Can pigeons learn to complete an analogy?

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Introduction

Learning the relation between relations is considered to be characteristic of human reasoning and to be beyond the abilities of non-language trained apes (e.g., Thompson & Oden, 2000).

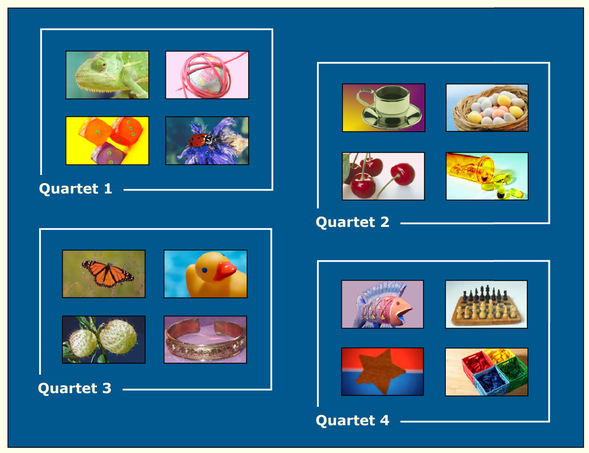
However, from an evolutionary point of view, it makes sense to imagine that the rudiments of analogical reasoning may be evident in other animals as well.

So, we sought to teach pigeons to complete a series of pictorial analogies.

Stimuli

In our study, the first-order relations were based on the perceptual identity or non-identity of 16 color photographs.

The 16 images were grouped into 4 quartets with 4 images each. Training trials were created from combinations within the same quartet, so that each particular image would always be presented with other images in the quartet and never with images in the other quartets. This method allowed us to create transfer testing trials with familiar pictures via fresh combinations.



Training

The pigeons were first shown two items that could be the same as or different from one another. Then, two choice alternatives appeared along with a third item; pigeons had to select the choice alternative that matched the relation displayed in the first place.

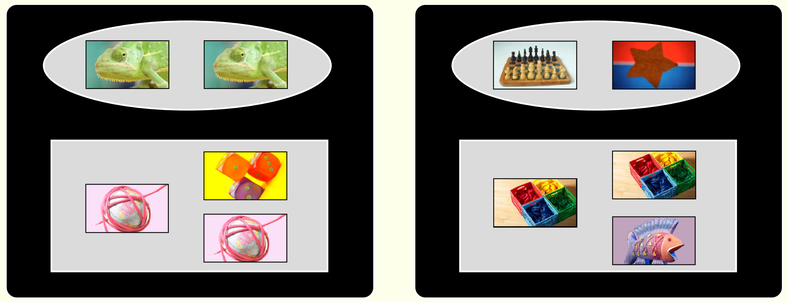


Figure 1. Illustration of one Match and one Non-match trial. Pigeons had to choose the picture that completed the analogy.

Results

This task proved to be difficult for our four birds; none of them reached a very high level of correct responses after an average of 400 training sessions. Nonetheless, trends were promising and they suggested that some learning had taken place.

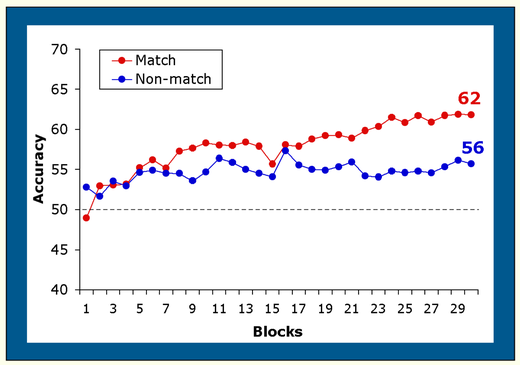


Figure 2. Mean percentage of correct responses across 30 blocks of 12-15 sessions for the four pigeons.

Overall accuracy rose from the beginning to the end of training.

Accuracy increased more for Match trials (M = 62%, in the last block), than for Non-match trials (M = 56%, in the last block).

Binomial tests showed that accuracy in the last block for Match trials and Non-match trials was significantly above the chance level ($p < .001$ in each case).

Testing

The first testing phase showed recombinations of the training sets so that, although the individual pictures were the same as in training, their particular combinations were novel.

Accuracy was reliably greater than chance for Non-match testing trials ($p < .001$), but not for Match testing trials ($p = .30$).

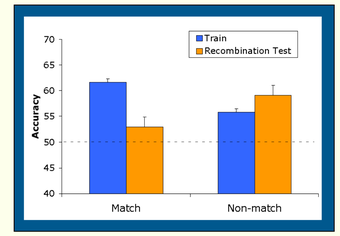


Figure 3. Mean accuracy in the recombination testing phase. For comparative purposes, accuracy to intermixed training trials during this testing phase are shown as well.

The second testing phase showed completely new pictures.

Accuracy on training trials was reliably greater than chance ($p < .001$), but accuracy on new testing trials was not.

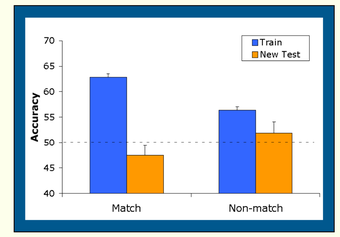


Figure 4. Mean accuracy in the new testing phase. For comparative purposes, accuracy to intermixed training trials during this testing phase are shown as well.

Conclusions

The accuracy of analogy completion attained only low levels in training, and this level of performance did not transfer to new stimuli.

Nonetheless, during the recombination testing phase, accuracy to Non-match testing trials was significantly greater than chance, a result that seems promising.

Different procedures might be more successful. We might need to explicitly teach the pigeons to report the nature of the first-order relation and then proceed to report the second order relation.

References

Thompson, R. K. R., & Oden, D. L. (2000). Categorical perception and Conceptual Judgments by Nonhuman Primates: The Paleological Monkey and the Analogical Ape. Cognitive Science, 24, 363-396.