discuss in this chapter. One such phenomenon that has implications for the notion of discourse subordination is modal subordination (Roberts 1989). At the same time, discourse structure in oral and written discourses is reflected by prosodic parameters such as pause duration and pitch range (cf. Mayer et al. 2006, Jasinskaja et al. 2004) and typographic means, such as bullet-lists (which can be described as coordinating structures that are altogether embedded) or headings and subheadings (which are treated in RST by means of the Preparation-relation that relates a heading as a Satellite unit to the entire text as a Nucleus, cf. RST website http://www.sfu.ca/rst/). Future research on discourse subordination will also have to take these aspects of discourse structure into consideration.

Acknowledgements

We would like to thank Katja Jasinskaja and Fabienne Salfner for their substantial contribution to developing the original conception and form of this chapter. We are also grateful to Anton Benz and Cathrine Fabricius-Hansen as well as two anonymous reviewers for their valuable comments on an earlier version of the chapter. The usual disclaimers apply.

References

Altmann, Gerry & Mark Steedman. 1988. Interaction with context during human sentence processing. *Cognition* 30. 191–238.

Asher, Nicholas. 1993. *Reference to abstract objects in discourse*. Dordrecht: Kluwer.

Asher, Nicholas & Alexis Lascarides. 2003. *Logics of conversation*. Cambridge: Cambridge University Press.

Asher, Nicholas & Laure Vieu. 2005. Subordinating and coordinating discourse relations. *Lingua* 115. 591–610.

Behrens, Bergljot. 1998. *Contrastive discourse. An interlingual approach to the interpretation and translation of free -ING participial adjuncts*. University of Oslo. (Doctoral dissertation).

Behrens, Bergljot & Cathrine Fabricius-Hansen. 2010. The relation accompanying circumstance across languages: Conflict between linguistic expression and discourse subordination? In Dengfang Shu & Ken Turner (eds.), *Contrasting meaning in languages of the East and West*, 531–552. Bern: Peter Lang.

Behrens, Bergljot, Cathrine Fabricius-Hansen & Kåre Solfjeld. 2012. Competing structures: The discourse perspective. In Cathrine Fabricius-Hansen & Dag Haug (eds.), *Big events, small clauses: The grammar of elaboration*, 179–226. Berlin: De Gruyter.

Benz, Anton & Katja Jasinskaja. 2017. Questions under discussion: From sentence to discourse. *Discourse Processes* 54. 177–186.

Bimpikou, Sofia, Emar Maier & Petra Hendriks. 2021. The discourse structure of free indirect discourse reports. *Linguistics in the Netherlands* 38. 21–39.

Blakemore, Diane. 1993. The relevance of reformulations. *Language and Literature* 2. 101–120.

Blühdorn, Hardarik. 2008. Subordination and coordination in syntax, semantics and discourse: Evidence from the study of connectives. In Cathrine Fabricius-Hansen & Wiebke Ramm (eds.), *'Subordination' versus 'coordination' in sentence and text: A cross-linguistic perspective*, 59–85. Amsterdam: John Benjamins.

Bott, Oliver & Torgrim Solstad. 2014. From verbs to discourse – a novel account of implicit causality. In Barbara Hemforth, Barbara Mertins & Cathrine Fabricius-Hansen (eds.), *Psycholinguistic approaches to meaning and understanding across languages*, 213–251. Heidelberg: Springer.

Bott, Oliver & Torgrim Solstad. 2021. Discourse expectations: Explaining the implicit causality biases of verbs. *Linguistics* 59. 361–416.

Brown, Roger & Deborah Fish. 1983. The psychological causality implicit in language. *Cognition* 14. 237–273.

Carlson, Lauri. 1983. *Dialogue games: An approach to discourse analysis*. Dordrecht: Reidel.

Carlson, Lynn & Daniel Marcu. 2001. *Discourse tagging reference manual*. Tech. rep. ISI-TR-545. http://www.isi.eduJ-marcuJdiscourse/. ISI Technical Report.

Cheung, Candice Chi-Hang & Richard Larson. 2015. Psych verbs in English and Mandarin. *Natural Language and Linguistic Theory* 33. 127–189.

Clark, Herbert H. 1996. *Using Language*. Cambridge: Cambridge University Press.

Clark, Herbert H. & Edward F. Schaefer. 1989. Contributing to discourse. *Cognitive Science* 13. 259–294.

Cooreman, Ann & Anthony J. Sanford. 1996. *Focus and syntactic subordination in discourse*. Research paper 79. Edinburgh: HCRC.

Danlos, Laurence. 2006. 'Discourse verbs' and discourse periphrastic links. In Miriam Butt (ed.), *Proceedings of konvens 2006*, 160–166. Konstanz University.

Danlos, Laurence. 2008. Strong generative capacity of RST, SDRT and discourse dependency DAGSs. In Anton Benz & Peter Kühnlein (eds.), *Constraints in discourse*, 69–95. Amsterdam: John Benjamins.

Egg, Markus & Gisela Redeker. 2010. How complex is discourse structure? In *Proceedings of the Seventh International Conference on Language Resources and Evaluation (LREC'10)*, 1619–1623. Valletta: European Language Resources Association (ELRA).

Engelberg, Stefan. 2018. The argument structure of psych-verbs: A quantitative corpus study on cognitive entrenchment. In Hans C. Boas & Alexander Ziem (eds.), *Constructional approaches to syntactic structures in German*, 47–84. Berlin: De Gruyter.

Fabricius-Hansen, Cathrine & Wiebke Ramm. 2008. Subordination and coordination from different perspectives. In Cathrine Fabricius-Hansen & Wiebke Ramm (eds.), *'Subordination' versus 'coordination' in sentence and text: A cross-linguistic perspective*, 1–30. Amsterdam: John Benjamins.

Farkas, Donka F. & Kim Bruce. 2010. On reacting to assertions and polar questions. *Journal of Semantics* 27. 81–118.

Ferstl, Evelyn C., Alan Garnham & Christina Manouilidou. 2011. Implicit causality bias in English: A corpus of 300 verbs. *Behavior Research Methods* 43. 124–135.

Fillmore, Charles J. 1969. Verbs of judging: An exercise in semantic description. *Paper in Linguistics* 1. 91–117.

Frazier, Lynn & Charles Clifton. 2005. The syntax-discourse divide: Processing ellipsis. *Syntax* 8. 121–174.

Frey, Werner. 2011. Peripheral adverbial clauses. In Elisabeth Breindl, Gisella Ferraresi & Anna Volodina (eds.), *Satzverknüpfung - Zur Interaktion von Form, Bedeutung und Diskursfunktion*, 41–77. Berlin: Mouton de Gruyter.

Frey, Werner. 2020. On the categorical status of different dependent clauses. Ms., Berlin: Leibniz-ZAS. Berlin. https://www.researchgate.net/publication/349924846.

Garnham, Alan, Svenja Vorthmann & Karolina Kaplanova. 2021. Implicit consequentiality bias in English: A corpus of 300+ verbs. *Behavior Research Methods* 53. 1530–1550.

Garvey, Catherine & Alfonso Caramazza. 1974. Implicit causality in verbs. *Linguistic Inquiry* 5. 459–464.

Ginzburg, Jonathan. 1996. Interrogatives: Questions, facts and dialogue. In Shalom Lappin (ed.), *The handbook of contemporary semantic theory*, 385–422. Oxford: Blackwell.

Grosz, Barbara J. & Candace L. Sidner. 1986. Attention, intentions and the structure of discourse. *Computational Linguistics* 12. 175–204.

Haegeman, Liliane. 2002. Anchoring to speaker, adverbial clauses and the structure of CP. *Georgetown University Working Papers in Theoretical Linguistics* 2. 117–180.

Haegeman, Liliane. 2004. The syntax of adverbial clauses and its consequences for topicalization. *Antwerp Papers in Linguistics* 107. 61–90.

Haegeman, Liliane. 2006. Conditionals, factives and the left periphery. *Lingua* 116. 1651–1669.

Hesse, Christoph, Anton Benz, Maurice Langner, Felix Theodor & Ralf Klabunde. 2020. Annotating QUDs for generating pragmatically rich texts. In Christoph Hesse, Maurice Langner, Anton Benz & Ralf Klabunde (eds.), *Proceedings of the workshop on discourse theories for text planning*, 10–16. Dublin: ACl.

Hobbs, Jerry R. 1979. Coherence and coreference. *Cognitive Science* 3. 67–90.

Hobbs, Jerry R. 1985. *On the coherence and structure of discourse*. Tech. rep. CSLI-85-37. CSLI, Stanford University.

Hoek, Jet. 2018. *Making sense of discourse: On discourse segmentation and the linguistic marking of coherence relations*. Utrecht. (Doctoral dissertation).

Holler, Anke. 2008. A discourse-relational approach to continuation. In Anton Benz & Peter Kühnlein (eds.), *Constraints in discourse*, 249–266. Amsterdam: John Benjamins.

Hunter, Julie & Márta Abrusán. 2017. Rhetorical structure and QUDs. In Mihoko Otake, Setsuya Kurahashi, Yuiko Ota, Ken Satoh & Daisuke Bekki (eds.), *New frontiers in artificial intelligence*, 41–57. Heidelberg: Springer.

Hunter, Julie & Nicholas Asher. 2016. Shapes of conversation and at-issue content. In Mary Moroney, Carol-Rose Little, Jacob Collard & Dan Burgdorf (eds.), *Proceedings of SALT 26*, 1022–1042. Ithaca: CLC Publications.

Jasinskaja, Ekaterina, Jörg Mayer & David Schlangen. 2004. Discourse structure and information structure: Interfaces and prosodic realization. *Interdisciplinary Studies on Information Structure* 1. 151–206.

Jasinskaja, Katja. 2010. Corrective contrast in Russian, in contrast. *Oslo Studies in Language* 2. 433–466.

Jasinskaja, Katja & Elena Karagjosova. 2020. Rhetorical relations. In Daniel Gutzmann, Lisa Matthewson, Cécile Meier, Hotze Rullmann & Thomas Ede Zimmermann (eds.), *The Wiley Blackwell companion to semantics*. Oxford: John Wiley. DOI: 10.1002/9781118788516.sem061.

Jasinskaja, Katja & Claudia Poschmann. 2018. Attachment in syntax and discourse: Towards an explanation for the flexible scope of non-restrictive relative clauses. In Sireemas Maspong, Brynhildur Stefánsdóttir, Katherine Blake & Forrest Davis (eds.), *Proceedings of SALT 28*, 433–453. Ithaca: CLC Publications.

Jasinskaja, Katja & Claudia Poschmann. 2020. Projection to the speaker: Non-restrictive relatives meet coherence relations. In Anke Holler, Katja Suckow & Israel de la Fuente (eds.), *Information structuring in discourse*, 141–162. Leiden: Brill.

Jasinskaja, Katja & Henk Zeevat. 2008. Explaining additive, adversative and contrast marking in Russian and English. *Revue de Sémantique et Pragmatique* 24. 65–91.

Karagjosova, Elena. 2011. Discourse particles, discourse relations and information structure. The case of *nämlich*. *International Review of Pragmatics* 3. 33–58.

Karagjosova, Elena. 2013. Aboutness topic, discourse topic and the structure of discourse. In Raquel Fernández & Amy Isard (eds.), *17th Workshop on the semantics and pragmatics of dialogue*, 199–201. Amsterdam.

Kehler, Andrew. 2002. *Coherence, reference, and the theory of grammar*. Stanford: CSLI Publications.

Kehler, Andrew, Laura Kertz, Hannah Rohde & Jeffrey L. Elman. 2008. Coherence and coreference revisited. *Journal of Semantics* 25. 1–44.

Kehler, Andrew & Hannah Rohde. 2019. Prominence and coherence in a Bayesian theory of pronoun interpretation. *Journal of Pragmatics* 154. 63–78.

Klein, Wolfgang & Christiane von Stutterheim. 1992. Textstruktur und referentielle Bewegung. *Zeitschrift für Literaturwissenschaft und Linguistik* 86. 67–92.

König, Ekkehard. 1995. The meaning of converb constructions. In Martin Haspelmath & Ekkehard König (eds.), *Converbs in cross-linguistic perspective*, 7–96. Berlin: Mouton de Gruyter.

Kortmann, Bernd. 1995. Adverbial participial clauses in English. In Martin Haspelmath & Ekkehard König (eds.), *Converbs in cross-linguistic perspective*, 189–238. Berlin: Mouton de Gruyter.

Kortmann, Bernd. 1997. *Adverbial subordination*. Berlin: Mouton de Gruyter.

Krifka, Manfred. 2008. Basic notions of information structure. *Acta Linguistica Hungarica* 55. 243–276.

Kutscher, Silvia. 2009. *Kausalität und Argumentrealisierung: Zur Konstruktionsvarianz bei Psychverben am Beispiel europäischer Sprachen*. Tübingen: Niemeyer.

Lakoff, Robin. 1971. If's, and's and but's about conjunction. In Charles J. Fillmore & D. Terence Langendoen (eds.), *Studies in linguistic semantics*, 114–149. New York: Holt, Rinehart & Winston.

Lang, Ewald. 1984. *The semantics of coordination*. Amsterdam: John Benjamins.

Lascarides, Alexis & Nicholas Asher. 2007. Segmented Discourse Representation Theory: Dynamic semantics with discourse structure. In Harry Bunt & Reinhard Muskens (eds.), *Computing meaning*, vol. 3, 87–124. Dordrecht: Kluwer.

Loock, Rudy. 2007. Appositive relative clauses and their functions in discourse. *Journal of Pragmatics* 39. 336–362.

Malchukov, Andrej. 2004. *Nominalization/verbalization: Constraining a typology of transcategorial operations*. München: LINCOM Europa.

Mann, William C. & Sandra A. Thompson. 1983. *Relational propositions in discourse*. Tech. rep. ISI/RR-83-115. Marina del Rey: Information Sciences Institute.

Mann, William C. & Sandra A. Thompson. 1986. Relational propositions in discourse. *Discourse Processes* 9. 57–90.

Mann, William C. & Sandra A. Thompson. 1987. *Rhetorical Structure Theory: A theory of text organization*. Tech. rep. ISI/RS-87-190. Marina del Rey: Information Sciences Institute.

Mann, William C. & Sandra A. Thompson. 1988. Rhetorical Structure Theory: Toward a functional theory of text organization. *Text* 8. 243–281.

Marcu, Daniel. 1997. From discourse structures to text summaries. In *Intelligent scalable text summarization*, 82–88. ACL.

Marcu, Daniel. 2000. *The theory and practice of discourse parsing and summarization*. Cambridge: MIT Press.

Matthiessen, Christian & Sandra A. Thompson. 1988. The structure of discourse and 'subordination'. In John L. Haiman & Sandra A. Thompson (eds.), *Clause combining in discourse and grammar*, 275–329. Amsterdam: John Benjamins.

Mauri, Caterina. 2008. *Coordination relations in the languages of Europe and beyond*. Berlin: Mouton de Gruyter.

Mayer, Jörg, Katja Jasinskaja & Ulrike Kölsch. 2006. Pitch range and pause duration as markers of discourse hierarchy: Perception experiments. In *Interspeech 2006*, 473–476. DOI: 10.21437/Interspeech.2006-150.

Moore, Johanna D. & Martha E. Pollack. 1992. A problem for RST: The need for multi-level discourse analysis. *Computational Linguistics* 18. 537–544.

Moser, Megan & Johanna D. Moore. 1996. Toward a synthesis of two accounts of discourse structure. *Computational Linguistics* 22. 409–419.

Onea, Edgar. 2016. *Potential questions at the semantics-pragmatics interface*. Leiden: Brill.

Polanyi, Livia. 1988. A formal model of the structure of discourse. *Journal of Pragmatics* 12. 601–638.

Reese, Brian, Pascal Denis, Nicholas Asher, Jason Baldridge & Julie Hunter. 2007. *Reference manual for the analysis and annotation of rhetorical structure*. Tech. rep. University of Texas at Austin & Institut de recherche en informatique de Toulouse (IRIT).

Riester, Arndt. 2019. Constructing QUD trees. In Malte Zimmermann, Klaus von Heusinger & Edgar Onea (eds.), *Questions in discourse*, vol. 2: Pragmatics, 403–443. Leiden: Brill.

Riester, Arndt, Lisa Brunetti & Kordula de Kuthy. 2018. Annotation guidelines for questions under discussion and information structure. In Evangelia Adamou, Katharina Haude & Martine Vanhove (eds.), *Information structure in lesser-described languages: Studies in syntax and prosody*, 403–443. Amsterdam: John Benjamins.

Riester, Arndt, Amalia Canes Nápoles & Jet Hoek. 2021. Combined discourse representations: Coherence relations and questions under discussion. In Kordula De Kuthy & Detmar Meurers (eds.), *Proceedings of the first workshop on integrating perspectives on discourse annotation*, 26–30. ACL.

Roberts, Craige. 1989. Modal subordination and pronominal anaphora in discourse. *Linguistics and Philosophy* 12. 683–721.

Roberts, Craige. 1996. Information structure in discourse. Towards an integrated formal theory of pragmatics. *Ohio State University Working Papers in Linguistics* 49. 91–136.

Sæbø, Kjell Johan. 2011. Adverbial clauses. In Claudia Maienborn, Klaus von Heusinger & Paul Portner (eds.), *Semantics: An international handbook of natural language and meaning*, 1420–1441. Berlin: Walter de Gruyter.

Salfner, Fabienne. 2018. *Semantik und Diskursstruktur: Die 'mäßig'-Adverbiale im Deutschen*. Tübingen: Stauffenburg.

Salkoff, Morris. 2002. Verbs with a sentential subject. *Lingvisticæ Investigationes* 25. 97–147.

Scheffler, Tatjana. 2021. Computational approaches to annotation of QUDs. In *Paper presented at the workshop on Annotating QUDs: Desiderata and approaches, 8 october, 2021, leibniz-ZAS berlin & U Bochum.*

Schilperoord, Joost & Arie Verhagen. 1998. Conceptual dependency and the clausal structure of discourse. In Jean-Pierre Koenig (ed.), *Discourse and cognition: Bridging the gap*, 141–163. Stanford: CSLI Publications.

Schlenker, Philippe. 2013. Supplements without bidimensionalism. Ms., Institut Jean-Nicod and NYU.

Simons, Mandy, Judith Tonhauser, David Beaver & Craige Roberts. 2010. What projects and why. In Nan Li & David Lutz (eds.), *Proceedings of SALT 20*, 309–327. Ithaca: CLC Publications.

Solstad, Torgrim. 2010. Some new observations on 'because (of)'. In Maria Aloni, Harald Bastiaanse, Tikitu de Jager & Katrin Schulz (eds.), *Amsterdam Colloquium 2009*, 436–445. Heidelberg: Springer.

Solstad, Torgrim & Oliver Bott. 2022. On the nature of implicit causality and consequentiality: The case of psychological verbs. *Language, Cognition and Neuroscience* 37. 1311–1340.

Stalnaker, Robert. 2002. Common ground. *Linguistics and Philosophy* 25. 701–721.

Stalnaker, Robert L. 1978. Assertion. In Peter Cole (ed.), *Pragmatics*, 315–332. New York: Academic Press.

Stede, Manfred, Maite Taboada & Debopam Das. 2017. Annotation guidelines for rhetorical structure. Ms., University of Potsdam and Simon Fraser University.

Stevenson, Rosemary J., Rosalind A. Crawley & David Kleinman. 1994. Thematic roles, focus and the representation of events. *Language and Cognitive Processes* 9. 519–548.

Sweetser, Eve E. 1990. *From etymology to pragmatics*. Cambridge: Cambridge University Press.

Traum, David R. 1994. *A computational theory of grounding in natural language conversation*. University of Rochester. (Doctoral dissertation).

van Kuppevelt, Jan. 1995. Main structure and side structure in discourse. *Linguistics* 33. 809–853.

von Stutterheim, Christiane & Wolfgang Klein. 1989. Referential movement in descriptive and narrative discourse. In Rainer Dietrich & Carl F. Graumann (eds.), *Language processing in social context*, 39–76. Amsterdam: North Holland.

von Heusinger, Klaus & Petra Schumacher. 2019. Discourse prominence: Definition and application. *Journal of Pragmatics* 154. 117–127.

Wolf, Florian & Edward Gibson. 2004. Representing discourse coherence: A corpus-based analysis. In *Proceedings of the 20th International Conference on Computational Linguistics* (COLING '04), 134–140. Geneva, Switzerland: Association for Computational Linguistics.

Zeevat, Henk. 2000. The asymmetry of optimality theoretic syntax and semantics. *Journal of Semantics* 17. 243–262.

Zeevat, Henk. 2011. Rhetorical relations. In Claudia Maienborn, Klaus von Heusinger & Paul Portner (eds.), *Semantics: An international handbook of natural language meaning*, 946–970. Berlin: Walter de Gruyter.