The Effect of Einstellung on Compositional Processes

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Step Skipping while Problem Solving

Blessing and Anderson (1996) examined how people learn to skip steps while solving a problem. One distinction that they made was between people *overtly* skipping steps versus c*overtly* skipping steps. That is, a problem solver may have learned enough facility with the task to physically skip producing some of the steps in solving the problem, but mentally still perform them (overt step skipping). With more time on the task, this problem solver may actually begin to mentally skip steps as well (covert step skipping). This distinction was based on an analysis of verbal protocols. The research presented here provides new insight and a new method to discern this phenomenon.

Whether people are covertly skipping steps or are merely overtly skipping has consequences for how such problem solving behavior should be modeled. The current version of the ACT-R cognitive architecture (Anderson et al., 2004) allows for compositional processes within procedural knowledge. Taatgen and Lee (2002) describe the compositional process that decides when and how to collapse rules together.

Luchins' (1942) finding of Einstellung ("mental set") has implications for composition. If the underlying component processes are well practiced, then the probability of steps being composed together may decrease. People may persist in performing multiple mental steps if the cost of composing does not outweigh the benefits. This experiment provides a method and data to examine this phenomenon.

Method and Results

Participants. Twenty-six undergraduates at the University of Tampa participated for extra credit in their general psychology class.

Materials. Participants learned a version of a task called Symbol Fun, similar to the one used in Experiment 2 of Blessing and Anderson (1996). Symbol Fun is a rough analog to algebra. A typical problem is presented below:

♥ ℘ ®Γ↔Φ	$-x + A = B$
♥ ℘ ↔Φ♥Γ	$-x = B - A$
℘ ↔Φ®Γ	$x = B + A$

Participants were given a problem like shown in line 1, and then expected to produce the solution. The rules of the task were presented explicitly to the participants in the introductory information, as well as a page of examples. They could refer back to this information.

Procedure. All participants solved 96 Symbol Fun problems. Half of the participants had to skip the intermediate step immediately and half had to skip that step after 48 problems.

At 4 different intervals while doing these problems (after problems 24, 48, 72, and 96), participants were asked to do a Symbol Fun recognition task. They were given 54 pairs of lines and asked to determine if the second line logically followed from the first; half the time a line was skipped (2-step) and half the time it was not. Figure 1 shows data for all correct responses when the response was "true."

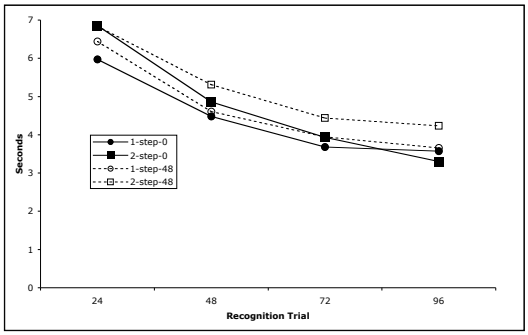

Figure 1: Performance on Recognition Trials.

For the participants who did not skip steps until problem 48, their performance gap on the 2-step problems increased over the experiment, and was significantly different by the end of the experiment ($F(1,24) = 4.38$, $p < .05$), suggesting they were never covertly skipping steps.

Discussion

These results have implications for how compositional processes should be modeled. A solver's facility at performing the individual steps may not warrant composition. Future work will create such a model to determine how practice and facility at doing the task determine step skipping performance.

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