Reports

Perception of Apparent Motion in the Common Toad

Abstract. A simple and inexpensive apparatus makes possible the feeding of nonliving objects to the toad. The device is used to demonstrate the perception of apparent or "induced" motion. Two methods are successful: (i) toad and food moving together at a constant velocity in a stationary environment; (ii) toad and food stationary with the environment moving. The phenomena are similar to those found in human beings.

Although the common toad is a fascinating specimen for the home terrarium and an interesting subject for the laboratory, its refusal to eat nonmoving food presents something of a problem in maintenance, particularly during the winter. Keeping colonies of earthworms, meal worms, or crickets is troublesome; hand-feeding by waving a pellet of hamburger on a toothpick in front of each individual is tedious. The apparatus described below makes it possible to feed a toad any food that it finds palatable. Hamburger is satisfactory (we maintained several toads for over a year on it), but toads will eat foods other than meat, including laboratory chow, carrots, and some breakfast cereals.

A 1/5 rev/min motor (Haydon Manufacturing Co., No. 8478, 2 watt) was mounted in the center of a strip of wood long enough to straddle the terrarium. A vertical shaft was attached to the center of a 12.9-cm metal disk (we used a lid from a 1-lb can of pipe tobacco). The disk was flush with the ground level of the terrarium. Small pellets of hamburger were placed on the rim of the slowly revolving disk. The toads *(Bufo terrestris)* approached the rim, flicked their tongues, and consumed the food. Five or six toads, each oriented toward the center of the disk, knocking off pellets of hamburger (accuracy, 95 percent) like sharpshooters potting ducks in a shooting gallery, make a spectacular sight. The apparatus might make an interesting demonstration for zoos, children's museums, or a science fair.

Our observation of the toads feeding from the motorized Lazy Susan led to the study of perception of apparent or "induced" movement. Toads frequently crawled onto the turntable itself. They faced the food on the rim, flicked their tongues, and swallowed the food. One hundred observations on 20 toads 2 to 8 cm long revealed 85 successes—that is, tongue flicks followed by consumption of food.

Since toads eat only moving objects, and the toad and food were stationary on the turntable, one concludes that the movement of the background induced the perception of motion. This interpretation is similar to a principle recently stated by Wallach (*1*), which seems to hold for perception of motion in human beings: ". . . visual perception (of motion) follows the rule that keeps the surrounding at rest and bestows motion upon the object surrounded." An example of this characteristic of perception occurs in the railway station when the train on the adjacent track pulls out. One has the sensation that one's own train is moving. Another example is the apparent motion of the moon when seen among drifting clouds.

Even though Honigmann (*2*) in his survey of the literature concludes that there is no convincing evidence that olfactory and visual cues are sufficient to elicit the flicking response in amphibians, a control experiment was performed because of the key importance of this assumption in the chain of reasoning attributing the results of the first experiment to apparent motion. The subjects were placed on a 1-, 2-, and 3-day food-deprivation schedule. The half-hour observation was divided into 5-minute periods. The motor was turned on during alternate periods. No toad tried for the food when the platform was stationary, although several stared at a pellet for a full 5 minutes. When the turntable moved, the toads immediately began to feed.

A consequence of the principle of induced motion is that toads should eat in a situation in which the food and the toad are stationary and the environment moves. This was the case. A cylinder 13 cm in diameter and 21 cm high, constructed of 2-mm mesh window screen and closed at one end (two inner hoops and one lid from tobacco tins were used in its construction) was attached to the motor shaft, the open end down. A band of plain white paper 10 cm wide was placed around the outside of the cylinder. The toad and the food were placed on a white stationary base within the cylinder. Food pellets were placed so as to just clear the inside of the moving cylinder. Feeding was not immediate; there was an interval of from 5 seconds to several minutes before the toads began to eat. Fifteen toads made a total of 100 tries; 80 were successes. One subject failed to respond on the day of the experiment but responded the next day.

Honigmann (*2*), after a most ingenious series of experiments on the toad's perception of "real" motion and several failures to demonstrate perception of "induced" movement, doubted the existence of the latter in lower vertebrates although, on the basis of another study (*3*), he believes that it may occur in birds. Honigmann's apparatus permitted vertical movement of the background, horizontal movement of the background, movement of the food, and movement of the toad, either individually or in combinations. However, the background moved was only that directly in front of the toad. The failure to demonstrate perception of induced movement may have been due to the nature of the visual field of the toad, which, because of the position of the eyes, has a shape roughly resembling an inverted cantaloupe half (360° ×180°). Moving the background in front of a toad changes only a fraction of the visual field. In our experiments a large portion of the visual field was moved.

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References

1. H. Wallach, *Sci. American* **201,** 60 (1959).
2. H. Honigmann, *Proc. Roy. Soc. London* **B132,** 306 (1944).
3. ———, *J. Exptl. Biol.* **19,** 156 (1942).

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Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to *one* 2-column figure (that is, a figure whose width equals two columns of text) or to *one* 2-column table or to *two* 1-column illustrations, which may consist of two figures or two tables or one of each.

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