

B Dialogue Example: Simulating a Question and Answer Dialogue

This scenario is centred on a set of verbal understanding tasks that we have used in task-oriented human-robot interaction studies (Li and Ross, 2023) to induce and monitor confusion states in users by answering mathss questions in an oral manner. In the following scenario, productive confusion is labelled “State A1”, unproductive confusion is labelled “State A2”, while “State B” refers to non-confusion state. The task-oriented dialogue scenario is as follows.

SYSTEM: I will ask you an interesting word problem. If you do not know the answer, please ask me to repeat it again, or you can give up answering anytime.

USER: okay.

SYSTEM: Jessica plans to make 6 litres of blackberry soda and 2 litres of lemon-lime soda for the class party. She also plans to make 18 batches of biscuits and 50 chocolate bars. She will buy 40 bags of crisps and 60 bags of candy. Due to her budget issue, she can only buy 10 batches of biscuits and make 2 more litres of blueberry soda. One litre of soda will serve 5.5 students at the party. The question is how many students can Jessica serve her soda to?

...: <The system observes user entering confused state (A1).>

SYSTEM: Hey my friend, do you need me to repeat this question?

USER: yes, please.

SYSTEM: <The system repeats the question.>

USER: Sorry, I don't know the answer.

...: <System observes continued confused state (A1)>

SYSTEM: <The system repeats the question slowly.>

USER: Sorry, I still don't know the answer.

...: <The user does not respect. System detects user's confusion state (A2)>

SYSTEM: I am sorry, maybe this question is too difficult, do you need my help to answer it?

USER: Yes, please.

...: <The user wants to solve this problem, and the system detects user's confusion state (A1)>

SYSTEM: <The system restates this word problem again with the extra information supplied step by step, slowly and briefly.>

First, Jessica plans to make 6 litres of blackberry soda and 2 litres of lemon-lime soda for the class party. Second, she also plans to make 2 more litres of blueberry soda. One litre of soda will serve 5.5 students at the party. The question is how many students can Jessica serve her soda to?

USER: The answer is 55.

SYSTEM: Yes, you are correct.

...: <The system observers user enters a non-confusion state (B)>

In this dialogue scenario, the first turn in the dialogue involves the agent posing a verbal problem to the user. The specific nature of the task here is not relevant – rather, it is part of some embodied task-oriented interaction. In the second turn, the user acknowledges the problem given, and thereafter the system continues to monitor the user's state. After a period, the system determines that the user is displaying indications of having entered productive confusion State A1. The system then restates the task to the user. Following a period, the system observes that the user remains in a confused state (A1), at which time the agent attempts to provide more help to answer the question.

However, the system first observing that the user has entered state A2, at which time the agent asks the user whether need help to continually answer the question, and the agent affirms that this question is difficult. Following the time that the system observes, the user re-enters in a confused state (A1). In the next step, with the help of the system, the user solves this problem with the correct feedback from the system. Finally, the user enters the non-confusion state (B). Such a policy is equivalent to providing more information or changing a topic and moving the conversation on, but may, of course, not always be appropriate depending on the specific nature of the task.

Moreover, a detailed step through of the associated updated information state policy with dialogue acts as follows.

1. <ask_question_to_usr>

Information state:

[Agent/BEL: {NULL}]
 [Agent/DES: {nonconfusion(usr)}]
 [Agent/AGENDA: <notify confusion(usr)>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A1}]
 [Public/LU: {Speaker: agent;
 Move: {answer(wordproblem(usr))}}]
Dialogue Act: {notify confusion(usr)}

2. <ask_question_to_usr_A1>

Information state 2.1:

[Agent/BEL: {State A1(usr), tohelp(agent)}]
 [Agent/DES: {nonconfusion(usr), tohelp(agent)}]
 [Agent/AGENDA:
 <restate(wordproblem(agent))>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A1}]
 [Public/LU:
 {Speaker: usr; Move: {confirm(help)}}]
Dialogue Act 2.1: {confirmation(usr)}

Information state 2.2:

[Agent/BEL: {State A1(usr), tohelp(agent)}]
 [Agent/DES: {nonconfusion(usr), tohelp(agent)}]
 [Agent/AGENDA:
 <inforExten(wordproblem(agent))>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A1}]
 [Public/LU: {Speaker: agent;
 Move: {restate(wordproblem(agent))}}]
Dialogue Act 2.2: {restatement(agent)}

3. <ask_question_to_usr_insufficient>

Information state:

[Agent/BEL: {State A1(usr), tohelp(agent)}]
 [Agent/DES: {nonconfusion(usr), tohelp(agent)}]
 [Agent/AGENDA:
 <inforSply(wordproblem(agent))>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A1}]
 [Public/LU: {Speaker: usr;
 Move: {inforExten(wordproblem(agent))}}]
Dialogue Act: {information extension(agent)}

4. <ask_question_to_usr_complex>

Information state:

[Agent/BEL: {State A1(usr), tohelp(agent)}]
 [Agent/DES: {nonconfusion(usr), tohelp(agent)}]
 [Agent/AGENDA:
 <confirm(answer(wordproblem)),

affirm(wordproblem(agent))>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A1}]
 [Public/LU: {Speaker: agent; Move: {inforSply(wordproblem(agent))}}]
Dialogue Act: {information supplement(agent)}

5. <ask_question_to_usr_complex_2>

Information state:

[Agent/BEL: {State A2(usr), tohelp(agent)}]
 [Agent/DES: {nonconfusion(usr), tohelp(agent)}]
 [Agent/AGENDA: <downdate(wordproblem)>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A2}]
 [Public/LU: {Speaker: usr;
 Move: {confirm(answer(wordproblem)),
 affirm(wordproblem(agent))}}]
Dialogue Act: {feedbackrequest(usr),
 affirm(agent)}

6. <ask_question_to_usr_state A2>

Information state:

[Agent/BEL: {State A2(usr), tohelp(agent)}]
 [Agent/DES: {nonconfusion(usr), tohelp(agent)}]
 [Agent/AGENDA:
 <notify confusion(usr), ack(answer(usr))>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State A2}]
 [Public/LU: {Speaker: agent; Move: {down-
 date(wordproblem)}}]
Dialogue Act: {notify confusion(usr)}

7. <ask_question_to_usr_state B>

Information state:

[Agent/BEL: {State B(usr)}]
 [Agent/DES: {nonconfusion(usr)}]
 [Agent/AGENDA: <NULL>]
 [Public/QUD: <?a.wordproblem(agent)>]
 [Public/COM: {State B}]
 [Public/LU:
 {Speaker: usr; Move: {ack(answer(usr))}}]
Dialogue Act: {notify confusion(usr)}

Li and Ross (2023): Na Li and Robert Ross. 2023. Hmm, you seem confused! tracking interlocutor confusion for situated task-oriented hri. In Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction, HRI '23, page 142–151, New York, NY, USA. Association for Computing Machinery.