How natural is natural language for Intelligent Tutoring Systems?

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Introduction

Recently, intelligent tutoring system designers have been adding multimedia to their systems (Cognition and Technology Group at Vanderbilt, 1996; Soloway & Pryor, 1996). In particular, natural language is being used more in intelligent tutoring systems and intelligent learning environments for both input (student talking) and output (tutor explaining). In past comparisons of human tutors and intelligent tutoring systems, it has been suggested that natural language is particularly good at tutorial explanations (e.g., Moore, 1996). However, most systems use natural language for both input and output, but the learning effects of using natural language have not been evaluated. How much should natural language be used in intelligent tutoring systems? A simple pilot study was designed to examine this issue.

Method

We manipulated whether subjects could use (typed in) natural language, direct manipulation, or a combination of natural language and direct manipulation for system input to a cartographic system called InterLACE.

InterLACE is a fully pannable, zoomable, mouse-sensitive graphical map display of southern Germany which has been interfaced to our natural language processor NAUTILUS to provide natural language capability. A simulated tank unit also responds to verbal route instructions and mouse drags. In this experiment, subjects who used natural language to issue commands and queries typed sentences or parts of sentences into an input window. Everything that could be done in one input-modality (i.e., natural language) could also be done in the other (i.e., direct manipulation). A more detailed description of InterLACE can be found in Wauchope (1996).

Users were presented with instructions like "Go to the intersection nearest town Fulda" or "Name the two roads that cross intersection 322." At the end of the session, subjects were asked to draw as much of the map as they could recall. Time on task and score on map-drawing task was recorded.

Subjects were 24 volunteers from NRL.

Results and Discussion

As Table 1 suggests, subjects who used only natural language drew the least accurate maps, while subjects who used direct manipulation drew the best maps, $F(2, 21) = 3.5$, $MS_e = 84$, $p < .05$, tukey post-hoc, $p < .05$.

A "time on task" explanation does not account for the superiority of using direct manipulation, since subjects in all conditions spent approximately the same amount of time

Condition	Time on Task	Score on Posttest
NL	36.6	6
GUI	36.8	12
Combined	39.6	18

Table 1: Time on task (minutes) and score on posttest. The higher the score on the posttest, the better.

$F(2, 21) = 0.7$, $MS_e = 3609$, $n.s.$, suggesting that subjects who used direct manipulation processed the map "deeper" than subjects in the natural language condition.

Since one of the theoretical advantages of direct manipulation is becoming more "engaged" in the system (e.g., Shneiderman, 1992), users may learn more when using direct manipulation. Clearly, natural language can be useful for many intelligent tutoring systems, but to use natural language for everything within an ITS may result in less productive learning rather than more.

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