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Authors
Morris, Bradley J.
Schunn, Christian D.

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Evidence for Multiple Strategy Use Within a Single Logic Problem

Bradley J. Morris (morrisb@gvsu.edu)
Grand Valley State University
One Campus Drive, Allendale MI, 49506

Christian D. Schunn (schunn@pitt.edu)
Learning Research and Development Center, University of Pittsburgh
3939 O'Hara St., Pittsburgh, PA 15260 USA

When solving a logic problem, do reasoners use a single processing step or do they use a series of steps? Further, are these steps derived from the same inferential mechanism or different inferential mechanisms? Traditional models of logical reasoning posit a single solution using one mechanism (e.g., rules, models). A modification of this model, the dual processing model, suggests that logical inferences are the result of a competition between two different mechanisms. Though there are two mechanisms, a single inferential step is executed based on a decision between two candidate solutions. A third possibility, the Logical Strategy Model (LSM), suggests that logical reasoning makes use of more than one inferential step making use of a variety of inferential mechanisms (i.e., strategies).

The LSM predicts that reasoners use strategies based on task demands such as believability. For example, given familiar content, a reasoner will likely use a knowledge-based heuristic. Reasoners may use multiple strategies at different points within a single problem. For example, reasoners might (1) begin with one strategy and shift to another strategy or (2) begin using one strategy and revise their approach using the same strategy. In either case, reasoners would be using a dynamic process in which they may begin with a strategy and change their approach based on changing problem factors and goal states (see Epstien, 1994). To examine this, we performed a verbal protocol study of a series of logical syllogisms.

Method

Subjects. Five University students were recruited from Introductory Psychology courses.
Materials. A series of 32 logical syllogisms were created varying the following dimensions: Abstract v. Concrete, Unfamiliar v. Familiar, Valid v Invalid X True v. False.
Procedure. Subjects were asked to "think-aloud" as they solved 32 syllogisms. As a warm-up, subjects were given a series of multiplication and word scramble problems to practice the verbal protocol.
Coding. Once completed, the session was transcribed. The resulting protocol was coded for strategy use. Strategy use was coded by matching elements of subject discourse to salient elements of proposed strategies. For example, a Token-Based strategy involves the creation (and search) of models derived from premises (e.g., "Some X are Y, so some X are not Y"). A Knowledge-Based strategy derives inferences from a match between problem elements and current knowledge (e.g., "It's not true that some fish have legs so this is false"). Finally, each problem was coded for cues indicating a change in current strategy (e.g., "that can't be right").

Results

All subjects used more than one strategy on a single problem, most (4/5) for each problem type. Subjects were most likely to use multiple strategies when validity and truth or falsity of the conclusion was in conflict (Valid & False, Invalid & True, see Table 1). In these cases, subjects were likely to re-examine their initial conclusion by using a new strategy than by using the same strategy in light of new information (i.e., a putative conclusion). Table 1 also reports whether the second strategy used was the same or a different than the initial strategy. The results indicate that reasoners commonly use multiple strategies in a single problem and that the type of strategies used can be predicted on the basis of task demands.

Table 1- Strategy use by problem type

Problem Type	Mean Number of Strategies	Most frequently used first strategy	Used Same	Used New
A	1.4	Token-based	**65%**	35%
C + U	1.4	Token-based	**70%**	30%
C + F + V + T	1.2	Knowledge-Based	**65%**	35%
C + F + I + T	1.9	Knowledge-Based	25%	**75%**
C + F + V + F	2.3	Knowledge-Based	40%	**60%**
C + F + I + F	1.4	Knowledge-Based	**80%**	20%

References

Epstein, S. L. (1994). For the Right Reasons: The FORR Architecture for Learning in a Skill Domain. *Cognitive Science, 18* (3): 479-511.