of pigeon IV may have been caused by erratic behavior which was exhibited throughout the experiment.

Discussion

Three things may be concluded from the data: first, that pigeons are capable of forming associations between colors; second, that these pigeons formed a backward association; and third, that the forward association was not significantly stronger than the backward association.

It is likely that these results are related to the manner of training; specifically, requiring the pigeon to peck at the stimulus color before pecking at the response color. In terms of the Asch-Ebenholtz studies, this procedure may help to equalize the "availability" of the S- and R-colors as contrasted to a procedure which requires pecking at R only. The present procedure was adopted in the belief that it would enhance the likelihood that the pigeons would pay attention to the S-color. Using a procedure which requires pecking the R-color only might result in the backward association being significantly weaker than the forward association.

It could be argued that the blackout after an incorrect response in backward testing strengthened the backward association. If the blackout explanation is correct, then the number of correct responses in the last half of the tests should be greater than those in the first half. This explanation is not supported by the data: the total number of correct pecks in the first 14 testing trials over all pigeons equaled the total correct in the last 14 trials. The same result was also true for the first versus the last 10 trials, as well as for the first versus the last 5 trials. Therefore, it would appear that the blackout during testing did not strengthen the backward association.

It should be noted that the results of this study are based upon intra-individual performance and not upon comparisons between pigeons. Therefore, the loss of pigeon II and the erratic behavior of pigeon IV do not destroy the conclusion drawn from the experiment.

The capacity to form backward associations may be used to evaluate differences in intelligence or learning ability, in much the same way that Bitterman (1965) has used the tasks of habit reversal and probability learning for evolutionary comparisons of learning ability.

References

Asch, S., & Ebenholtz, S. The principle of associative symmetry. *Proc. Amer. Phil. Soc.*, 1962, 106, 135-163.

Bitterman, M. E. Phyletic differences in learning. *Amer. Psychol.*, 1965, 20, 396-410.

Note

1. This study started as a Science Fair project at Martin Junior High School, Raleigh, North Carolina, in 1962. I am indebted to Norman Guttman and Slater E. Newman for advice and to Gilbert Gottlieb and my father, Clifton Gray, for guidance. I am also indebted to Ray Moore for instruction and help in circuitry design, to Connecticut College for shop facilities and laboratory space, and to my father for statistical analysis. I also appreciate the secretarial help of the North Carolina Department of Mental Health.

Reply to David J. Barker *by Allan L. Jacobson*

Barker is correct in concluding that by "predominant choice," we meant the alternative chosen 13 or more times on the 25 test trials. We did not intend to suggest anything else, and in fact, we pointed out in the text that "absolute preferences were on the whole small."

As for the statistical test: the approximate number of Ss and the way we would treat the data were decided in advance. We did not expect to obtain strong preferences, even if our results were positive, since (among other reasons) recipient rats were never rewarded during testing; thus we chose a "sensitive" criterion of preference. Perhaps in so doing, we inadvertently capitalized on the vagaries of χ^2. If so, Dr. Barker is indeed justified in considering our conclusion too strongly stated. We hope at some future time to resolve this question more satisfactorily in the laboratory.

For Comment on Jacobson et al see page 314.