On The Relationship Between User Models and Discourse Models

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The best way to summarize my view of the relationship between user models and discourse models is that they are separate, but related to each other. This paper will show why the two terms have completely distinct elements, and where the common ground between the two lies. It is also important to acknowledge at the outset that the two terms have not been well defined in the literature.

For the discourse model, I am including everything that should be derived from an analysis of discourse, to present a representation for the structure of the discourse, useful in subsequent responses. In this sense, I focus on the interpretation of a discourse from the point of view of one of the conversants. I essentially include in the discourse all the components covered by the model of Grosz and Sidner (1986). For the definition of the user model, I also ground the discussion in the point of view of one conversant. The model is thus an analysis of the other conversant (subsequently referred to as the speaker). The term user model is especially obscure, because in the context of this journal it is confined to a derivation of background knowledge and goals of a user which influence the language used in the discourse. (One can use a similar term in the design of graphical interfaces, for instance).

The discourse model must thus contain the following key elements: an indication of the structure of the discourse and an organization of the objects of the real world mentioned in the discourse (to help anaphora resolution, for example). As soon as this kind of history of objects is included (covered in the model of Grosz and Sidner (1986) by tracking attentional state and the objects currently in focus), there are elements that are not specifically attached to the user himself.

The structure of the discourse is essentially provided in two different ways. Which of the actual utterances of the discourse group together into logical segments is covered by the "linguistic structure" of Grosz and Sidner (1986). Often clue words (such as "but anyway") will indicate how to segment the utterances into logical segments, without concern for how individual utterances within that segment relate. In addition, there is an indication of the intentional structure. Here, I would reinterpret slightly the term as used in Grosz and Sidner (1986) (see Cohen 1986). Intentional structure should indicate the intentional relations between, again, actual utterances. For instance, it is important to determine the cases where the goal underlying an utterance "contributes to the satisfaction of" the goal underlying another utterance—e.g., getting the hearer to believe some proposition p contributes to the satisfaction of getting the hearer to believe some proposition q (determined as dominance relations in Grosz and Sidner (1986). In this sense, my interpretation of the derivation of intentional structure agrees well with Wahlster's appeal for an incremental derivation of the discourse model).

I believe that the intentional structure is related to, but not identical with, the plan of the speaker underlying discourse. For one, the plan of the speaker can be reconstructed at a different level of detail than what is actually uttered. For an example, see Appendix 1.

This leads me to where I feel the discourse model and user model relate. The plan of the speaker underlying discourse is one part of the user model and is related to the intentional structure of the discourse. But there is more to the user model as well. There has been a good deal of work on co-operative responses (e.g., Joshi et al. (1984)). Van Beek (van Beek and Cohen 1986, van Beek 1986) shows that goals and systemwide preferences of a user can influence appropriate responses (e.g., preferring to take numerical analysis courses in a course advisor domain). It is thus important to include a model of the user's goals (beyond an understanding of the goal underlying each individual utterance, useful for the reconstruction of the intentional structure). This kind of

goal is not part of the discourse per se. Other important components of the user model are background knowledge of the user (e.g., Cohen and Jones (1988) show that it is important to vary the response to a parent vs. a teacher in a domain of educational diagnosis; Paris (1985) shows how the form of response can vary according to the level of expertise; Chin (1986) also uses the level of expertise of the user, together with a labeling of difficulty of the system's knowledge, to produce good responses). Especially if the user is modeled over a period of time, these "values" can change and must be monitored.

The bottom line, I feel, is that what is included in the user model or the discourse model is dependent on what the system employing these models is being designed for. (Again, I agree with Wahlster's perception of the problem—the discussion of what is in the UM or DM can be guided by how systems should be designed).

I prefer the point of view of a NLUS, taking the role of a conversant, analyzing the discourse of the speaker (using a model of the user as well as an incrementally built model of the discourse), to be used to eventually respond. If a representation to facilitate response is what is needed, it seems clear that both a picture of the discourse as it proceeded and an understanding of the person producing the discourse will be important distinct factors. Understanding the structure enables the hearer to comprehend the points made by the speaker, to then evaluate and address a response. Deeper knowledge of the speaker will then facilitate constructing a response that can be well understood (for which the goal of the hearer in producing the response will succeed). For an example, see Appendix 2.

I will close with some comments about the terminology used by Schuster. I feel that the definition of discourse model here is too narrow—there is more to a model of discourse than an indication of the underlying entities (objects, events). Schuster seems to suggest that some of the structuring provided in Grosz and Sidner (1986) is there only to highlight the entities. In my view, the actual utterances themselves are worth examining as participating in some structure.
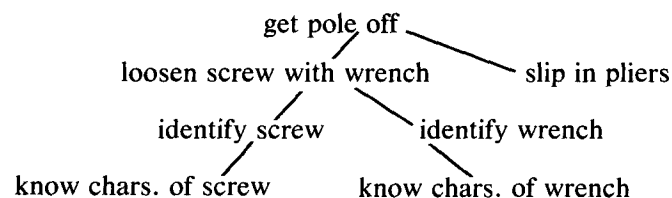
I also find Schuster's definition for user model—the information a system has about the user—somewhat problematic. I think that the user model must concentrate on dynamic information, that is, which has some potential for change. In any case, the information should be such that different values make for different analyses (of the discourse where the user model is derived). Otherwise, why have a model at all? So if all the users of a system are male, why record this fact in the user model for each one? (My views here thus coincide with Sparck Jones's claim that a user should be modeled if there are particular characteristics which set her apart.)

Finally, relevant to Schuster's discussion on agent models and user models (see also Wahlster and Kobsa 1988; Kass and Finin, this issue), I reiterate that the focus should be on the user as conversant. If the topic of conversation is another agent, it is useful to know about this person, in the same sense that it is useful to know about any topic discussed (e.g., the working of a nuclear power plant). (Note that the system's and the user's view of the topic may not coincide, and thus this view of the world may need to be modeled of the user as well).

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1. See that screw
2. The one with the funny top
3. Loosen it with the wrench
4. That black wrench there
5. OK—now you can slip in the pliers
6. And the whole pole comes off

Plan of Speaker:
The top level goal is get pole off, which succeeds if the following hierarchy of subgoals succeeds:

get pole off
loosen screw with wrench   slip in pliers
identify screw   identify wrench
know chars. of screw   know chars. of wrench

Intentional structure of discourse (as in Grosz and Sidner 1986):

Primary Intentions:
I1: intend H (get pole off);
I2: intend H (loosen screw with wrench)
I3: intend H (identify screw)

Segmentation Structure:

(((1 2 (ds3)) 3 4 (ds2)) 5 6 (ds1))

There are three segments: ds3 with I3, ds2 with I2, and ds1 with I1, where I2 DOM I3 and I1 DOM I2 (i.e. I3 contributes to the satisfaction of I2, etc.)

There are two main sources of difference between the plan of the speaker and the intentional structure of discourse, illustrated by the above example: (i) there may be no direct match from the utterances to the units (subgoals) of the plan; here, there is no utterance corresponding to "identify wrench", on top of utterance 4, which serves to let the hearer "know characteristics of the wrench"; (ii) the intentions recorded for

the intentional structure may be at a higher level of detail.

The examples provided in Grosz and Sidner (1986), for instance, only record those attached to segments of more than one utterance. There are, indeed, many issues regarding the relationship of plans and discourse structure; we will not elaborate further here. Our main point is that the two terms should be related, but distinct.

Appendix 1. Plans vs. Intentional Structure.

Example:
2. 1. Prime Minister Mulroney is wonderful.
    2. He refuses to back off on the free trade plan.
2b. 1. Prime Minister Mulroney is wonderful.
    2. For example, he refuses to back off on the free trade plan.

In Example 2b, the structure of the discourse, indicated by the connecting phrase "for example", suggests an intentional connection between (1) and (2). (One way to view this discourse is as an argument where the speaker utters (2) in order to get the hearer to believe (1)). Clue words alone may provide a basis for the determination of the segmentation of this small example.

Now, if we also know of the speaker (or derive, on

the basis of the likely intended connection above) that he is an arch-conservative, we have additional information to facilitate response. One such rejoinder might be:

2c. Yes, but won't this prevent big private companies from making lots of money?

This rejoinder would not be appropriate for a fiery labor supporter (e.g., New Democrat, in Canadian politics).

Example 2 is also a case where having a model of the user's beliefs (e.g., he's an arch-conservative stereotype) may facilitate derivation of the intended structure of the discourse, in the absence of clue words. This thus also argues for inclusion in the user model information additional to the structure of discourse determined so far.

Appendix 2. Using Discourse Structure and User Models for Response.

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