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Grooming at a preferred site reduces heart rate in horses

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Abstract. It is commonly suggested that the principal function of allogrooming is to reduce social tension between group members, but direct evidence of the physiological consequences of grooming at particular sites is lacking. By filming allogrooming sequences in a herd of Camargue horses, *Equus caballus*, their preferred grooming site, which lies on the lower neck, was identified. Experimental imitation of grooming at this site reduced the heart rate of the recipient while grooming on a non-preferred area did not, in both adults and foals. This preferred site lies close to a major ganglion of the autonomic nervous system.

Grooming is an important interaction between group members in many social mammals. Suggested functional explanations of grooming include removal of ectoparasites (Barton 1985) and the reduction of social tension between individuals (Schino et al. 1988). Allogrooming in primates seems to have evolved from a purely hygienic function to a social one (Dunbar 1991).

Free-living Camargue horses, *Equus caballus*, like many other social mammals forming stable groups, groom each other regularly (0·05–0·1 times/h; Wells & von Goldschmidt-Rothschild 1979). Grooming is usually mutual, partners facing each other and scratching the other's skin, typically on the head, neck, chest or forelegs with their incisors (Keiper 1988; see Fig. 1). Most (90%) grooming bouts last for less than 3 min (Feist & McCullough 1976).

If grooming has a social function, for example, by reducing tension between individuals, a direct rewarding action should be found. However, only two studies have attempted to link grooming to physiological parameters. In talapoin monkeys, *Miopithecus talapoin*, an increase in grooming was correlated with an increase in level of beta-endorphins (Keverne et al. 1989). Heart rate monitored in one female pig-tailed macaque, *Macaca nemestrina*, decreased when it was being groomed (Boccia et al. 1989).

Here we investigate whether mutual grooming in horses is concentrated on a preferred area and whether experimental imitation of grooming at this specific site, as well as on other areas, affects the heart rate of the recipient.

METHODS

Identification of Preferred Grooming Site

During May and June 1990 we recorded grooming sites in a herd of Camargue horses (nine stallions, 13 mares and their offspring), living in natural family groups since 1978. At this time of year the horses' ectoparasite load is minimal. We filmed 38 grooming sequences in 18 animals at a right angle with a video camera. Each dental impact ($N=728$) was then mapped onto a profile of a horse, using transparencies superimposed on a television screen.

Grooming Frequency

Because we were able to see all individuals of the herd simultaneously, 'all-occurrences' sampling was used to establish grooming frequency in spring and winter.

Experimental Imitation of Grooming

Having identified the preferred site at the base of the neck, we imitated grooming on other individuals at this site as well as on another area on the shoulder which we never saw being used by the study horses (Fig. 2). This was chosen in preference to other non-preferred areas on the rump or neck so that the observers did not have to move during the sequence of grooming imitation.

We chose eight hand-tame adult horses aged between 3 and 20 years and eight foals aged between 6 and 10 months for these experiments. They live outside the whole year round, on typical

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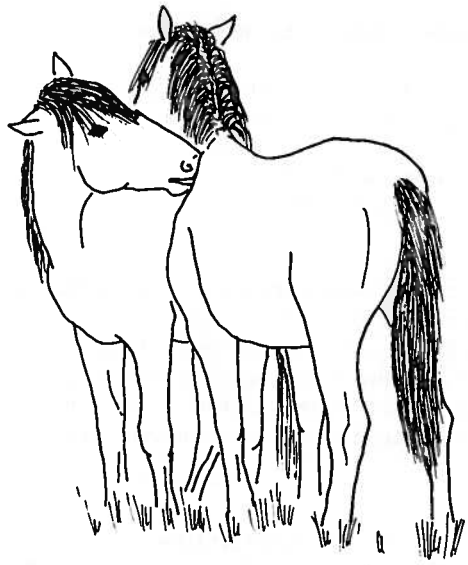

Figure 1. Two Camargue horses allogrooming at the preferred grooming site at the base of the neck typically adopt an anti-parallel position. The mouth is slightly opened, the upper incisors scratching the other's skin at regular intervals.

Camargue pastures ranging from 10 to 40 ha. The groups they lived in ranged from four to 12 animals and were mixed-sex or consisted of only males. One of us imitated grooming by manually scratching the skin at the same frequency (2/s) at which horses groom each other, while a second observer monitored the recipient's heart rate through a stethoscope, dictating numbers of heartbeats every 30 s into a tape-recorder. We performed two sequences of treatment, starting only once the horses had adopted their resting position. In sequence 1, 3 min of no grooming were followed by 3 min of grooming at the preferred site on the neck, and then 3 min of grooming on a non-preferred area 40 cm below the preferred one, low on the shoulder (Fig. 2). To check for any delayed effect of grooming on heart rate we performed a re-arranged sequence on the same horses, several hours or a day later. In sequence 2, we monitored heart rate before grooming, during grooming on the non-preferred area and, subsequently, during grooming at the preferred site.

RESULTS

Identification of Preferred Grooming Site

Our observations of adults showed that grooming was strongly localized at the base of the partner's neck, in front of the shoulder blade and including part of the withers (Fig. 2). The underlying anatomical structures of the peripheral nervous system at this site are dorsal root nerves from the last cervical and first thoracic vertebrae. Per space unit, we recorded significantly more dental impacts on the preferred grooming site ($N=351$) than on the less preferred grooming sites (Fig. 2; $N=377$; $\chi^2=381{\cdot}87$, $df=1$, $P<0{\cdot}001$). Over half (51·8%) of grooming contacts occurred at this single site representing 1·2% of the horse's body surface (outline of rump and neck). All 18 horses included in this study showed a strong preference for grooming in this area.

Frequency of Grooming Pairs in Adult Horses

In spring, grooming was more often observed for male–female pairs ($N=72$; number of possible pairs: 16) than for female–female pairs ($N=20$; number of possible pairs: 8; $\chi^2=5{\cdot}57$, $df=1$, $P<0{\cdot}02$). This difference disappeared in winter (male–female pairs: $N=17$; number of possible pairs: 15; female–female pairs $N=9$; number of possible pairs: 8; $\chi^2=0{\cdot}002$, $df=1$, NS). Male–male pairs were never observed to allogroom.

Experimental Imitation of Grooming

In both sequences (Fig. 3), heart rates differed between individuals (sequence 1, adults: $F_7=4{\cdot}76$, $P=0{\cdot}005$; foals: $F_7=35{\cdot}22$, $P<0{\cdot}001$; sequence 2, adults: $F_7=8{\cdot}61$, $P<0{\cdot}001$; foals: $F_7=45{\cdot}61$, $P<0{\cdot}001$) and between treatments (sequence 1, adults: $F_2=42{\cdot}66$, $P<0{\cdot}001$; foals: $F_2=36{\cdot}79$, $P<0{\cdot}001$; sequence 2, adults: $F_2=27{\cdot}99$, $P<0{\cdot}001$; foals: $F_2=30{\cdot}96$, $P<0{\cdot}001$).

Following resting in sequence 1, heart rate decreased significantly once grooming was imitated at the preferred site (Fig. 3; paired t-test, adults: $t=7{\cdot}93$, $N=8$, $P<0{\cdot}001$; foals: $t=9{\cdot}71$, $N=8$, $P<0{\cdot}001$) and increased significantly again when grooming was imitated on the non-preferred area (paired t-test, adults: $t=7{\cdot}64$, $N=8$, $P<0{\cdot}001$; foals: $t=6{\cdot}74$, $N=8$, $P<0{\cdot}001$). There was no significant difference in heart rate when the horses were resting prior to grooming and when grooming was imitated on the non-preferred area (paired t-test, adults: $t=0{\cdot}32$, $N=8$, $P>0{\cdot}5$; foals: $t=0{\cdot}68$, $N=8$, $P>0{\cdot}5$).

In sequence 2, heart rates did not decline significantly when grooming was first imitated on the

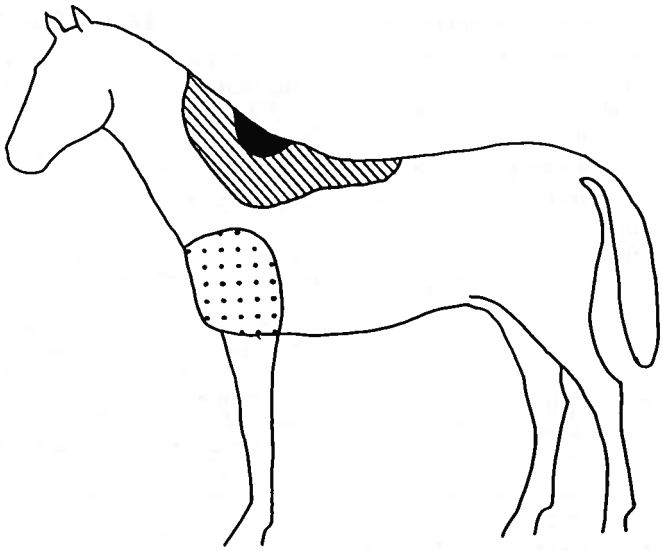

Figure 2. The total area groomed during the 38 filmed sequences is shown. ■: The preferred grooming site; ▨: less preferred grooming sites; ⊡: the non-preferred grooming area chosen for the experiments when imitating grooming.

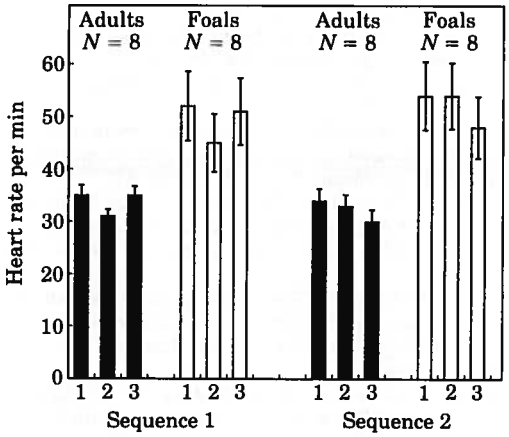

Figure 3. Changes in heart rate following experimental imitation of grooming. Each sequence lasted three times 3 min. Sequence 1: 1: heart rate before grooming; 2: heart rate while grooming at the preferred site; 3: heart rate while grooming on non-preferred area. Sequence 2: 1: heart rate before grooming; 2: heart rate while grooming on non-preferred area; 3: heart rate while grooming at the preferred site.

non-preferred area following resting (Fig. 3; paired t-test, adults: $t=1{\cdot}53$, $N=8$, $P>0{\cdot}1$; foals: $t=1{\cdot}06$, $N=8$, $P>0{\cdot}1$), but did when grooming was subsequently imitated at the preferred site (paired t-test, adults: $t=7{\cdot}04$, $N=8$, $P<0{\cdot}001$; foals: $t=6{\cdot}14$, $N=8$, $P<0{\cdot}001$). Heart rates were higher when the horses were resting prior to grooming than when grooming was imitated at the preferred site (paired t-test, adults: $t=6{\cdot}0$, $N=8$, $P<0{\cdot}001$; foals $t=5{\cdot}52$, $N=8$, $P<0{\cdot}001$).

DISCUSSION

Our experiments showed that imitation of grooming on adults at the preferred site consistently reduced the heart rate in all eight recipients by 11·4% on average, while imitation of grooming on a non-preferred area had no effect. When grooming at the preferred site preceded grooming on non-preferred areas, heart rates of subjects fell during grooming at the preferred site and increased subsequently in all cases. Results were similar for experiments on foals, heart rates decreasing by 13·5% on average when grooming at the preferred site. These results indicate that grooming at the preferred site exerts a calming effect on the recipient, in both adults and foals. Although they show no direct effect of grooming at a particular site, the two studies on primates linking grooming to physiological parameters suggest a similar conclusion (Boccia et al. 1989; Keverne et al. 1989).

The effects of grooming probably explain why it is commonly associated with circumstances of mild social tension. In primates, grooming often follows

agonistic interactions (Dunbar 1988) and is a common interaction during reconciliation (De Waal 1984, 1986). Partners who are frequently involved in grooming include females of adjacent dominance rank and grooming is typically directed by subordinates towards dominants (Seyfarth 1983). In Camargue horses, stallion–mare pairs groom each other most often during the breeding season (this study). The reason might be that social tension between males and females is higher during this period.

Why the effects of grooming on heart rate in horses are restricted to a specific site is not clear but it seems likely that the parasympathetic part of the autonomic nervous system is involved. The second largest ganglion in horses, the ganglion stellatum, lies close to the preferred grooming site and is known to be connected to important efferent cardiac pathways (Tagand & Barone 1967). Although for a long time the peripheral nervous system was thought to contain no afferents of the autonomic nervous system owing to the lack of distinct morphological features (Langley 1903), there are grounds for contention (Prechtl & Powley 1990). It is interesting that the preferred grooming site identi fied in this study is used by veterinarians employing acupressure on horses to calm nervous animals (Giniaux 1986).

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