Towards a Dialogue Taxonomy

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Abstract. Two interrelated points are made in this paper. First, that some of the characteristics of the language used in spoken dialogues are also observed in typed dialogues, since they are a reflection of the fact that it is a dialogue, rather than the fact that it is spoken. A corollary of this is that some of the results obtained in previous work on typed dialogue, especially Wizard of Oz simulations of human-computer natural language dialogues, can be of use to workers on spoken language dialogue systems. Second, it is claimed that we need a more fine grained taxonomy of different kinds of dialogues. Both for making it possible to make use of results obtained by other workers in developing dialogue systems, and for the development of our theoretical understanding of the influence of non-linguistic factors on the language used in human-computer dialogues. A number of such dimensions are described and their influence on the language used is illustrated by results from a empirical studies of language use.

1 Introduction

There is a strong trend in present-day computational linguistics towards empirically based models and theories. In the area of dialogue systems there is concurrently a shift away from typed dialogue to spoken dialogue systems. Since there exist a body of empirical results and models for typed dialogues systems, the question arises to which extent these results are useful and applicable also for spoken dialogue systems. What makes this question difficult to answer is the relative neglect of mainstream linguistics concerning the issue of what characterizes the language used in different domains and situations[1]. Consequently, many of the views on what characterizes spoken or written language are often less than accurate for professional linguists and laypersons alike. Linell (1982) has forcefully argued that mainstream linguistics suffer from a "Written Language Bias". And Volosinov (1973:71) claims that "European linguistic thought formed and matured over concern with the cadavers of written languages; almost all its basic categories, its basic approaches and techniques were worked out in the process of reviving these cadavers".

While not all workers on spoken language and dialogue would subscribe to the strong positions taken by Linell and Volosinov, there seem to be an explicit or

[1] In some areas of linguistics this is of course not a correct characterization, as illustrated by the work on sub-languages by Grishman and Kittredge (1986) and others.

implicit view among many workers in the field that large portions of the current linguistic theories are not relevant for the development of spoken dialogue systems. While not explicitly stated, the implicit argument seems to be something like the following.

Premise 1. Spoken and written language are different.

Premise 2. Current linguistic theories (e.g. grammars) are developed for written language.

Conclusion: We cannot make use of results and theories based on written language, but have to start more or less from scratch.

While I agree with the basic arguments by Linell and Volosinov, and while I agree that there are important differences between spoken and written language, one claim of the present paper is that the dialogue community risks throwing out the baby with the bathwater, and this for the following reason. The arguments on the differences between spoken and written language do not sufficiently take into account the fact that the prototypical spoken and written language situations differ on more than one dimension; the prototypical spoken language is a dialogue, the prototypical written language is a monologue. And the claim here is that some of the characteristics attributed to spoken language does not depend on the fact that it is spoken, but that it is a dialogue.

Before continuing I want to stress that I do not deny that there *are* differences between spoken and written dialogues. The speech recognition problem of decoding the acoustic signal is an obvious example of this. But since these differences are well known, my aim is here instead to argue that there are important similarities between dialogues, regardless of the communication medium.

2 Spoken and Written Dialogues

There is no denying that the language used in naturally occurring dialogues does not look like the language we were taught to write in grammar school. And there is no denying that the language used in the prototypical spoken dialogue and in the prototypical written text (monologue) differ along the lines often described. But prototypes are not the only members of categories. The issue I want to address here is to what extent it is the medium (spoken versus typed) or the interaction type (dialogue versus monologue) that accounts for the linguistic qualities observed in spoken dialogue. Unfortunately there are not many published studies that I am aware of that explicitly address this issue. But there have been quite a number of studies of typed dialogues, many being so-called Wizard of Oz-experiments. While the latter fact perhaps makes it difficult to ascertain whether the observed qualities are caused by the interaction modality or the perceived qualities of the non-human dialogue partner, this does not need to be a major concern for the computational linguistic community, since the aim here presumably is to design interfaces for interaction with computers.

There are a number of studies of human-computer interaction using typed natural language, that show that these dialogues exhibit many of the attributes characteristic of spoken dialogues. If we look at some of the early ones, Reilly

(1987a 1987b) and (Malhotra 1975) have shown that the syntactic variation is rather limited. Furthermore, so-called ill-formed input is very frequent, especially the use of fragmentary sentences and ellipsis. Guindon et al (1986, 1987) present a detailed analysis of the language used by their subjects. They report that 31 % of the utterances contained one or more ungrammaticalities. The most common of these were fragments (13 %), missing constituents (14 %), and lack of agreement (5 %).

These results (and others, for a larger review of the early studies in the field, see Dahlbäck, 1991) indicate that typed and spoken dialogues share many qualities, and in many respects deviate from ordinary typed language in similar ways. Hence, the argument from the Call for Papers for a recent workshop on Spoken Dialogue Systems that spoken dialogues differ from typed ones because

> " ... spoken input is often incomplete, incorrect and contains interruptions and repairs; full sentences occur only very occasionally. Therefore new basic units for the development of dialogue models have to be proposed ... "

seems to be somewhat lacking in empirical support.

There are of course also observed differences between typed and spoken dialogues. Cohen (1984) studied the effects of the communication channel on the language used in task oriented dialogues. When comparing spoken (telephone) and teletype conversations he noted that " keyboard interaction, with its emphasis on optimal packaging of information into the smallest linguistic "space", appears to be a mode that alters the normal organization of discourse". (Cohen, 1984, p 123) To take one example, the use of cue-words to introduce new discourse segments occurs in more than 90 % of the cases of spoken discourse, but in less than 45 % of the written dialogues.

But note here that the observations made by Cohen and others, do not indicate that the language of the typed dialogues resembles the prototypical written language, but instead that it in some respects, e.g. tersness, deviates even more from the norm of 'normal' written language than does the language of spoken dialogues.

I am not familiar with any systematic studies of the differences in dialogue structure between spoken and typed dialogues. What seems to affect the dialogue structure is rather whether you are interacting with a computer or a person. I will get back to this issue later.

While the number of studies is limited, and while therefore the conclusions drawn need to be considered tentative, at least to my mind it seems clear that there are a number of important similarities between spoken and typed dialogue, and that consequently workers on spoken dialogue, at least to some extent, can make use of the results obtained from analyzing typed dialogues.

While I have previously stressed the similarities between spoken and typed dialogues, it should also be noted that there seem to be some differences too, for instance regarding the dialogue structure. An illustration of this is is found in the different kinds of basic dialogue structure proposed by us for typed dialogues

(Dahlbäck 1991, Dahlbäck & Jönsson 1992, Jönsson 1993) and for Bilange (1991) for spoken dialogues. The dialogues involve in both cases information retrieval. The dialogue models developed by us and by Bilange are very similar, whichs makes a comparison between the models on a detailed level possible. We then find that the spoken dialogues seem to exhibit a three-move structure (called Negotiation, Reaction, Elaboration by Bilange), whereas in the typed dialogues a two-move structure (Initiative, Response) is sufficient. Since also Stubbs (1983) found a similar three-move pattern in his analysis of spoken dialogues, this suggests that there is some general difference between spoken and typed dialogues in this respect.

Before leaving this dimension I wish to suggest that one important difference between spoken and typed dialogues with computers affecting the discourse, is that in typed dialogues parts of the dialogue remain in front of the user when planning and executing the next move. We have for instance found in our work on typed dialogues that even with extremely long response times (due to a very slow simulation environment at the time), users make use of anaphoric expressions, including ellipsis in the dialogues.

3 Towards a Dialogue Taxonomy

The results from the studies described above indicate that there are important similarities between dialogues, regardless of the medium used, but these studies also make it clear that the four categories of dialogue created by the two binary dimensions, spoken-written and monologue-dialogue, are not sufficient for describing the factors that influence the language used in aspects important for the development of computational models of discourse. The rest of this paper will therefore be devoted to providing the first steps towards the development of such a taxonomy, with special emphasis on discourse aspects relevant for computational theories of discourse[2].

As pointed out above, the difference between the prototypical spoken and written language is really not one but many. Rubin (1980) suggests that the communicative medium or the communication channel, should be partitioned into the following seven dimensions: modality (written or spoken), interaction, involvement, spatial commonality, temporal commonality, concreteness of referents (whether objects and events referred to are visually present or not), separability of characters. Below I will present observations suggesting that at least some of these dimensions influence language in aspects of interest to computational linguists.

I make no claim that the dimensions described below constitute an exhaustive list, nor do I wish to claim that they are independent. It is much too early to make such conclusions. My goal is a more modest one; I hope to initiate a discussion on some of the aspects I consider important here, since I believe that the healthy development of the field requires clarification on these issues.

[2] Parts of this material was previously published in Dahlbäck (1995)

In Linköping we have recently been involved in a project aimed at comparing different kinds of computational discourse models empirically. We have not only used our own dialogue corpora from previous work, but have tried to gain access to other corpora as well. We found in the course of this work that different kinds of computational models seemed to be more adapted to some kinds of dialogues than to others. This led us to partly reformulate the aims of the project to also focus on a descriptive scheme of different kinds of dialogues. No claim of originality is made concerning the dimensions mentioned here. As will be obvious to many readers, much of what is presented below is based on or influenced by work of others, probably even more so than is made evident in the references. I have tried to enforce my argument that these factors need to be taken seriously by the computational discourse community by illustrating the possible ways in which the factors mentioned influences or might influence the computational treatment of discourse.

3.1 Kinds of Agents

The fact that the dialogue partner is a person or a computer seems to influence a number of linguistic aspects, from the use of pronouns to the dialogue structure. Guindon (1988) showed that the dialogue structure differed between dialogues with persons and with computers in similar situations. When interacting with a computer, the dialogue structure was simpler. The work by Kennedy, Wilkes, Elder and Murray (1988) showed that the language used when communicating with a computer, as compared with a person in a similar situation, has the following characteristics: Utterances are shorter, the lexical variation is smaller and the use of pronouns is minimized. The results concerning the limited use of pronouns when communicating with computers has been established in a large number of studies (for a summary of a number of studies on this and other aspects of 'computerese', see Dahlbäck 1991, ch 9). In most cases it is, however, not possible to ascertain whether the differences found are caused by influences of the channel (typed vs spoken) or the perceived characteristics of the dialogue partner (human vs computer).

In a current project in Linköping we are comparing the language used when communicating with a computer or with a person in identical situations (typed information retrieval with or without the possibility of also ordering the commodities discussed). The only difference between the two situations is what the subjects are told they are interacting with; whether it is a person or a computer. In all other respects the situations are similar (and the 'wizards' are not told beforehand under which condition the specific subject is run). It is interesting to note that it is in this situation rather difficult to find any differences between the dialogues with humans and those with computers. If this result holds after a more thorough analysis, this indicates that *communication channel* and *kinds of tasks* influence the dialogue more than the perceived characteristics of the interlocutor. It is, however, still possible that there are differences between these dialogues in for example the dialogue structure, something which has not been analyzed yet.

We have recently extended this work by comparing spoken dialogues with computers from the Waxholm-project (Bertenstam et. al., 1995) with dialogues between people. In both cases the task was information retrieval. This far, our observations suggest that it is possible to adapt our LINLIN dialogue model (Dahlbäck and Jönsson, 1992), which was developed for typed dialogues with computers, to cover also spoken dialogues with computers without any major modifications (Jönsson, 1996), but this is less so for dialogues between people.

A tentative preliminary conclusion possible to draw from the collected observations mentioned above on the dialogue structure is that typed dialogues with computers, both in information retrieval and in at least some advisory situations (Guindon), exhibit a rather simple structure possible to model with a context free dialogue grammar. This is also true for spoken dialogues with computers, at least for information retrieval (Bilange), whereas the dialogue structure in dialogues between people, also in information retrieval dialogues, exhibit a more complex structure.

3.2 Interaction

The interaction dimension (dialogue versus monologue) seems to influence among other things the use of pronouns and the pattern of pronoun-antecedent relations. In typed human-computer dialogues pronouns are rarely used (Guindon, 1988, Dahlbäck & Jönsson, 1989, Kennedy et al, 1988). The anaphor-antecedent relations seem to be of a rather simple kind in these kinds of dialogue. To take one example, we found in an analysis of these patterns in one of our corpora of Wizard of Oz-dialogues that in those cases where the personal pronouns had an antecedent, the distance between pronoun and antecedent was very small. The analysis suggested that the antecedent could be found using a very simple algorithm which basically worked backwards from the pronoun and selected the first candidate that matched the pronoun on number and gender and which did not violate semantic selection restrictions (Dahlbäck, 1992). The algorithm described and evaluated on a number of computer manuals by Lappin and Leass (1994) is more complicated and uses among other things an intrasentential syntactic filter for ruling out anaphoric dependence of a pronoun on an NP on syntactic grounds. It is not clear that such a filter would improve the recognition of the antecedent in our dialogues, where instead the dialogue structure was needed to stop the search for antecedents to the pronouns when these were not found within the local structure unit. The reason for this rule was that in our corpus as many as 1/3 of the personal third person pronouns lacked an explicit antecedent, but instead made use of some kind of associative relation to the antecedent, or belonged to the class of pronouns called 'propositional' by Fraurud (1988).

As already pointed out, an important difference between spoken and typed language is that spoken language seems to contain more ungrammaticalities. But as an aside, perhaps some caution could be used here in labeling these occurences 'ungrammatical', since our grammars might be carriers of the 'Written Language Bias' that Linell (1982) talks about. Violations of number agreement is of course ungrammatical, but the use of sentece fragments seems less so, it we do not take the prototypical written language as the norm.

3.3 Shared Context

Spatial and *temporal commonality* also seem to influence aspects of discourse. Not only is the use of deictic expressions made possible with a shared temporal/spatial context, but it is also possible that the use of other anaphoric devices is influenced. Guindon (1988) found, for instance, in her analysis of advisory dialogues for the use of a statistical computer package that pronouns either had their antecedent in the current sub-dialogue, or they referred to the statistical package that was present on the screen all through the dialogue. And as an aside, it is perhaps worth pointing out that the celebrated example from Grosz' dissertation (Grosz 1977, p 30), where the pronoun 'it' is used to refer to the pump just assembled, which has not been mentioned for 30 minutes and 60 utterances, could be seen as belonging to this category too. But also in other kinds of discourse where there is no shared physical context, and where the interaction is minimized there sometimes occur privileged entities that can be referred to using a pronoun even if the antecedent in the strict sense has not been mentioned for a long time. These so-called 'primary referents' (Fraurud, 1988) are for instance the main actors in a novel.

The other dimensions discussed by Rubin are probably also important not only for human dialogues, but also for human-computer dialogues. They seem to be of use, for example, when discussing and comparing different kinds of multi-media or multi-modal interaction.

Rubin also discusses a number of message-related dimensions (without claiming them to be independent), especially topic, structure and function. I will here address two dimensions closely related to the ones mentioned by Rubin, namely task structure and kinds of shared knowledge.

3.4 Dialogue-task Distance

That the task structure influences the dialogue structure was an important aspect of Grosz' (1977) early work. But she also pointed out that for man-computer dialogues "there seems to be a continuum (...) from the totally unstructured table filing dialogues to the highly structured task dialogues (ibid, p 33). In the task oriented dialogues the structure of the task was shown to influence the structure of the dialogue and this result was the starting point for the use of the underlying task structure in the analysis of discourse. An important corollary of this is of course that the dialogue structure will differ depending on which kind of task is being performed.

But it is my impression that not only different tasks will influence the structure of the dialogue, but that this is true also for a different but closely related factor which I call *dialogue-task distance*. This is based on the observation that there seems to be a closer connection between task and dialogue in for instance an advisory dialogue than in an information retrieval dialogue. For the task oriented dialogues, we know that we need to understand the non-linguistic tasks and acts to be able to understand and respond correctly to our dialogue partner's speech acts. But this is less true for simple iformation retrieval. For instance, to answer the question of when there are express trains to Stockholm within the next two hours, in most cases there seems to be no need to know why the questioner needs to know the answer. I am not denying that there are cases when the information provider can be more helpful when knowing this. But the prime case of this is probably when it is not possible to provide an answer, as for instance when in the case above, there are no trains of the requested kind within the specified time limit. In such cases humans often seem to ask for the information needed to provide additional help and presumably computer systems can do the same.

My hypothesis is therefore that we here have a dimension which is characterized both by differences on the need to understand the underlying non-linguistic task, and on the availability of linguistic information required for doing so. Reichman (1985, p 21) has argued that "though it is true that conversational moves frequently reflect speaker's goals, it is important to stress that these moves can be identified and interpreted without reference to a speaker's underlying intent for an utterance." My claim here would be that this is true, but only for some kinds of dialogues, namely those resembling information retrieval dialogues in having a long dialogue-task distance. For other kinds of dialogues, where this distance is shorter, I am inclined to believe that Reichman's claim is less valid. And this in fact to the extent that I hypothesize that different kinds of computational discourse models are to be preferred depending on the value taken on this dimension.

The closer the language-background task connection, the more appropriate become plan or intention based models. In these situations it is less difficult to infer the non-linguistic intentions behind a specific utterance from knowledge of the general task structure and from observations on the on-going dialogue. But with larger distance between the dialogue and the underlying task, as in the information retrieval case, the more difficult it becomes to infer the underlying intentions from the linguistic structure, and at the same time the need for this information in order to provide helpful answers diminishes. In these cases dialogue grammar models based on the conversational moves or speech acts made by the interlocutors are probably a better choice.

One observation from our on-going work that seems to support this position is that we have found that the coding of the underlying intentions in an information retrieval dialogue becomes really difficult if the coding is done move by move, i.e. when the move is classified without knowledge of what follows later in the dialogue. But this is, of course, the situation a computer system will be in. A coding scheme based on more surface-oriented criteria seems to be at advantage in this situation.

It is not only the connectedness between the linguistic and the non-linguistic task that influences the complexity of the dialogue. The *number of different* *tasks* managed linguistically is another such factor. In our work we have compared cases of information retrieval dialogues with dialogues in the same domain (travel information) where the user also can order a ticket. In the latter case not surprisingly, a more complex topic management was required (Jönsson, 1993, Ahrenberg, Dahlbäck, Jönsson, forthcoming).

This dimension seems to me to point to an important difference between human dialogues and human-computer dialogues, since there are fewer different things that can function as topic in a dialogue with a computer system.

3.5 Kinds of Shared Knowledge

The influence of different kinds of shared knowledge between dialogue participants on the use of referring expressions has been discussed by Clark and co-workers in a number of important papers (e.g. Clark & Marshall, 1981; Clark & Carlsson, 1981; for a summary see Clark, 1985). The basic point of this work is that a necessary pre-requisite for the successful use of a definite description is that speaker and listener share a common ground of mutual knowledge, beliefs, and assumptions, and furthermore that, were it not for a number of heuristics used by people, the acquisition of this mutual knowledge would require checking an infinite number of assumptions. The bewildered or skeptical reader of this claim is referred to the original sources. In this context I only want to use Clark's taxonomy of the basic classes of such heuristics for my present purposes. Clark's claim is that there are three basic such classes or kinds of information that can be used to infer the common ground between speaker and listener; shared perceptual, linguistic and cultural knowledge. Two of these have in different ways already been addressed previously. *Perceptual knowledge* is usable when the physical or visual context is shared; the shared *linguistic knowledge* is in this context another name for the shared knowledge of the previous text or dialogue. But what has not been discussed previously is the use of shared *cultural knowledge*, where 'cultural' here is used in its widest possible sense, including factual knowledge etc.

The basic idea here is that there are things that everybody in a community knows and which therefore can be used as common ground. The problem with this is, of course, to determine if my dialogue partner belongs to the same community as I do, or rather which cultural knowledge from different sub-communities that I can assume that we share. In face-to-face communication between people, we often can make a good guess at what cultural knowledge we share with our interlocutors, since choice of clothing, ways of speaking etc give clues on this. And even though we all know of embarrassing situations when the assumptions we made were blatantly wrong, the very fact that we remember these situations as something that stands out in our memory also indicates how good we often are at making these kinds of inferences.

This seems to be an aspect worth considering when selecting tasks and domains for which an interactive computer system should or could be designed. Note that in many cases the computer is worse off than a human in the same situation not only because the computer's inferential abilities are less powerful than those of the person, but also because it has a more impoverished empirical basis to build its deductions on. It cannot see its interlocutor and does not remember the person from previous encounters.

My suggestion here is that it will be difficult, at least in the short run, to develop dialogue systems for those kinds of applications where the common cultural ground needs to be acquired during the on-going dialogue. And a possible explanation for the successful information retrieval systems developed is that they operate in domains where it can be assumed that all users will have the same basic knowledge of the domain. Hence the need for clarification sub-dialouges is diminished or obsolete, as well as the need for user-modeling of a kind not yet achieved.

4 Summary

"That language varies according to the situation is a truism; however, the details and implications of that truism are far from obvious, whether your enterprise is theory formation or system construction" (Pattabhiraman, 1994). I have here tried to show that while there is still lots of work that need to be done to make the implications of this truism obvious, there are already enough observations available to make it possible to make the first steps on the path towards this goal. I have here described a number of such dimensions that I believe influence one or more important parameters for any kind of computational theory of discourse, and have tried to illustrate their possible influence on different discourse phenomena. The dimensions discussed were the following.

- Modality (spoken or written)
- Kind of agent (human or computer)
- Interaction (dialogue or monologue)
- Context (spatial and/or temporal commonality)
- Number and types of tasks
- Dialogue-task distance
- Kinds of shared knowledge (perceptual and/or linguistic and/or cultural)

The list is by no means intended to be all-inclusive and final. There are in all probability other dimensions not mentioned here that are of equal importance. And even for those dimensions described here, we do not know enough about their influence of language and interaction. But I believe that we do know enough to take them seriously in our continued work on empirically based computational dialogue models.

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