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Collaboration in Peer Learning Dialogues

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Abstract

Our project seeks to enhance understanding of collaboration in peer learning dialogues, to develop computational models of peer collaborations, and to create an artificial agent, KSC-PaL, that can collaborate with a human peer via natural language dialogue. We present some initial results from our analysis of this type of dialogues.

1 Introduction

Peer tutoring and collaboration strongly promote learning (Cohen et al., 1982; Rekrut, 1992; van Boxtel et al., 2000); however, there are no models of collaboration in dialogue that can fully explain why collaboration between peers engenders learning for all the peers involved more than other learning situations, even when one peer is more "expert" than the other. There is general consensus that working together encourages students to generate new ideas that would probably not occur to them if working alone; mechanisms that support such exchanges include co-construction (Hausmann et al., 2004) and knowledge sharing (Soller, 2004). We will refer to all these mechanisms as KSC, or "Knowledge Sharing and Construction". To contribute to an increased understanding of peer learning, we have started to apply our *balance-propose-dispose* model of negotiation (Di Eugenio et al., 2000) to this type of learning dialogues. In that model, partners first balance their knowledge distributions, then propose a possible next step and lastly decide to commit to a proposal or postpone it in order to further balance the knowledge needed for problem solving. We expect this model will be affected by (a) the knowledge distribution, (b) a collaborator's estimates of what types of knowledge the partner has, (c) decisions on what knowledge to share and (d) the detection of proposals and of problem solving or collaboration impasses. The initial model was based on the Coconut dialogues, collected in a setting where the task was simple (furnishing a two room apartment) and knowledge was equally distributed. Our new domain is the fundamentals of data structures and algorithms in Computer Science, and the task is finding conceptual mistakes in simple code. Not only is knowledge much more complex, but it is of different kinds – e.g., one collaborator may know (more) about null pointers and the other about loops.

In this poster, we briefly outline some preliminary results from our data collection.

2 Collaborating on Data Structures Tasks

We have developed a set of data structures tasks for peers to solve and pre/post tests to measure whether the interaction is beneficial (a beneficial collaboration is one in which at least one student learns); we pilot tested both in a face to face setting; we then proceeded to collect data in a computer mediated environment. The specific task is debugging or explaining easy routines for fundamental data structures such as linked lists, stacks and binary search trees. We are interested in *conceptual*, not *syntactic* mistakes, and we inform our subjects of this.

We have chosen a computer mediated environment to more closely mimic the situation a student will have to face when interacting with KSC-Pal, the artificial peer agent we intend to develop based on our *balance-propose-dispose* model and our empirical findings. In addition, in (Di Eugenio et

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14:01:56 C:  unless the "first" is just a dummy node
14:02:20 D:  i don't think so because it isn't depicted
             as a node in the diagram
14:02:28 C:  OK
14:03:13 C:  so you would draw something like...
14:03:24 D:  i believe it will make the list go like this:
             bat, ant, cat
14:03:40 C:  draw: add pointer second (n100)
14:03:44 C:  draw: move n100
14:03:46 C:  draw: link n100 to
14:03:47 C:  draw: link n100 to n002
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Figure 1: An excerpt from one of our dialogues

al., 2000), we had shown that such a setting affects the length of turns and turn taking, but does not change the nature of collaboration. Our computer-mediated environment supports typed natural language dialogue, task-specific drawing tools and menu-based code mark-up. These features were based in part on observations on the face to face interactions: the peers frequently drew data structures and deictically referred to the code they were diagnosing or explaining. In addition they collaboratively marked up the code under discussion.

We have collected dialogues using the computer mediated interface for 12 pairs thus far. Each dyad was presented with 5 exercises and all but two solved all 5 exercises. Figure 1 shows a short excerpt from one dialogue. Note that it includes drawing actions in addition to verbal exchanges.

These dialogues differ from the face-to-face dialogues collected in the pilot study in that the dyads appear to be more focused when using the computer-mediated environment. There is only a small amount of off-topic chat compared with the face-to-face dialogues. Also, there is less hedging and hesitation in making problem-solving suggestions. The drawing appeared to be more purposeful as well, although this could be the result of the constraints of the drawing tool instead of the environment itself. Interestingly for our *balance-propose-dispose* model, proposals can be conveyed by drawing, as in Figure 1. C. announces he will propose a solution at 14:03:13, and then proceeds to draw it starting at 14:03:40. We have observed at least 5 instances in which a problem solving proposal was made by drawing in our dialogues. In addition, the drawing tool wasn't consistently used by the dyads. We have analyzed in more detail 18 of the debugging dialogues, i.e., 9 dyads each solving exercise 3 on linked lists and 4 on stacks. 7 dyads (78%) drew something for problem 3, but only 4 dyads (44%) did for problem 4; two of the four dyads use the tool just once to place a single object on the screen. This could be related to the nature of the problem since exercise 3 involved linked-lists which are generally believed to be more confusing than stacks.

Another interesting observation was that 8 of the 18 dialogues do not appear to follow a recursive, stack-based dialogue structure (Rosé et al., 1995). In these 8 dialogues, the dyads separately identify the errors in the programs and then return later to discuss and correct them. However, the topics were not revisited according to recency of mention but by the order in which problems were identified. Additionally, the dyads occasionally revisit errors, not to reopen the discussion, but rather to reaffirm corrections that have already been made. Not only does this not follow the recursive, stack-based dialogue structure, it also creates difficulties in identifying the point of disposition.

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