Tutoring Real-Time Dynamic Task Performance: Using ADAPT to Augment Pilot Skill Acquisition

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Background

This research examines the role of comprehension-based cognitive processes in the acquisition of skills in real-time dynamic task environments. A theoretically-based model of pilot instrument flight (ADAPT) is used as the student model component (VanLehn, 1988) of an intelligent tool for training real-time complex task performance. ADAPT is a computational model of action-planning with an architecture based upon Kintsch's (1994; 1998) construction-integration theory of comprehension. ADAPT's learning mechanisms are used to model instrument flight skill acquisition (Doane, Sohn, McNamara, & Adams, 2000) and to select instructions intended to optimize pilot performance.

In previous research, rigorous tests of ADAPT's predictive validity compared performance of individual pilots to that of their respective models (Doane & Sohn, 2000; Doane, 2001; Sohn & Doane, 2002). Individual pilots were asked to execute a series of flight maneuvers using a flight simulator, and their eye fixations and control movements were recorded in a time-synched database. Models of the 25 individual pilots were constructed and used to simulate pilot execution of the same flight maneuvers. The time-synched eye fixations and control movements of individual pilots and their respective models were compared. The results suggest that the model explains and predicts a significant portion of pilot visual attention and control movements during flight as a function of piloting expertise.

Current Research

Current research is focused on incorporating ADAPT into a prototype training system that can identify training opportunities. In the training system, human pilots accomplish flight maneuvers using a graphical flight simulator. Their eye movements are tracked by an ASL oculometer and their control movements and flight performance are recorded by flight simulator software. The flight simulator and oculometer data are time-synched, passed to the ADAPT model for analysis, and then ADAPT selects instructions that optimize pilot comprehension of their current task environment.

Of particular interest for cognitive science is how ADAPT uses performance data to make inferences about individual pilot knowledge, skill, and focus of attention, and the ability of the model to run simulations in real-time to predict future pilot actions and to select instructions that optimize future performance. Instructions will be delivered to pilots via agents that use verbal (e.g., voice instructions via earphones) as well as nonverbal forms of communication. The major challenge will be to accomplish this goal without disrupting pilot performance. We will measure subject response to instruction and the time course of their learning and relate these back to the a priori individual differences in pilot performance

This research will make a theoretical contribution to our understanding of the role of comprehension-based cognitive processes in real-time complex and dynamic task performance. It will also make practical contributions to training technologies that can be used to augment the acquisition of complex task performance skills.

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