Earthworms in Behavioral Neuroscience: Nearly a Century of Studies

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Yeke's (1912) examined the ability of earthworms to learn a T-maze. Since then the earthworm has been a subject not only in other T-maze studies but also in North America, where its configuration is 25 cm. However, lumenescent behavior is not easy to maintain in a laboratory environment; it lives naturally in a permanent form that can be as deep as 1 or 2 cm. Even if the proper habitat is created in the laboratory, retrieving the worm for study would be difficult. Two other species, relatively large, are easily capable of being maintained in a laboratory because they are epiptic — live in loose soil litter or burrow very shallowly in loose dirt. These two species, Eudrilus eugeniae and Eisenia fetida (respectively the African and European nightcrawlers) are far less common in behavioral studies but are the species with which I am working.

Earthworm Species

Earthworms comprise thousands of different species. One, Lumbricus terrestris, the European nightcrawler, has been the focus of most of laboratory studies, possibly because it is the largest worm readily available in Europe (respectively the African and European nightcrawlers). Following his lead, many others used this T-maze procedure with earthworms until 1975, when Rosenkoetter & Boice demonstrated that it is a maze in earthworms and used it to show the behavior to reward; worms start preferring one of two equally)-(2)

Instrumental Learning

In the present study, the authors used the T-maze procedure with earthworms until 1975, when Rosenkoetter & Boice demonstrated that it is a maze in earthworms and used it to show the behavior to reward; worms start preferring one of two equally)-(2)

Pavlovian Learning

Classical conditioning studies are a challenge in earthworms because of their limited sensory capabilities. Among the stimuli that have been employed are light, vibration, and odor. Pavlovian conditioning in earthworms have been accomplished with various procedures: conditioning, habituation, and withdrawal.

Running Wheels

Several versions of running wheels have been used for earthworms, with varying speeds up to 30rpm reported. Wheels have been as simple as a piece of clear plastic tubing placed around the circumference of a tape reel, and as elaborate as a milled trackway in a machined piece of Plexiglas. In all cases, the wheel is the minimal apparatus needed for an experiment. The rat and mouse are the most popular animals for running wheels, but earthworms running wheels have been implemented for earthworms as well. Running wheels of Marion & Abramson (left) and the author (right) are shown in Figure 4.

Surgical & Anatomical References

Some surgical manipulations of the comparatively simple nervous systems of worms have tended to be crude. Ratner & Stein (1965) describe the following procedures. The group was not anesthetized; each was placed on the dissecting board. The animal was then cut with a razor blade and was returned to be fixed for 48 hr.

Other procedures, including Ratner & Stein in other surgeries described in the present paper, have suggested additional manipulations that involve small surgical incisions and careful removal of various ganglia. It is also possible to cut the fiber bundles connecting the supra- and subesophageal ganglia, or to divide the left and right sides of these ganglia.

An oblique cut is made from a red plastic flying disc. See CAMPUS. ALBION.EDU/WILSON/RESEARCH for a video of a worm in a T-maze.

References


The Canadian Journal of Neurological Sciences, 17, 161–165. [Y-maze; shock]

The Psychological Record, 5, 310–315. [Milled plastic; light/dark effects]

Running wheels of Marion & Abramson (left) and the author (right) are shown in Figure 4.

The American Biology Teacher, 43, 1–14. [Suprapharyngeal ganglion removed; sensory axons]

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