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Sand bathing behaviour of Indian gerbil *Tatera indica indica* Hardwicke

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Abstract. The Indian gerbil, *Tatera indica indica* Hardwicke, bathes by alternately rubbing its flanks (side-rubs) in the substrate, such as sand. Bathing frequencies are ordinarily low; but significant increments follow modifications made in pelage condition. When these are asymmetrical, more actions are directed towards the treated than the untreated side. Evidently, peripheral input regulates the behaviour.

Keywords. Sand bathing; side rubs; ventrum drag; coat care; *T. indica indica*.

1. Introduction

Most rodents possess an integrated system of behaviour for coat care (Griswold *et al* 1977). This includes washing of face, grooming and scratching (Barnett 1975). It is, however, observed that a number of species, particularly heteromyids and gerbils, bathe in substrates such as sand or dust to dress their fur (Eibl-Eibesfeldt 1951; Eisenberg 1963).

Sand-bathing behaviour of Indian gerbil, *Tatera indica indica* Hardwicke has however, not been studied. Results of experiments designed to study it are discussed here.

2. Material and methods

Adult gerbils trapped from fallow lands around Aligarh City were housed separately in wire-mesh enclosures (1.32×1×0.32 m). Wooden nest-boxes with paper strips were supplied for nesting; sand in dissection trays was given for bathing. The gerbils were fed on a mixed diet of cereals and vegetables; water was given *ad lib.* The experimental subjects were released in an all-glass acquarium (0.9×0.45×0.35 m) with a 10 cm layer of sand for substrate. The substrate was changed after each test. The aquarium was placed in a room fitted with 60W red bulbs for lighting. The observer sat at a distance of 2 m from the glass-front.

2.1 *Experimental procedure*

As the gerbils are nocturnal, all tests were made early in the activity period (1800—1930 hrs). Subjects were observed for 10 min intervals; actions were counted manually and timed by stop-watch.

The subjects were included at random in bisexual groups. Except for one group (controls 20 gerbils), gerbils of the other groups were tested after one of the following pre-treatments.

(a) *Deprivation treatment:* The sand-trays were removed for a week and the gerbils were individually studied.

(b) *"Wetting" of pelage*: Gerbils selected for this treatment were showered with water and observed in the test arena.

(c) *Application of oil to pelage (symmetrical modifications)*: Symmetrical changes in pelage condition were made by applying 10 drops of lubricating oil to both the right and left sides of each subject.

(d) *Application of oil to pelage (asymmetrical modifications)*: Oil drops were again used to alter the pelage on (i) right side only, (ii) left side, (iii) back and (iv) ventrum of gerbils belonging to four separate groups.

The results were statistically analyzed according to methods described by Bailey (1959) and Lehner (1979).

3. Results

The results are presented in table 1.

3.1 *Description of movements*

As observed, the sand-bathing behaviour of *T. indica* consisted of 'side-rubs'. It included well-coordinated movements or alternate extension and flexion of the body. These occurred rapidly as the gerbil shifted from one side to other. The two sides were thus attended alternately.

Another component identified was 'ventrum-rub' often displayed by male gerbils. It involved rapid extension and flexion of the body in a 'stretching' position. Lowering of the body on the substrate and dragging it in a forward direction, occurred separately from ventrum-rub. This did not involve any stereotype actions. Rollings on back were not seen.

3.2 *Bathing frequencies*

The untreated subjects released into the test-arena, were observed to bathe between bouts of exploratory activity. The number of actions was, however, limited to two at the most, in a 10 min observation period.

3.3 *Relative frequencies after deprivation*

The gerbils denied access to sand for a week displayed relatively more bathing by side-rubs than controls (Wilcoxon test; $P < 0.05$). The scores of actions were significantly higher for males than females ($x^2 = 12.5$; $P < 0.05$).

The number of actions directed towards the two sides were equal (Right rubs = 5.00 ± SE 0.33; Left rubs = 5.00 ± SE 0.33; table 1). Rubs were, however, made at irregular intervals; there was much exploration, but very little sand-digging.

3.4 *Effect of "wetting"*

After 'wetting' of pelage, the gerbils bathed intensely by side-rubbing. The increment in the number of actions as compared to bathing frequencies in

Table 1. The number of rubs performed by gerbils on each flank after various treatments given.

Expt. No.	Description of Subjects – sex, body wt (g)	Treatment	No. of actions (Mean ± SE)	
			Right rub	Left rub
1	3 M (150, 157, 158) 3 F (103, 130, 140)	Deprivation	5.0 ± 0.33	5.0 ± 0.33
	2 M (152, 160) 2 F (121, 131)	Control	1.0	1.0
2	3 M (134, 148, 152) 3 F (125, 134, 142)	Wetting	19.66 ± 4.48	18.33 ± 4.18
	2 M (141, 171) 2 F (123, 141)	Control	2.0	2.0
3	2 M (124, 165) 2 F (125, 152)	Symmetrical modification by oiling	12.0 ± 0.707	11.25 ± 1.118
	3 M (141, 131, 149) 1 F (171)	Control	1.0	1.0
4	2 M (148, 168) 1 F (132)	Asymmetrical modifications by oiling (a) Left side	3.00 ± 1.411	20.66 ± 0.59
	1 M (152) 2 F (131, 138)	(b) Right side	21.33 ± 1.23	2.66 ± 1.7
	1 M (132) 1 F (132)	(c) Back	13.25 ± 0.87	14.25 ± 1.167
	1 M (172) 1 F (137)	(d) Ventrum	3.0	3.0
		Ventrum drag		3.30 ± 1.30
	2 M (108, 138) 2 F (101, 103)	Control	2.0	2.0
		Ventrum drag		0.0

'*t*' comparisons between treated and controls were found significant ($P < 0.05$) in each case.
M = Male; F = female.

untreated subjects, was obviously significant (Wilcoxon test; $P < 0.05$; table 1).

However, the same side was often rubbed in a sequence of 2-4 actions before attention was turned to the opposite flank. Thus the number of actions recorded on the two sides, was not always equal (left rubs = 19.66 ± SE 4.48; right rubs = 18.33 ± SE 4.18; table 1). The differences were not significant.

Exploratory activity and sand-digging were observed very late.

3.5 *Effect of symmetrical modifications in pelage condition*

Symmetrical modifications made in pelage condition by application of oil resulted in a large number of actions directed alternately towards the two flanks (table 1). The increments in bathing frequencies was significant (Wilcoxon test; $P < 0.05$).

Rubbings were, however, performed slowly; each act appeared deliberate, unlike the rapid actions noticed after wetting. The behaviour was eventually

interrupted by sand-digging. Exploration was seen only by the end of the observation schedule.

3.6 *Behaviour after assymmetrical modifications*

(i) Application of oil to only one flank, induced similarly significant increase in bathing frequencies (Wilcoxon test; $P < 0.05$; table 1). However, most actions were directed towards the treated side (left rubs = 20.66 ± SE 0.59; right rubs = 3.00 ± SE 1.411 or right rubs = 21.33 ± SE 1.23; left rubs = 2.66 ± SE 1.7; table 1) and differences between the number of actions recorded on treated and untreated flank were not only unequal, but significant ('*t*' test; $P<0.05$).

(ii) Oiling of back produced an equal number of side-rubs on the two flanks (left rubs = 13.25 ± SE 0.87; right rubs = 14.25 ± SE 1.67; table 1). Some subjects attempted to turn on their back, but without much success.

(iii) Subjects treated with oil on the ventrum displayed, however, 'dragging of ventrum' on substrate; though some side-rubs were also seen (table 1). The difference between frequencies of two components was significant (Wilcoxon test; $P<0.05$); but no sequential relationship was evident. There was much sand-digging between ventrum-drags.

4. Discussion

4.1 *Bathing patterns in T. indica*

Sand or dust-bathing by rodents consists of three main components (i) ventrum-rub, (ii) side-rub and (iii) rolls on back. These involve an equal number of fundamental acts, which are universal motor patterns in vertebrates (Eisenberg 1963). Evidently, it is by integrating a few basic acts that natural selection has produced functional bathing patterns. Side-rubs are, however, used to the exclusion of both 'ventrum-rub' and 'rolls on back' by *Gerbillus nanus* (Kirchshofer 1958). Thus, the bathing behaviour of *T. indica* is similar to that of *G. nanus*. If only side-rubs are performed, the absence of 'ventral glands' is indicated. These are residual; corresponding actions to clean ventrum are, therefore, not required. However, stereotyped rubbings of ventrum are often displayed by male *T. indica* because only males possess ventral scent glands (Prakash and Kumari 1979).

4.2 *Functional relationships*

Sand-bathing behaviour is prominently related to cleaning of fur (Borchelt *et al* 1976). This amounts to removal by rubbing in substrate of sebaceous secretions, mostly lipids, coming on to pelage; and similarly the materials that may get struck or are applied to it (Borchelt *et al* 1976; Griswold *et al* 1977). If allowed to accumulate lipids are likely to mat the fur; bathing obviously restores pelage condition.

Seemingly sebaceous secretions that come on to the pelage in *T. indica*, have a particular spatial distribution. These are mostly extruded on flanks, and the area requires frequent rubbings to remove them. Deprivation thus enhances side-rub frequencies with the actions on both sides being equal (table 1). The same actions

are elicited by modifications made in pelage on flanks; with more actions directed on the 'treated' side if these are asymmetrical (table 1). As in other areas, pelage is cleaned without similar stereotyped actions.

Thus, bathing patterns of *T. indica* closely correspond to functional needs, as contended by Borchelt *et al* (1976).

4.3 *Changes in temporal organization of bathing bouts*

In subjects given access to sand, and tested without pretreatment, bathing action frequencies are ordinarily very low. Rubbings, if any, along with grooming and scratching, are seen between various activities as exploration, but without any time-sequence relationship with other events.

However, modifications in pelage condition as a result of pretreatments bring about a marked change in temporal organization of bathing bouts. Actions tend to 'cluster' at the beginning of observational periods, while other activities are relegated towards the end.

In spite of individual variations, temporal organization of bathing can thus be readily altered to suit requirement, as observed in kangaroo rats (Griswold *et al* 1977).

4.4 *Breakdown of sequential patterning of bathing actions*

While bathing, the gerbil, *T. indica* attends to its flanks alternately; in a single bout one action is thus directed to each side.

Such sequential patterning of action seems to breakdown, however, with asymmetrical manipulations of pelage condition. More actions are then directed towards the treated than the untreated side (table 1). In case of wetting, unequal distribution of water on the two sides may give a similar result (table 1).

Thus the sequential patterning of bathing actions is also rapidly altered according to need.

4.5 *Regulation of behaviour*

As observed earlier in kangaroo rats (Griswold *et al* 1977) and *Gerbillus nanus indus* (Prakash and Jain 1971) the responses of *T. indica* to changes in pelage condition also clearly suggest that 'peripheral input' mainly elicits the behaviour. Thus, the responses are quantitatively different with symmetrical and asymmetrical modifications made in the pelage condition (table 1).

Likewise, it appears that the behaviour is elicited from a central neural mechanism. It mediates the input to release bathing actions, and allows rapid adjustments thus in temporal and sequential patterning of actions, which are otherwise rigorously controlled (Griswold *et al* 1977).

Although peripheral-input 'threshold' in gerbils are not recognizable, even a small increase in input activates the mechanism. Slight wetting for example releases the behaviour in gerbils.

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References

Bailey N T J 1959 *Statistical methods in biology* (London: The English University Press).

Barnett S A 1975 *The rat: A study in behaviour* 2nd edn (Chicago: University Press).

Borchelt P L, Griswold J G and Branchek R S 1976 An analysis of sand-bathing and grooming in the kangaroo rat *(Dipodomys merriami)*; *Anim. Behav.* **24** 347-353

Eibl-Eibesfeldt I 1951 Getangemschafts bedrachterngen and der persichen Wiistermous *(Meriones persicus persicus* Blanford*)*; *Z. Tierpsychol.* **8** 400-423

Eisenberg J F 1963 A comparative study of sand-bathing behaviour in Heteromyid rodents; *Behaviour* **22** 16-23

Griswold J G, Borchelt P L, Branchek R S and Bensko J A 1977 Condition of the pelage regulates sand-bathing and grooming behaviour in the kangaroo rat *(Dipodomys merriami); Anim. Behav.* **25** 602-608

Kirchshofer R 1958 Freiland and Gefomgenschafts beobachtungen on der nordafrikanischen Renn-maus; *Z. saughtiert* **23** 33-49

Lehner P N 1979 *Handbook of ethological methods* (New York and London: Garland TPM Press).

Prakash I and Jain A P 1971 Some observations on the wagners gerbil *Gerbillus nanus indus* (Thomas) in the Indian desert; *Mammalia* **35** 614-628

Prakash I and Kumari S 1979 Occurrence of ventral marking gland in Indian desert rodents; *Saugetier Mitteil* **27** 315-316