The reinforcing value of physical contact and the effect on canine heart rate of grooming in different anatomical areas

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Abstract

The human–animal relationship frequently involves physical touch, and this may have benefits for both participants. Grooming of horses at the withers has a calming effect on recipients, a phenomenon regularly used to reward horses. No studies on the effect on heart rate of grooming in different anatomical areas have been conducted in dogs, even though they are often given physical contact as a putative reinforcer. Kennelled Greyhounds ($\underline{n}$ = 16) and guide dogs (Golden Retrievers, Labrador Retrievers and their crosses, $\underline{n}$ = 12) were stroked for eight minutes using a grooming device in each of four areas in random order. These sites were selected on the basis of their being innervated by the dorsal branches of the spinal nerves, lateral branches of the spinal nerves, ventral branches of the spinal nerves and the caudal nerves. Heart rate measurements were taken every 30 seconds using an ECG recorder. There were no observed differences in the mean heart rate based on the region of the body groomed ($\underline{p}$ = 0.893), nor was any interaction of any other factor with area of the body significant (all $\underline{p}$ > 0.5). However, for all dogs, there was a highly significant trend (overall reduction) over time ($\underline{p}$ < 0.001), and Greyhounds had consistently higher mean heart rates than guide dogs ($\underline{p}$ < 0.001). Within Greyhounds, groomed dogs had significantly lower mean heart rates than non-groomed animals ($\underline{n}$ = 8, $\underline{p}$ = 0.003). That is, grooming had a substantial effect on reducing heat rate, but the area of the body where grooming was conducted was not important. In addition, males had consistently lower heart rates than females ($\underline{p}$ < 0.001). If having a reduced heart rate is a sign of reduced stress, then we can assume that non-invasive interventions that have this effect are reinforcing. The extent to which all dogs are reinforced by physical contact depends on their socialization and familiarity with personnel. The intrinsic reinforc-

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ing value of physical contact for dogs seems likely to be outweighed by its effect as a secondary reinforcer.

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Many people enjoy a "bond" or relationship with animals, especially with euthermic (warm-blooded) animals such as cats (Curtis, Knowles and Crowell-Davis 2003) and dogs (Hart 1995), and will frequently stroke or pet their animal. Physical contact such as petting may also be used by humans as a secondary reinforcer for desired behavior in some species, e.g., dogs and horses, as an alternative to offering food.

Animals that have evolved to live within groups may appear to enjoy being petted more than members of species that are solitary. Most dogs, for instance, enjoy being petted. This may reflect the social nature of canids, but free-ranging dogs may exhibit less allogrooming than cats or horses in contexts other than courtship and parenting (Houpt 1991). This is surprising when one considers the close proximity of canine group members with one another at rest.

In addition to reducing the parasite load and keeping the animal's coat healthy, grooming activities that include stroking or petting can have a significant role to play in enhancing the human–pet bond. And petting may have significant health benefits for humans. Stroking an animal may have a calmative effect, and human blood pressure and heart rates have been shown to decrease when a dog is patted, suggesting that a positive relationship with a companion animal may result in a reduction in cardiovascular disease (Odendaal and Meintjes 2003). In human–dog contact, concentrations of β-endorphin, oxytocin, prolactin and β-phenylethylamine were found to increase in both species during positive interspecies interactions such as gentle scratching of the body and ears (Odendaal and Meintjes 2003).

Studies in horses have shown that the sense of touch is variable over different areas of the horse's body. The withers, mouth, flank and elbow regions are very sensitive areas. Some horses dislike their ears, eyes, groin and bulbs of the heels being touched (McGreevy 2004). Cats also demonstrate preferences for specific areas of the body being touched, with the temporal region (between the eyes and ears) preferred over the caudal region (Soennichsen and Chamove 2002).

Mutual grooming allows horses to reach areas that defy self-grooming strategies, and facilitates the exchange of odors (Kiley-Worthington 1987). As well, it has been shown to reduce heart rate when conducted in certain parts of the mane and withers (Feh and de Mazieres 1993). Grooming of the withers by humans has a similar calming effect (Normando et al. 2002). This phenomenon is regularly employed by personnel who want to reward horses without using food. Further recent investigation of the effect of massaging horses at six different sites (thoracic trapezius [withers], mid-brachiocephalicus, cervical ventral serrate and cervical trapezius [mid-neck], proximal gluteal fascia and proximal superficial gluteal [croup], proximal and mid-semitendinosus [second thigh], lateral triceps, proximal extensor carpi radialis and proximal common digital extensor [forearm], proximal brachiocephalicus, proximal splenius and ear [poll and ears]) has shown, that during massage, all sites except the forearm resulted in a significant reduction in heart rate, with massage at the preferred sites of allogrooming (the withers, mid-neck, and croup) having the greatest effect (McBride, Hemmings and Robinson 2004).

Although it has been shown that stroking by humans can reduce mean arterial blood pressure in general (cited by Cusack and Smith 1984), no studies on the effect on heart rate of grooming in different anatomical areas have been conducted in dogs. It is known that tactile stimulation derived from an experimenter normalizes cardiac acceleration caused by aversive stimuli in dogs (Lynch and Gantt 1968). Furthermore, when a dog was petted by an experimenter who had previously punished it, an acceleration of heart rate was observed (Anderson and Gantt, 1966). Anecdotal reports suggest that companion dogs may have preferences for being groomed in certain areas, such as the ventral thoracic inlet. Despite this, there seems to be a tendency for humans to stroke dorsal regions including those of the cranium and neck. It is thought that contact in these areas may elicit aggression in some dogs, as intraspecfic contact with the shoulder region has been related to attempts to assert rank (Rogerson 1991).

Previous studies have used a combination of physical contact and verbal communication, so it was appropriate to design a study that used only one of these stimuli. The aim of the current project was to determine the effect on canine heart rate of grooming in different anatomical areas. This may lead to a better understanding of the effect of human touch on our canine companions.

Methods

Animals

Two groups of dogs were selected. Kennelled Greyhounds (12 females and six males) and trainee guide dogs (Golden Retrievers, Labrador Retrievers and their crosses; six females and six males). The trainee guide dogs had been in family homes for the previous 12 months, so it was assumed that they had experienced considerable contact with human companions. Racing Greyhounds were of interest because they are rarely petted and therefore may be less likely than many other dogs to have learned preferences for being groomed in certain areas.

In addition to comparing responses to grooming of Greyhounds and guide dogs, it was also of interest to assess the effect of grooming versus not grooming, although this comparison was done with only the Greyhounds. This was not replicated with guide dogs, as it was felt that their history of having been companion animals in family homes with 12 months of "puppy-walking," would have increased individual differences in preferred grooming sites. Of the 16 Greyhounds groomed, eight were re-assessed without grooming, and two additional Greyhounds were also included in this non-groomed group to improve the balance of the numbers groomed and not groomed.

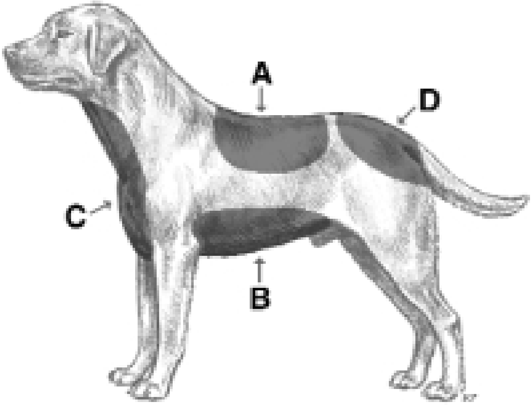
The mean age of the Greyhounds was 75 months, compared with a much younger 15 months for trainee guide dogs, so this needs to be considered in relation to any behavioral differences observed.

Procedure

Two women alternated in the grooming of the dogs for this study. A grooming device (Zoom Groom™, Company of Animals, Surrey, UK) was used to standardize the interface between the operator and the dog's skin. To reduce operator effect and acclimatize the dog to the grooming device, each dog was allowed to investigate the operator while she was wearing the grooming mitt.

All operators were shown a drawing of a lateral view of a dog (see Figure 1) and asked to stroke the dog rhythmically, in the direction of hair growth, using the grooming device in the center of each of four areas (labelled tail, saddle, ribs and chest). These sites were selected on the basis of them being innervated by:

Figure 1. Lateral view of dog demonstrating areas of grooming.



A. the dorsal branches of the spinal nerves (labelled saddle),
B. the lateral branches of the spinal nerves (labelled ribs),
C. the ventral branches of the spinal nerves (labelled chest), and
D. the caudal nerves (labelled tail).

Figure 2. Decline in canine mean heart rates (bpm) over time (mins) showing the three breed/grooming groups

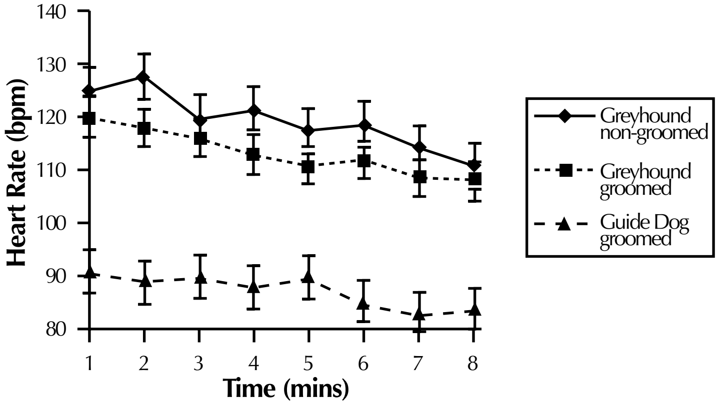


Figure 3. Decline in male and female mean heart rates (bpm) over time (mins).

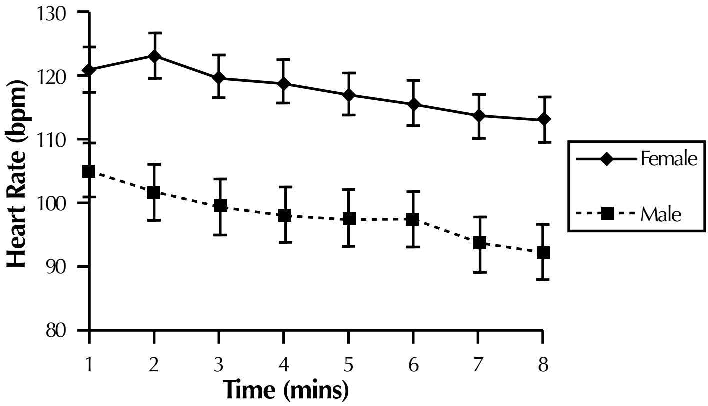
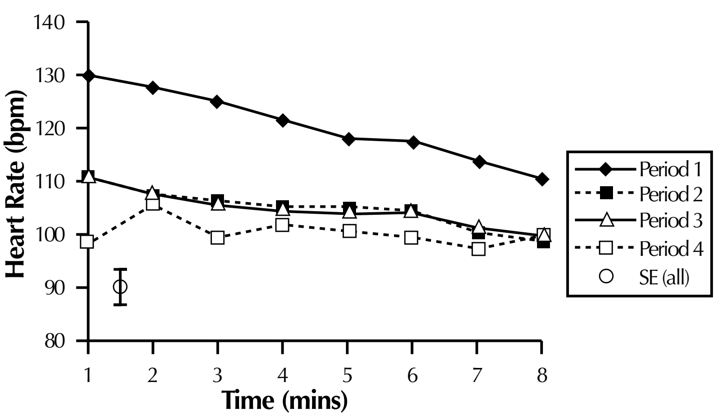


Figure 4. Decline in canine mean heart rates over each of the four periods.



Based on there being 24 permutations of the order in which the four areas could be groomed, dogs were randomly assigned the order in which they were to be groomed. Operators were directed to groom areas in the pre-determined randomized order to control for the order effect.

All four areas were groomed for eight minutes each, and heart rate measurements were taken with an ECG every 30 seconds. A two-minute period without grooming was inserted between grooming the second and third areas, so that the dogs could adjust their posture.

Statistical Analysis

Due to the repeat measurement nature of the data, and the partial design imbalance, REML (Restricted Maximum Likelihood) was adopted as the method for analyzing the heart rate data, and this was performed using GenStat (Lawes Agricultural Trust 2003). Initial modelling included fixed-effect terms for grooming, area of dog groomed, group (Greyhound or guide dog), sex, period (grooming sequence 1 to 4) and time (1 to 8 mins).

In addition, all two-factor interactions were also fitted initially, with non-significant ($p > 0.05$) ones eliminated in successive models. To take care of additional correlation structure between observations, nested random effects for Dog Number, Dog Number × Area of dog, and Dog Number × Area of dog × Time were included in the model.

Results

There were no observed differences in the mean heart rate based on the region of the body that was groomed ($p = 0.893$), nor were there any significant interactions between area of the body and any other factor (all $p > 0.5$). However, there was a highly significant trend in overall heart rate reduction over time by 1.43 beats per minute (bpm) ($p < 0.001$), and this same rate of decline was exhibited in both groomed and non-groomed Greyhounds and (groomed) guide dogs (Figure 2). Within Greyhounds, groomed dogs had a heart rate that was 5.9 bpm lower than non-groomed dogs, on average ($p = 0.003$), and groomed guide dogs had a heart rate averaging 26.4 bpm lower than that of groomed Greyhounds ($p < 0.001$). Regardless of the breed or grooming status, males had consistently lower heart rates than females (19.4 bpm lower, $p < 0.001$), and this continued throughout the study period (Figure 3).

As mentioned previously, the experiment was organized into a sequence of four sessions for each dog, with grooming areas randomly assigned (if the dog was in the grooming category). While there was no relationship with the actual area groomed, the mean heart rate declined over the grooming periods, as shown in Figure 4. Period 1 was associated with the greatest within-period decline, and subsequent periods with lower initial heart rates also exhibited slower declines within the period (Period $\times$ Tine interaction: $p < 0.001$).

Discussion

In this study, the area of dog groomed had no significant effect on cardiac response. This is in contrast to cats (Soennichsen and Chamove 2002) and horses (Kiley-Worthington 1987), which have been shown to have preferences for certain areas of their bodies being touched.

It is possible that in dogs there are no critical areas for touch, perhaps because they rarely indulge in mutual grooming. Alternatively, the areas we selected for grooming may have somehow failed to include responsive areas. A third explanation is that the groups of dogs studied did not represent typical populations of dogs. However, two groups were selected that had considerable differences in their rearing and management. Both were kennelled immediately prior to this study and it is possible that heart rate response would differ with area groomed in dogs housed under different conditions, e.g., home environment. Also, differences in heart rate responses between the breeds of dogs used in this study may reflect physiological and behavioral differences between breeds and also differences in management and training regimens.

Male dogs had consistently lower heart rates than female dogs. This difference is intriguing and is not commonly reported in the literature. It is possible that this simply reflects a predictable difference that relates to the larger body mass typical of male dogs. However, the difference merits further investigation. It mirrors reports that male humans often have lower heart rates than females (Storstein et al. 1991; Ahimastos et al. 2003).

Veterinarians should note the length of time taken for the heart rates to decline in this study, as these data show that taking pulse rates at the beginning of a physical exam or indeed even twenty minutes later may give a false indication of tachycardia.

Duration of grooming in this study is probably greater than any canine self-grooming bout in a single area. Humans may be more likely than dogs to stroke for this length of time, and the effect of physical contact on heart rate may constitute a reinforcer, but only after some time. Therefore the proximate reinforcing effects of physical contact are likely to be secondary to other benefits such as the proximity of social affiliates.

This study aimed to investigate the effect of grooming on different canine anatomical areas, and we have shown in this short-term trial that grooming does have an effect on heart rate, with heart rate response decreasing over time. This supports early studies, using smaller numbers of dogs, that suggested that heart-rate deceleration is an important component of cardiac response to petting reward (Kostarczyk and Fonberg 1982). The area of the body groomed, however, had no effect. Further study is required to determine if dogs do have preferred areas of touch, but we can hesitantly conclude that to enhance the human–animal bond, canine companions should be petted over different regions of their body and for a lengthy period.

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