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Research

Relationship between behavior and cardiac response to round pen training

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ABSTRACT

The aim of this study was to assess the correlation between heart rate (HR) and heart rate variability (HRV) and the most expressive behaviors of horses during pretraining, based on the natural horsemanship method. The study involved 20 Arabian stallions and 20 thoroughbred stallions. The horses had not been previously trained. The study covered a 3-day training cycle aimed at horse acceptance of the rider. The training lasted for 15 minutes each day (three 5-minute intervals). HR and HRV parameters (root mean square of successive beat-to-beat differences, low frequency, high frequency, and low frequency/high frequency) were used as physiological indicators of stress. At the same time, 3 inexperienced observers noted the behavioral reactions of the horses. Further analysis involved only those behavioral reactions that were spotted by all the observers at the same time. These behavioral reactions were defecation, vocalization, high head position, oral behavior, and escape attempt. It was found that the assessment of horse behavior, based on the behavioral responses of the horses while using the natural horsemanship method of training, was not accurate. This was evidenced by the small number of significant correlations between the frequency of behavioral reactions and the HR and HRV parameters in thoroughbreds and the lack of correlation in Arabian horses. Escape attempt and frequency of vocalization should be considered as the most important behavioral responses in the assessment of thoroughbred horses. It is also important to carry out a proper assessment of the emotional reaction in the first 10 minutes of training, which are the most stressful.

Introduction

Although the natural training methods have already been studied (Visser et al., 2009; Kędzierski et al., 2012; Janczarek et al., 2013a) and are becoming ever more popular, they are still called into question by breeders and practitioners (Goodwin et al., 2009). Generally, the results of the studies show a positive influence of those methods, particularly in the case of some breeds, for example, thoroughbreds (Janczarek et al., 2013b). On the other hand, the effects of the natural training do not remain for long (Krueger, 2007). Another controversial issue is the understanding of the body language expressed by the horse. The architects of the natural horsemanship method overtake each other in describing the emotional tone of particular elements of that language (Parelli, 2000; Roberts, 2002). The low position of the head, turning the ear toward the human, licking, and slowing of movement are assumed to be the most important positive behavioral reactions. The horse expresses negative emotions by a high head position, teeth grinding, turning away from human, vocalization, and escape attempts. The researchers also focus on the elements of the body language (Krueger, 2007; Fureix et al., 2009). The frequencies of particular behaviors are most often studied during initial training and specific behavioral tests (Rietmann et al., 2004; Leiner and Fendt, 2011). However, it is not possible to interpret the tone of some behaviors unambiguously. According to McGreevy (reported by Visser et al., 2009), licking does not mean compliance but instead results from the dry mouth caused by adrenaline excreted during the stress. Similarly, the defecation may indicate either stress or relaxation. The assessment of behavioral reactions with physiological parameters is also problematic. Tests used in such an assessment are not well standardized and validated (Forkman et al., 2007). In addition, most elements of body language are shown by

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the horses implicitly. Hence, the body language is difficult to interpret by nonprofessional behaviorists. The human also has problems with demonstration of the equine body language, for example, because of the impossibility of moving ears (Goodwin et al., 2009). On the other hand, as the natural horsemanship methods gain in popularity, these techniques are used by more and more nonprofessionals. It may be expected that inaccurate assessment of what are often very subtle and ambiguous behavioral reactions may adversely affect training and the animal's welfare. Were this to happen, the creators of the natural horsemanship schools may be discredited. There is also a physical danger posed to humans if behavioral reactions are misunderstood, especially in the case of stallion training (Goodwin, 2007). Male horses express aggressive responses more often than mares, even in very young animals (Christensen et al., 2002).

We formulated the hypothesis that it is possible to choose horse behaviors that are easily perceived and understood by nonprofessionals. We also hypothesize that it is possible to confirm underlying physiological responses using equine body language. This assumption led to the aim of this work: assessing the correlation between cardiac activity parameters and the most expressive behaviors of horses during round pen method before training.

Material and methods

The study was supported by the State Committee for Scientific Research, Poland (grant number N31 502039). Animal care and experimental procedures were in accordance with the European Committee regulations for the protection of experimental animals and approved by the second Local Ethics Review Committee for Animal Experiments at the University of Life Sciences in Lublin, Poland.

The study included 20 Arabian stallions aged 33-36 months and 20 thoroughbred stallions aged 16-19 months. At the time of the study, the animals were clinically healthy. None of the horses had been previously trained. Their contact with people was limited to being fed, receiving basic care, and taking part in veterinary procedures. Before the start of the experiment, the horses were brought to a box-stall stable. The next day, a licensed trainer began the training procedures that were based on the natural horsemanship method. A 3-day long training cycle was planned. Single training units lasted no more than 60 minutes. The duration of the training unit was adapted to the behavioral responses of individual horses. The behavioral responses were treated as the emotional state indicators of the horses.

The trainer divided the training into consecutive tasks that required the horse to focus its attention on the trainer, desensitization, preparation for saddling, saddling, preparation for mounting, and finally mounting. The subsequent task began after completion of the previous one. Each day, the trainer began by going over the tasks that the horse had already completed. The horse's body language was most evident to the trainer in the initial stages of the training. After consultation with the trainer, the first 15 minutes of the training were divided into 3 equal intervals (the first, second, and third interval) and analyzed. During the first 15 minutes, the trainer tried to make the horse focus (3-5 minutes: task duration) and worked using desensitization (10-12 minutes: time included in the experiment) to accustom the horse to the touch of a hand, a whip, or other objects, for example, by putting a saddle blanket on the horse's back and touching different parts of the horse's body. Before training, a telemetric Polar heart rate monitor (model RS800CX; Polar Electro Oy, Kempele, Finland) was put attached to the horse's chest using an elastic belt. The following heart rate (HR) variables were quantified: (1) the mean HR (in beats per minute), (2) root mean square of successive beat-to-beat differences (rMSSD [in ms] estimate high-frequency [HF] beat-to-beat variations that represent mainly vagal regulatory activity) and frequency domain parameter, (3) low frequency (LF, ms^2) of the signal assigned to the tone of the sympathetic system, (4) HF assigned to the tone of the vagal system (ms^2), and (5) LF/HF (ratio between LF and HF content of the interbeat interval signal; indicates sympathovagal balance of regulation) (Stein et al., 1994). Cardiac activity parameters were analyzed using Kubios heart rate variability (HRV) software, version 2.0 (Biomedical Signal Analysis Group, Department of Applied Physics, University of Kuopio, Finland 2008). To remove trend components, the data were detrended, and the artifact correction was made following established procedures (Tarvainen et al., 2002).

The prevalence of behavioral responses in successive time intervals was determined by 3 independent people. All 3 people had been previously taught the basics of the natural horsemanship training methods for young horses. These people were asked to note all behaviors that they believed were elements of horse body language, together with the time when the behaviors were spotted and how long it lasted. The observers stood outside the openwork round pen. All the handheld stopwatches used by the observers were synchronized with the stopwatch of the telemetric device mounted on the horse's body, enabling assignation of the behaviors to specific time intervals and records of cardiac activity. Further analysis included only those behavioral reactions that were spotted by all the observers at the same time (Table 1). As a result of this selection, the following behavioral reactions were chosen: defecation, vocalization, high head position, oral behavior, and escape attempts. Behavioral reactions during round pen training were identified through correlations between selected reactions and readings of HR and HRV at the time of their occurrence.

Multivariate analysis of variance (general linear model) was made using Statistica, version 10.0 software (StatSoft, Inc., Tulsa, USA.), using the horse as a random effect and the horse breed, training day, subsequent time interval, location where bred, and interaction between these factors as fixed effects. The data followed a normal distribution. The significance of differences between the means was determined using Tukey test. Relationships between the number of behavioral responses and horse cardiac activity parameters were determined using Pearson correlation coefficients.

Results

There were no significant differences between the mean number of observed behavioral reactions for each of the analyzed factors (Table 2). The most frequently observed reactions were the high head position in the thoroughbred stallions and vocalization in the Arabian stallions. The mean values for the other reactions were the same in both breeds. On the consecutive training days, a lower number of analyzed reactions was observed. The regression was especially revealing for the mean number of vocalizations and

Table 1
The ethogram of selected behavioral reactions

Behavior	Behavioral description
Defecation	Elimination of feces
Vocalization	Whinny (neigh)—a horse elevates the head, opens the mouth slightly, ears and eyes usually forwarded (McDonnell and Haviland, 1995; Waring, 2003)
High head position	Nose above the withers (Rietmann et al., 2004)
Oral behavior	Teeth grinding (Cooper and McGreevy, 2002)
Escape attempt	Escape from a trainer, turning away from a trainer, running along the perimeter of the training corral, trying to leave the training corral