Implicit Learning of Invariants

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Implicit learning is learning of complex information, without the use of conscious hypothesis testing strategies, and without resultant consciously accessible knowledge sufficient to account for performance on an indirect test of learning (Seger, 1994). Most research in implicit learning has used tasks in which subjects learn relationships between stimulus elements. For example, in artificial grammar learning, subjects learn letter bigrams and trigrams and rules relating letters to each other (Seger, 1994; Knowlton & Squire 1996). Relatively little work has investigated subjects' ability to implicitly learn about invariant properties of complex stimuli (Frick & Lee, 1995). Learning relationships between items may require different forms of processing than identifying such invariants.

The experiment presented here investigated how well subjects learned two kinds of invariants: an item identity and location invariance, and an item identity and color invariance. In both condition, subjects were presented with displays consisting of 5 differently colored letters. For each subject, there was a particular letter that repeated in each display (the invariant letter). In the location invariant condition, the invariant letter appeared at the same location in each stimulus, whereas in the color invariant condition, it appeared in the same color in each stimulus. Otherwise, the stimuli were constructed randomly. After observing 30 displays and recalling the letters (but not the colors or locations) present in each, subjects were tested two ways. In the single item judgment test (1IJ), subjects were presented with novel patterns, half of which had the invariant and half of which did not. Subjects indicated for each pattern whether it followed the rule present in the studied items or not. The other test was a two alternative forced choice test (2AFC) in which subjects chose which of two patterns presented simultaneously followed the pattern present in the studied items. In both tests, the distractors were of two types: in one type of distractor the invariant letter appeared, but in a different location or color than in the studied exemplars. In other type of distractor the invariant letter was absent.

In order to investigate how much consciously verbalizable knowledge subjects had about the invariant, they were given a questionnaire to complete at the end of testing. Subjects who identified the invariant letter and its location or color on the free response questions, or who guessed the correct letter and indicated a high degree of confidence in their guess, were classified as having explicit knowledge of the invariant and were not included in the analyses. More subjects achieved explicit knowledge of the invariant in the location condition than the color condition, indicating that a letter-location invariance may be more salient than a letter-color invariance.

The 1IJ and 2AFC tests were differentially sensitive to implicit knowledge of the invariant. Subjects performed better on the 2AFC test than on the 1AJ test. The superiority of the 2AFC test could be because in that test subjects can compare the two stimuli and simply select which is more correct, rather than having to compare each stimulus to a mentally held criterion. In other words, relative correctness appears to be easier to determine than absolute correcness.

In addition, there was evidence that subjects did not learn the pairing between the invariant letter and the invariant location or color. Separate scores were calculated for the 2AFC test for pairs in which the distractor lacked the invariant letter altogether, and pairs in which the distractor included the invariant letter but in an incorrect location or color. Subjects performed above chance only on the pairs in which the invariant letter was absent, indicating that they could not reliably differentiate between stimuli solely on the basis of the invariant being in the correct location or color.

Acknowledgement

This research was supported by a NRSA postdoctoral Individual Research Award to the author.

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