

Discourse-Trees and Dynamic Updates

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1 Introduction

1.1 Implicated Questions

In this paper I investigate the question how the notion of ‘implicating a question’ can be formalized. For concreteness I’ll concentrate on questions implicated by *contrastive topics* such as in (1)/(2), though there are doubtlessly other ways of achieving a similar effect:

- (1) Wie war’s in Berlin?
 how was it in Berlin
 ‘What was it like in Berlin?’

- (2) In ↗BerLIN war’s SCHÖN↘
 in Berlin was it nice
 ‘It was nice in Berlin.’

The arrows ↗ and ↘ are intended to mark upward and downward pitch movement, respectively, on the syllables marked by capitals. Downward pitch movement marks *focal* constituents, upward movement marks a *contrastive topic*. *In Berlin* (or just *Berlin*) is thus the contrastive topic in sentence (2).

One effect of the contrastive topic marking in this sentence is that it implicates the presence of a question such as *Wie war’s in Utrecht?*, or an answer to such a question like *... und in Utrecht war’s sogar noch schöner* in the discourse (‘What was it like in Utrecht?’/‘...and Utrecht was even nicer.’).

The aim of this paper is to make precise what it means to implicate such a question from a discourse update perspective. I will discuss two implementations, one based on the theory of contrastive topic as presented in Büring (1997b), and a more involved one utilizing *discourse trees* as proposed in unpublished work (Büring (1999)).

1.2 Background on Contrastive Topics

The account proposed in Büring (1997b) provides a compositional way to derive from a sentence like (2) above a set of question meanings corresponding to questions of the form ‘What was it like in x?’, where *x* is a (possibly contextually restricted) variable over individuals, including

places; call this set the *question set* (associated with sentence S). The gist of the theory can be summarized as follows:

- A sentence containing a contrastive topic is at the same time a *payoff move* and a *set-up move* (in the terminology of Carlson (1983)); it answers a question and at the same time poses a new one.
- The payoff part is subject to familiar conditions on discourse coherence; it has to be in accord with the current *question under discussion* (more exactly, the question under discussion has to be one of the questions in the question set).
- The set-up part sets up a question from the question set as the new question under discussion; that question has to be non-redundant.

It is the last bullet that I am interested in here. Taking as a starting point the function of ‘normal’ (i.e. non-implicated) questions, I will ask (and answer) the question: Just what does it mean formally to set up an implicit question?

2 ‘Question Under Discussion in a Dynamic Setting

Groenendijk (1998) is an extension of dynamic semantics that incorporates a notion of question under discussion. There, a question under discussion is a property of an information state as a whole. In essence (though not literally) it is a partition of the worlds from the possibilities in the information state. Similarly in Büring (1997b) and Roberts (1996), where the question under discussion is an extra part of the representation of an information state.

Such a model, however, falls short of being able to capture the above intuition. After all, a hearer will not usually know, *which* of the non-redundant questions in the question set is established as the new question under discussion. Take (2) from above again: The implicated question could be ‘What was it like in Utrecht?’ or ‘What was it like in Moscow?’ etc. etc. All we know from the answer is that *some* such question is being posed. It is that intuition we must formally capture. (Note that this insecurity is real both from a speaker and from a hearer perspective: The hearer of course doesn’t necessarily know which question the speaker wants to see discussed. But even the speaker herself might want to implicate a series of questions of the form of those in the question set, but in no particular order.) After the update with a sentence like (2), an information state should reflect a certain *insecurity* about what the new question under discussion is.

In this respect, an information state after update with a declarative containing contrastive topic is somewhere in the middle between one updated with a *bona fide* interrogative and one updated with a declarative without a contrastive topic. The former sets the question under discussion to one particular question (the one denoted by it), the latter doesn’t set the question under discussion at all, which we might alternatively think of as setting the question under discussion to any of the non-redundant questions w.r.t. to information state itself.

The technical amendment that I suggest is a theory of information states in which each possibility comes with its own question under discussion. A possibility is thus (at least) a triple $\langle \text{world}, \text{assignment}, \text{qud} \rangle$, rather than just a world-assignment pair (since it is orthogonal to the

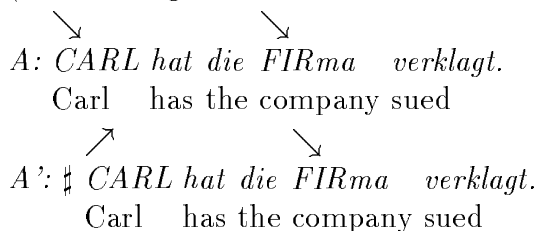
issue, I leave out assignments in what follows). The updates associated with the three utterance types can thus be characterized as follows (formalization is straightforward, but verbatose; conditions on the domain of the update function are omitted for reasons of perspicuity):

- (3) let s be an information state, i.e. a set of pairs $\langle w, qud \rangle$ with $w \in W, qud$ a set of propositions, then
- a. s updated with a declarative sentence A expressing the proposition a is $\{\langle w, qud \rangle \mid w \in s \ \& \ w \in a \ \& \ qud \text{ is any question meaning}\}^1 \ ^2$
 - b. s updated with an interrogative sentence B expressing the set of propositions b is $\{\langle w, qud \rangle \mid w \in s \ \& \ qud = b\}^3$
 - c. s updated with a declarative sentence A containing a contrastive topic, expressing the proposition a and associated with the question set q is $\{\langle w, qud \rangle \mid w \in s \ \& \ w \in a \ \& \ qud \in q\}$

Such a system can handle implicated questions as setting up a restricted number of different questions under discussion in the different possibilities of an information state.

This treatment also affords an account of the restrictions on the use of contrastive topics, prominently among them the ‘disputability condition’. Observe that the use of a rising pitch accent is inappropriate in a truly exhaustive answer (cf. also Jacobs 1997:100):

- (4) (Q: I don’t get it. Did Carl sue the company, or did the company sue Carl?)



In the acceptable pronunciation (4A), both *Carl* and *company* receive falling pitch accents. To be precise, both are marked by a high accent tone, with the second downstepped relative to the first, and followed by a low phrase and boundary tone (this is why the two accents don’t *sound* exactly the same, but they are arguably the same ‘morpheme’, i.e. a high accent tone signalling focus). The second variant, with a rising pitch on *Carl* is clearly unacceptable.

In theoretical terms, then, the contrast between (4A) and (A’) shows that *Carl* cannot be a contrastive topic in this context. The reason for this, I argue, can be tracked down to the set-up function of sentences with contrastive topics as follows. The question set associated with the unacceptable (4A’) consists of questions like ‘Who did x sue?’, with x either Carl or the company. By (3c), one of these questions must be the qud in the possibilities in the resulting information state. However, given the context, the question has been answered completely: It is clear that *either* Carl sued the company *or vice versa*, but not both.

Assume, then, that an information state must be non-redundant in the sense that the quds in it must represent *open* questions (cf. note 2 above):

¹ $w \in s$ abbreviates $\exists qud[\langle w, qud \rangle \in s]$; analogously for $qud \in s$ below.

² I assume that the restriction to non-redundant question is brought about by a general condition on information states; that way the update remains distributive.

³I assume that questions don’t add information, though nothing hinges on this.

- (5) a. s is an information state only if for all $qud \in s$, qud is open in s
 b. a question q is open in an information state s iff for all $p \in q$, $\{w \mid w \in s\} \neq \{w \mid w \in s\} \cap p$

What is wrong with (4A') above is that it tries to set the *qud* to a question that is already answered. The result are non-information states, i.e. objects that disqualify as information states by (5). The good version (4A) doesn't contain a contrastive topic. Therefore, it updates by rule (3b), which doesn't impose any special conditions on *qud* (other than that there be *some* open question at all, which we can safely assume to be the case.)

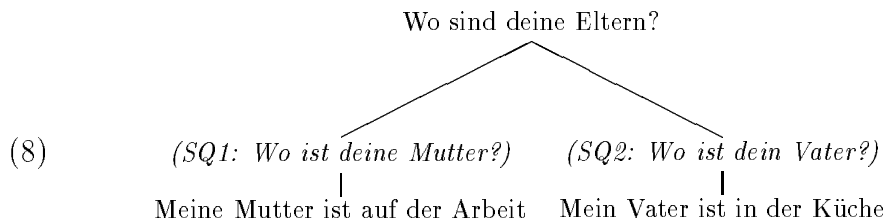
3 Discourse Trees

Büring (1999) revises the theory of Büring (1997b) so as to broaden its empirical coverage and simplify some of its definitions. This account utilizes *discourse trees* as representations of more complex aspects of discourse structure. The nodes of d(iscourse)-trees are *moves*, with declaratives in terminal, and interrogatives in non-terminal position. Daughterhood in the tree corresponds to the notion of 'being a subquestion (non-terminals) or an answer (terminals) to'.

It is claimed that this kind of complex structure is crucial in accounting for the 'non-directedness' of the implicated question. Thus, while in (1)/(2) the implicated question will indeed follow the sentence containing the contrastive topic, this is not the case for the second part of the answer in the following example:

- (6) Wo sind deine Eltern?
where are your parents
- (7) a. Meine ↗MUTter ist auf der ARbeit ↘ ...
my mother is on the work
 'My mother is at work ...'
 b. ... und mein ↗VAtter ist in der KÜche ↘.
and my father is in the kitchen
 '...and my father is in the kitchen.'

Obviously, (7b) doesn't set up another question of the form 'Where is your x ?' (as (7a) arguably does); the contrastive topic is licensed by the *preceding* question (or answer, see Büring (1999) for details). What (2) and (7b) have in common, however, is that the contrastive topic indicates the presence of questions from the question set, and that these questions either dominate or 'c-command' the sentence with the contrastive topic in the d-tree. A d-tree representation for the above looks like in (8):



\nearrow \searrow
 ‡ A2': *BEI*de *HAB*en bezahlt.
 both have paid

Imagine A1 and A2 being spoken by two different speakers, or A2 being preceded by something like *In fact...* or *Come to think of it...* Then Q-A1-A2 makes for a perfectly acceptable exchange, with the intonation indicated. But Q-A1-A2' doesn't.

The contrastive topic in A1 is justified by the implicit questions 'Did Lilia pay (already)?' and 'Did Knut pay (already)?', which are in the required configuration and are members of the question set 'Did x pay already?' with $x \in \{ \text{Lilia, Knut} \}$:

Q: Haben Lilia und Knut schon bezahlt?

(11) \swarrow \searrow
 (SQ1: Did Lilia pay?) (SQ2: Did Knut pay?)
 |
 A1: Lilia hat bezahlt.

Now, the question set of (10A2') is arguably the same as that of (10A1): 'Did x pay already?' (with $x \in \{ \text{Lilia, Knut} \}$). What prevents us from attaching (10A2') in the above tree underneath SQ2, where it would meet the CT condition in the exact same way as (10A1)?

The answer, I submit, lies in a general condition on d-trees, namely that answers must be attached as high as possible. Since 'Both have paid.' is a complete answer to 'Did Lilia and Knut pay already?', it must be attached directly underneath it. The correct representation is thus:

Q: Haben Lilia und Knut schon bezahlt?

(12) \swarrow \searrow \searrow
 (SQ1: Did Lilia pay?) (SQ2: Did Knut pay?) A2: Beide haben bezahlt.
 |
 A1: Lilia hat bezahlt.

In (12), SQ1 and SQ2 are not sisters to the question dominating A2 (nor do they dominate A2 themselves). This blocks the use of a contrastive topic as in (10A2') and forces a realization as in (10A2) without a contrastive topic.

The 'politician cases' of Büring (1997a) follow the same pattern. The central observation, going back to Jacobs (1984), was that (13), with the contrastive topic marking as indicated, can only be interpreted with inverse scope ($\neg\forall$ -reading). The otherwise possible surface scope interpretation ($\forall\neg$ -reading) is absent with the accentuation as indicated:

(13) \nearrow \searrow
*AL*le Politiker sind *NICHT* korrupt.
 all politicians are not corrupt

a. $\neg\forall$ -reading: not all politicians are corrupt
 b. $\forall\neg$ -reading: all politicians are un-corrupt (= clean)

The above is obviously but a rough sketch; $w(p)$, $dtree(p)$ and $pointer(p)$ refer to the first, second, and third member of p , respectively, i.e. w, d and p if $p = \langle w, d, p \rangle$. $dtree(n)(p)$ refers to the n -th move in the discourse-tree of p . The crucial third clause above simply states that a move has to advance the pointer within the discourse tree to a move that is U . All other conditions on discourse-coherence are implicit in the fourth condition: the discourse-tree in p must be well-formed to begin with.

Let me illustrate. Take a simple question-answer pair Q-A. After the question, the information state s will consist of possibilities in which the pointer points to a node in a discourse tree which corresponds to that question.⁶ Unless Q is discourse initial, the various discourse trees in the possibilities in s will more or less converge up to the point of the question. (I say ‘more or less’ because there could be certain unclarities about just what has been said, and, more interestingly, what implicit moves have been made.) The answer A will now eliminate possibilities in the usual way. Moreover, it will advance the pointer by one or more moves (‘or more’ given that there might be implicit questions between Q and A) to a node which corresponds to A. Provided, that is, that there is at least one discourse tree in (a possibility in) p in which A is a direct or indirect follow-up on Q (this will not be the case if for example A is irrelevant to Q, or redundant, or has improper focus or contrastive topic marking).

Assume next the case in which A contains a contrastive topic. In this case, possibilities after updating s with A are restricted to ones in which the pointer points towards a node which corresponds to A and has questions out of A’s question set as mother or ‘aunt’ nodes. Again, if no such possibilities exist (e.g. because there is no well-formed discourse-tree containing such a configuration), the update with A leads to an empty information state, which we take to be the counter-part to an infelicitous utterance.

The idea behind this is simple enough and should be clear by now. There is a to my mind very counter-intuitive aspect to the proposal, however. It presupposes that for every conceivable move M, there already are (possibilities containing) discourse-trees containing M in the information state prior to the update with M. Put a little crudely, every conceivable continuation of the discourse is already there in the form of a discourse-tree in one of the possibilities.

I can, however, see nothing strictly wrong with this. At first blush it appears as if this leads to an explosion of possibilities beyond anything assumed in similar theories. I believe, however, that this appearance is wrong. For note that there can be no two possibilities that differ in their d-tree but not in their world, simply because the ongoing discourse is part of the world, so the worlds in the two possibilities differ at the very least in how the discourse will proceed. As a consequence, there are at most as many possibilities in any context as there are possible worlds.

This doesn’t make the idea any more intuitive. But it points to an important fact, namely that the same counter-intuitive property already resides in even the most basic models of update semantics. A world is really a world history, and as such it contains the entire dialogue, including its continuation. The above proposal adds nothing to this situation.

Many standard update semantics embody the idea that world-related information is eliminative, while discourse-related information is ‘constructive’: it is modelled by the addition of discourse referents to the possibilities. Our proposal in section 2 does, too, in that the qud is constructed, rather than selected. This is different in the revised proposal in this section, where

⁶I use ‘corresponds to’ rather than ‘is identical to’ here and henceforth because I want to stay uncommitted as to what exactly the moves in a discourse-tree are (i.e. are they meanings, syntactic representations, or both?).

the updating of discourse-related information, embodied as a discourse-tree in the possibilities, is eliminative (the system is perhaps comparable to the version of update semantics in Heim (1982), where assignment functions aren't partial and therefore possibilities can differ only in stretches of assignment functions which aren't even used so far; indeed, Heim's domain set plays a role comparable to our pointer). Again, I can see no reason why one architecture should be preferred over the other.

In sum, I believe that a treatment of implicated questions, even of the complex type modelled with discourse-trees, requires certain complex but in the end manageable modifications of what an information state in a dynamic setting is.

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