Acquisition of polymorphous concepts

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In a polymorphous concept, features are characteristic rather than defining. In Figure 1a, a triangle, an upwards arrow and a pound sign are characteristic of category A. Stimuli are members of category A if they contain more features characteristic of A than features characteristic of B. Dennis, Hampton and Lea (1973) found that polymorphous concepts took considerably longer to acquire to an errorless criterion than either conjunctive or disjunctive rules; conjunctive rules being precisely the sort of structure rejected as "unnaturalistic" by much of contemporary categorization research.

Humans are not the only species to find the acquisition of polymorphous concepts very difficult. In one study with pigeons (von Fersen & Lea, 1990), separate training on each of the stimulus feature-pairs was eventually required in order to train the concept. If it could be demonstrated, with appropriate control groups, that this sort of pre-training was more effective than an equal length of training on the full problem, this would present a challenge to some theories of learning in both pigeons and in people.

Method

The left-hand panel of Figure 1b shows a stimulus containing all five features characteristic of category A. From the outside in, the five feature-pairs are a) flankers (fine/coarse), b) trapezium, c) stars/blobs, d) colored square (yellow/blue), and e) lines (orientation).

Sixty undergraduate students from Exeter University participated for course credit or 4 GBP. Standard category acquisition procedures were followed throughout - stimuli were presented one at a time, a category decision requested ("category A or B?") and feedback given immediately after each decision.

There were three between-subject conditions. In the SINGLE condition, feature pairs were trained one at a time. For example, a participant might first be trained on the problem "stars -> category A / blobs > category B", and would then move on to the next feature-pair. The order in which the five feature-pairs were trained was randomized across participants. Once all five feature-pairs had been trained individually, participants were moved, in the second phase, to the full polymorphous set of 32 (2^5) stimuli for four blocks of trials. Subjects in the POLY condition received the same total number of training trials as the subjects in the SINGLE condition, but all trials were with the full polymorphous stimuli.

Subjects in the SINGLE (REV) condition received single-feature training in the same manner as the SINGLE group. The difference was that the category associations of three out of the five feature pairs were (unbeknownst to the subject) reversed prior to the polymorphous training phase. Thus, if they had initially been trained that "stars -> category A / blobs > category B", then in the polymorphous phase, "blobs" were characteristic of category A and "stars" were characteristic of category B.

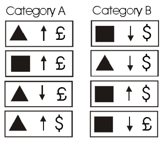

Figure 1a

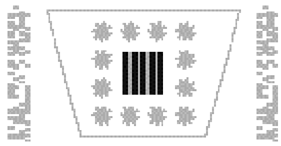

Figure 1b

Results and discussion

Participants in SINGLE condition were considerably more accurate on the polymorphous problem than participants who had done that problem throughout, but they were also slower (longer RTs).

If these results were entirely due to general motivation or strategic factors then one might expect the reversal in the SINGLE (REV) condition to have relatively little effect. In contrast, if the SINGLE group is more accurate and slower because specific categorical knowledge acquired in phase one is transferred to phase two, then this reversal between the phases should dramatically affect performance. In fact, participants in the SINGLE(REV) condition were significantly worse at the polymorphous problem than participants in either of the other two conditions, but their reaction times were comparable to those in the SINGLE condition. Our working hypothesis is that the specific categorical knowledge acquired in the single feature-pair phase does indeed facilitate polymorphous categorization, but that there may also be important strategic/motivational effects.

Exemplar models (e.g. Nosofsky, 1986) explain aquisition of categorical knowledge by stating that we store labelled instances of categories. In "broad-brush" terms, it seems difficult to explain, from an exemplar-based account, why trading an exact copy of the stimulus you need to make a decision about for stimuli that contain only small parts of it would be beneficial to categorization accuracy.

References

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