Afterword *

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Back in the seventies before the term *information structure* was part of our standard vocabulary notions like new and old information, while intuitive enough, seemed totally unformalisable from the perspective of formal semantics. This was when truth-conditional semantics was quite new to linguistics and when what we had to work with was truth conditions and possible worlds.

Lots has happened in semantics since those days. It is now standard to take a dynamic perspective on semantics where meaning is regarded as representing update potential rather than merely truth conditions. There are various notions of structured meanings around which give us a more articulated view of meaning than Montague's classical approach. The dynamic and structured approaches are exploited in work which brings semantics together with dialogue management. Here I am thinking of the notion of dialogue game-board, including questions under discussion (e.g., Ginzburg, 1996a, Ginzburg, 1996b) and in general what has come to be called the information state approach in some of the literature on dialogue semantics, basically the idea that the interpretation of dialogue is to be treated in terms of updates of the information states of each of the dialogue participants (e.g., Larsson, 2002). A recent application of these ideas to information structure is given in Kruijff-Korbayová *et al.* (2003). These new developments in semantics place us, in my view, on the verge of a much deeper and more rigorous understanding of discourse and information structure.

I would like to point to two ideas which I think might play a key role in this development. The first is the idea that questions, or issues, under discussion (QUD) play a key role in information structure and discourse and dialogue structure. The idea is an old one, but has recently gained a more formal development in the work by Ginzburg and others. The second idea is that anaphora is a broader phenomenon than pronominal reference to objects introduced or quantified over by noun-phrases.

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1. Questions

1.1. QUESTIONS AND INFORMATION STRUCTURE

The new more formal development of questions and their relation to dialogue management issues gives us a way of talking about information structure. Often in the literature, questions are used informally to give an intuitive account of which information structure is intended, but then the actual structural analysis of the information structure is cast in terms of some kind of constituent structure, which may even, in the case of Steedman's analysis, coincide with syntactic constituent structure. This leads to the kind of analytical issues that Komagata discusses in his paper: can information structure be assigned to more than one clause in a structure? can it be recursively structured? Komagata argues for one information structure per sentence/utterance and this corresponds to the intuition that information structure has something to do with the pragmatic contribution of an utterance. I suspect that taking the role of questions in discourse and dialogue more formally as is done in the game-board/information state based approaches will give a different character to these issues and will possibly lead to clarification of certain issues. For example, consider the example in (1) which Komagata discusses, and which is originally due to Kruijff-Korbayová and Webber.

(1)   If it's Sunday, we buy wine over the state line.

From a constituent view it might seem problematic to divide this example up into theme and rheme. Depending on the context we might propose the following two analyses

(2)   a. [If it's Sunday, we buy wine]$_\theta$ [over the state line]$_\rho$

   b. [If it's Sunday]$_\rho$, [we buy wine]$_\theta$ [over the state line]$_\rho$

(2a) is possibly problematic because the theme is something which is not a syntactic constituent. (2b) is possibly problematic because the rheme is discontinuous (or maybe there are two rhemes, or maybe *if it's Sunday* is not a rheme but some other kind of focussed constituent). In a QUD-based approach, the issue might be to determine which question on QUD the utterance can be addressing rather than assigning information structure as such to the current utterance. Two possibilities, corresponding to (2a,b) are given in (3a,b).

(3)   a. Where do you buy wine on Sunday?

   b. Where do you buy wine?

Elevating the question to formal status rather than simply a way of making the example intuitive, might allow us to, for example, predict prosody from a pair of a question and an utterance rather than first assign information structure as a constituent structure to the utterance and then predict prosody from that. Building further on this example, if the question under discussion is (3b) and the answer is (4), then perhaps there is an issue of whether one should regard this as one or two alternative answers to the question.

(4) If it's Sunday, we buy wine over the state line but otherwise, locally.

The issue is one of the best way to analyse answers to questions. There need not be, on this view, an independent issue of whether single utterances can have two rhemes and themes.

1.2. Questions and discourse structure

McCoy's paper is particularly fascinating because her analysis of Russian particles makes clear the relationship between information structure and discourse structure. The question generated by the particle gives us a view of information structure. Presuppositions about what the answer to the question is and which of the dialogue participants have knowledge of the answer tells us about discourse structure. Thus in terms of information structure

(5) u   tebja-to sovok
     at you-*TO* scoop

     You-*TO* have a scoop

addresses the question *What do you have?* (i.e. *a scoop* is the rheme) and in terms of discourse structure it prepares the ground for raising a new question *What does x have?* where x is to be chosen for the next question since *TO* marks *you* as a contrastive focus.

(6) ona zhe   uzhe   ubita
     she *ZHE* already killed

     It *ZHE* is already killed

raises the question *Is it already killed?*, asserting emphatically that the answer is "Yes" and presupposing that the other dialogue participant believes the answer to be "No".

(7) oni stoyat   ved' na nozhkakh
     they are standing *VED'* on little legs

    They are standing *VED'* on their feet

raises the question *Are they standing on their feet?*, asserting that the answer is "Yes" and presupposing that the other dialogue participant also believes the answer to be "Yes". Another interesting aspect of these particles is that they in general can be used to raise both *wh-* and polar questions depending on focus represented by word-order and prosody.

1.3. QUESTIONS AND DISCOURSE TREES

Polanyi, van den Berg and Ahn take up the idea that the information structure of a sentence is determined by what question it is to be an answer to and present their notion of discourse structure, seen as a tree, as an alternative. One of the problems they point to with the question approach is that it normally relies on a question which has been introduced in the previous turn. However, notions like QUD, question accommodation and reraising which have been introduced into the information state approach relax this kind of constraint. It is an interesting issue how much of discourse structure should be analyzed in trees and how much can be dealt with in terms of questions, or indeed which tree analyses can be recast in terms of questions and vice versa. For example, in Polanyi *et al.*'s discussion of theme-theme chaining they say that (8a) is an example of subordination whereas (8b) is an example of coordination.

(8) a. John is a nice looking guy. He has blond hair.

    b. John is a nice looking guy. He works for a bank.

In (8a) they say that the rheme of the second sentence *has blond hair* is "derived from" the rheme of the first sentence *is a nice looking guy* and that this is why (8a) is an instance of subordination. In (8b) we do not have such a relationship and it is therefore an instance of coordination. It seems to me that the notion *derived from* could be interestingly construed in terms of what issue is addressed by the second sentence. In (8a) the second sentence can be seen as addressing the issue of whether the first sentence is true. According to Ginzburg any assertion can potentially make available the question of whether it is true as an issue for discussion. Having blond hair can be construed as providing a partial answer to a question of whether someone is a nice looking guy. Working at a bank would not normally be construed in

this way. Notice that this means that deciding between coordination and subordination is very dependent on the beliefs and knowledge of the dialogue participants and indeed on what has been established so far as being assumed for the sake of the dialogue. Consider (9)

(9)   John is a nice looking guy. He works as a dancer.

Is this coordination or subordination? It depends on whether you think (or are assuming for the sake of the dialogue) that dancers are nice looking or that being a dancer is evidence for being nice looking at least.

2. Generalised anaphora

There appears to be a scale of complexity concerning how anaphoric elements can be related semantically to their antecedents. The simplest kind of case is standard anaphoric cases of pronouns relating to NPs (some of the *it* cases discussed by Gundel, Hegarty and Borthen). A bit further up the scale are cases of *that* picking up on a proposition introduced earlier or a related property which has to be extracted from a proposition, e.g. as in Gundel, Hegarty and Borthen's example (22).

(10)   White says they may have a "mythological" role ... That seems likely for at least one of the newly rediscovered figures.

These cases are interesting because we cannot reasonably expect that all possible antecedents (propositions, properties etc.) immediately introduced as discourse referents on the off-chance that something later in the discourse will refer to them. From a processing point of view it seems much more likely that we have to search through a structured meaning representation of the previous discourse at the point where we encounter the anaphor in order to find an appropriate referent.

The kind of anaphoric reference to presuppositions that Spenader discusses are similar in terms of their complexity.

A more complicated and indirect relationship to the antecedent is represented by Forbes, Miltsakaki, Sarkar, Joshi and Webber's discussion of *however*. Following Knott and Lagerwerf they assume that the interpretation of *however* introduces a defeasible rule whose conditional antecedent is what I would like to call the anaphoric antecedent of *however* and whose consequent is the negation of a proposition introduced by the sentence in which *however* occurs. Thus the interpretation of *however* in (11a) involves constructing a defeasible inference rule such as (11b).

(11)   a. Mary smiled. However, John frowned

       b. If Mary smiled, then (one might expect that) John didn't frown

Ginzburg and Cooper (2001) and Cooper and Ginzburg (2002) treat slightly more complex cases in their work on clarification ellipsis where they argue that you have to construct the meaning of a clarification on the basis of *part* of the meaning of the previous utterance rather than the whole of it as is the case with *however*.

3. Conclusion

These papers represent part of a development in our understanding of information and discourse structure which looks set to yield powerful new formal techniques over the coming years. Information structure and management is contributing something new to theoretical linguistics which is distinct from both what is traditionally considered as semantics and pragmatics. It is also of great importance for language technologies, promising improvements in speech generation and understanding, and dialogue management.

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