Learning to Categorize in the Context of Item Triples

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Background

We evaluate the relative contributions of two mechanisms of category learning: 1) *abstraction* across examples of the same category and; 2) *differentiation* between examples of different categories. A novel "triples" paradigm is introduced in which each classification target is presented with two different context items. Learners are informed of the structure of the triples so they may take advantage of knowledge about the relative category status of the items. We use feature-based categories with perceptually subtle variation among examples. The study is designed to advance a naturalistic yet controlled basis for the study of category learning by using multiply-instantiated feature values (Markman & Maddox, 2003) and three-way rather than binary classification decisions.

In a control condition, items were presented one at a time. Learning was also tested under five experimental conditions based on the following triple structures: aAA (both context items match the category of the target 'a'), aAB (one matching and one mismatching context item), aBB (both context items mismatch the target, but the context items match one another), aBC (both context items mismatch the target and the context items also mismatch one another), and aXX (no systematic structure).

One possible learning strategy is to locate common features between items known to belong to the same category and perform abstraction -- in which case the aAA group should have an advantage. Another potential strategy is to identify contrasts between items known to belong to all three categories -- in which case the aBC structure should be most beneficial. The aAB structure is least informative under either strategy because the learner is unable to know for certain whether any pair within the triple are in the same or different categories. The aBB group benefits from weaker forms of both abstraction and differentiation on each trial.

Method

The stimuli consisted of organism-like patterns created in Adobe Photoshop that varied systematically along three dimensions: body-aspect ratio, flagella length, and stripe width. Each dimension had eight possible values. Three categories called Gex, Kij, and Zof were defined using the higher or lower four dimension values (e.g., Zofs had rounder bodies, longer flagella, and wider stripes) for a total of 192 possible items. Each category was distinct from the other two in terms of exactly one dimension.

Each of sixty-six college students was randomly assigned to one of the six conditions described above (single item control condition, aAA, aAB, aBB, aBC, or aXX) and tested in two phases, a training phase of 144 trials with feedback given on target classification responses, and a test phase without feedback and using all 192 stimuli. Except for the single target control condition, stimuli were always presented in the triples context, and the structure of the triple was carefully explained to participants at the outset.

Results

The manipulation significantly affected accuracy and speed of performance during the first (training) phase of the experiment ($F(5,60) = 3.423$, $p = .0087$), with the aBC condition yielding the best performance (83% correct overall, with chance performance of 33%). As expected the least learning took place in the aAB group (55%). To our surprise, the aAA group was also quite low (63%) and did not differ significantly from the aAB group. Performance was intermediate in the aBB (74%), single item control (73%), and aXX (69%) conditions, which did not differ significantly. Examining performance over the course of 12 blocks of 12 training trials, the aBC condition was most accurate for every single block. Overall accuracy in phase two ranged from 61% (aAB) to 78% (aBC), but there was no main effect of condition at that point.

These results indicate that, at least in the early stages of learning in this context, between-category differentiation is more important than within-category abstraction. Additional experiments are underway to explore whether removing the information given about the triples structure, or highlighting it more dramatically, will alter the outcome.

Acknowledgments

Our thanks to the Undergraduate Research Summer Institute at Vassar College, and to Jessica Cicchino, Emma Myers, and especially Peter Alfaro for assistance with this study.

References

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