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Subordinating and coordinating discourse relations

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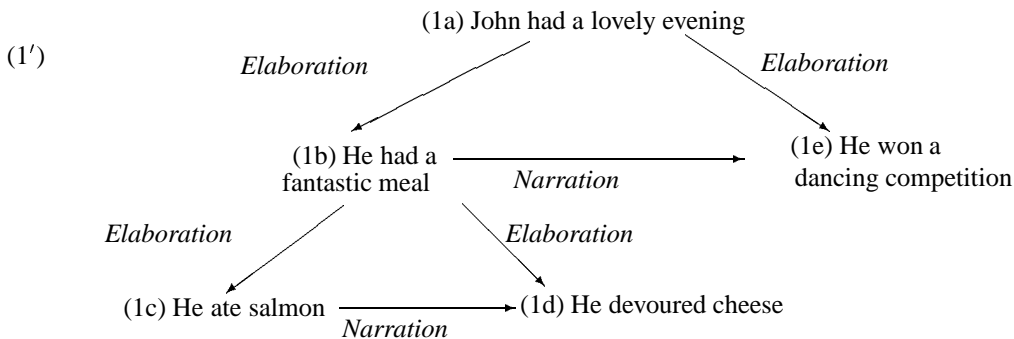
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1 introduction

Most discourse analysts assume that a discourse has a hierarchical structure (to name a few: Hobbs (1985), Polanyi (1988), Grosz&Sidner(1986), Mann&Thomson (1987), Asher(1993), van Kuppevelt(1995)). One motivation for this is intuitive: some parts of a text play a subordinate role relative to other parts; to give a simple, grade school example, the lead sentence of a paragraph gives that paragraph's main idea, while the other sentences in the paragraph should elaborate or support that idea with arguments. Other motivations for a hierarchical structure come from the way authors have used discourse structure to constrain anaphora resolution, the process by which a pronoun comes to have its referent. Consider (1), for example, that we'll analyze more in detail below:

- (1) a. John had a great evening last night.
b. He had a great meal.
c. He ate salmon.
d. He devoured lots of cheese.
e. He then won a dancing competition.
f. ?Then he had a great dessert.
f'. #It was a beautiful pink.
f''. John had lots of fun.

Clauses (1c–d) elaborate the meal (1b), which in turn elaborates the evening (1a). (1e) also elaborates the evening, but unlike (1c–d) it doesn't elaborate the meal. Rather, it forms a narrative with (1b). So (1e) shouldn't be considered part of the same 'segment' as (1c–d). Let's suppose, in line with Hobbs (1985) and Asher (1993), that the discourse relation of *Elaboration* induces 'subordination' in discourse segmentation, whereas *Narration* induces 'coordination'. Then graphically, the hierarchical structure of (1a–e) can be represented as in (1'), using vertical (or oblique) arrows for subordinating relations and horizontal ones for coordinating relations:



This notion of hierarchical structure is given a theoretical importance when the so-called “right-frontier-constraint” (Polanyi 1988) is adopted. Only the discourse constituents on the right frontier of the graph (here, (1a) and (1e)) may provide attachment points for the next constituent. This explains the awkwardness of (1a–f): having dessert is usually part of a meal, but since neither (1d) nor (1b) are on the right frontier, (1f) cannot be attached at one of these points to further elaborate (1b), the meal. This right-frontier constraint, together with some additional “accessibility constraint”, also explains the incoherence of (1a–f’), i.e., why we cannot identify *it* with *salmon*. On the other hand, if we consider the discourse (1a–e,f’), then assuming that *to have fun* has an anaphoric component (i.e. John had fun in some eventuality), we could resolve the anaphoric element in that component either to the eventuality introduced in the top constituent (*a lovely evening*) or in a lower level constituent (*a dancing competition*). Whether the lower constituent's antecedent was permissible or not given the right frontier constraint would depend on where (1f) was attached in the structure, i.e., (1a) or (1e).

In the literature, several features have been claimed to be involved in the hierarchization of discourse (cf. van Kuppevelt 1995):

- temporal order:** for narratives, whether the events are presented in their temporal order (coordination) or not (subordination);
- discourse intentionality:** whether the ‘discourse purpose’ of the segment contributes to (coordination) or is unrelated to (subordination) the discourse purpose of the larger segment this and the segment it is linked to are part of;
- topicality:** whether the topic of the segment constitutes a topic alteration with respect to that of the segment it is linked to, and therefore fully contributes to the topic of the larger segment (coordination), or is simply a sub-topic of it (subordination);
- functional symmetry:** whether the segments linked are on an equal footing (coordination) or there is an asymmetry between them (subordination), which corresponds to the preservation of coherence after deletion of the subordinated segment.

But despite the pervasive assumption of hierarchical structure in the literature, and even though the above elements may provide some guidelines, there hasn’t been a systematic investigation of which *discourse relations* are subordinating and which are coordinating nor have any general tests or criteria been devised to test hypotheses about coordinating and subordinating conjunctions. This paper initiates such an undertaking.

2 Background: SDRT

To carry out this investigation properly, we need to settle on a theory of discourse interpretation. We will choose SDRT, a theory in which the hypothesis that discourse has a hierarchical structure upon which interpretation depends is given a formal account. For our purposes we will need the following features of SDRT (see, e.g., (Asher 1993), (Asher 1996) or (Busquets et al. 2001) for details):

- SDRT’s semantic representations of discourse known as SDRSs are recursive structures. A basic SDRS is a labelled logical form for a clause, and a complex SDRS will involve one or more discourse relation predications on labels, where each label is associated with a *constituent*, i.e., a perhaps complex SDRS.
- The discourse relations used in SDRT are binary and either *coordinating* or *subordinating*, which we will indicate with the properties Coord and Subord. Some coordinating relations are topic-requiring, i.e., there must be a simple, constituent, a common ‘topic’, that subsumes the two related constituents which are also linked to it by the subordinating *Topic* relation. If this third constituent has not been explicitly given in the previous discourse, it must be ‘constructed’.
- Attachment is governed by the right-frontier rule: only the (simple) constituents situated on the right frontier of the graph sketching the SDRS’s structure (in which coordinating relations yield horizontal edges, with the newer constituent to the right, and subordinate relations vertical edges, with the newer constituent below) are open sites for attachment.
- Referent accessibility for anaphora resolution is governed by a ‘look-left-one-step-only-or-look-up’ rule (on the same graph): referents in the constituent where we attach to the current one are accessible (one step, left or up) as well as those of all constituents that dominate the current constituent (up).

In addition to the right frontier and accessibility constraints, the following ones are either explicit principles of SDRT (e.g., Continuing Discourse Patterns) or follow from principles and choices about how the representations of logical forms in SDRT are constructed; they limit what hypotheses we can make about subordinating and coordinating relations:

- *Continuing Discourse Patterns (CDP)*: If $R_1(\alpha, \beta)$ and $R_2(\beta, \gamma)$ and $\text{Subord}(R_1)$ and $\text{Coord}(R_2)$ then $R_1(\alpha, \gamma)$ and $\text{Continuation}(\beta, \gamma)$ (in addition to $R_2(\beta, \gamma)$), *Continuation* being a coordinating relation. This implies that coordinated constituents of a sub-structure must present an homogeneous behaviour with respect to a dominating constituent.

- Any two relations holding between the same two constituents are of the same type: If $R_1(\alpha, \beta)$ and $R_2(\alpha, \beta)$ then $\text{Subord}(R_1)$ iff $\text{Subord}(R_2)$. In other words, you can't have both a vertical edge and an horizontal one between the same two nodes on the graph.

SDRT has provided an analysis of many examples that motivate this formal proposal, among which a variant of (1) above (Lascares&Asher 1993). These analyses, as well as most of those situated in other theoretical frameworks, take for granted that Narration is the prototype of a coordinating relation and Elaboration that of subordinating ones. On the basis of this theory we want to develop more definite tests for establishing whether one of the many discourse relations is subordinating or coordinating.¹ We'll look mainly at narratives.

3 Previous Theoretical Proposals

In articles on discourse relations (many but not all using the framework of SDRT) we come upon the following classification² for coordinating and subordinating relations, without a lot of justification:

Coordinating: Narration, Background, Result, Continuation, Parallel, Contrast, Correction.

Subordinating: Elaboration, Explanation, Precondition, Topic, Commentary, Consequence (DRT's \Rightarrow)

In Asher (1993) where the coordinating / subordinating distinction is first given in SDRT, there's the following definition for a subordinate discourse relation which is marked by a \Downarrow . \Downarrow should be understood as a marker of subordination, not itself a discourse relation, or as a discourse relation that's compatible with all of the subordinating relations. Indeed, in Asher (1993) a relation is considered as subordinating just in case it combines with \Downarrow . The definition of \Downarrow is a disjunctive one:

$\Downarrow(\alpha, \beta)$ 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 .

This definition works fine with Elaboration and with Topic, that is, with the constructed topics of Asher (1993). The relation of Precondition, on which the subordinate constituent is a precondition for the superordinate one might work too, as long as the preconditions were sufficient at least defeasibly to entail what they are preconditions of. Beyond that, the definition of \Downarrow seems to not fit the relations that have been thought to be subordinating. Examples are: Explanation, Consequence and Commentary. There is clearly no subsumption relation or entailment relation between the requisite terms of a Commentary relation nor with Consequence. With Explanation one might have the appropriate entailments if the cause had a unique (deterministic) effect given in the first term, but clearly this cannot be required of all (causal) Explanations.³

Why should these relations have been thought to be subordinating? One reason is that they obey similar attachment patterns to Elaboration. For instance, we can have several commentaries that bear upon the same event. This would not be possible according to the constraints in SDRT if Commentary were a coordinating relation.

- (2) The Fed today lowered the prime interest again today for the third time in a month. Most economists greeted the move with skepticism. Wall Street also displayed a lack of confidence in the move, as stocks moved broadly lower. The President expressed confidence in the strategy of the Federal Reserve Chairman.

¹Except perhaps for the technical relation of Continuation which is assumed to be coordinating.

²Asher (1993) actually distinguishes between the structural relations (currently only 3 of them: Contrast, Parallel and Correction) and other discourse relations whose definition directly depends and affects the propositional content of the constituents. The structural relations, whose triggering conditions have to do with the *form* of what is said, have typically been understood to be coordinating as well but the way anaphoric dependencies work with them depends more on how the relation is determined than on the simple right frontier constraint (cf. Asher 1993, Webber 2000). Thus, we will keep them apart as special cases and in what follows we will look only at the distinction between coordination and subordination among those relations whose semantics and triggering conditions have to do with *what* is said in the two related constituents.

³On the other hand, if some effect should have a unique or preferred cause, then this definition would also apply to some occurrences of Result.

Other relations are similar, though we note that there are examples where Result, usually taken to be coordinating, also behaves in a similar way:

- (3) I screamed. The burglar ran away. Max woke up. The neighbor came in to see what happened. (for other examples see Asher 1993, p.339)

In order to handle discourse relations that don't meet the semantic definition for \Downarrow , one could use the structural definition of subordination from (Busquets et al. 2001):

Is subordinating a discourse relation that is able to introduce a complex SDRS. That is, it is possible that $R(\alpha, \beta)$ where β is a complex SDRS, which implies that R 'distributes' over β 's constituents.⁴

Is coordinating a discourse relation that is unable to introduce a complex SDRS. That is, for all instances $R(\alpha, \beta)$, β is a simple constituent.

This definition trivially distinguishes between those relations that are considered to be subordinating and those that are coordinating, but it does so only in terms of how these relations are depicted in the representation of logical form. It doesn't offer any direct criterion for the classification.

In (Txurruka 2000), it is argued that the connective *and* is a marker of coordination, in other words, all discourse relations that may hold between two clauses linked with *and* are coordinating. This is a clear test, though it doesn't in itself provide an explanation of what are coordination and subordination.

4 Four proposed linguistic tests

Our proposal to distinguish coordinating and subordinating follows the strategy of Dowty (1986) concerning thematic roles. We isolate below several criteria or tests for subordinating vs coordinating relations. Given that Narration is the prototype of a coordinating relation and Elaboration that of subordinating ones, we show that these criteria are coherent in that these two relations tend to satisfy all of the criteria for coordinating relations or none of them. The next task will then be to put other relations to these tests.

In the first three criteria, we try to test the type of a relation R_1 , assuming that i) we have two successive constituents, labelled with α and β for which $R_1(\alpha, \beta)$ is already established and ii) we are now considering the possible extensions with a next constituent γ . The first test has to do with the attachment of possible γ and the right frontier constraint of SDRT:

Test 1 If you can attach somme γ to α , then R_1 is subordinating. If you can attach only to β , R_1 is coordinating. (Notice that β being the label of last constituent, it necessarily belongs to the right frontier.)

This test is clear, but it is problematic in that we don't have hard and fast criteria for knowing when one is attaching to α and when not. How do you know where you attach? One can have intuitions about what is in the scope of a particular discourse relation, intuitions related to all four general features underlying the notion of discourse hierarchization mentioned above. For example in (1), it is clear that the information about the dancing competition should not attach to material elaborating the meal, but is rather part of the nice evening out, and this is correctly accounted for by the triggering rules and semantics of Elaboration⁵, together with the CDP principle. In our graph representation of the discourse structure of (1), α is the label for (1b), β for (1d), γ for (1e) and R_1 is the arc connecting (1b) to (1d).⁶ This test thus shows that R_1 , that is, Elaboration, is subordinating. On the other hand, we can see that if we continue (1a–e) with something like (1f), trying to attach back to the meal after the dancing competition, we wouldn't be able to do it—clearly indicating that the relation Narration between (1b) and (1e) is coordinating.

⁴By the right-frontier rule, if $R(\alpha, \beta)$ then α is always simple.

⁵We will not discuss here the 'triggering rules' nor the semantics of each discourse relation, since many SDRT articles have previously dealt with this.

⁶This isn't quite the right SDRT representation for this discourse, since it doesn't introduce a complex constituent containing the elaboration of the meal, but this is a good thing since the less "partisan" graph above allows us to test whether Elaboration is subordinate or not.

In some occasions, when the relation between γ and its attachment point is lexically marked in γ , the semantics of this relation may rule out some possible attachment points, and the test needs not rely on intuitions that are only partially accounted for in the theory. In (4), an example taken from (Knott et al. 2000), the connective *however* is a marker of the Contrast relation (Concession in RST’s terms) and this relation requires an opposition in the propositional content of the two constituents (see Asher et al. 2001), which we find only if we attach (4c) to (4a):

- (4) a. Arts-and-Crafts jewels tend to be elaborate.
 b. They are often mass-produced.
 b’. Ornateness was the fashion at the turn of the century.
 c. However, this jewel is simple in form.

Test 1 applied on this example shows us that the relation between (4a) and (4b)—called “Object-attribute Elaboration” by the authors of this paper, and that we would rather distinguish as some kind of Continuation (maybe the name ‘Description-Continuation’ is appropriate)—is coordinate while the relation between (4a) and (4b’), Explanation, is subordinate. Indeed, the content of (4c) forces us to attach it to (4a), and (4a,b,c) is incoherent while (4a,b’,c) is coherent.

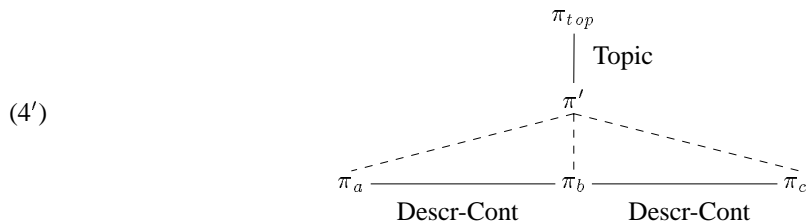
A variant of Test 1 exploits SDRT’s construction of complex constituents and is therefore also related to the Continuing Discourse Patterns principle, as well as to the definitions of coordinating and subordinating relations proposed in (Busquets et al. 2001) and described in the previous section:

Test 2 Assume we are attaching γ to β with some kind of Continuation relation and we don’t have the same Continuation between α and β . In other words, β and γ (but not α) form a complex constituent, and by CDP γ should actually bear the same relation R_1 to α as β does. This means that γ has to be attached to α too, and, as a result, that R_1 is subordinating. Conversely, if one cannot introduce information γ that ‘continues’ β , then R_1 is coordinating.

Again, the example (1) when used in conjunction with this test shows that Elaboration, the relation holding between (1b) and (1c) is subordinating. Nevertheless, this variant test is particularly useful to focus on a possible theoretical complication with the introduction of constructed topics. As mentioned above, some coordinating relations require a dominating ‘topic’ constituent. Narration, for example, is of this kind, and the relation Description-Continuation introduced above for (4), too. Then, we can have a ‘continuation’ of β , while attaching γ to the constructed topic and not to α . For instance, we have just seen that Test 1 tells us that Description-Continuation is coordinating and yet, we can continue (4a,b) with the following:

- (4) c’. They are often found in non-expensive jewelry shops.

which would yield the following structure:⁷

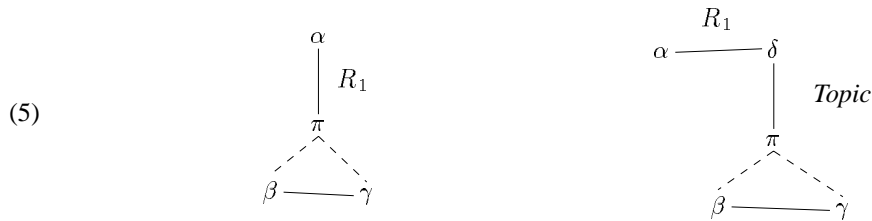


The important difference here is whether β and γ form a complex constituent to be attached to α , as hypothesized in Test 2, or whether the three of them, α , β and γ form a homogenous segment, i.e., a complex constituent, here dominated by a constructed topic constituent.

The key issues now are whether all coordinating relations require a topic or not, and, even more crucially, whether we should accept for any relation R_1 , an associated coordinating and topic-requiring relation

⁷One important fact to note is that when $R(\alpha, \beta)$ requires a topic which is not already available in the structure, SDRT inserts a constructed topic by substituting α in the structure with the new constructed topic node along with the new complex SDRS constituted of α and β it dominates. On this figure, π' labels the complex SDRS constituted of π_α , π_b and π_c , while π_{top} labels the constructed topic constituent whose propositional content may correspond to *Description of Arts-and-Crafts jewels*.

‘ R_1 -Continuation’, which would enable the introduction of a complex constituent constituted of β and γ , via the substitution of β with some ‘topic’ δ —corresponding to something like *That which is R_1 to α* , dominating the complex constituent. In such a case, the definitions given above and based on the potential introduction of complex segments would prove inappropriate, since they wouldn’t distinguish between the following two structures:



Nevertheless, these two structures are not equivalent. For one thing, Test 1 checks whether α is open for attachment or not, which is true on the first structure and false on the second. Next, accessibility from γ to referents in α makes the difference, as the third test tells us.

Test 3 Assume γ is attached to β . If, for all γ , no pronominal element in γ can be bound by referents in α , then R_1 is coordinating. If some can, then it means R_1 is subordinating.⁸

Here too, this test can be used on variants of example (1), for instance (1a,b,c,d,f*), to show that Narration is coordinating. But here again, we observe that topic construction may often interfere with this test. Suppose R_1 is coordinating and introduces a topic δ dominating α and β (as on fig. (4')). If the topic δ contains α 's referents, which is not an unlikely case, then these are accessible from γ , whether we attach it to β by a coordinating (by CDP, δ should then be a topic for γ as well) or subordinating relation.

A last test exploits SDRT's hypothesis that between two constituents one cannot have one relation that is subordinating and another that is coordinating.

Test 4 Use the fact that Narration is the Coord prototype to test compatibility with it: if $R(\alpha, \beta)$ and $Narration(\alpha, \beta)$ then R is Coord.

This test mainly serves to pick out coordinating relations, though it would also work with subordinating relations, substituting Narration for Elaboration. This test works in SDRT but not, for instance, in RST. In RST we have only one relation, subordinating or coordinating, at a time. Because of the underlying nonmonotonic inference system used to infer discourse relations in SDRT, as many discourse relations between constituents are inferred as are consistent with the context.

5 Conclusions

These tests together give a reasonably concrete picture of the distinction made in SDRT between coordinating and subordinating relations. One can notice, however, that only the last one is based on SDRT's hypothesis that relations are of one kind (in addition to the assumptions, corroborated by Tests 1–3 that Narration is coordinating and Elaboration is subordinating). One could adopt a more context sensitive view and say that at least some relations may vary in their character on this score depending on the context. Our Tests 1–3 would establish then not that a relation was always coordinating or subordinating but that it was Coord or Subord on that occasion of use.

They have certain specific problems that we've mentioned, in particular regarding the facts that there is no generic criteria to know where to attach, and that the existence of constructed topics may prevent the Tests 2 and 3 from giving a definite answer, in large part because what exactly are topics in SDRT is still quite a mystery...

⁸There may be exceptions to the accessibility rule: definite descriptions, use of structural relations, and probably also an overriding rule like "last constituent's referents are always accessible" (even after a discourse pop).

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