

PARSING METACOMMUNICATION IN NATURAL LANGUAGE DIALOGUE TO UNDERSTAND INDIRECT REQUESTS¹

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ABSTRACT

This paper reports on development of a natural language processing system based on human communication theory. Our system, DIALS (for DIALogue Structures), implements and extends the theory of metacommunication developed in the field of human speech communication. The theory of Dialogue Structures is based on research showing that the interpretation of conversation is enabled by metacommunications helpful in managing interactions and that indirect requests are usually patterns expressing relationships in the interaction rather than simply expressing the content of the request. As such, indirect requests are best interpreted by a semantic grammar expert at managing communication, rather than a semantic grammar knowledgeable on some specific task domain. Our system, based on this approach, correctly interprets all indirect requests from a corpus of 1500 requests transcribed from tape recordings with a combined total of over 80 minutes of continuous conversation of 27 dialogues between airline reservation agents and customers.

INTRODUCTION

We approach the programming of NLP systems from the perspective of human communication theory. We believe that the theory of metacommunication (Sanford & Roach, 1987a, 1987b, 1987c, 1988, in press) provides an approach to framing linguistic utterances. Indeed, we argue that the communicative behavior of the interactants is more important than task-specific knowledge for making such inferences. Our

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theory of Dialogue Structures currently does not cover the entire domain of interpersonal interaction. People with a history of interaction develop unique phrasings and interpretations, requiring representations of memory structures for interpersonal relationships that we have not developed yet. Therefore, we are focusing our initial research on contexts that involve strangers interacting. In particular, we choose to focus on interactions between airline reservation customers and agents, which involves utterances rich with requests. In this paper, we will explain how DIALS (our implementation of DIALogue Structures) identifies and uses metacommunicational knowledge to determine the meaning of indirect requests uttered in such contexts. We cannot explain everything about our theory in seven pages, so our explanation of the theory will be incomplete, at best.

INDIRECT REQUESTS

Grosz (1980) and Allen (1983) define indirect requests as requests in which the surface utterance appears to be asking for a yes/no response, while the underlying intention is to get something else. We consider indirect requests to be conventionalized phrasings of pleading “imperative force,” a metacommunicational expression used to manage interaction rather than a source of task-specific information. We divide this section into two parts: we first analyze how people use indirect requests and then we explain how DIALS handles indirect requests.

How People Use Indirect Requests

There are two possible functions of requests worded indirectly: first, they are **not** truly indirect and are asking for a yes/no response; second, they are truly indirect and expect the respondent to do more. A communicator is confronted with deciding which is intended and why.

Knowledge Needed for Analyzing Indirect Requests

Content metaknowledge. When an “indirect request” is actually direct, i.e., when the requestor wants a yes/no response, metaknowledge about the task domain is needed to answer the question. First consider an example from Allen (1983): “Do you know when the Windsor train leaves?” How could a NLP system determine whether to answer this with a yes or no? It could examine its database, seeing if it can find a departure time for a train headed to Windsor. If it finds such an entry, then it answers “yes”; if not, it answers “no.” Either way, it determines the embedded request and bases its answer on its success at fulfilling the

underlying request. But consider this strategy with an example from Grosz (1980): "Can you help me get a banana?" To answer, it tries to help get a banana. If it is successful at getting a banana, then it says "yes." But we began by assuming that the requestor simply wanted a yes/no response. To give such a response, this strategy requires that the embedded indirect request be fulfilled. The better strategy is to provide the system with metaknowledge about the task domain. It must not only know things (e.g., departure times of trains) and be able to do things (e.g., get bananas), but must know that it knows them or that it can do them. This was first recognized when John McCarthy (1968) proposed knowledge structures that included the "canult" metaknowledge structure, i.e., that the system "can ultimately" do something.

Relationship metaknowledge. Now consider the alternative, that the "indirect request" is actually indirect. The system parses the indirect request, "Do you know when the Windsor train leaves?" checks its metaknowledge and finds that it can indeed provide the information. It could stop there and simply say "yes." But we are assuming that this is an indirect request. How does the system know this? It needs other metaknowledge useful for inferring that "yes" is insufficient. One valuable type of metaknowledge would involve some additional knowledge about the task domain. For example, it would be useful to know that having information about train departure times is often needed to ride a train. This is information about a speaker's task goals or intentions, in this case, the goal of riding on a train.

Why did the speaker use indirection to ask when it leaves? Some theorists (e.g., Searle, 1975) say that speakers use indirection to appear polite. Now we are no longer talking about intentions related to a single task domain, such as train transportation, but to a second task domain about managing interpersonal relationships. This is communication related to a special type of metaknowledge, called "metacommunication." We finally arrive at our major theoretical hypothesis, that there are two types of metaknowledge needed to handle indirect requests: content metaknowledge about task domains, such as booking reservations, and relationship metaknowledge about managing interactions.

Behavioral Data on Use of Indirect Requests

Our research is based on a collection of 1500 requests transcribed from 27 telephone conversations between airline reservation agents and customers. In addition to our own collection of actual human behavior, some of this analysis is based on the behavioral research of others.

Frequency of use. Out of our 1500 sentences, only 17, or 1.13%, are indirect requests. This may sound surprising, considering that

interactions between airline reservation agents and customers is a context in which there are a great many requests. Although indirect requests seem to be seldom used, when they are used they should be correctly interpreted by a NLP system. Interestingly, of our 27 conversations, the 17 indirect requests appear in only 11 conversations. One conversation has three indirect requests, four conversations contain two indirect requests each, six conversations contain one indirect request each, and 16 of the conversations have no indirect requests.

Evidence on order of analysis for indirect requests. If the surface meaning is automatically interpreted first, because it would take more work and time to go on, mistakes would more likely involve saying "yes" or "no" when the requestor really wanted something more. If the surface form is ignored and the underlying meaning is processed first, then mistakes would more likely involve saying or doing more when only a yes/no response was sought. Consider if someone asks, "Do you know the time?" and receives the response, "Yes." The requestor assumes that the respondent is being uncooperative or funny; people generally do not use language in such a naïve manner. But when people give more when only a yes/no response is wanted, the requestor is more likely to accept it as a mistake in interpretation. And in reference to the time taken to process the direct vs. indirect meanings, when researchers measured the time taken by adults to interpret requests that were embedded in a story context, it actually took longer to understand surface meanings than indirect meanings (Gibbs, 1979).

Representing Metacommunication for Indirect Requests

Our representation of requests starts with a typology of 22 categories of request forms based on our research into the "imperative force" with which a request is phrased. Indirect requests express pleading imperative force and appear in six categories (see Table 1).

In addition to representing the form of requests in English, Dialogue Structures provides a representation of the conversation as a network of interacting participants (Sanford & Roach, 1988). This representation includes not only who is speaking to whom, but who is speaking for whom. That is, it is common for one person to act as a communicative "proxy" for another person, e.g., a secretary is "deputized" to speak for his/her boss and the reservation agent is "deputized" to speak for the airlines in negotiating the sale of a ticket. Usually, this "proxy/deputer" structure remains in the background. Occasionally it is made explicit such as in one of our transcripts; when an agent does not want to be blamed for the high cost of a ticket, she says, "TWA is showing me a fare, high season of \$703 based out of Washington."

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When two people are interacting, they usually act as proxies for separate people, that is, both speak for themselves or someone else. But occasionally, one participant speaks for the other participant in the conversation. In this case, an indirect request provides added complications. Before showing how we handle this case, let us consider the simpler case in which each is speaking for someone other than the other participant.

When an indirect request is encountered, DIALS has a set of rules for transforming such patterns into a direct, canonical form. For example, an indirect pattern such as "Do you know" is transformed into "I request to know" and "Can you help me" is transformed into "I request you help me." In the case where one speaker is acting as a proxy for the other speaker, the set of transformations are slightly different. For example, if the speaker wants to use a pay phone, "Do you have a dime?" is transformed into "I request to have a dime." But when the hearer is trying to use a pay phone and is checking his pockets or her purse, the speaker is acting as a proxy for the hearer when stating, "Do you have a dime?" and this is transformed into "I request to give you a dime."

The full set of indirect requests from our protocols and their respective direct transformations are presented in Table 1. As it shows, all 17 of the indirect requests in our protocol collection of 1500 requests are correctly transformed by DIALS. The identification of the form and imperative force of each request and the transformation to a standard form takes between 3 and 14 CPU seconds using a 1 klips PROLOG interpreter running on a VAX 11/780. DIALS can identify the category of and transform over 5000 surface forms of a single underlying request content in comparable time.

CONCLUSION

The main problem with current approaches to analyzing indirect requests is that they are trying to make inferences about the relationship component of communication by using content-based knowledge. Indirect requests are conventionalized patterns for expressing metacommunicational information. To parse them correctly requires a pattern parser that knows the forms in which requests may be embedded, how to transform such forms, and the metacommunication being expressed by the forms. There are components of the theory of Dialogue Structures that impact the analysis of indirect requests, such as elements representing the social context of conversations, that were not mentioned here due to a lack of space. Our system, DIALS, knows our behaviorally validated typology of request forms; it knows how to transform requests into and out of each category, including transforming

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from indirect to direct forms; and it knows the "imperative force," i.e., the metacommunicational value, of the forms associated with each category of request pattern. This can be seen by the fact that DIALS correctly transformed all examples of indirect requests from a corpus of actual human dialogue comprised of 27 conversations with a total combined time of over 80 minutes of continuous conversation. DIALS can identify the category and imperative force of and transform over 5000 conventionalized surface forms of requests.

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Table 1
18 Indirect Requests and Their Direct Transformations

Indirect Requests	CPU Secs. [†]	Direct Transformations
-----Modal-Auxiliaries-----		
(1) Could you make that later?	3.31	(1) I request you make that later.
(2) Can you tell me if there is a meal served on that flight?	10.14	(2) I request to know if there is a meal served on that flight.
(3) Can you tell me if it is possible to get a kosher meal on the plane?	12.92	(3) I request to know if it is possible to get a kosher meal on the plane.
(4) Well, then can you check and see if you can route us back through Pittsburgh?	13.94	(4) Well, then I request you check and see if you can route us back through Pittsburgh.
(5) Could you give me something maybe earlier than that?	5.09	(5) I request to have something maybe earlier than that.
(6) Can you tell me how much the fare will be?	5.28	(6) I request to know how much the fare will be.
(7) Could you hold on just a second?	6.25	(7) I request you hold on just a second.
-----Asking-for-Suggestion-----		
(8) Do you know how long you will be staying if you leave on the 5th?	11.75	(8) I request to know how long you will be staying if you leave on the 5th.
-----Asking-for-Permission-----		
(9) May I have your last name, sir?	4.37	(9) I request to have your last name, sir.
(10) Could I have a name and phone number?	5.55	(10) I request to have a name and phone number.
(11) Could I have your business phone number?	4.58	(11) I request to have your business phone number.
-----Asking-about-Convenience-----		
(12) Would you mind checking on that for me?	3.64	(12) I request you check on that for me.
-----Interrogative-Indicatives-----		
(13) Are there any other flights that I could take, like routed differently?	12.16	(13) I request you tell me about any other flights that I could take, like routed differently.
(14) Are there later ones?	4.00	(14) I request you tell me about later ones.
(15) Is there any later flights than that 9:55?	8.56	(15) I request you tell me about any later flights than that 9:55.
(16) Is there a morning flight?	5.02	(16) I request you tell me about a morning flight.
(17) Is there one that gets there like in the afternoon?	10.20	(17) I request you tell me about one that gets there like in the afternoon.
-----Request-to-Request-----		
‡(18) Can I ask you to check on that for me?	3.60	‡(18) I request you check on that for me.

† Measurements of time taken to perform transformations were made with a 1 klips PROLOG interpreter running on a VAX 11/780.

‡ This is an example made up to complete the categories of indirect requests. This category was not used in the 1500 requests that comprise our protocols.