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FUNCTIONAL ASPECTS OF PRIMATE GROOMING[1]

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Abstract. Experimental walks with a tame primate reveal that free living primates are likely to be subject to frequent infestation by ticks. Observations on the grooming behavior of mangabeys, red colobus and blue monkeys demonstrated that self grooming is primarily directed to parts of the body not subjected to allo-grooming, and that its role is a cursory brushing away of loose particles rather than a detailed cleansing. Allo-grooming is directed towards the detailed cleansing of the skin and fur, and is associated with frequent particle removal. Length of body fur has a considerable influence on the amount of grooming different parts of the body receive. I suggest that sexual dimorphism, age, sex and dominance status are important in determining rates of ectoparasite acquisition, and so the amount of grooming individuals need and receive.

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Numerous workers have emphasized the social roles of primate allo-grooming (*e.g.*, Hall and Mayer 1967, Rowell 1968). Investigation of grooming's functional aspects has been limited to casual field observations (*e.g.*, Schaller 1963, Struhsaker 1967), or studies on captive primates and extrapolation to what grooming may do under natural circumstances (*e.g.* Hutchins and Barash 1976). In this paper, I give an experimentally determined estimate of the rate at which a primate is likely to acquire ticks in Kibale Forest, Uganda, and provide a detailed account of self and allo-grooming in three primate species: the mangabey (*Cercocebus albigena*), the red colobus monkey (*Colobus badius*) and the blue monkey (*Cercopithecus mitis*).

MATERIALS AND METHODS

Study Area. The study was carried out in the Kanyawara study area of Kibale Forest, Uganda (0°13′ to 0°41′ N and 30°19′ to 30°32′ E). Detailed descriptions of the Kanyawara study site are available in Struhsaker (1975) and Waser (1974).

Acquisition of Ectoparasites. During the months May to October 1974, a pet *Cercopithecus ascanius* (an old juvenile male) was taken for a total of nine walks through the forest at Kanyawara. On each of these walks the monkey's owner (Mrs. R. Rudran), the monkey and I spent one hour in the forest. During this time we walked a more or less fixed path of 750 m. The monkey was allowed to roam freely. Not all walks could be made to be one hour, but accurate time records were kept. The monkey did not behave as is normal for *Cercopithecus ascanius*. In particular, most of his activity (usually gathering and eating insects, fruits and leaves) was confined to less than 20 ft above ground. Wild *C. ascanius* spend most of their time at heights greater than 20 ft (Freeland 1977). At the end of each walk the monkey was thoroughly searched for ectoparasites. I recorded the number of ticks I acquired in more than 500 hours spent in the forest during the months May to October 1974.

Grooming Obervations. Observations of grooming were made while following particular groups of each monkey species. All grooming was recorded according to time of day, whether it was self or allo-grooming, parts of the body groomed and the type of grooming motion employed. During any single grooming bout, several observations were likely to be made of grooming to different parts of the body. A single grooming observation was defined as grooming motions to a particular part of the body. If grooming to a particular body part continued for longer than two minutes, it was recorded as an additional grooming observation. If different grooming motions were applied to the same body part, it was regarded as a single grooming observation with several different subcategories. A minimum sample of 500 observations of self and allo-grooming was made for each species.

Division of the body into parts was made according to which parts seemed to be distinguished by the monkeys themselves (figure 1). Surface area of skin was not taken into account. Where a part of a body was actually two parts (*e.g.*, there are two inner thighs) it was regarded as one. Records were taken with the aid of a tape recorder.

Measurements were made of the length of hair on the different parts of the body of all three species. The mangabey skin used was that of an old juvenile male in the museum of the Zoology Department, Makere University, Uganda. The blue monkey used was an adult female found dead at Kanyawara. The red colobus (*Colobus badius*) was an adult female from the Tana River, Kenya (courtesy of the Amer. Mus. Nat. Hist.). The hair lengths used in the analyses are the means of five measures of maximum hair lengths taken from each body part.

RESULTS

Acquisition of Ectoparasites. The only ectoparasites acquired by the tame *C.*

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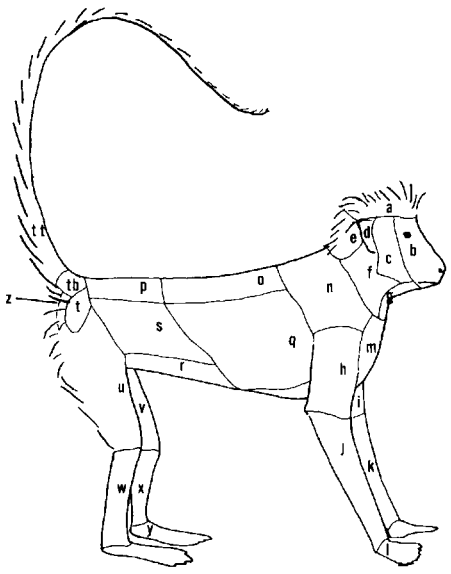

FIGURE 1. A drawing of a mangabey showing the way in which the body was divided into parts for recording grooming. a=top of head, b=face, c=cheeks, d=ears, e=top of neck, f=side of neck, g=throat, h=outer upper arm, i=inner upper arm, j=outer lower arm, k=inner lower arm, l=hands, m=chest, n=shoulders, o=mid back, p=lumbar back, q=chest side, r=stomach, s=lumbar side, t=hip, u=outer thigh, v=inner thigh, w=outer lower log, x=inner lower leg, y=feet, z=ano-genital region, tb=tail base end and tt=tail.

ascanius were ticks. The monkey often presented to its owner in such a way as to reveal the location of a tick. During the nine tick walks, the pet monkey acquired a total of 74 ticks. This is a rate of ectoparasite acquisition of 8.2 ticks/hr. The number of ticks acquired on a single walk varied from 0 to 26. During more than 500 hours in the forest, I acquired 7 ticks, giving a maximum estimate of 0.01 ticks/hr.

Grooming Movements. The types of grooming motions used by each species were very similar. For all species, I classified these motions as scratching or as fur parting. Scratching consisted of a brisk raking of the fingertips through the fur, usually applied so as to be against or across the grain of the fur. During these movements, the animal did not usually look at the area being groomed. The toes of the hind foot were also used for scratching. The foot was brought forward to the animal's side, arm, or under or over the arm. Fur parting was a much slower motion than the scratch. When fur parting, a monkey watches what it is doing. Fur parting consisted of the monkey slowly moving its fingertips across or against the fur. One hand was used, or both were used in alternation. One hand was often used to hold back a layer of fur, while the other was used to carry out the long raking motions of fur parting. A refinement of this motion is found, particularly among the species having a well developed thumb (*i.e.*, not the red colobus). This motion consists of holding the fur between the thumb and fingers and gradually drawing the hand away from the base of the fur. The red colobus occasionally did this, but held the fur between the fingers, as the thumb is greatly reduced in size. These fur drawing motions may be related to removal of particles from the fur, but did not always seem to be so. Definite particle removal was operationally defined as being associated with either a movement of the hand from fur to mouth or with the direct application of the mouth to the area being groomed. Hand to mouth motions were rare in all species, mouth applications being relatively common. Direct mouth application was frequently associated with the removal of a mouthful of fur. In allo-grooming, this fur removal was often associated with a small but pronounced jump on the part of the recipient. This motion was particularly so for the red colobus. Only when the mouth was involved could particle removal be relatively safely assumed. Fur drawing motions lacking mouth involvement are classed with fur parting. Fur drawing was relatively uncommon.

Cercocebus albigena. The parts of the body groomed during self and allo-grooming were significantly different (table 1) ($X^2=342.6$, d.f.$=27$, $P<.001$). Significantly more particle removals occurred during allo-grooming than during self grooming (table 1). If the grooming observations are broken down into scratches and fur parts, 86.7% of self grooming was scratching, while 100% of allo-grooming was fur parting (table 2).

The parts of the body groomed during self and allo-grooming were to a certain ex-

TABLE 1

Parts of the body groomed by Cercocebus albigena during self and allo-grooming.

Body parts	Self grooming*	Allo-grooming*	Partical Removal	
			Self	Allo
Head top	13	23	-	-
Face	15	2	-	-
Cheeks	12	11	-	1
Ears	18	7	-	1
Neck side	21	31	-	2
Neck top	0	28	-	-
Throat	6	12	-	-
Upper arm, out	22	17	-	1
Upper arm, in	12	10	1	1
Lower arm, out	16	12	1	1
Lower arm, in	19	6	1	1
Hand	1	0	-	-
Chest	14	24	-	2
Shoulders	5	52	-	2
Mid back	0	47	-	4
Lumbar back	0	42	-	7
Chest side	39	55	-	1
Lumbar side	35	40	-	3
Ano-genitals	2	17	-	1
Hip	36	13	-	2
Thigh, out	58	23	-	7
Thigh, in	51	12	2	1
Leg, out	55	3	-	-
Leg, in	30	4	1	1
Tail base	4	6	-	1
Tail	10	8	-	-
Foot	23	0	1	-
Stomach	9	8	-	-
Totals	526	513	7	40

*Number of observations.

tent complementary. For example, no self grooming was observed on the mid and lumbar back, both of which received large amounts of allo-grooming. Complementarity does not explain all the variation. Areas such as the chest and lumbar sides received a great deal of attention from both types of grooming. If self and allo-grooming are summed, there is a significant correlation between total grooming attention areas received, and the average hair lengths in the various areas (r_s=.53, N=28, P<.01) (table 3).

TABLE 2

Percentages of scratching and fur parting in self and allo-grooming.

	Scratching	Fur parting
C. albigena		
Self grooming	86.7	13.3
Allo-grooming	0.0	100.0
C. badius		
Self grooming	69.6	30.3
Allo-grooming	0.6	99.4
C. mitis		
Self grooming	81.6	18.4
Allo-grooming	0.0	100.0

TABLE 3

The relationship between hair length and number of grooms to particular parts of Cercocebus albigena, Colobrus badius, Cercopithecus mitis.

Body parts	Hair length (mm)			Total grooms		
	Cerc	Colo	Cerp*	Cerc	Colo	Cerp*
Head	57	16	20	36	34	30
Face	8	14	15	17	11	15
Cheeks	12	6	38	23	13	36
Ears	—	10	5	—	20	25
Neck top	113	12	44	28	25	31
Neck side	103	19	34	52	39	59
Throat	38	8	16	18	16	34
Upper arm, out	75	19	40	39	40	28
Upper arm, in	71	14	26	22	30	15
Lower arm, out	32	12	20	28	24	18
Lower arm, in	29	17	15	25	36	17
Hand	13	7	9	1	14	1
Chest	53	20	44	38	41	27
Shoulders	138	25	60	57	53	52
Mid back	128	23	51	47	47	34
Lumbar back	88	18	52	42	38	31
Chest side	148	35	65	94	72	76
Lumbar side	105	34	68	75	71	51
Stomach	44	14	33	17	30	20
Ano-genitals	24	9	34	19	18	22
Hip	85	23	55	49	47	34
Thigh, out	40	37	53	81	77	29
Thigh, in	32	16	63	63	33	26
Leg, out	41	26	46	58	55	27
Leg, in	36	13	42	34	28	17
Foot	20	15	11	23	31	5
Tail base	73	8	47	10	16	23
Tail	65	29	22	18	60	20

*Cerc=*Cercocebus albigena;* Colo=*Colobus badius;* Cerp=*Cercopithecus mitis.*

Colobus badius. Results for this species were very much the same as for the mangabey. There is a significant difference between the areas groomed by self and allo-grooming (table 4) (X^2=276.1, d.f.=27, P<.001), and a much greater amount of particle removal during allo-grooming than during self-grooming (table 4). Self grooming involved mostly scratching, while fur parting predominated during allo-grooming (table 2). When self and allo-grooming for each body part are summed, a significant correlation exists between fur length and amount of grooming attention (r_s=.61, N=28, P<.01) (table 3).

TABLE 4

Parts of the body groomed by Colobus badius during self and allo-grooming.

Body parts	Self* grooming	Allo-* grooming	Particle Removal	
			Self	Allo
Head top	16	18	1	2
Face	25	5	-	-
Cheeks	8	5	-	1
Ears	6	14	-	1
Neck top	0	25	-	2
Neck side	14	25	-	3
Throat	5	11	-	5
Upper arm, out	17	23	-	5
Upper arm, in	22	8	-	2
Lower arm, out	14	10	-	3
Lower arm, in	29	7	1	-
Hand	14	0	1	-
Chest	16	25	-	4
Shoulders	5	48	-	8
Mid back	0	47	-	2
Lumbar back	4	34	-	3
Chest side	27	45	-	6
Stomach	13	17	-	1
Lumbar side	32	39	-	2
Ano-genitals	3	15	-	4
Hip	29	18	-	1
Thigh, out	46	31	-	2
Thigh, in	22	11	3	1
Leg, out	47	8	1	-
Leg, in	23	5	1	-
Foot	28	3	5	2
Tail base	3	13	-	1
Tail	33	27	-	-
Totals	501	27	15	61

*Number of observations.

TABLE 5

Parts of the body groomed by Cercopithecus mitis during self and allo-grooming.

Body parts	Self* grooming	Allo-* grooming	Partial Removal	
			Self	Allo
Head top	1	29	-	2
Face	12	3	-	-
Cheeks	11	25	-	2
Ears	9	16	-	-
Neck side	14	45	-	4
Neck top	0	31	-	3
Throat	8	26	-	6
Upper arm, out	5	23	-	4
Inner arm, in	6	9	-	-
Lower arm, out	9	9	-	-
Lower arm, in	13	4	2	1
Hand	0	1	-	1
Chest	6	21	-	2
Shoulders	3	49	-	2
Mid back	1	33	-	1
Lumbar back	0	31	-	2
Chest side	26	50	-	3
Lumbar side	11	40	-	5
Ano-genitals	0	22	-	2
Hip	3	31	-	-
Thigh, out	14	15	-	-
Thigh, in	22	4	-	1
Leg, out	26	1	-	-
Leg, in	14	3	2	1
Tail base	0	23	-	1
Tail	10	10	4	3
Foot	5	0	-	-
Stomach	9	11	-	-
Totals	238	565	8	46

*Number of observations.

Cercopithecus mitis. Results were similar to those found with the other two species. Self and allo-grooming were directed towards different parts of the body ($X^2=274$, d.f.$=27$, $P<.001$) (table 5). More fur parts and particle removals occurred during allo-grooming than during self grooming (tables 6 and 2), and a significant correlation exists between fur length and total amount of grooming attention ($r_s=.61$, $N=28$, $P<.01$) (table 3).

DISCUSSION

Although there are reported observations of monkeys carrying ticks (*e.g.,* Schaller 1963), a large sample of shot Ugandan monkeys (Haddow 1952) failed to reveal even one tick or other type of ectoparasite. Experimental walks with the pet *C. ascanius* indicated that monkeys in Kibale Forest are liable to tick infestation. Given the role of ticks in transmitting diseases among primates (*e.g.,* Garnham 1957, Rajagopalan and Anderson 1971), tick removal is likely to be important to individual primates. The importance of tick removal is further emphasized by the observation of solitary red tail monkeys entering red colobus groups and presenting so as to be groomed (Struhsaker 1975, personal observation). Juvenile and female red colobus do groom solitary red tail monkeys. Juvenile red colobus were observed to attempting to groom red tail monkeys that were not solitary and were trying to avoid being groomed rather than presenting for grooming.

Grooming observations on the three species revealed that self and allo-grooming in the wild serve somewhat different functions. The two types of grooming are directed to largely different parts of the body. Self grooming, mainly scratching, appears

to be rapid brushing of the fur and removal of loose dirt particles and perhaps unattached arthropods. Allo-grooming emphasizes a slow, concentrated parting of the fur and fairly frequent removal of particles. It appears to be geared towards minute skin and fur cleansing, and the removal of attached arthropods.

The significant correlation between fur length and amount of grooming is of particular interest. Many monkey species exhibit a gross sexual dimorphism in terms of fur lengths and/or body size. It is frequently observed that sexually dimorphic males receive more grooming attention than do other group individuals (*e.g.*, Struhsaker 1975). Fur length could be of importance in determining the number of ectoparasites acquired and so the amount of grooming necessary. There is another parameter that could influence the number of ectoparasites an animal receives and so be related to the amount of grooming attention required. This is the amount of time an animal spends moving, and/or the distance an animal moves. Most primates do not have a particular nest site. Ectoparasites are likely to be scattered throughout a primate's environment (some probably occuring in dense patches). The more often an animal moves, or the further it travels, the more likely it is to encounter ectoparasites. As yet, there are no data on rainforest monkeys giving estimates of the relative amount of movement by different individuals according to sex, age or dominance status. It is not unreasonable to assume that the functions and maintenance of dominance may increase the distance moved by and the frequency of movement of adult males. If this is the case, a more dominant individual may need more grooming than a subordinate animal, simply to remove a higher ectoparasite load. If these parameters prove to be of importance in determining the amount of grooming needed and received, then the apparently excessive grooming of dominant individuals may reflect a liability of dominance, as well as the benefits dominance brings. A full assessment of the social role of allo-grooming cannot be made without taking these factors into account.

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