The Benefit of Structured Interfaces in Collaborative Communication

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Abstract

One way to help to infer intent in collaborative tasks is to impose structure on communication through the use of restricted interfaces. Structured interfaces allow work in areas of interest to this symposium such as intelligent agents that interact with users, task analysis at a team level, and managing dialog. This paper describes structured interfaces that allowed intelligent agents to interact with users in a simple communication task with minimal disadvantage as compared to unrestricted chat conditions.

Introduction

Intent inference can be a difficult problem. One way to help to infer intent in collaborative tasks is to impose structure on communication through the use of restricted interfaces. But wouldn't structured communication be detrimental to the collaborative task? With increasing computer processing power, shouldn't computer-supported collaboration be as high-bandwidth as possible (real-time audio/video)? Perhaps not. Some research has shown that restricting communication from audio/visual to text can actually be beneficial to the collaborative process (Kvan, Yip, & Vera, 1999; Olson, Solson, & Meader, 1997). Furthermore, there is some evidence that restricting text communication to speech-act related patterns may be beneficial to the collaborative task (Baker & Lund, 1996; Robertson, Good, & Pain,1998). In addition, structured interfaces allow work in the specific areas of interest of this symposium, namely intelligent agents that interact with users (Rich, Sidner, & Lesh, 2001; Matessa, 2000), task analysis at a team level (Soller, 2001), representing collaborative tasks with Hidden Markov Models (Soller & Lesgold, 2000), and tracking progress and managing dialog (McManus & Aiken, 1995).

This paper describes the structured interfaces found in Matessa (2000) that allowed intelligent agents to interact with users in a simple communication task. The task involved constructing graphs made up of colored objects connected by lines. Pairs of subjects were given parts of a whole graph and were allowed to communicate through a chat window to give information about their parts and get information from their partners' parts. A pilot study first investigated the effect of a restricted interface on human performance. In the main experiment, some subjects were paired with an intelligent agent that used the restricted interface to facilitate the inference of subject intent. Other subjects were paired with humans using either the restricted or unrestricted interface to test the effect of the restricted interface on human performance.

Pilot Study

Twenty-four subjects participated in the pilot study – six pairs in a restricted interface condition and six pairs in an unrestricted interface condition. Figure 1 shows the restricted interface used in the pilot study. Subjects were given topics of discussion (paired connections between objects, number of objects, etc.) and buttons under each topic allowed actions to be taken (make statement, ask question, etc.). Templates were then presented with pull-down menus for word choices so that messages such as "My leftmost red circle is above my rightmost green circle" could be created and sent to the partner. Unrestricted communication consisted of a simple chat window.

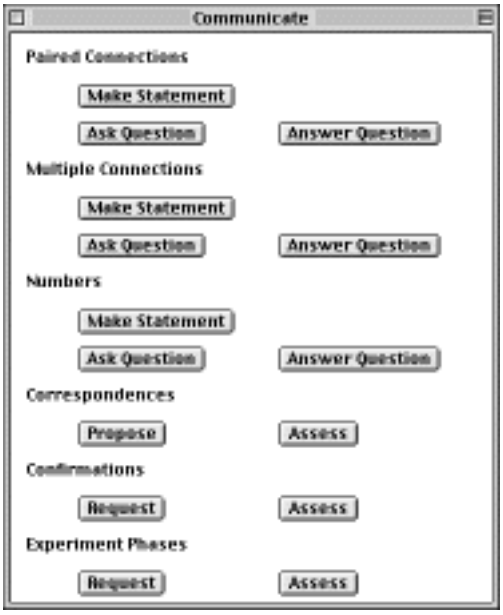

Figure 1: Restricted interface for pilot study.

Results

Table 1 shows overall measures of performance in the pilot study. Performance was similar for both unrestricted and restricted conditions on measures of turns to solve the problem, time to solve the problem, and final problem score.

	Unrestricted		Restricted	
	mean	[min,max]	mean	[min,max]
turns	21.5	[11,28]	24.7	[12,33]
time	22.3	[15,34]	28.3	[15,33]
score	90.0	[60,100]	98.3	[90,100]

Table 1: Overall measures of performance

Table 2 compares the conceptual content of messages sent with the restricted and unrestricted interface. Pluses indicate that the restricted interface supported discussion of particular content. One difference is that subjects took advantage of the concept of "blank" spaces in rows or columns that was supported by the restricted interface but that was not used as much in the unrestricted interface. Another difference is that subjects talked about being done with particular phases of the experiment ("I'm done with my circles") but this concept was not supported in the restricted interface.

	Restricted Interface	Restricted Pairs (n=6)	Unrestrictd Pairs (n=6)
Paired Connections			
statement	+	83%	100%
question	+	67%	100%
Multiple Connections			
statement	+	100%	100%
question	+	50%	67%
row	+	100%	100%
column	+	33%	17%
blank	+	100%	33%
Numbers			
total	+	50%	50%
colors	+	67%	33%
row	+	50%	33%
column	+	33%	17%
in row	-	0	17%
in column	-	0	17%
Confirmations			
explicit	+	100%	100%
sequence plan	-	0	50%
Experiment Phases			
more info?	-	0	17%
done info	-	0	67%
end experiment	+	100%	100%

Table 2: Conceptual content

Main Experiment

Seventy-six subjects participated in the main experiment -- eleven pairs in the unrestricted interface condition, sixteen pairs in the restricted interface condition, and twenty-two subjects in the intelligent agent condition. Fewer objects per problem were used than the pilot experiment so that more problems could be solved. Figure 2 shows the restricted interface used in the experiment. Subjects were given topics of discussion and sample sentences representing speech act types. After choosing a particular sentence, a template appeared with menu options for legal words. Words not on the menu were unable to be typed. Unrestricted communication consisted of a simple chat window.

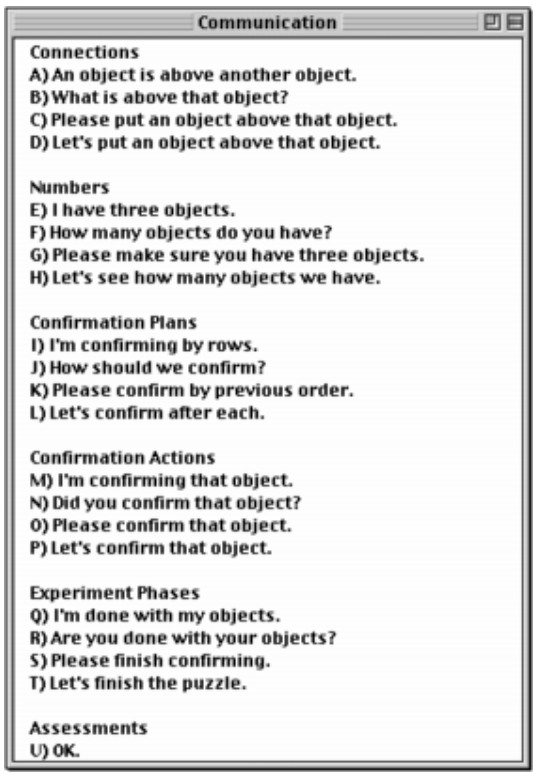

Figure 2: Restricted interface for main experiment

Results

Since the problems in the experiment contained fewer objects than in the pilot study, pairs had time to solve up o twelve problems. Figure 3 shows the time to solve problems, grouping problems into triplets. Subjects using the restricted interface initially took longer to solve problems compared to subjects using the unrestricted interface, but this difference disappeared after a few problems. The pilot study did not show this initial difference in the time to solve the problem, and this may be

due to the greater number of objects in the pilot study. Subjects in the pilot study may have become accustomed to the restricted interface in the greater amount of time needed to solve the problem with the greater number of objects compared to the main experiment. In the main experiment there was no difference in problem errors between the two interfaces. The restricted interface allowed intelligent agents to understand the intent of their partners and to solve the problems in much the same way as human partners. Results for subjects interacting with agents and subjects interacting with humans were similar for time to solve problems and errors in problems. In addition, roughly half of the subjects interacting with intelligent agents thought they were working with human subjects (there is still room for improvement, however, since only 10% of subjects interacting with human partners thought their partners were computers)

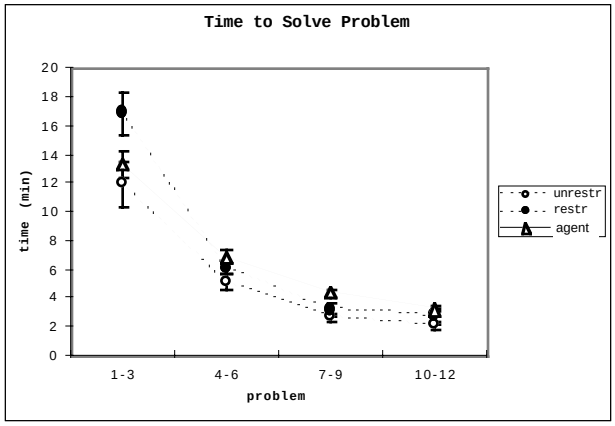

Figure 3: Time to solve problems

Conclusions

The structured interfaces shown in this paper allowed intelligent agents to interact with human subjects in a simple communication task with minimal disadvantage as compared to unrestricted chat conditions. Until the problem of intent recognition in unrestricted communication is solved, structured interfaces may be a way of including computer automation in more collaborative communication projects in the future.

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