Conditional Responses in Information-Seeking Dialogues

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Abstract

The paper deals with conditional responses of the form "Not if **c**/Yes if **c**" in reply to a question "?**q**" in the context of information-seeking dialogues. A conditional response is triggered if the obtainability of **q** depends on whether **c** holds: The response indicates a possible need to find alternative solutions, opening a negotiation in the dialogue. The paper discusses the conditions under which conditional responses are appropriate, and proposes a uniform approach to their generation and interpretation.

1 Introduction

The goal of this paper is to provide a basic account of *conditional yes/no responses* (CRs): We describe the conditions under which CRs are appropriate, and how these conditions translate into a uniform approach to understanding and producing CRs.[1]

We focus on information-seeking dialogues between a human user and a dialogue system in the travel domain. We allow for *mixed initiative* and *negotiation* to let a dialogue be more collaborative than "quizzing". In this context CRs arise naturally (1).

(1) U.1: Do I need a visa to enter the U.S.?
S.1: Not if you are an EU citizen.

(2) S.1': Yes, if you are not an EU citizen.

(1:S.1) is an example of a *negative CR*, asserting *If you're an EU citizen, then you do not need a visa to enter the U.S.* An alternative, *positive CR* is (2:S.1'), asserting *If you're not an EU citizen, then you do need a visa to enter the U.S.*.

In both cases, the system answers the question (1:U.1), but it makes the answer conditional on the value of a particular attribute (here, citizenship). Moreover, the CR suggests that, for another value, the answer may be different (2).

The CRs in (1:S.1) and (2:S.1') are elliptical utterances. Intuitively, they can be expanded to the complete propositions in (3) and (3′). The material for resolving the ellipsis comes from the immediately preceding context. In the approach we work with, ellipsis is resolved with respect to the current *question under discussion* (QUD, (Ginzburg, 1996)).

(3) No, you don't need a visa to enter the U.S. if you are an EU citizen.

(3′) Yes, you do need a visa to enter the U.S. if you are not an EU citizen.

The *dialogue move* of a CR depends on the context. Consider (4) and (5). Similarly to (1), in (4) the system does not know an attribute-value (A/V) on which the positive or the negative answer to the yes/no question is contingent (here, whether the user wants a business or economy class flight).[2]

(4) U.1: A flight from Köln to Paris on Sunday.
S.1: I'm sorry, there are no flights from Köln to Paris on Sunday.
U.2: Can I fly on Monday?
S.2: Not if you want business class.
S.2′: Yes, if you want economy class.

(5) U.1: I want a business class flight from Köln to Paris on Sunday.
S.1: I'm sorry, there are no business flights from Köln to Paris on Sunday.
U.2: Can I fly on Monday?
S.2: Not if you want business class.
S.2′: Yes, if you want economy class.

The system's CR (4:S.2) is a request for further information: whether the user wants a business flight (Monday is out), or does not (she is able to fly on Monday). Likewise, (4:S.2′) is a request for further information whether the user wants an economy flight (Monday is available), or not (Monday is out).

Dialogue (5) is different. Now the user indicates that she is interested in a business class flight

[1] This work was done in SIRIDUS (Specification, Interaction and Reconfiguration in Dialogue Understanding Systems), EC Project IST-1999-10516. We would like to thank Geert-Jan Kruijff for detailed discussion and comments .

[2] We realize that intonation might play a role. However, given space restrictions we cannot address this issue here.

(5:U.1). The system by default assumes that this remains unchanged for another day of travel.

What both the negative and positive CR in (5) do is to start a negotiation to either confirm or revise the user's decision for business class. The system's response (5:S.2) or (5:S.2′) indirectly proposes a change (to economy class) to achieve the higher-level goal of finding a flight from Köln to Paris on Monday. If the user insists on business class, this goal cannot be achieved.

If we want a dialogue system to understand and appropriately produce CRs, we need to describe their semantics in terms of the contextual conditions and communicative goals under which these responses occur, and the effects they have on the dialogue context. We aim at providing the basis of an account that can be implementated in the GoDiS dialogue system. GoDis is an experimental system in the travel domain, using the information-state approach to dialogue developed the TRINDI and SIRIDUS projects (Cooper et al., 1999; Lewin et al., 2000). We focus on aspects that can improve its flexibility and functionality.

Overview. In §2 we discuss the uses of positive and negative CRs in terms of their appropriateness conditions and their interpretation. In §3 we discuss dialogue moves. We end the paper with conclusions.

2 Uses of conditional responses

In this section we present two different types of CRs and discuss in what contexts they are appropriate.

CRs can be used as answers to yes/no-questions.[3] A CR does not provide a yes/no answer simpliciter, though: It provides an answer that is *contingent* on the value of some attribute. Consider (1). The system's reply (1:S.1) provides an answer that is contingent on the value of the *citizenship* attribute. If the value is (or implies) EU citizenship, the answer is *negative*: If the user is an EU citizen, she does not need a visa to enter the U.S.

The CR in (1) also seems to suggest the contrapositive that if the value is "non-EU-citizen", the answer is positive. (2) illustrates the opposite case. We consider this additional suggestion an *implicature*. The assertions and implicatures that arise from CRs are summarized in Figure 1.

Green & Carberry (1999) characterize CRs in terms of the speaker's motivation to provide information "about conditions that could affect the veracity of the response". However, they only consider cases like (4) in which the A/V on which the CR is contingent has not yet been determined in the preceding context (or cannot be assumed). Cases like (5) where the A/V has been determined are left unnoticed.[4] We discuss each of the cases below.

Not-determined A/V. The A/V on which a CR is contingent can be one that has not yet been determined in the preceding context, as in (1) and (4). We call this type of CR a *non-determined A/V CR* (NDCR). Besides the assertion and the implicature that answer the yes/no question as specified in Figure 1, the NDCR amounts to indirectly giving rise to the question "whether **c** holds".

Consider the user's utterances in (6) as continuations of (1). They show that the implicitly raised question cannot be answered just by "yes" or "no". Rather, it requires some content that matches with **c**.

(6) U.2: Yes. | No.
U.2′: Yes, I am. | No, I am not.
U.2″: Yes, I have German citizenship. |
No, I have Czech citizenship.

The responses in (6:U.2) could be interpreted as acknowledgments, but certainly not as answers to whether the user is an EU citizen. This is corroborated by the following continuation of (6:U2') where the system does answer the pending question.

(7) S.2: Then you do (not).
S.2′: Then you do (not) need a visa.

(7:S.2) is elliptical for (7:S.2′). Correct resolution of the ellipsis is possible only if the question whether the user needs a visa is the topmost QUD.

The need to answer the implicitly raised question depends on what goals the participants try to achieve. "Do I need a visa?" in (1) is satisfactorily answered with either a yes or a no, or when enough information is provided so the asker can find out the answer herself. On the other hand, consider (8).

(8) U.1 Can I fly to Paris tomorrow?
S.1 Not if you want to fly economy class.

[3] Corpora show also occurrences of CRs in response to statements, cf. (Karagjosova and Kruijff-Korbayová, 2002).

[4] Both cases are attested in corpora (Karagjosova and Kruijff-Korbayová, 2002).

Y/N-Question	?**q**	?**q**
Response	Not if **c**	Yes if **c**
Assertion	If **c**, not-**q**	If **c**, then **q**
Implicature	Possibly, if not-**c**, then **q**	Possibly, if not-**c**, then not-**q**

Figure 1: Patterns of conditional responses

In (8) the response is contingent on whether the user wants to fly economy class. Before flight selection can proceed further, the question whether **c** holds must be answered. In order to satisfy its goal of finding a flight which satisfies the user requirements, the system does need to know whether **c** holds to find out whether **q** holds. This is a difference between (8) and (1). In (1), the system's goal is merely to answer the user's question.

To summarize, the interpretation of a CR in response to a question whether **q** in a context where **c** has not been established is that (i) it is still not determined whether **q**, because (ii) the answer (specified in Figure 1) is contingent on **c**, and thus (iii) the question whether **c** holds is implicitly raised.

As for production, it is appropriate for the system to produce a NDCR when (i) answering a yes/no-question whether **q**, where (ii) the answer is either **q** or **not-q**, depending on some additional A/V **c** which has not yet been established in the context. We conjecture that whether a positive or a negative CR is more cooperative in a particular context depends on what the preferred answer to the question "whether **q**" is assumed to be.

Contextually-determined A/V. Another context in which a CR is appropriate is when an answer to a yes/no-question is contingent on an A/V that has already been established in the preceding context, as in (5). We call this type of CR a *contextually-determined A/V CR* (CDCR).

What does a CDCR communicate besides the assertion and implicature that answer the question as specified in Figure 1? We suggested in §1 that it initiates a negotiation about the already established A/V. However, this cannot happen by simply raising the question whether **c** holds, because **c** *has* already been established. We suggest that a CDCR implicitly proposes to consider *changing* the A/V: It *re-raises* the question whether **c** holds. Re-raising **c** differs from raising a "new" question at least in two aspects: **c** must be *negotiable*, and re-raising **c** means it cannot be answered simply by providing a sufficiently discriminative positive or negative response. To see the difference, consider (5) with (5:S.2) continued by the following utterances.

(9) U.3: Yes. | No.
U.3′: Yes, I do. | No, I don't.
U.3″: Yes, I want business class. |
No, I don't want business class.

(10) U.3: OK, I can fly economy.
U.3′: But I do want business class.

(11) U.3: How about Tuesday?

Like the responses in (6), the response in (9:U.3) cannot be interpreted as answers to whether the user wants to change her mind from business to economy class. It seems hard to interpret even as acknowledgment. But then we observe a number of differences from the NDCR in (6):

The responses in (9:U.3′) and (9:U.3″) are not appropriate as answers to the implicitly re-raised **c**, because a revision of an A/V is involved. Hence, some kind of acknowledgment of the revision is needed in addition to answering whether or not the A/V is to be revised (and how). Such acknowledgments are present in (10). In (10:U.3), 'OK' can be seen as acknowledging the revision from business to economy class. In (10:U.3′), 'but' acknowledges the contrast between the proposed revision and the actual preservation of the A/V (here, business class). The continuation in (11), on the other hand, refuses the proposed revision only implicitly by proposing instead to check the flight possibilities on another day.

Another observation concerning a CDCR is that it cannot immediately follow after an utterance in which the value is established, as the inappropriateness of (12:S.1) and (12:S.1′) shows.

(12) U.1: Can I fly business class from Köln to Paris on Sunday?
S.1: Not if you want business class.
S.1′: Yes if you want economy class.

Intuitively, the reason for this is that there needs to be some degree of uncertainty (in the sense of being assumed but not known to be shared) about the A/V. For example, in (5), the business class requirement is assumed to be maintained when the day is revised. The inappropriateness of (12:S.1) and (12:S.1′) can also be explained on purely semantic grounds. When both the assertion and the implicature as specified in Figure 1 are taken into account, a contradiction arises: Given that the elliptical answer is resolved to the previous utterance, (12:S.1) asserts *If user wants business class, then a business flight from SB to Paris on Sunday is not available*, and implicates *If user does not want business class, then a business flight from SB to Paris on Sunday is available*. Similarly for (12:S.1′).

Thus, the interpretation of a CDCR is that (i) it is now determined whether **q** or **not-q** holds, because (ii) the answer (specified in Figure 1) is contingent on **c** and **c** is established. Also, (iii) the CDCR indicates the reason for the answer, and (iv) proposes to reconsider the earlier made decision by implicitly re-raising the question whether **c** holds, and (v) making a suggestion for it to be revised. A negotiation is started in which the conflicting A/V is either revised or confirmed. In the latter case a different solution to the overall goal must be sought.

As for production, the system may produce a CDCR when (i) answering a yes/no-question whether **q**, where (ii) the answer is either **q** or **not-q**, depending on some A/V **c** which has been established in the context prior to the question whether **q**. Again, what polarity of CR is more cooperative in a particular context depends on what the preferred answer to the question whether **q** is assumed to be.

3 Conditional response dialogue moves

According to the dialogue annotation scheme of (Allen and Core, 1997), utterances in which "the participant does not address the proposal but performs an act that leaves the decision open pending further discussion" are called *hold* moves. The dialogue moves of a NDCR seem similar to *hold* in that the answer to **q** remains pending due to its contingency on an unknown A/V **c**. Once **c** is determined, **q** is answered. Hence, we propose to characterize a NDCR as a dialogue move combining the backward-looking function of a partial yes/no-answer and *hold*, and the forward-looking function of a yes/no question whether the condition holds. A CDCR is different in that it proposes to reconsider a contexually-determined **c**. Allen & Core provide no suitable characterization of this. We propose to characterize a CDCR as a dialogue move that combines the backward-looking function of a yes/no-answer with the forward-looking function of an alternative question whether **c** is preserved or revised.

4 Conclusions

We proposed an approach to dealing with *conditional responses* (CRs), which arise naturally in dialogues allowing for mixed initiative and negotiation. We proposed two types of CRs. One type describes the case where the answer is contingent on an attribute/value that has not yet been determined in the context (NDCRs). The other type deals with an attribute/value that has already been set in the context, and which now needs to reconsidered (CDCRs). The distinction properly clarifies the different effects on dialogue context CRs may have. We are currently developing an implementation of CRs in the GoDiS system (Kruijff-Korbayová et al., 2002).

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