The Kamin effect in fish¹

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The effect of intersession interval on the relearning of an incompletely learned shuttlebox avoidance response in fish was investigated. The results revealed a U-shaped function, with the poorest performance occurring 24 hr. after original learning.

Studies of the relearning of an avoidance response in the shuttlebox have been carried out by a number of investigators (Kamin, 1957; Denny, 1958; Segal & Brush, 1959; Denny & Ditchman, 1962; Brush, Meyer, & Palmer, 1963; Brush, 1964). In each case, the results have indicated the presence of what is commonly referred to as the "Kamin Effect." This phenomenon manifests itself in the form of a decrement in performance at rather specific time intervals during the relearning phase of the experiments. The present study was designed to investigate the possibility of the existence of the Kamin effect at a different phyletic level, since all previous work had been done with the white rat as S.

Method

The Ss for this experiment were 63 experimentally naive goldfish, 2 in. to 3-1/2 in. in length. They were obtained locally and housed for several weeks in 20 gallon community tanks. Two days before training began, they were placed in individual tanks which were heated and continuously aerated. The apparatus was an aquatic shuttlebox built from an 18 in. Betta splendens display tank. The tank was divided into two compartments of equal size by a gray Plexiglas doorway, and was enclosed in a plywood shell which contained two 25 watt bulbs, one at each end of the shuttlebox. The CS was the onset of the light at the end of the compartment occupied by S, and the US was an electric shock delivered through a pair of electrodes set in the ends of the tank. The shock was developed from a 110 volt source passed through a variable resistor and pulsed by a shock interrupter. The shock level used was the lowest voltage required to bring about consistent escape responses on the part of pilot Ss. A pair of Hunter interval timers controlled the onset and duration of the CS and US, and a Standard electric timer recorded latencies to the nearest .01 sec. Six identical shuttleboxes were used.

Each S was given a 30 min. adaptation period in the shuttlebox on the day preceding the beginning of training. Twenty-four hr. later, each S was given 10 pretraining trials during which only the CS was presented. The light followed the fish from compartment to compartment for a period of 20 sec. per trial. Ss were dropped from the study if they avoided the CS on more than 5 of the 10 pretraining trials, or on more than 2 of the last 5 trials.

Three Ss were eliminated for this reason. Three min. after the 10th pretraining trial, original learning trials began and continued until three avoidances had occurred. A delayed conditioning procedure was used, with a 10 sec. CS-US interval, and a 5 sec. shock. A 3 min. intertrial interval was used throughout the study. A response to the CS alone terminated the CS and allowed S to avoid the shock completely. A response during the 5 sec. shock period terminated the light and the shock. The CS and the US were terminated automatically at the end of 15 sec. on those trials where S failed to make a response. Three min. after making the third avoidance, S was removed from the shuttlebox and placed in his home tank for the appropriate intersession interval.

Twelve Ss were assigned to each of five intersession intervals; .08 hr. (5 min.), 1 hr., 4 hr., 24 hr., and 168 hr. (1 week). At the end of their respective intersession intervals, Ss were returned to the shuttleboxes for the relearning phase of the experiment. Relearning for all groups consisted of 40 trials of avoidance training which were the same as those in original learning.

Results

The five intersession interval groups were matched on the basis of the number of trials required to make the third avoidance during original learning. Means for the individual groups of Ss were 11.25, 11.08, 11.00, 11.67, and 11.00 for the .08, 1, 4, 24, and 168 hr. groups respectively, with the grand mean for all five groups being 11.25.

The effect of intersession interval on the number of trials required to relearn to the original criterion of three avoidances can be seen in Fig. 1. This figure shows clearly that rate of relearning was a decreasing function of intersession interval up to 24 hr., but that it was an increasing function beyond that point. Analysis of variance indicated that this effect was significant beyond the .05 level of confidence ($F = 2.67$, $df = 4/55$). The effect of intersession interval on relearning was further observed by plotting the number of avoidances made in successive blocks of 10 trials. No change in the function from that shown in Fig. 1 was observed.

Discussion

The results of this study indicate that rate of relearning in fish is a function of intersession interval. This has previously been demonstrated with rats as Ss by Kamin (1957) and Brush, Meyer, & Palmer (1963). The basic difference between the results of the work with rats and the present study centers around interval time. In the present study, intersession interval seems to have little effect until after the 4 hr. period. The number of trials required to relearn to the criterion

Fig. 1. Mean number of trials required to relearn to the original criterion of three avoidances. The dashed horizontal line at the 11.25 point indicates the grand mean number of trials required to reach the criterion of three avoidances during original learning. Interession intervals are plotted on a logarithmic scale.

avoidance for the .08 hr., 1 hr., 4 hr., and 168 hr. groups differs very little, but the 24 hr. group required more trials to relearn than it did during original learning. Mean trials to criterion during original learning for the 24 hr. group was 11.67, while they required 12.33 trials to relearn to the same criterion. Other research now in progress bears out this relationship.

The 24 hr. decrement is surprising, since previous work indicated that the greatest interference was at the 1 hr. to 4 hr. intervals. A phyletic difference was expected, but not one of this magnitude. It may be that the time periods chosen for this study were not fine enough to locate the true interval of greatest interference. Further research with fish needs to be done with interession intervals closer to the 24 hr. period

than the 4 hr. and 168 hr. intervals used in the present experiment. The phylogenetic difference revealed by this study also suggests that a worthwhile line of research would be one comparing the Kamin effect across a wide range of species.

These data would seem to support the "parasympathetic over-reaction" explanation of the Kamin effect suggested by Brush, Meyer, & Palmer (1963). They suggest that this reaction follows original fear conditioning, and that Ss are ill-equipped to deal with the stress of relearning if the relearning trials are initiated at or near the peak of the over-reaction. Figure 1 indicates that the decrement begins sometime between 4 hr. and 24 hr., reaches its peak around 24 hr. after original conditioning, and returns to its preconditioning level by 168 hr. As stated above, a closer look at time intervals between 4 hr. and 168 hr., with attention focused around the 24 hr. point, needs to be taken.

The results would further suggest that a close look be taken at the common experimental procedure of avoidance conditioning of fish which calls for blocks of 10 or 20 trials separated by 24 hr. periods. The results of such studies must certainly be contaminated by the Kamin effect.

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