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A Note on Heart Rate Response to Massage in Stereotyping and non Stereotyping Horses

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Abstract: Allogrooming was found to decrease heart rate in horses. Some authors found that stereotyping horses showed a different autonomic regulation of heart rate and that their heart rate decreased while they performed the stereotypy. The aim of this study was to investigate the heart rate response to allogrooming in stereotyping and non stereotyping horses. Twenty-seven horses (10 mares and 17 geldings), aged 2 to 25 years, were studied. All were housed in the same yard and managed similarly. Twelve presented different stereotypies (two horses had oral, three horses locomotion and seven horses both oral and locomotion stereotypies) and 15 were non-stereotyping control horses. Heart rate was recorded, using a stethoscope, at rest and during seven minutes of manual imitation of allogrooming. This procedure was performed by the same person, who was familiar with the horses. The data were analysed using a GLM. In our experience non stereotyping horses showed a significant decrease in heart rate in response to allogrooming, while stereotyping horses showed a significant increase ($p<0.0001$). These quite unexpected results seem to indicate that this kind of inter-specific interaction can be perceived differently by the two groups of horses.

Key words: Horse, stereotypies, massage, heart rate, human-animal interaction

INTRODUCTION

Mutual or social grooming, called also allogrooming, is widespread affiliative social behavior based on tactile interaction. Tactile interactions, such as stroking and scratching, are also considered common social interactions between people and their pets (Odendaal and Meinties, 2003). Allogrooming has acquired, in addition to role in defense from parasites, a stress reducing function in social animals, as suggested by the results of Schino *et al.* (1988) in primates. Many physiological changes have been reported happening in the animals which received allogrooming (Gust, *et al.*, 1996; Keverne *et al.*, 1989), among which a decrease in Heart Rate (HR) has been found in response to allogrooming and grooming performed by people in many animal species (Lynch and Gantt, 1968; Boccia, *et al.*, 1989; Aureli, *et al.*, 1999; Lynuh *et al.*, 1974; Feh and Mazieres, 1993; Me Bride *et al.*, 2004).

In particular the research of (McBride *et al.*, 2004) suggests that massage could be effectively used to reduce stress in horses.

A decrease in HR has been found also in crib-biting horses when they perform the stereotypy (Lebelt *et al.*, 1998; Minero *et al.*, 1999). (Bachmann *et al.*, 2003) found a HR variability characterized by lower vagal tone and higher sympathetic tone between crib-biters and control horses. These results seem to indicate some differences in the tuning of the autonomous nervous system between the two groups.

The aim of this preliminary study was to investigate the heart rate response of stereotyping and control horses to manual imitation of allogrooming (termed massage in the text) in order to verify whether massage had the same effect on stereotypers than on non-stereotyping horses.

MATERIALS AND METHODS

We studied twenty-seven horses, aged 2 to 25 years and belonging to various common saddle breeds. They were stabled in single box-stalls at the same yard, fed concentrate 3 times a day (at 07:00, 14:00 and 20:00) and were allowed to graze in a field at least 3 hours a week. All the horses had been in the yard for at least 2 months and were clinically sound. They had not been exercised for 3 hours before the experimental sessions.

We used the horse's history and direct behavioral observation to assign each horse to either the stereotyping (12 horses, 6 mares and 9 geldings) or the control (15 horses, 4 mares and 8 geldings) group. Each stereotyping horse had been showing the stereotypy for at least 2 months when the experiment was carried out.

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Two of the stereotypers were affected by oral stereotypies, seven by locomotion stereotypies and three presented both.

In order to investigate the possible effect of grooming on HR, the experiment itself consisted in a treatment session (baseline-massage session; B-M) which took place for all the 27 horses as follows:

- The experimenter first entered in the box and waited for 2 minutes in order to give the horse time to become accustomed to her presence;
- Then she proceeded to measure the HR for two minutes, recording the HR for each minute separately (baseline pre-massage phase). This constituted the baseline HR value, being measured at rest before any experimental manipulation;
- Finally she performed the manual imitation of allogrooming continuously for 7 min and recorded HR on the sixth and 7th min separately (massage phase).

SThe massage phase was standardized as much as possible. The action of grooming consisted both of scratching and muscle massaging with the tips of the fingers on the back of the horse, along the spine, especially on the withers, while the horse was free in its usual box stall. The choice to leave the horse free was due to the fact that tying it could have frustrated some horses (e. g., locomotion stereotypers) more than others and this could have biased the results. Moreover the horse would not be able to reciprocate allogroming if tied, while having another person holding the horse and allowing it to allogroom the experimenter, but not to move away would have introduced another source of variability in the design. In fact, whether the horses responded to the social interaction by reciprocating allogrooming on the experimenter massaging it was also recorded for all the horses.

However, if the horse tended to move around in the stable the experimental session was aborted in order to avoid the risk that locomotion and physical exercise could cloud the HR results. In the very few cases in which this happened the horse was tested at least half an hour later.

Furthermore, in order to be sure that the eventual modifications in HR, if any, were indeed due to the massage and not, for example, to the protracted presence of the experimenter near the horse, we also scheduled a baseline-control (B-C) session for each of the 27 horses in a different day to the B-M session. We also randomized session order in order to minimize the effects of repetition. Thus half of the animals (chosen at random) in each group (i.e. ST and NST) underwent first the B-M then the B-C session, while the other half had first the B-C then the B-M session. However, one horse was unexpectedly sold after the B-M session, before the scheduled B-C session could be carried out. The B-C session was similar to the B-M session except for the fact that the grooming phase was substituted by a control period in which the experimenter stood near the horse without massaging it. Also B-C sessions were interrupted and rescheduled in case the horse was moving around in the stable in a way which could have effected the HR measurement.

All the sessions were carried out in the early afternoon. We measured HR using a stethoscope. When HR was measured during the massage phase, the experimenter used the stethoscope with one hand while continuing the massage with the other. The same person, who was familiar with the horses, performed the two sessions for all the horses. We chose a person which was known to the horse because allogrooming in social animals is performed between animals knowing each other, so selecting an unfamiliar person could have altered the meaning of the procedure. The experimenter carrying out the massage was not the same one who had carried out the behavioral observations, in order for the former to be as blind as possible to the stereotyping/non stereotyping status of the horses. However, as the stereotyping horses were mostly heavy stereotypers, they could easily be seen stereotyping by anyone spending even little time in the yard.

Statistical analysis: We calculated mean HR values from the two HR values of each phase and used them for the statistical analyses.

A general linear model (SAS, 1989) was performed on the following model to evaluate the source of variance of the difference in heart rate between pre-massage and massage, pre-control and control, pre-massage and pre-control:

$$Y_{ijklm} = \mu + cl\_age_i + gender_j + work_k + ster_l + \varepsilon_{ijklm}$$

In which: Y = difference in heart rate between pre-massage and massage, pre-control and control, pre-massage and pre-control (27 observations), μ = mean; cl-age = variable age (2 levels: young horses, aged less than 5 years, vs. adults); gender = variable gender (2 levels: mares vs. geldings); work = training (2 levels: regularly trained = horses regularly worked at least one hour a day for 6 days a week vs. irregularly trained = horses worked less than that or not worked at all); ster = variable stereotypy (2 levels: absence vs. presence); ε = random residual.

Table 1: HR (mean±SD in beats per minute) in Stereotyping (ST) and control (NST) horses during pre-massage and massage phases and percentage variation between the two phases

	Pre-massage HR	Massage HR	% Variation
ST	40.7 ± 4.5	43.9 ± 4.3	7.9 ± 3.4
NST	40.9 ± 5.2	38.2 ± 4.7	-6.6 ± 4.0

Even if oral and locomotion stereotypies are thought to be differently motivated, it was decided to use only absence vs. presence of stereotypies as a variable, as all the horses in the stereotyping group showed exactly the same kind of response to massage (i.e., all increased their HR). This was also corroborated by the results of preliminary exploratory data analyses in which the kind of stereotypy was used as an independent variable and was found as being non significant.

A Fisher Exact test was used to assess difference between stereotyping and non stereotyping horses in the number of horses reciprocating allogrooming.

RESULTS

The GLM found that pre-control and control, pre-control and pre-massage heart rates were not statistically different. As far as the pre-massage minus massage model (R-square = 70.5%, F = 13.15, D.F. = 4, $p<0.0001$) was concerned, the presence/absence of stereotypies was the main effect in the model ($F=48.28$, D.F.= 1, $p<0.0001$); other effects were non-significant. The LS means of this effect were-2.7 bpm for non-stereotypers and+2.6 bpm for stereotypers ($t=-6.95$ $p<0.0001$) meaning that non stereotyping horses significantly decreased their HR in response to massage while stereotypers significantly increased it (Table 1).

DISCUSSION

Horses of the control group decreased HR in response to massage, as expected, while in neither group there was an effect of the mere presence of the experimenter near the horse in the control phase. Although an increased HR does not necessarily correspond with stress, massage seemed to have a de-arousing, and probably a stress reducing, effect on these animals, as already found by (McBride *et al*., 2004). This result can be important in the management of these animals and in human-horse interactions. On the other hand, the finding that massage had a completely opposite effect on the HR of stereotyping horses was unexpected. Differences in the cardiac activity regulation of this kind of horse had already been highlighted by other studies(Minero *et al*,. 1999; Bachmann, *et al*., 2003). (Minero *et al*., 1999) found a higher HR in crib-biters than in control horses, which decreased when performing the stereotypy. (Bachmann *et al*., 2003) found out that the Low-Frequency component (LF) of the HR variability, assigned to the tone of sympathetic system, was higher, but only at rest, in crib-biters compared to controls, while the opposite was observed for the High-Frequency component (HF) assigned to the tone of vagal system. Moreover, when they submitted the horses to a situation which was likely to cause frustration (horses could see, but not reach the food), no significant physiological response was observed in stereotyping horses (crib- biters), while control animals had a significant increase of the HF component and a significant decrease of the LF component in comparison with baseline conditions.

Nevertheless, it is not easy to explain why stereotypers showed an increase of HR when allogroomed; increase in HR is generally believed to be a consequence of sympathetic system activation which characterizes the emergency response elicited e.g. by exercise or acute stressor. This could suggest that the procedure was perceived differently by the two groups of horses, hinting to a different motivational state. However, it is interesting to note that only 10 horses (6 controls and 4 stereotypers), responded to the massage by allogrooming the experimenter and that the ratio of horses responding vs. non responding was not statistically different between the two experimental groups.

As often people tend to discourage horses for stereotypy performance applying negative stimuli, one could hypothesize that stereotypers could had associated human contact with punishment and this anticipation could give rise to the different response. However, the 3 of the stereotyping horses, which had been born in the yard and were never punished for stereotyping, showed increased HR as well. Moreover no rise in HR was found in stereotyping horses during the control phase in which the experimenter was very near the horse in order to use the stethoscope.

The fact that some of the horses performed their stereotypy during the massage phase is not likely to have altered the results, as these horses were all performing oral stereotypies, which have been seen to lower HR(Minero *et al*., 1999). On the contrary, horses did not seem to perform locomotion stereotypies during massage. In fact horses tended to remain still during the sessions (both B- M and B-C) and in the few cases in which there were bouts of locomotion, the session was aborted and postponed.

CONCLUSION

The effect of manual imitation of allogrooming on cardiac response of stereotyping horses was the opposite to that of control horses, suggesting a different motivational state. In fact stereotyping horses showed a significant HR increase when massaged whose meaning is not easy to explain. Although further research will be needed to clarify this aspect, it is worth noting that this kind of inter-specific social interaction could have been perceived in a different way by horses showing stereotypies and that, if HR is deemed a suitable indicator of arousal, massage could not have a de-arousing effect on this kind of horses.

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