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Where Do Problem-Solving Strategies Come From?

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Research has shown that people often generate problem-solving strategies in a new domain by processing example solutions. However, this approach presumes the existence of some related strategies for processing examples in that new domain. The question then becomes: Where do *those* strategies come from? An important aspect of processing examples is knowing which features of the example problems are structurally significant and which features are superficial. Indeed, much research on expert-novice differences highlights experts' great advantage in properly representing and categorizing problems in terms of deep features (e.g., see Chi, Glaser, & Farr, 1988). But how can problem solvers new to a domain achieve this skill? In many domains, solvers have preconceptions of which features are significant and which are superficial. When these preconceptions are on target, i.e., the presumed-significant features are indeed relevant to the solutions and the presumed-superficial features are irrelevant, then learning by example can proceed effectively and efficiently. However, when solvers' preconceptions do not match reality for a given domain — either because their preconceptions mis-map features to the significant-superficial distinction or because their preconceptions are too weak to enable encoding of the relevant features — then learning is impeded.

Background Research

In previous work, Lovett and Schunn (1999) demonstrated that the same task with different superficial features could lead participants to generate very different strategies and, depending on their individual strategies, achieve very different learning gains. Specifically, in one version of the task, participants tended to encode their choices in terms of a single feature — whether each choice had the same color as the preceding stimulus — whereas in the other version of the task, participants were not biased to any particular feature. The experiment was then designed so both task versions would be best solved using a common, structurally important feature, and this was *not* the same-color feature salient in version 1. As predicted, performance was degraded in version 1. This was attributed to the difficulty — for participants in verson 1 — of learning to ignore a preconceived-relevant feature and having to generate new strategies that did not use this feature. Lovett and Schunn presented a process model, called ReCyCLe, of how features enter and leave one's task representation and, hence, how strategy sets evolve. One prediction of theReCyCLe model is that solvers are more likely to change their representation when their current stsraties' success rates are low.

Goals and Method

The current studies attempt to replicate this previous work under slightly different conditions and to address two additional questions:

(1) What, if any, are the local triggers for problem solvers to change their representations and generate new strategies?
(2) What is the role of explicit instruction (e.g., hints) in helping solvers to adjust their strategy sets?

Question (1) was addressed by asking a subset of participants to provide talk-aloud protocols and comparing coded occurrences of strategy-generation or strategy-change events to similar profiles among the non-protocol participants. Question (2) was addressed by manipulating if, when, and how participants would receive a textual hint about important features to include/exclude in their representation of the task. Also varied in this experiment was the degree of success of the best strategy. In particular, the best strategy's success rate could be increased/decreased by decreasing/increasing the overall randomness of the task environment. This manipulation is, simply construed, a task difficulty manipulation.

Results

Regarding the first question, results suggest that, at least when they are asked to talk aloud, participant engage in a considerable amount of explicit strategy (or hypothesis) generation. And, while participants tend to launch anew strategy immediately following a problem-solving failure rather than success, this is not always the case. Regarding the second question, results suggest that, when solvers mismap features (i.e., when they consider the superficial features in a domain to be significant and vice versa), an explicit hint can help problem solvers more quickly incorporate the structurally important task features in their representations and strategies. Even with such hints, however, performance is still aided by further problem-solving practice. The instructional implications of these results will be discussed.

References

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