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Scent marking in the Indian gerbil, *Tatera indica* in response to conspecific odours

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Abstract. Results of experiments conducted in T-maze to probe the functional role of conspecific odours indicated that whereas the male Indian gerbil, *Tatera indica indica* invariably prefers odours (from their body, that of the sebum exudation of scent marking gland, urine and faecal matter) of strange males, the females with and devoid of the scent marking gland show slight preference for male odours. However, all the categories of *Tatera indica* placed their preference for their own odours at the lowest. This behaviour suggests that the role of scent marking to label the habitat for its own use or to signal 'home' to the marking animal may not be the sole function of scent marking in this species. It is quite possible that in the desert grassland, scent marking is being used for maintaining a minimum distance between two animals or pairs, as exhibited by the diversity in the occurrence of the scent gland in the field (pair-tolerant) and urban (gregarious social organisation) populations of *Tatera indica*. This type of spatial distribution, maintained by scent marking behaviour, may be important to withstand the low carrying capacity of the aridland which suffers from almost a perpetual paucity of food.

Keywords. Cue; olfactory communication; scent marking; social behaviour; T-maze; urine marking.

1. Introduction

The Indian gerbil, *Tatera indica indica* (Hardwicke) is one of the predominant rodents found in the Thar desert. It occupies two distinct habitats i.e. desert grasslands and urban settlements. In the former situation it lives singly or in pairs in burrows situated quite far away from each other. In the urban habitat of Bikaner town (28°0′N, 73°17′E) where they are mostly found in the streets, their social organisation is gregarious and 4–70 gerbils occupy a single burrow system. In the field population, the ventral scent marking gland occurs in 91·4% males and 38·5% females whereas in the urban one, in 85·6% males and 3·2% females (Idris and Prakash 1983). However, the rate of scent marking in the gerbils of latter community is relatively of low order ($P < 0{\cdot}05$, unpublished results). We are seeking the reason for these differences in the frequency of occurrence of the scent marking gland and behavioural implication in the two types of populations of *T. indica* with a view to probe the functional role of conspecific odours in their social organisation.

2. Methods

Wild *T. indica* were collected from the scrub grasslands around Jodhpur (26°18′N, 73°01′E). The sexually mature rodents were divided into 3 groups of 12 animals each:

male possessing the scent marking gland, female possessing the gland and female devoid of the gland. Each animal of a group was released in the control chamber of a T-maze of which 3 arms carried different odours provided in 3 combinations. The released rodent was free to move and explore any of the arms. The number and duration of visit to each arm, frequency of sniffing, grooming, scent marking, urine marking, urination and defecation were recorded for 30 min at their maximum activity period (20·00–22·00 hr) under dim red light. Such observations on each rodent were made for 12 days.

The arms attached to the T-maze were prepared for exposure to new animals by separately lodging the 3 types of *T. indica* (male and female with gland, and female without gland) for 24 hr. During this duration the animals possibly saturated the maze arm with the odours from their body, scent marking gland, urine and faecal matter.

3. Results

The activity pattern pertaining to grooming, urination and defecation exhibited in various odour environments by the three classes of *T. indica* (male, female with gland, and female without gland) was not significantly different, therefore they have not been taken into account of results summarised in tables 1–3.

3.1 *Behavioural responses of male T. indica*

The male *T. indica* preferred the odour environment of strange male as indicated by the frequency of their sniffing ($P < 0{\cdot}01$; $P < 0{\cdot}001$), scent marking ($P < 0{\cdot}01$), urine marking ($P < 0{\cdot}001$) and frequency of visits to the arm ($P < 0{\cdot}05$) as compared to their activity in clean arm of the T-maze (table 1). However, a comparison of activities in environ of strange male, strange female and clean box revealed that the difference in frequency in former two environments was not significantly different. It further indicates that choice of male *T. indica* for strange male and female odours is more or less equal.

Another point which is clearly brought out by the behavioural responses of male *T. indica* is that it did not prefer its own odour even in comparison to that of clean environment (table 1) but the duration of time during which the males stayed in own-odour environment is significantly more ($P < 0{\cdot}05$) as compared to the arms carrying other odours.

3.2 *Behavioural responses of female T. indica possessing gland*

The females possessing scent marking gland also preferred the clean environment over own odour as their sniffing and urine marking activities were significantly less ($P < 0{\cdot}05$) in the maze arm carrying own odour (table 2). These females, however, differ from male *T. indica* in spending significantly less ($P < 0{\cdot}05$) time in the arm carrying their own odour as compared to the clean arm. Female possessing scent marking gland were found to be more attracted towards the odour of strange female possessing the gland (table 2), as indicated by frequency of scent marking and number of visits

Table 1. Behavioural responses (Mean ± SE) of male *T. indica* to different conspecific odours.

Conspecific odour choice	(N)	Behavioural acts in 30 min period			No. of visits	Duration of visits (seconds)
		Sniffing	Ventral marking	Urine marking		
Own odour		5·83 ± 1·07 NS	2·33 ± 0·43[a]	1·50 ± 0·31 NS	9·91 ± 0·96 NS	835·00 ± 47·40[a]
Strange male	12	10·91 ± 1·23[a]	6·00 ± 0·71[b]	2·08 ± 1·72 NS	13·68 ± 1·37 NS	477·00 ± 54·94 NS
Clean box		6·66 ± 1·21	3·41 ± 0·41	1·58 ± 0·35	11·58 ± 2·50	488·25 ± 24·21
Strange male		9·08 ± 1·27[c]	4·91 ± 0·27[a]	2·33 ± 0·35[a]	10·16 ± 0·73[a]	588·75 ± 61·68
Strange female with gland	12	5·16 ± 0·92 NS	4·35 ± 0·68[a]	2·33 ± 0·35[a]	9·91 ± 5·70 NS	659·00 ± 42·59 NS
Clean box		4·25 ± 0.64	2·63 ± 1·28	1·00 ± 0·36	8·38 ± 0·70	560·41 ± 64·57
Strange male		7·75 ± 0·83 NS	5·66 ± 0·59[c]	2·27 ± 0·27 NS	12·33 ± 1·10[a]	708·55 ± 55·83[a]
Strange female with gland	12	7·45 ± 0·73	3·00 ± 0·37 NS	1·58 ± 0·35 NS	9·33 ± 6·49[a]	614·33 ± 38·78[a]
Strange female without gland		5·83 ± 0·63	2·08 ± 0·35	2·21 ± 0·29	7·90 ± 0·57	477·00 ± 47·95

Student's t test, level of significance. [a] $P < 0.05$; [b] $P < 0.01$; [c] $P < 0.001$; NS = Not significant.

Table 2. Behavioural responses (Mean ± SE) of female *T. indica* with gland to different conspecific odours.

Conspecific odour choice	(N)	Behavioural acts in 30 min period			No. of visits	Duration of visits (seconds)
		Sniffing	Ventral marking	Urine marking		
Own odour		8·66 ± 1·05[a]	1·86 ± 0·44 NS	1·26 ± 0·32[a]	11·16 ± 0·80 NS	422·66 ± 45·08[b]
Strange female with gland	12	14·55 ± 1·36[b]	3·00 ± 0·53 NS	2·41 ± 0·41 NS	16·50 ± 1·01[a]	713·50 ± 57·30 NS
Clean		11·83 ± 0·96	2·30 ± 0·47	2·72 ± 0·48	13·58 ± 1·13	663·83 ± 67·47
Own odour		10·56 ± 0·81	1·66 ± 0·48	1·75 ± 0·42	8·83 ± 0·70	453·83 ± 53·53
Strange female with gland	12	12·00 ± 1·31 NS	3·58 ± 0·58[a]	1·41 ± 0·37 NS	12·75 ± 1·21[a]	692·00 ± 70·73[a]
Strange female without gland		13·83 ± 0·92[a]	1·66 ± 0·53 NS	1·16 ± 0·53 NS	9·50 ± 1·19 NS	654·16 ± 37·27[a]
Strange female with gland	12	9·83 ± 1·83 NS	2·00 ± 0·38 NS	1·58 ± 0·35 NS	9·15 ± 0·77 NS	649·88 ± 66·61[a]
Strange female without gland		7·25 ± 2·43	1·58 ± 0·33	0·83 ± 0·33	7·25 ± 0·86	482·33 ± 57·88
Strange male		10·83 ± 2·45 NS	2·58 ± 0·57 NS	0·76 ± 0·24 NS	12·08 ± 1·32[b]	667·83 ± 49·37[a]

Student's *t* test, level of significance. [a]$P < 0.05$; [b]$P < 0.01$; NS = Not significant.

Table 3. Behavioural responses (Mean ± SE) of female *T. indica* to different conspecific odours.

Conspecific odour choice	(N)	Behavioural acts in 30 min. period			No. of visits	Duration of visits (seconds)
		Sniffing	Ventral marking	Urine marking		
Own odour		5·88 ± 1·39 NS	—	2·08 ± 1·50 NS	8·33 ± 0·92 NS	400·25 ± 68·67[c]
Strange female without gland	12	12·50 ± 1·46[a]	—	3·00 ± 0·57 NS	11·33 ± 1·21 NS	692·50 ± 47·23 NS
Clean		8·58 ± 1·70	—	2·69 ± 0·47	8·50 ± 0·87	706·38 ± 56·85
Own odour		10·66 ± 1·09	—	1·33 ± 0·35	8·58 ± 1·07	589·00 ± 45·48
Strange female with gland	12	13·83 ± 1·32 NS	—	3·58 ± 0·52[c]	11·09 ± 0·79[a]	450·40 ± 34·82[a]
Strange male		15·41 ± 5·63[a]	—	4·66 ± 0·84[b]	12·83 ± 1·20[a]	761·58 ± 47·43[a]
Strange female without gland		12·60 ± 1·39 NS	—	1·50 ± 0·31 NS	10·00 ± 1·12 NS	533·00 ± 44·54 NS
Strange female with gland	12	12·45 ± 1·23	—	1·41 ± 0·60	13·00 ± 0·44	462·41 ± 22·28
Strange male		13·83 ± 0·13 NS	—	4·75 ± 0·59[c]	13·25 ± 1·35 NS	805·41 ± 38·61[c]

Student's t test, level of significance. [a]$P < 0·05$; [b]$P < 0·01$, [c]$P < 0·001$; NS = Not significant.

($P < 0{\cdot}05$) as compared to the responses to own odours. But no sooner the odour of strange male was available (table 2), the preference was for the strange male though it never enhanced to a significant level than that in the arm carrying odours of female possessing the gland. In this hierarchy of preference, the body odours of the female devoid of the scent gland were rated at the lowest level.

3.3 *Behavioural responses of female T. indica without gland*

The behaviour of females without the gland was almost similar to that of females possessing the gland, own odour was rated lowest (table 3), male odours and that of female with gland were equally preferred with an edge for the female odours (table 3).

4. Discussion

The results indicate that the male *T. indica* invariably prefers the odour of strange individual of their own sex but its scent marking response in presence of odours of female possessing the gland was also equivalent to that of strange male. The female possessing the gland, rate the strange male odour and strange female odour almost at an equal level. The female devoid of the gland also preferred the odours of strange males but when the choice was between the odours of female with the gland and male, the difference between their rating was not significant. The individuals belonging to 3 categories of *T. indica* exhibited lowest preference for their own odour.

Both types of female were attracted to male odours as indicated by the frequency of sniffing, scent marking, urine marking and the number and duration of visits to the arm containing the male odour. However, the males were attracted towards female odours only when those of a strange male were not available to them.

The odours which an animal (*T. indica*) can possibly impregnate in an environment (the maze arm in this study) are (i) body odour, (ii) odour of the sebum of the ventral scent marking gland, (iii) odour of urine and (iv) odour of the faecal matter. It is not possible to say which one of these is involved in the attraction. However, if the responses of female *T. indica* devoid of scent gland (table 3) are considered, it would appear that the sebum odour plays a major role in the olfactory communication. Male *Meriones tristrami* also show attraction towards odours from strange males whereas females do not show a consistent preference (Thiessen *et al* 1973). Likewise female, *M. unguiculatus* does not show any significant preference for the odour of males in single choice tests; but when tested together, the female show a slight preference for own sex odour (Thiessen *et al* 1970).

It is known that female *T. indica* possessing scent gland (Prakash and Idris 1982), enhance scent marking and urine marking frequency in the presence of urine and sebum odours of strange female in oestrus (Prakash and Idris 1982). The males also do so in similar environment (Idris and Prakash 1983), indicating the involvement of odours in the reproduction activity. Our results suggest that males prefer female odours in the absence of their own sex odour (table 1). Females also show a similar preference (table 2). The observations confirm the involvement of odours in the olfactory communication during the reproductive activity in *T. indica* (Kumari and Prakash 1983). The odours have also been found to be broadly correlated with dominance hierarchy in *T. indica* (Idris and Prakash 1985). However, the situation is

not clear with respect to the females of *T. indica*, possessing the scent marking gland and those devoid of it since in the latter, urine marking, which is subsidiary to sebum marking in other categories of *T. indica*, plays the prime role in olfactory communication (Idris and Prakash 1983).

The low rating of own-sex odours by the 3 categories of *T. indica* (tables 1–3) cannot be properly explained. Earlier, we have interpreted that the function of scent marking in this species is more of a familiarisation nature to label the habitat for its own use and in orientation or to signal "home" to the marking animal (Idris and Prakash 1982). Other workers (Ewer 1973; Mykytowycz 1970; Ralls 1971) have also suggested this function, who believe that the scent marks provide a sense of security and increase confidence of the animals in the general area of their home range. Such a confidence-enhancing effect is, however, not supported by the results of our study; in that *T. indica* does not prefer its own scent in comparison to strange animals of own sex or opposite sex. In fact various categories of *T. indica* rated their own odour even below clean arm of the T-maze. The behaviour of *T. indica* in this respect is quite perplexing unless it is assumed that the frequency of various behavioural activities (tables 1–3) of 3 categories of *T. indica* in their own odour arm of T-maze provided to them 'familiar' odours environment and hence their scent marking activity in these arms was low as compared to others (carrying sebum odour of strange male or female) in which they enhanced their scent and urine marking activities to saturate them with their own odours to make them 'familiar'.

It is quite possible, however, that scent marking cues may be used by *T. indica* inhabiting the scattered population in open grasslands for maintaining a minimum distance between two animals or pairs. This concept gets support from our findings (Idris and Prakash 1982) about the diversity in the frequency of occurrence of the scent gland in two types of populations living in different social organisation. The maintenance of a minimum distance between two pairs may be necessary not only from the social interactions point of view but also in consonance with the carrying capacity of the arid land which suffers from almost a perpetual paucity of food.

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