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Modeling the clarification potential of instructions: Predicting clarification requests and other reactions

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Abstract

We hypothesize that conversational implicatures are a rich source of clarification requests, and in this paper we do two things. First, we motivate the hypothesis in theoretical, practical and empirical terms and formulate it as a concrete clarification potential principle: *implicatures may become explicit as fourth-level clarification requests*. Second, we present a framework for generating the clarification potential of an instruction by inferring its conversational implicatures with respect to a particular context. We evaluate the framework and illustrate its performance using a human−human corpus of situated conversations. Much of the inference required can be handled using classical planning, though as we shall note, other forms of means-ends analysis are also required. Our framework leads us to view discourse structure as emerging via opportunistic responses to task structure.
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1. Introduction

We cannot fully understand the meaning of language in conversation without understanding the mechanisms that make conversation such a robust process. Nor should these mechanisms be seen as peripheral; arguably they are central to an adequate theory of meaning:

> *The adequacy of a semantic theory involves the ability to characterize for any utterance type the* ***contextual update*** *that emerges in the aftermath of successful exchange and the range of* ***possible clarification requests*** *otherwise − this is, arguably, the early 21st century analogue of truth conditions (Ginzburg, 2012, p. 8).*

That is, clarification requests are not a necessary evil but an intrinsic mechanism of language. Interpreting an utterance centrally involves characterizing its range of possible clarification requests, its *clarification potential* as we shall call it. Now, dialogue system designers have already realized the practical interest of clarification requests: see Gabsdil (2003), Purver (2004), Rodríguez and Schlangen (2004), Skantze (2007), Rieser and Lemon (2010),

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Stoyanchev et al. (2013). Moreover, in sociolinguistics and discourse analysis, where clarifications are known as *repairs*, they have been a central theme for more than three decades now; see Schegloff (1987) as a representative example. However, the theoretical scope of the phenomena and its wider implications for a theory of meaning are still being delineated; our main goal in this paper is to contribute to this discussion.

In this paper, we shall model the clarification potential of a single utterance type: instructions in task-oriented interactive settings. The following exchange illustrates the interactions we target:

Ann(1): Turn it on.
Bill(2): By pushing the red button?
Ann(3): Yeah.
Adapted from (Rodŕguez and Schlangen, 2004, p. 102)

To spell this out a little, in order to carry out Ann's request (turning something on) it is necessary to push the red button. By uttering (1), Ann has conveyed (by exploiting contextual knowledge of the task domain) that Bill should carry out a "push the red button" action although she did not say this explicitly. Bill might have known what was required and pushed the red button without further ado − but, for some reason, he chose instead to check with Ann that this was the required action.

Roughly speaking, our inference framework takes as input sentences like (1) and explains how (2) can be generated: it indicates what kinds of knowledge need to be represented and what kinds of inferences are involved in the process of generating utterances like (2). That is, it explains why this example constitutes a coherent dialogue by saying how the clarification is *relevant* to the instruction. Our framework makes explicit the relations between the instruction, its clarification and the context of the conversation. We do so by linking clarification with a central notion from pragmatics, namely the Gricean notion of conversational implicature.

As we discuss in Section 2, conversational implicatures are *negotiable*. And dialogue provides an intrinsic mechanism for carrying out negotiations of meaning: clarification requests. We hypothesize that conversational implicatures are a rich source of clarification requests: clarification requests make explicit what is *tacitly* conveyed by implicatures. In Sections 3 and 4 we present a framework for calculating the clarification potential of an instruction by inferring its contextualized conversational implicatures: each instruction is rooted in its context through utterance level *micro-planning*. The core inference method we use for micro-planning is classical AI planning, though other forms of means-ends analysis (such as inferring the next relevant action by computing affordabilities) are also required. In Section 5 we empirically evaluate the predictions of our inference framework, and in Section 6 we discuss the picture our framework gives rise to: discourse structure emerges as an opportunistic response to task structure. Section 7 concludes.

2. Definitions and motivations

In this section, we motivate our framework from the *practical perspective* of dialogue system designers, from the *theoretical perspective* of pragmatics, and from the *empirical perspective* of a human−human corpus. We first review a method of identifying clarification requests proposed in the dialogue system literature. Our review makes clear the necessity of further refinement, and we sketch what is required. We then discuss motivations from the perspective of pragmatics; in particular, we introduce the central notions of conversational implicatures and their negotiability. We view conversational implicatures as key to defining the *clarification potential* of an utterance. Lastly, we empirically motivate our work by presenting a corpus of task-oriented conversations.

2.1. Practical: defining clarification requests

Giving a precise definition of a clarification request (CR) is a difficult task. For a start, one might think that CRs are realized as questions; however corpus studies indicate that the most frequent realization of CRs is the declarative form (see Purver, 2004 for discussion). Indeed, although the form (including intonation pattern) of a CR exhibits some correlations with the CR function (Rodŕguez and Schlangen, 2004), form is not generally a reliable indicator of the role the CR is playing.

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