Visual discrimination in deermice¹

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Five species of deermice (*Peromyscus*) were tested for a light-on, light-off discrimination with water reinforcement. All species acquired the discrimination similarly, but the number of bar pressing responses during the S^D differed among the species. Species-specific reactions to the water deprivation and the test situation could account for the S^D response rate differences.

Comparisons of behavior among closely related species can suggest the nature of the selective forces responsible for the evolution of species-specific behavior patterns. Since species-specific behavior is largely a product of natural selection operating in the native environment of that species, small differences in behavior related to a particular environment may indicate the causal mechanism. Differences in age of eyelid-opening and adult lens size (adjusted for body weight) among several species of the rodent genus *Peromyscus* (deermice) (King, 1965), suggest that some visual process has been differentially selected in the environment characteristic of each species. The purpose of this investigation was to ascertain whether this visual process was related to attention to a visual cue. The readiness with which a species learned a simple light-off, light-on discrimination could indicate attentiveness to the visual cues. The operant procedures described by Herrick, Myers, & Korotkin (1959) and Pierrel & Sherman (1962) were used for this purpose.

Method

Ten Ss from each of five species and subspecies were tested: *Peromyscus maniculatus gracilis*, *P. m. bairdii*, *P. leucopus*, *P. eremicus*, *P. floridanus*. The laboratory history of these stocks is described in King (1965) and King & Weisman (1964). Their geographic distribution, phylogenetic relationships, and habitats are given in Hall & Kelson (1959).

Two identical plastic boxes 4.5 in. by 5 in. by 6 in. high were used as test chambers. Solenoid operated fountains (Polidora & Meyer, 1961) delivered 0.04 cc water. The S^D was a disc of projected light from an Industrial Electronic Engineers, Inc. display cell. The test chambers were in a sound deadened, temperature controlled room at 70°F. Programmers and relay circuits in another room controlled the length of S^D and S^A periods and independently presented a VI 1 min. schedule of reinforcement during S^D periods.

Ss had food available ad lib in home cage, but water was available only in the test chambers. Ss were shaped with continuous reinforcement from 2-4 days and trained on the VI 1 min. schedule in the presence of S^D for 1 hr. each day over the next 3-5 days. During discrimination, all Ss had water reinforcement on the VI 1 min. schedule during S^D periods (light-on) and no

Fig. 1

reinforcement during S^A periods (light-off). S^A periods of 2, 4, and 6 min. were alternated with S^D periods of 1, 2, and 3 min. for a 1 hr. test period providing 40 min. S^A and 20 min. S^D . Each S was tested 1 hr. per day for 20 days. Extraneous stimuli were controlled by disconnecting S^D lights for an additional test day of an hour. Without the light, Ss bar pressed at a constant rate throughout the test hour.

Results

Figure 1 shows the mean number of bar presses during S^D periods averaged over four day blocks. The rate of pressing remained more or less constant over sessions ($F=1.502$, $df=4/180$), but this "constant" rate was different for each species ($F=4.923$, $df=4/45$, $p<.01$). Individual comparison between species (Duncan's test, $p<.05$) showed that *P. m. bairdii* and *P. eremicus* pressed more frequently during S^D periods than *P. leucopus*, *P. floridanus*, *P. m. gracilis*.

The results of discrimination training on the discrimination ratio (S^A responses/ $2S^D$ responses) are shown in Fig. 2. The discrimination ratio decreased over days for all species ($F=69.75$, $df=4/180$, $p<.001$). The species all appear to have learned the discrimination at the same rate since neither the main effect for species ($F=1.290$, $df=4/45$) nor the interaction with sessions ($F<1.0$, $df=16/180$) was significant.

Fig. 2

Discussion

The five species and subspecies tested in this experiment are morphologically similar except for the divergence in relative eye size indicated by fresh lens weight, which ranged from 0.87 mg lens wt/gram body wt. in *P. eremicus* to 1.25 mg/g in *P. floridanus* (King, 1965). Despite this divergence of eye size, the light served as an adequate cue to all species tested. Furthermore, all species were equally capable of learning the discrimination. Apparently the phylogenetic and ecologic divergence of these species has not resulted in differences in their capacity to make a simple visual discrimination. The divergence in eye size requires an alternative explanation which is not readily apparent.

The primary difference in this study is in the number of bar presses during S^D . Since none of the species changed bar-pressing rates significantly over the 20 sessions, the different rates suggest species-specific behavior in the response required or in the motivational levels. All species pressed the bar easily, but direct observations of their pressing behavior revealed interesting differences. *P. eremicus* was exceedingly active and leapt about the chamber, frequently striking the bar in the process of leaping. Some individuals of

P. m. bairdii grasped the bar in their teeth and shook it vigorously. Both behaviors could account for the high rates in these two species. *P. floridanus* often depressed the bar, but not far enough to make it operate. *P. leucopus* pressed the bar adequately, but they tended to sit motionlessly in a corner of the chamber.

Motivational properties of the water may vary in accordance with the availability of water in the habitats of the mice. *P. eremicus* is an inhabitant of the desert; *P. m. bairdii* inhabits grasslands; and *P. leucopus* and *P. m. gracilis* are from mesic forest habitats. Although *P. floridanus* inhabits areas of heavy rainfall, Fertig & Layne (1963) found their habitat to be xeric. Water consumption per gram body weight is not conspicuously different among these species (Lindeborg, 1952). While motivation for water has yet to be systematically examined, their response to water deprivation may be more critical. For example, *P. leucopus* may have been subdued by water deprivation and the novelty of the testing situation. In contrast, the same situation may have excited *P. eremicus* and *P. m. bairdii* to hyperactivity and frequent accidental bar presses.

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Notes

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