Statement of Research Interests

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Over the past few years, I have been studying the cognitive processes associated with diagram construction for problem-solving. My goals in this work have been to understand (a) the mechanisms underlying acquisition of diagram construction skills in the context of problem-solving and (b) how diagram construction contributes to forming a mental representation of a problem.

Previous work (Anzai & Katz, 1989; Katz & Anzai, 1990) focused on how students learn diagram construction in a well-defined problem solving domain: elementary physics. Longitudinal analysis of subjects' verbal and diagram-drawing protocols uncovered distinct changes in the diagram construction methods employed and the role played by the diagram in problem solving. The basic result from this work is a description of how two initially independent processes, constructing diagrams and making inferences (from the diagram and relevant equations), combine to form more efficient problem-solving strategies. As subjects learn to represent relevant information succinctly in a physics diagram, these diagrams begin to highlight those problem solving steps (i.e., calculations) that are likely to lead to a solution. When an analogous problem is encountered later, subjects use their knowledge of the calculations likely to be involved in the new problem to structure their diagram specifically to aid with these calculations.

With simple physics problems, diagram construction is largely a reactive process: a more complete understanding of the calculations required for solution leads subjects to represent more directly in their diagrams the information needed for those calculations. With ill-structured problems, such as those encountered in architecture, diagram construction plays a pro-active role as a problem-solving heuristic for organizing a person's knowledge of complex problems.

Before beginning a detailed drawing, architects often employ analysis techniques in which relatively simple diagrams are constructed to explore certain aspects (e.g., spatial and functional constraints) of an incomplete design specification. Recent pilot work (Katz, 1991; Katz & Martinez, 1991) has begun to address how architects construct diagrams to (a) uncover implicit constraints in design specifications, (b) identify competing constraints and decide among them, and (c) propagate constraint decisions to update their understanding of the design problem. Preliminary analyses suggest that some of the complexity in diagram construction processes occurs because a person's interpretation of a diagram is not static, but may change as new information is discovered in the course of problem-solving.

References

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