The use of exemplar information in classification-based and inference-based category learning

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A prominent aspect of categorization is our ability to extract categories out of a wide range of items. Unlike most experimental situations where a limited set of category instances is presented repeatedly, we are able to learn about a variety of categories in the world even though each exemplar we see may be unique. Two experiments were designed to capture this aspect of categorization. We presented subjects with one of three types of category learning — Classification learning, Inference Learning or Mixed Learning — and examined how these procedures interacted with different types of stimulus depiction in which each feature of a stimulus was depicted by either a single instance or by a large number of distinct instances.

In the two experiments, subjects were randomly assigned to one of three learning conditions — Classification learning, Inference learning and a mixture of the two. Classification learning was a standard category learning procedure, in which subjects saw an entire stimulus and classified it into one of two groups. Subjects learned the categories incrementally via feedback given immediately after each trial. Subjects in the inference learning condition followed a similar procedure except that on each trial they had to fill in the value of a different missing feature given the other features and the category label. The Mixed condition was the mixture of the two learning conditions, on which half of trials were made of classification and half were inference. Subjects conducted one of three learning tasks until they reached a criterion. After learning, subjects made classification and inference transfer of old stimuli as well as new stimuli.

The success of exemplar models suggests that specific exemplar information is processed for classification (Nosofsky, 1986). In contrast, abstract relational information seems to play a crucial role for inference (Lassaline & Murphy, 1996; Markman, Yamauchi & Makin, in press). The current studies tested this hypothesis by contrasting three different learning situations — Inference learning, Classification learning, and the mixture of the two conditions — in two independent experiments. In one experiment, each feature had a single manifestation. For example, the feature "round head" is represented by a single feature instance throughout the experiment. In a second experiment, each stimulus was depicted by different manifestations of features so that no two instances were exactly the same. For example, each feature value (e.g., round head) was depicted by one of four different variations of that feature value.

If classification learning is primarily based on the storage of episodic information of exemplars, it will require many trials to reach a learning criterion when each feature of a stimulus is represented by many distinct instances. In contrast, if inference learning rests more on processing abstract relational information than does classification, the same manipulation may not affect subjects' ability to learn categories.

The results of the two experiments showed that 23 out of 24 subjects given Classification learning were unable to learn the categories in the specified period when a feature of a stimulus was depicted by multiple instances, whereas only 7 out of 24 subjects in the same condition were unable to learn the categories when a feature of a stimulus was shown by a single instance throughout learning. Subjects given Inference learning and subjects given Mixed learning were unaffected by this manipulation: more than 85% of subjects in the two learning conditions could learn categories irrespective of the way each feature was depicted. The results of the experiments suggest that category learning based on classification relies heavily on storing specific exemplar items during learning, whereas category learning based on inference rests on processing some abstract category information. Since classification learning is not suitable to deal with this situation, category formation may be mediated by some other cognitive functions along with classification including inference, comparison, abduction, and reasoning. The results further imply that categorization models based primarily on classification learning are problematic since category learning in natural settings occurs in a situation in which a variety of category instances are experienced.

References

Lassaline, M.E., & Murphy, T. D. (1996). Induction and category coherence. *Psychonomic Bulletin and Review,* 3(1), 95-99.

Markman, A.B., Yamauchi, T., & Makin, V.S. (in press). The creation of new concepts: A multifaceted approach to category learning. To appear in T.B. Ward, S.M. Smith, & J. Vaid (Eds.) *Conceptual Structures and Processes: Emergence, Discovery, and Change.* Washington, DC: American Psychological Association.

Nosofsky, M. R. (1986). Attention, similarity, and the identification -categorization relationship. *Journal of Experimental Psychology: General, 115,* 39-57.