

Prey recognition learning by red spitting cobras, *Naja mossambica pallida*

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Eleven ingestively inexperienced red spitting cobras (*Naja mossambica pallida*; 4 weeks old) failed to respond to food items (neonatal mice, *Mus musculus*, and live lizards, *Sceloporus undulatus*). Live prey were inside clean plastic boxes that were placed into snake cages for 5 min. Rate of tongue flicking and number of biting attacks were recorded. The cobras were then offered neonatal mice (but not lizards), and gradually, these prey were accepted. By the end of the 5th week, all snakes had eaten at least one mouse. From this time until the snakes were 10 months old, mice were offered once each week, and most snakes ate each week. Prey recognition tests were conducted again (at 10 months), and the snakes responded to mice but not to lizards (*Anolis carolinensis*). It is concluded that increased response to mice between the 1-month and 10-month tests was not based on increased predatory motivation and/or acclimation to the laboratory, because these factors should also produce increased response to lizards. Accordingly, it seems probable that experience with mice resulted in the acquisition of stimulus control by mouse-derived cues over snake predatory behavior (i.e., prey recognition learning).

Recognition of certain natural prey and associated predatory behaviors are innate in many ophidian species (see Burghardt, 1970, 1980, for reviews). Yet, prey preference of some species can be altered by experience (Arnold, 1978; Burghardt, Wilcoxon, & Czaplicki, 1973; Fuchs & Burghardt, 1971; Loop, 1970; see Burghardt, 1977, for a review of reptilian learning). Cobras appear to exhibit similar behavior modifications, as may be inferred from reports (Finstrom & Winton, Note 1) about initial failures and eventual successes experienced in inducing captive specimens to accept foods that they would not encounter in nature (see Oliver, 1956, for an exception). The purpose of this study was to record measures of prey recognition by ingestively inexperienced hatchling red spitting cobras (*Naja mossambica pallida*) and to determine if systematic changes occurred in these measures as a consequence of feeding experience.

METHOD

Eleven *N. m. pallida* selected from two litters hatched (August 1-4, 1980) at the New York Zoological Park were shipped to the University of Colorado (August 25, 1980). The snakes were not fed prior to shipment. Snakes were housed in individual glass terraria (50 x 27.5 x 30 cm) containing glass vessels filled with water, paper floor coverings, and cardboard hide boxes (10 x 10 x 2.5 cm). Electric heaters kept the ambient temperature at 26°C ± 1°C during photophase (0700-1900 h) and at 23°C ± 1°C during scotophase.

Five days after arrival, hide boxes were removed, and on the next day, each snake was observed for 5 min in each of three

We thank John L. Behler and the New York Zoological Society for the specimens of *N. m. pallida*. Reprint requests should be sent to D. Chiszar, Department of Psychology, University of Colorado, Boulder, Colorado 80309.

conditions: (1) control—an empty, clear Plexiglas cube (9 cm/edge, walls 6 mm thick, and perforated with 25 6-mm holes) was placed into the cage about 2 cm from the snake's snout; (2) neonatal mouse—a cube identical to the control but containing a live, 5-day-old neonatal mouse (*Mus musculus*) was placed into the cage; and (3) lizard—a cube identical to the control but containing a live adult lizard (*Sceloporus undulatus*; about 6 cm snout to vent, S-V) was placed into the cage. Each snake experienced each cube in a random order; intertrial interval was 20 min. The dependent variable was number of tongue flicks emitted during the 5-min trials.

One hour after completing these tests, a live neonatal mouse was offered to each snake, and all snakes ingested their prey within 24 h. Similar food was then offered on a weekly schedule for the next 9 months. Lizards were never offered. Gradually, snakes were shifted from newborn mice to recently furred pups. When the snakes were 10 months old, they were tested under four conditions: (1) control—as before; (2) neonatal mouse—as before; (3) furred mouse—a cube identical to the control but containing a 12-day-old mouse was placed into the cage; and (4) lizard—as before, except that a specimen of *Anolis carolinensis* (about 6 cm S-V) was in the cube. Each snake experienced each stimulus condition for 5 min; order of presentation was randomized, and intertrial interval was 20 min.

RESULTS

Mean rates of tongue flicking (per minute; RTFs) for all stimulus conditions are shown in Figure 1. When the cobras were 1 month old, they did not respond to the mouse or to the lizard, as indicated by the absence of significant differences between RTFs directed to control, lizard, and mouse (three columns on the left side of Figure 1). Differences were evaluated by two-tailed sign test (Lentner, 1975; all $ps > .05$). Another sign test compared the two control tests (1 month vs. 10 months), and the difference was not significant. Also, RTFs during the 10-month control test did not differ from the RTFs emitted to the 10-month lizard

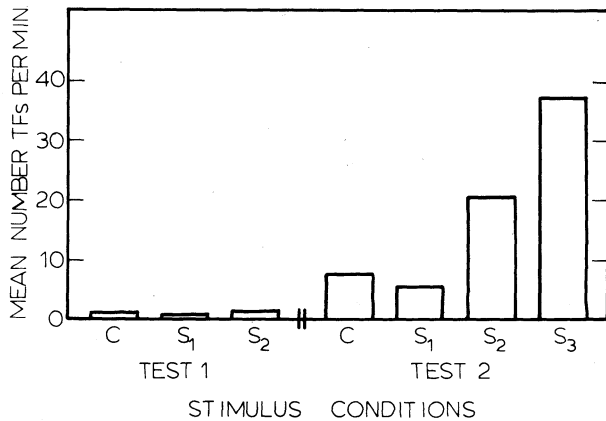


Figure 1. Mean number of tongue flicks per minute directed by 11 *N. m. pallida* at stimuli presented when snakes were 1 (Test 1) and 10 (Test 2) months old. C = control, S₁ = lizard, S₂ = 5-day-old mouse, S₃ = 12-day-old mouse; see text for further details and for statistical analyses.

stimulus. However, RTFs during both 10-month tests with mice differed significantly ($p < .05$) from RTFs emitted to all other stimuli, but not from each other ($.10 > p > .05$).

Moreover, during the 10-month tests, eight of the cobras made immediate and vigorous head contact with both cubes containing mice, as if attempting to penetrate the Plexiglas and attack the mice. Such snout pushing never occurred with the control cube or with the cube containing the lizard. Snout pushing never occurred during tests conducted when the snakes were 1 month old.

Finally, during Feeding Sessions 1-3 (i.e., when the snakes were 5, 6, and 7 weeks old), the cobras behaved as if they did not recognize live neonatal mice as food. No cobra struck immediately, and most did not strike for several hours. On the fourth feeding session, all cobras accepted mice immediately, and this pattern continued throughout the study.

DISCUSSION

That cobras did not respond to mice at 1 month of age but did so later is not automatically evidence of learning. It could be that predatory motivation and/or acclimation to the laboratory increased after the first test, or it could be that subsequent feeding experience caused some increase in attentiveness to food-related stimuli in general, rather than to stimuli specifically associated with mice. However, all of these ideas suggest that the

snakes should have responded to the lizard during the 10-month test. Because the cobras did not respond to the lizard, it is concluded that their attentiveness to mice was based on their recognition of these specific stimulus items as prey and that experience with mice was required for the development of this recognition.

It is not here suggested that *N. m. pallida* can learn to accept any prey that might be offered. Instead, it seems more likely that organisms resembling those that *N. m. pallida* is innately prepared to attack will be most readily assimilated into the feeding repertory. In any case, the present data strongly suggest that *N. m. pallida* learned to use specific features of neonatal *M. musculus* as releasers for predatory behavior and that such learning did not transfer to stimulus features of lizard prey with which the snakes were unfamiliar. If some snakes had been raised with lizard prey, and if these snakes responded to lizards but not to mice at 10 months of age, this conclusion would be more firmly supported.

REFERENCE NOTE

1. Finstrom, M., & Winton, K. Personal communication, 1981. (Unpublished observations on captive elapids at Knoxville Zoo, Reptile Department.)

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(Received for publication November 23, 1981.)