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What drives learning by classification?

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The classification learning paradigm has been the dominant technique across decades for the study of categorization (Murphy, 2002). The learning procedure consists of passes through a set of training items presented one at a time in random order. On each trial, an example is displayed with a forced-choice classification question. Responding elicits corrective feedback followed by an inter-stimulus interval.

The goal of this research is to look inside the classification trial in order to identify the locus of learning. The roles of feedback and intentionality have been investigated elsewhere (e.g., Love, 2002). The factors addressed here are: 1) unlimited access to the stimulus during responding; 2) availability of the stimulus during feedback; and 3) generation of a classification response.

In the Init+During condition, the classification trial is executed in standard fashion except the stimulus is removed during feedback. This allows us to evaluate the importance of coordinated evaluation of the stimulus and the correct label at the end of the learning trial. In the Init+Final condition, each stimulus is presented for 3s and then removed when the classification question appears. After the response, the stimulus re-appears along with corrective feedback to allow coordinated evaluation. Speeded classification has been a topic of past research (e.g., Nosofsky & Palmeri, 1997), but the present question is about limiting access to the perceptual stimulus without any requirement of fast responding. In the Init-Only condition, we test the combined effect of limited initial access plus absence of the stimulus during feedback.

Finally, in the No-Response condition, each trial consists of presentation of the stimulus and its correct category. The learner observes the association and presses a button to continue. This allows us to address the common intuition that generating a response and evaluating success plays a critical role in classification learning. Many models of category learning operate on the basis of error correction between an output and a feedback signal.

In order to compare these conditions, three category prototypes were designed using 4x4 grids of half gray and half white squares. The training set consisted of 16 examples of each category generated by distorting the prototype with exactly two squares of reversed color. Participants (n=199) were randomly assigned to one of five conditions. The study phase consisted of a maximum of 192 trials. After every twelve trials, performance was evaluated against a 90% criterion for stopping learning. The test phase consisted of standard classification of all items.

Ease of learning was measured by percentage of participants reaching criterion and performance on the test phase common to all conditions. Impaired performance in any experimental condition relative to the control group would highlight a critical aspect of classification learning.

Approximately half of all learners reached criterion (11/12 correct). In the test phase, participants were well above chance (33%), though quite far from ceiling.

Table 1: Learning performance across conditions

Condition	% Ss reach criterion	% correct at test
Standard	54	69
Initial Only	40	63
Init+During	47	69
Init+Final	65	72
NoResponse	--	72

To our considerable surprise, none of the experimental conditions differed reliably from the control group on either measure. The only significant difference was between the Initial-Only and Initial+Final groups. This appears to be attributable to a slight disadvantage in the Init-Only condition combined with a slight advantage in the Init+Final. We draw the preliminary conclusion that none of the elements considered, i.e., extended evaluation of the stimulus during responding, coordinated evaluation during feedback, nor response generation can be considered critical components of classification learning. Learners are able to adapt fairly seamlessly in each case. These data suggest that as long as the learning trial includes the item and its label, the rest is more or less bells and whistles.

Acknowledgments

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