in "inhibitory" generalization gradients instead as generalization around S^D is clearly more parsimonious. R_2 is never directly observed unless all stimuli except S^D set the occasion for R_1 , e.g., Brown & Jenkins (1967), Johnson, Kinder, & Scarboro (1969), otherwise absence of R_1 may mean the presence of either R_2 or $\bar{R}_1 \cup \bar{R}_2$. Maintenance of the excitatory-inhibitory gradient distinction in Jenkins's sense derives from identifying different physical specifications for a white vertical line and a field of 490-nm light (as in Terrace, 1966) or unlit, black vertical line on a white lit background and a fully white lit key (as in Honig et al, 1963). But behavioral equivalence is an empirical matter, and Lashley (1938) observed generalization of R_1 between many stimulus pairs of different physical specifications. If orthogonal physical dimensions guaranteed stimulus control independence, it would be impossible to understand how Jenkins & Harrison (1960), who first found flat generalization gradients for pigeons across tonal frequency, later found peaked gradients across frequency following discrimination training between tone and no tone! Generalization of inhibition must be observed in the same circumstances in which inhibition is unequivocally identified.

The foregoing suggests that errorless discrimination training makes S^D control quite independent of S^A dimensions except those on which generalization may have been previously trained, such as brightness, by natural or experimental conditions.

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Prey selection in naive *Elaphe obsoleta* (Squamata: serpentes) — A reappraisal*

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Naive hatchling *Elaphe obsoleta* were exposed to extracts prepared from prey eaten by young (lizard, frog) and adults (mouse, bird, rat). A preference was shown for the frog (*Hyla*) extract, a favorite food of young of this species. Young will also accept adult prey species provided they are cut into small pieces. This suggests that prey size is an important determinant of the feeding response in this species.

A body of literature is growing which indicates that newborn snakes of various species demonstrate clearcut preferences for extracts prepared from natural prey species over nonprey species (Burghardt, 1966, 1967, 1969). These studies are all based on relatively prey-specific species or, at least, species which eat the same prey throughout their lives. A recent study (Morris & Loop, 1969), utilizing *Elaphe obsoleta*, a species which varies its prey as growth proceeds, suggests that naive young of such species are less specific in their response to animal extracts. The data Morris and Loop presented indicate feeding habits for the species at variance with the experience of herpetologists familiar with *Elaphe obsoleta* and suggest a more complex picture of the stimulus controls of prey attack in naive snakes than that indicated in the studies by Burghardt. The present data were gathered incidentally to a study of the role of experience in shaping the food preference in this species and suggest an interpretation different from that presented by Morris and Loop.

METHOD

Fourteen Ss were obtained from eggs from a female *Elaphe obsoleta* collected in

Butler Co., Pennsylvania. They were normal in size, color, pattern, and morphology for the species. The stimulus items were extracts, prepared by Burghardt's (1966) method, of laboratory rat and laboratory mouse (strains uncertain), fish (whiting), domestic chick (*Gallus*), earthworm (*Lumbricus*), lizard (*Anolis carolinensis*), and frog (*Hyla squirella*). Distilled water served as control.

The Ss were housed in individual gallon jars with cheesecloth covers at a temperature of 24°C to 28°C and were tested initially 1 month after hatching. Each extract was presented once only in a random order, different for each S, with the constraint that the control be presented first and last always. Extracts were introduced into the jar at 2-min intervals on a standard 15-cm cotton swab and brought to within 2 cm of the snake's snout. After 30 sec, if no attack occurred, the swab was slowly moved forward until it touched the snout, then withdrawn 2 cm. The scoring method devised by Burghardt (1966) was used, except that attack latency was measured to the nearest 1 sec rather than to the nearest 0.01 min.

RESULTS

Considerable individual variation was evident in the responses of the Ss. These, in general, reflected the overall response of the Ss to the experimental situation; some

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Fig. 1. Mean tongue-flick/attack score for each stimulus item.

Ss initially tried to escape their cage, others demonstrated defensive postures and others responded, initially, with overt aggressive displays. In general, the defensive and aggressive individuals provided the highest response rates, those inclined to escape responded much less.

In the 117 trials five attacks were recorded. In the remaining trials the number of tongue flicks to a single extract ranged from 0 (2 trials) to 68 (2 trials). One S did not respond in the test situation and has been deleted from the data that follow. Figure 1 presents the mean score for each stimulus extract. The highest score was obtained to the frog extract, and this is the only stimulus to evoke more than one (3) attack. One attack each was elicited by lizard and worm extract.

Due to the variability in the total number of responses given by each S (77-417), the data were normalized by expressing each S's score for each stimulus item as a percentage of that S's total score. Friedman's two-way analysis of variance (Siegel, 1956) was then used to analyze the data. A first test across all stimulus items showed a significant difference ($p < 0.01$). A second test across all items, excluding the control, also showed a significant difference ($p < 0.02$). A third test across all stimulus items, excluding control and frog extract, showed no significant difference ($0.2 < p < 0.3$). The conclusion is that the responses to the prey-object extracts differed from the response to the control and that, within the prey-object extracts, only the frog extract elicited a significantly distinct response.

It is important in dealing with species such as *Elaphe obsoleta*, which can be

quite aggressive each as hatchlings, to recognize the difference between a positive food-grasp attack and an aggressive/defensive attack where no attempt to feed is indicated. Both types of responses are quite probable in this experimental situation, with this species, and are obviously not equivalent in regard to our interest in the stimulus control of the feeding response. In addition, it was noted that aggressive individuals had a much higher tongue-flick rate than did defensive or escape-oriented individuals. The overall response to the test situation, thus, can be a significant nonfood-related variable that needs to be taken into account when scoring these tests.

DISCUSSION

Contrary to the statement by Morris and Loop, frogs constitute an important, if not the major, food item for young *Elaphe obsoleta*. Hatchling individuals will also accept lizards of convenient size, baby mice, mouse legs, and chick legs, although exposure to whole adult mice or chicks frequently results in trauma, which will block proper feeding responses for variable, and often extended, periods of time.

The data presented here clearly show a preference for frog as a prey item by naive *Elaphe*, in keeping with the natural history data available for the species. This is similar to the response curves obtained by Burghardt for species of *Thamnophis*, which show a clear preference for normally eaten prey. The low score for frog obtained by Morris and Loop may have resulted from their unfortunate selection of *Rana* as a source of the test extract. Many of the species of this genus possess noxious skin secretions that render them unpalatable to

many predators. *Hyla squerrila* is used as a standard food item for young *Elaphe* by reptile fanciers in the southeastern United States.

Six of the Ss used here were presented with live 3-5 g *Anolis carolinensis* several days after the first test session. None of the *Anolis* were eaten over a 24-h period. Subsequently, these same six Ss were presented with live baby *Mus*. Three Ss ate their mouse within a 2-h period. Inasmuch as *Anolis* was among the highest and *Mus* the lowest scoring of the test extracts, some question is thrown on this test method as a predictor of food preference in this species. Morris and Loop obtained similar results with their Ss: an acceptance of the relatively low-scoring baby *Mus*, which they suggested indicated a willingness to accept the other, higher-scoring items, *Rattus* and fish. Fish is seldom, if ever, acceptable as food to young, or adult, *Elaphe* and live adult *Rattus* elicit violent defensive and escape reactions. Possibly these test data indicate a general arousal level to a stimulus, combining defensive, aggressive, and fear responses, as well as the feeding response. A more fine-grained analysis of the present data is currently under way to determine if this complex of responses can be individually identified by a more thorough behavioral analysis.

As Morris and Loop point out, *Elaphe obsoleta* adults take prey unsuitable as food for small individuals. The readiness with which young *Elaphe* accept small portions of chick or mouse and their defensive response to whole, live individuals suggest that prey size is important in their feeding response. The variable food preferences of captive adults suggests that experience may also play an important role in establishing or modifying food preference. Under natural conditions, the establishment of feeding preferences in this and similar species is probably regulated by a complex interaction of experience and developmental changes. This is a fascinating area for future examination.

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