A test of Klopfer's empathic learning hypothesis^{1, 2}

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Klopfer, (1957) proposed that naive ducks could learn to avoid a potentially dangerous situation by observing the behavior of experienced ducks toward it. Such second-hand learning was termed empathic. The domain of this hypothesis was extended and tested under less stringent conditions. Forty pairs of chicks were used. The demonstration bird was presented with a series of mealworm larvae, varying in color pattern and palatability, and the number of trials it took for each bird to reject five such larvae in succession was recorded. The observer birds were then exposed to the same test. There was no decrease in the number of trials to reach criterion.

Klopfer (1957) proposed that naive ducks could learn to avoid dangerous prey by observing and imitating the reactions of other experienced ducks to them. He termed this imitative behavior empathic. His hypothesis is attractive because of its usefulness in explaining how naive predators avoid dangerous and distinctive prey without previous first-hand experience. In his tests the original learners were exposed to two feeding dishes, one of which was marked uniquely and connected to an electric grid and which they learned to avoid. Under certain conditions the observer ducks also learned to avoid the wired dishes, presumably without the benefit of first-hand experience. Klopfer then showed that a second generation of observer birds also learned to avoid the wired dish by watching the first generation of observers. If one assumes that avoidance of harmful situations can be learned vicariously under harsh conditions, one might further assume that the same process would occur to a lesser extent under less harsh, but still negative conditions. The present study was designed to test Klopfer's hypothesis under experimental conditions less stringent than he imposed.

Method

The prey were *Tenebrio* larvae of one of two basic types, each further subdivided. The first group, the models, were those larvae dipped into a 10% solution of a quinine dihydrochloride solution. Larvae of the second type, the mimics, were dipped into tap water. The terms model and mimic as used here are operationally defined. Members of each type either were painted red on segments 4-7 or remained unpainted. The proportion of models to mimics presented to the chicks was about 4:1, with a random order of presentation.

The predators were white leghorn chicks hatched in our laboratory and then placed together in a standard incubator where they were fed and watered ad lib. Birds were selected for the actual experiment

by testing their response to full-sized *Tenebrio* larvae. Only those birds which initially accepted both the model and mimic appropriate to the experimental treatment were used as original learners; only those birds which initially accepted the assigned mimic were used as observers. Birds were individually marked, weighed, and designated as a member of a pair (A or B) or of a trio (A, B or C).

The tests were run in a double-compartmented canary breeding cage, each compartment measuring 25 x 23 x 26 cm. Chick starter and water were kept in both compartments and were freely available to the chicks through all tests. During the first half of each test, birds A and B were placed in a cage, one in each unit, and each had a clear view of the other's compartment. Bird A, the original learner of each pair or trio, was then offered a series of single models and mimics, and his reactions to them were noted. The first nine presentations were 60 sec. long, thereafter 30 sec. Bird A was considered to have learned to avoid a model when it rejected the model for five consecutive presentations.

After A had performed to criterion, the test was repeated within a half an hour with bird B, the original observer. However, in half of the cases, the companion in the adjacent compartment was the A bird while in the other half the companion was the C bird, a naive chick which had never experienced the models.

If the domain of Klopfer's empathic learning hypothesis is assumed to cover this experimental situation, one would expect that the B bird, regardless of its companion, would reach a criterion in fewer trials than did its A partner. The data were evaluated from this point of view.

Results and Discussion

The validity of the present experiment is dependent upon knowing that the chicks distinguished between untreated larvae and those dipped into quinine, and that they ceased eating because of the quinine treatment, not because of habituation. Eighty chicks were used in the formal experiment involving treated larvae. The mean number of trials to reach criterion was 19 with SD=9. A separate group of seven chicks was tested with untreated larvae (but painted for some birds, unpainted for others), and the corresponding means was now 52 trials with SD=13.8. The probability of obtaining a sample mean of 19, based upon a sample size of 80, from a population mean of 52 and SD=13.8 is less than 0.001, and we infer that the treatment, i.e., quinine, did affect the response measured independently of other experimental manipulations.

The basic data are presented in Table 1. Forty

Table 1. Mean number of trials for chicks to reach criterion
N = 5 for all means

Model Painted Mimic Painted		Model Unpainted Mimic Painted	
A Birds	B Birds with C	A Birds	B Birds with C
19.8	19.2	17.6	20.6
A Birds	B Birds with A	A Birds	B Birds with A
23.2	19.0	21.6	20.4

Model Painted Mimic Unpainted		Model Unpainted Mimic Unpainted	
A Birds	B Birds with C	A Birds	B Birds with C
16.4	26.8	11.8	12.6
A Birds	B Birds with A	A Birds	B Birds with A
17.0	18.4	22.0	16.2

tests, each with an A and B bird were run. These tests were equally divided between four model-mimic combinations: both painted, neither painted, model painted and mimic unpainted, and the reverse. We performed a number of different statistical tests in order to test Klopfer's hypothesis fully.

An analysis of variance of the number of trials to criterion for A and B birds showed no difference on the basis of model or mimic condition, partner condition of B bird and category of bird being tested (A or B). A second analysis of variance of the difference between the performance of A and B birds showed no difference on the basis of mimic condition (painted or unpainted), model condition (painted or unpainted), and partner condition of bird B (C or A present). A third analysis of variance similar to the second but using percent transfer

(no. trials to criterion of B - no. trials to criterion of A)
no. trials to criterion of A

yielded no significant differences. Nor did a fourth analysis using percent transfer corrected (the number of trials until the beginning of the criterion). Multiple regression analysis was tried next using five situational and three derived variables. The former included model condition, mimic condition, partner of bird B, bird tested and trials to criterion. The derived variables were mean differences between partners, percent transfer and percent transfer corrected. For our

sample there was no linear regression equation which could be used to predict trials to criterion of the B bird to any significant extent.

There have been other studies of the effect of a trained bird upon the learning ability of an untrained one, confronted with negative stimuli (Klopfer, 1958, 1959; Dawson & Foss, 1965). Their conclusions are similar to ours. In Klopfer's studies, greenfinches, used singly and in certain social groupings, were given the opportunity to learn to discriminate between palatable and unpalatable food items, each type being marked differently. The presence of a trained bird did not enable an untrained one to discriminate faster than single birds. Dawson & Foss (1965) using budgerigars, concluded that observational learning, measured as time taken to carry out a task, was not enhanced in observer birds over demonstrator birds.

On the basis of our experiments, plus those of Dawson & Foss (1965) and the later ones of Klopfer (1958, 1959), we conclude that the domain of Klopfer's empathic learning hypothesis cannot be extended to include those cases in which the negative stimuli are relatively mild. While this conclusion does not negate the idea as originally proposed, we suggest that at best, it is restricted to the extreme levels of variables Klopfer has postulated as relevant to model-mimic systems.

References

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Notes

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2. The facilities of the Washington University Computation Center (NSF G-22296) were used; Drs. James Vanderplast, Peter Klopfer, and James Polt helped through discussion and suggestions.