Lick rates and topographies as taxonomic criteria in southwestern rodents¹

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Lick rates and stereotyped patterns of licking were compared in eight species of rodents: Neotoma micropus, Neotoma albigula, Neotoma mexicana, Dipodysmus ordii, Onychomys leucogaster, Eutamias quadrivittatus, Sigmodon hispidus, and Rattus norvegicus. Although previous research with laboratory rodents suggested that lick rates might be species specific, there were overlaps of mean lick rates per sec within and between genera. Ritualized patterns of licking to noncontingent stimuli were apparently more sensitive to species differences in behavior.

Two conditions must be met if, as Schaeffer & Huff (1965) suggest, the licking behaviors of rodents may be criteria for use in taxonomic classification. First, there must be evidence for the innateness of the response since zoological taxonomy recognizes only genetically determined characteristics (King & Nichols, 1960). The reflexiveness of the domestic rat's licking response is well established with a mean of six to seven licks per second independent of age, deprivation state, or type of nonviscous solution (Schaeffer & Premack, 1961; Keehn & Arnold, 1960). Second, the behaviors must effectively differentiate species within and between genera. To date, studies of lick rates have used only two species of rodents, the domestic Norway rat and the domestic hamster (Schaeffer & Huff, 1965).

This study reports some preliminary findings of research aimed at delineating reflexive constancies of licking behavior in rodents selected for reasons of genetic similarity and type of water balance. Licking is considered simply, in terms of mean rate and range, and complexly, in terms of patterns similar to serial homologues (Tinbergen, 1959). Taxonomic differences are examined in rodents from three families and six genera, three species of which are closely related (*Neotoma micropus*, *albigula*, *mexicana*) and two of which (*Dipodysmus ordii* and *Onychomys leucogaster*) can survive without drinking (Schmidt-Nielsen, 1965).

Method

Each group of Ss consisted of four (two males and two females) wild-caught adults from the following species: (a) pack rats—*Neotoma micropus*, *albigula*, and *mexicana*; (b) cotton rats—*Sigmodon hispidus*; (c) Colorado chipmunks—*Eutamias quadrivittatus*; (d) Norway rats—*Rattus norvegicus*; (e) grasshopper mice—*Onychomys leucogaster*; and (f) kangaroo rats—*Dipodysmus ordii*. Except for the cotton rats, which were trapped in San Antonio, Tex., the animals were trapped in the Albuquerque, N. M. area. All Ss were maintained in individual cages from capture with ad lib Wayne Breeder Blox.

The lick-box apparatus is described elsewhere (Boice & Denny, 1965). Essentially, it was a plastic box with inside dimensions of 8 x 4 x 8 in., a stainless steel grid floor, and an enclosed drinking well at one end. Individual drops of water (.20 cc; see Hulse, 1966) were pulsed via a Skinner valve to the tip of a 17 gauge hypodermic needle (ground flat and smooth) which projected vertically into the drinking well. Licks were measured by a Grason-Stadler lickometer. The CS was a 10 W bulb mounted next to the drinking well.

Following 10 days of unrestricted water and six days of water deprivation (1 h per day availability), all Ss were run individually for 100 conditioning trials. Trials consisted of a water drop (UCS), preceded and succeeded by a 2 sec CS presented every 35 sec. Licks were recorded in 1 sec intervals on digital counters. Mean lick rates were computed on the basis of counts in which there were no noticeable pauses during the interval.

Results and Discussion

Table 1 indicates ad lib and time restricted water intake of each of the species before testing. These data closely replicate those of Boice & Boice (1967) and suggest the suitability of thirst as a motivator in desert rodents. The kangaroo rats showed stable water intake in both conditions despite the claims of some authors (e.g., Morris, 1965) that these animals never drink water.

The overall ranges and ranges of mean lick rates between Ss appear in Fig. 1. Uninterrupted 1 sec intervals of licking most typically occurred immediately upon the presentation of the water drop. Every animal showed a consistent mean lick rate over trials with a decrease in uninterrupted bursts of licking as conditioning occurred. There were no discernible sex differences in licking behavior for any of the species. Although there are some apparent differences in mean rates and overall ranges between species, licks per second may not be species specific.

Table 1. Mean water intake preceding testing in lick box

Genus	Species	N	24 h/day available	1 h/day available
<i>Neotoma</i>	<i>micropus</i>	4	53.7	11.9
<i>Neotoma</i>	<i>albigula</i>	4	38.6	9.8
<i>Neotoma</i>	<i>mexicana</i>	4	48.1	8.2
<i>Dipodysmus</i>	<i>ordii</i>	4	8.7	4.2
<i>Onychomys</i>	<i>leucogaster</i>	4	8.6	3.5
<i>Eutamias</i>	<i>quadrivittatus</i>	4	14.8	4.6
<i>Sigmodon</i>	<i>hispidus</i>	4	12.6	7.1
<i>Rattus</i>	<i>norvegicus</i>	4	32.4	8.9
	(wild)			
<i>Rattus</i>	<i>norvegicus</i>	4	35.0	10.3
	(domestic)			

Two of the pack rat species (*N. albigula* and *N. micropus*), which sometimes share the same habitat in the Albuquerque area, were quite similar in terms of rates. A third species, *N. mexicana*, which lives at higher elevations, can be differentiated from the first two using lick rate criteria. It is interesting to note that the Mexican pack rats demonstrated many behavioral differences in the laboratory, thumping with both back feet, for instance, instead of one as with the other pack rats.

None of the new world rodents (Cricetids) had a range or mean lick rate as high as that of the old world rodents (Murids), the Norway rats. There was no apparent difference in ranges or means of lick rates between the wild Norway rats and a group of domestic Norway rats used as controls.

Ethologists use differences in ritualized patterns of behavior, serial homologues, to classify species (e.g., Tinbergen, 1959). It may be possible to view lick topographies (Fig. 2) as serial homologues, in that markedly stereotyped patterns of licking occur during and around the CS for all species. Figure 2 represents modal topographies which dominantly typified each of the groups before conditioning began. The most striking differences in the lick topographies show in the conservativeness of licking, both in terms of burst length and position of high-rate intervals. This method of comparison, for instance, suggests that an effect of domestication in the Norway rat is the greater stability of licking in response to a CS and UCS. Figure 2 also depicts the relatively erratic style of licking in the kangaroo rats and Mexican pack rats, and the more consistent style of the other pack rats.

In either lick rates or lick patterns, there was re-

Fig. 1. Overall ranges (unshaded) and range of means (shaded) of lick rates per sec.

Fig. 2. Modal lick topographies from early acquisitions showing licks per sec before the water pulse (light-shaded) and after the water pulse (dark-shaded).

markable consistency within Ss and little variance between Ss of the same species. Either type of measure of licking behavior may not be able to stand alone as a classifier but the combination of both should add valuable aid in the use of behavior as taxonomic criteria in rodents.

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Note

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