Attention Allocation in Inference Learning

Bob Colner (bob.colner@nyu.edu)
Aaron Hoffman (aaron.hoffman@nyu.edu)
Bob Rehder (bob.rehder@nyu.edu)
Department of Psychology, New York University
6 Washington Place, New York, NY 10003 USA

The majority of experimental research on human concept learning has relied on the supervised classification task. Recently it has been argued that a complete understanding of concept learning requires expanding laboratory techniques to account for other uses of categories.

Yamauchi and Markman (1998) examined the relationship between the use of categories and their representation by contrasting traditional supervised classification learning and inference learning. Participants learned about a 4-dimensional family resemblance category structure by either classifying items into 2 categories or by making inferences about missing features with the items' category label present. The learning phase continued until participants reached an accuracy criterion.

In a subsequent test phase all participants made inferences about every dimension of every item. Inference learners were significantly more likely then classification learners to make inferences in accordance with the category prototype. This was the case even when the to-be-predicted dimension had displayed an exception feature (i.e., a feature from the opposite category) when that item had appeared during training. This result has been interpreted as evidence that inference learning induces learners to represent the internal structure of categories, including typical features and within-category correlations (Chin-Parker & Ross 2002; Yamauchi & Markman, 1998). In contrasts, classification learning seems to encourage learning only the dimensions that are diagnostic of category membership.

However, an alternate explanation for inference learners' preference for prototype consistent features is that participants may be learning simple bidirectional rules relating the category label to each feature (Johansen & Kruschke, 2005). This explanation is reasonable because the inference learners only predicted features that were consistent with the category prototype during learning.

A replication of Yamauchi & Markman (1998) Experiment 1 was conducted with an eye tracker because the two hypotheses make different predictions about attention allocation. If inference learners are motivated to learn the structure of a category they should attend multiple dimensions; in contrast, a category label-based rule would only require attending to the label.

The main behavioral results replicated, including the fact that the inference condition (M = 7.95) required significantly fewer blocks than the classification condition (M = 18.61). The theoretically interesting effect from the test phase was also observed in that inference learners responded to exception-feature queries in accordance with the category prototype significantly more than classification learners (M = .94, M = .68).

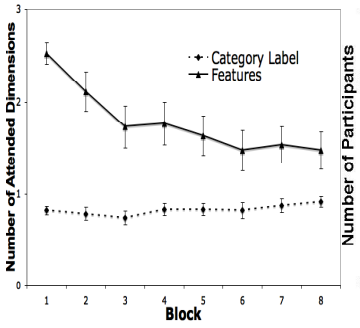

Fig. 1

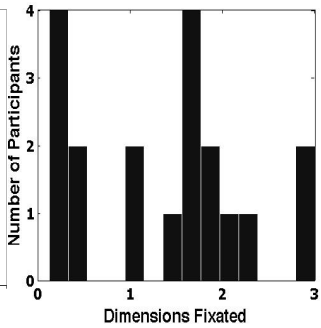

Fig. 2

The eye tracker recorded whether a dimension was fixated on each trial. This number-of-attended-dimensions variable (ranging from 0-4) was averaged over blocks and participants; fixations to the queried dimension were excluded. If participants were using a rule involving the category label, then attention should be limited to the label, certainly by the end of learning.

Fig. 1 illustrates the pattern of fixations over the course of learning and demonstrates that attention was allocated to many of the items features as well as the category label. These results are consistent with the hypotheses that inference learning promotes a richer representation of the internal structure of family resemblance categories then bidirectional label-based rules.

The histogram in Fig. 2 shows the individual results for the number of dimensions fixated on the last block of learning. The cluster around 0 represents learners who relied entirely on the category label while the cluster around 2 reveals that many participants were attending to multiple features in addition to the category label. A pair of participants managed to solve that task without using the category label by attending to all 3 available features.

References

Chin-Parker, S. & Ross, B. (2002). The effect of category learning on sensitivity to within-category correlations. *Memory & Cognition*. *30*, 353-362.

Johansen, M. & Kruschke, J. (2005). Category representation for classification and feature inference. *J. of Exp. Psychology: Learning, Memory, and Cognition*. *31*, 1433-1458.

Yamauchi, T. & Markman, A. (1998*)*.Category learning by inference and classification. *J. of Memory and Language. 39*, 124-148.