The effects of blindness on bluegill, *Lepomis Machrochirus*, activity[1]

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Surgically blinded bluegill, Lepomis macrochirus, *were found to be significantly less active than those with normal vision. Following Hebb's theory, the results indicated that fish do not have an optimum arousal level.*

There have not been any studies concerned with the effects of blindness on the activity of the fish and other nonmammalian vertebrates, e.g., amphibians, reptiles, and birds. However, it has been established that blinded rats (Glickman, 1958) and mice (Wimer & Sterns, 1964) are more active than are those with normal vision. Glickman (1958) postulated that the increase in locomotor activity counteracted the loss of informative visual stimuli so that the organism's optimal arousal level was maintained. Hebb (1955) suggested that this optimal arousal level was only necessary for the higher areas of the brain, i.e., the neocortex. Specifically, to function, the neocortex needs to be in an aroused state. This aroused state, according to Hebb, is maintained by an optimum rate of sensory input. Therefore, if Hebb's theory is correct, the fish, which does not have any neocortex (Brown, 1957), would have no need to maintain an optimal arousal level. It was hypothesized that a loss of vision in the bluegill sunfish, *Lepomis macrochirus,* would not result in an increase in locomotor activity.

SUBJECTS AND APPARATUS

The Ss were adult bluegill sunfish, *Lepomis macrochirus,* of both sexes, approximately 9 cm in length, raised undisturbed in the Fremont High School Science Pond, Sunnyvale, California.

The apparatus was a 48 x 27 x 22 cm glass aquarium with translucent (illumination only) sides. The apparatus was divided into 8 x 9 x 11 cm units so that the activity of the S could be measured three-dimensionally. The aquarium was filled with pond water; the oxygen content and the temperature, approximately 19° C, were consistent with that of the pond.

PROCEDURE

The Ss were caught with unbarbed hooks and divided randomly into two groups. Group B (N = 15) Ss were surgically blinded. To prevent light from reaching the optic nerve, a 1-cm incision was made across the cornea, the lens was removed, moist cotton was placed into the eye cavity, and the cornea was returned to its original position. The entire surgical procedure took less than 45 sec; no anesthesia was used. The nonblinded group, Group NB (N = 15), Ss were handled in the same way except that their eyes were not surgically damaged.

Postoperatively, each S was placed in a pond-water-filled retaining tank that resembled the test apparatus. The Ss were maintained on an ad lib food schedule. After 2 days in the retaining tank, the S was placed into the test apparatus. The apparatus was situated between the direction of the sun and the E; there was sufficient sunlight filtering through the translucent sides of the apparatus to allow the E to observe the well defined outline of the S without the S seeing the E. The number of units that the S traversed in the first 5-min period was recorded; the S was considered to have entered a unit when its head, the area anterior to the gills, was totally within that unit.

RESULTS AND DISCUSSION

A summary of the results is shown in Table 1. The Ss in the blinded group were significantly [Mann-Whitney U test (Siegel, 1956), $n_1 = n_2 = 15$, $U = 55.5$, $p < .02$, two-tailed) less active than were those in the nonblinded group. The smaller activity scores of the blinded Ss could not be attributed to the aftereffects of the operation. There are no pain receptors in the fish cornea or eye cavity (Brown, 1957), the operation was bloodless, and there was no nerve damage; thus, a 2-day recovery period was more than sufficient.

It could be proposed that the nonblinded bluegill were more active because they had not habituated to the apparatus and, therefore, were trying to escape the aversive visual apparatus stimuli. However, this hypothesis does not seem tenable for several reasons. First, the retaining tank and the test apparatus were similar; no new visual or olfactory stimuli were presented in the test situation. Second, when placed in the test apparatus after 2 days of retention, the control Ss did not exhibit the escape behavior that had been seen when they were first placed in the retaining tank, i.e., flurries of extremely high activity that frequently resulted in collisions with the sides of the tank. In addition, bluegill habituation to the apparatus in 2 days is consistent with what has been found in other studies (Thorpe, 1966) dealing with the effects of aquarium life on wild fish.

Table 1
Summary of the Effects of Visual Loss on Bluegill Activity

Group	Independent Variable	N	Median (Units Traversed/ 5 Min)	Semi-quartile Range (Units Traversed/ 5 Min)
B	Blinded	15	56.5	14-100
NB	Nonblinded	15	95.0	49-125

The experimental hypothesis was supported; a loss of visual stimulation did not increase the locomotor activity of the bluegill. It is proposed that no activity increase was found because the fish do not have an optimum arousal level like that suggested for the rat (Glickman, 1958). Following Hebb's (1955) theory, it is further proposed that this is due to the fish's lack of neocortex.

In addition, the blinded bluegill were less active than were those with normal vision. This indicates that if an organism does not have a level of optimum arousal, then the amount of locomotor activity is positively related to the rate of sensory input.

Since the amphibian, reptile, and bird do not have neocortex, it is predicted from the above hypotheses that, when blinded, they will not exhibit any evidence of an optimum arousal level; rather, they will show a decrease in locomotor activity. However, further studies using nonmammilian species should be conducted to determine the validity of these predictions.

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NOTE

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