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Research

Preliminary results suggest an influence of psychological and physiological stress in humans on horse heart rate and behavior

Katrina Merkies [a,*], Anja Sievers [b], Emily Zakrajsek [a], Helen MacGregor [a], Renée Bergeron [a], Uta König von Borstel [b]

[a] Department of Animal and Poultry Science, University of Guelph, Guelph, Ontario, Canada
[b] Department of Animal Breeding and Genetics, University of Göttingen, Göttingen, Germany

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ABSTRACT

People may involuntarily emit fear or distress signals when around horses, and interpreting how horses respond to these messages is important, particularly for human safety around horses. No studies have been done to determine if horses can differentiate between humans who are physiologically stressed (e.g., after exercising) as opposed to psychologically stressed (e.g., afraid). Horses (N = 10) loose in a round pen were randomly subjected to the presence of a stationary blindfolded human in each of 4 treatments: (1) calm human comfortable around horses (CALM), (2) physically stressed human (PHYS; exercised to 70% maximum heart rate [HR]), (3) psychologically stressed human (PSYCH; afraid of horses), or (4) no human (CONTROL). Both humans and horses were equipped with an HR monitor. Physiological and behavioral observations (gait, head position relative to the withers, distance and orientation toward human) were recorded and analyzed using a mixed model with horse and human as random effects. Increasing human fearfulness was associated with a decrease in horse HR ($P = 0.0156$). Horses moved at a slower gait in PSYCH ($P < 0.0001$), and horse head position was lower during PHYS and PSYCH compared with CALM or CONTROL ($P < 0.0001$). Human HR was highest in PHYS ($P < 0.0001$) and decreased over time in all treatments. Human HR increased when the horse was facing away ($P = 0.0395$). Overall, horses appear less stressed in the presence of a stationary fearful or physically stressed human than a calm person. Thus, horses in the presence of fearful humans, particularly where participants may not be comfortable around horses, should not pose any additional risk provided normal safety precautions are used.

Introduction

Horses are preferred animals in animal-assisted therapy programs for the direct behavioral feedback they provide the human participants (Fine, 2010). During therapy sessions, horses are exposed to humans having physical or psychological trauma, and participants may be unfamiliar with horses, which may cause the participant to become nervous. Often family members are involved in therapy programs (All and Loving, 1999), possibly increasing the number of humans who may be unfamiliar or afraid of horses. An increase in heart rate (HR) is one of the strongest physiological indicators of stress from anxiety, fear, and nervousness in humans (Kreibig, 2010). A crowd of nervous and inexperienced people can create a potentially dangerous situation for both the participants and the horses. Even for experienced horse riders and handlers, the probability of serious injury while working around horses is 20 times higher than for motorcyclists (Silver, 2002). A comprehensive review of injuries to horse riders and handlers by Hawson et al. (2010) indicated factors, such as age and size of the horse, and gender and riding experience of the human influence the risk of human injury while working with horses. However, horse behavior, almost always associated with a fear response from the horse, is the most common factor related with injuries. The unpredictable nature of horses is often cited as the cause of injuries, when in reality it may simply be a lack of understanding of the equine ethogram and/or a failure to appropriately apply learning theory that leads to confusion and conflict behavior responses by the horse. From this, Hawson et al. (2010) recommended an emphasis on understanding horse behavior as a preventative measure against human injuries around horses.

* Address for reprint requests and correspondence: Katrina Merkies, PhD, Department of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada. N1G 2W1. Tel: +1-519-824-4120; Fax: +1-519-836-9873.
E-mail address: kmerkies@uoguelph.ca (K. Merkies).

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In horses, HR and behavior are sensitive and reliable indicators of fear or anxiety (Gehrke et al., 2011; Visser et al., 2002). Horses that are in discomfort are more aggressive toward humans (Popescu and Diugan, 2013) or may display increased HR, motor activity, and vocalizations (reviewed in the study by Forkman et al., 2007).

Many experienced horse handlers believe that being in a calm mental state can decrease stress in the horse. Horses demonstrate more relaxed behavior with humans having positive attitudes toward horses (Chamove et al., 2002), whereas being stroked by a negatively thinking person causes an increase in horse HR (Hama et al., 1996). Nervousness can be transmitted from humans to their horses under handling and riding conditions, as indicated by a rise in horse HR without visible changes in behavior such as an increase in speed of walking or a change in posture (Keeling et al., 2009; von Borstel, 2008). When riders only pretended to be nervous, horses showed no change in HR but did show changes in behavior (von Borstel and König, 2008), indicating that horses are very sensitive to the rider's psychological state. Conversely, no difference was shown in horse HR in a dressage test performed as practice versus one done in front of an audience, whereas there was a significant increase in HR of the rider from practice to performance (Lewinski et al., 2013). This could validate horses as a therapy animal because, unlike dogs that have been shown to have increased stress levels in environments that were busy with humans (King et al., 2011), horses appear to be less sensitive to having additional humans in the nearby area.

A nervous or fearful person may display an increased HR, and also a physically exercised human will have a higher HR. Because not only the human's safety is important but also the welfare of the horse, it is vital to know how physical and psychological stress of the humans may influence the horse. The aim of this study was to investigate whether horses can distinguish between humans in differing states, that is, physically or psychologically stressed, and the response of the horses to these differences in terms of their HR and behavior.

Materials and methods

Participants

Animals

Cohen's f^2 was used for an a priori test to determine sample size with the following parameters: α level = 0.05, anticipated effect size (Cohen's f^2) = 0.35, desired statistical power level = 0.80, and 5 dependent variables. Calculations outlined by Soper (2006-2014) predicted a minimum required sample size of 43 animals. Because each horse was exposed to each treatment, and there were 4 treatments, the total number of horses required was divided by 4. As only 10 horses were available, all 10 horses (2 stallions and 8 geldings) between 4 and 19 years (average ± standard deviation, 10.7 ± 4.9 years) were used (5 Percheron, 1 American cream draft, 1 shire, 1 Drum horse, 1 Caspian, and 1 Friesian 7× Standardbred). The horses were privately owned by 2 different stables and trained for jousting and/or riding and driving. All horses were moved to the same facility 2 months before data collection and regularly received 24-hour turnout and with grass hay as necessary to supplement pasture.

Humans

Using the same a priori tests for sample size as mentioned previously in the calculation by Soper (2006-2010) (α level = 0.05, anticipated effect size [Cohen's f^2] = 0.35, desired statistical power level = 0.80) for a single dependent variable yielded the requirement for 25 human participants. However, only 16 humans were recruited by means of local advertisement for this study (9 females and 7 males; mean age, 45.5 ± 12.8 years; mean weight, 77.2 ± 18.4 kg; mean height, 173.3 ± 13.1 cm). None of the participants had interacted with the research horses before the study, and they were fully informed of the purpose of the research. All participants ranked themselves before testing regarding their fear of horses (0 = very confident around horses and 10 = extremely afraid of horses). For the purposes of the treatments as outlined later, the 2 humans (1 female and 1 male) who ranked themselves as 0 were used for all the calm and physically stressed treatments, whereas the remaining 14 humans (8 females and 6 males; average rank, 6 ± 3) participated 1 time each in the psychologically stressed treatment. All the participants had limited (beginner level) to no previous horse experience.

All protocols were approved by the Canadian Council of Animal Care (CCAC, 2009) following standards of equine care and use as well as by the Canadian Research Ethics Board for use of human subjects in research.

Treatments and procedures

Each horse received each of the following treatments: (1) CALM: exposure to a calm human, neither afraid of horses nor physically stressed, (2) PHYS: exposure to a human who was not afraid of horses but was physically stressed with an HR at 70% of maximum, determined by the Karvonen formula (Karvonen et al., 1957) immediately before entering the pen, (3) PSYCH: exposure to a psychologically stressed human because of fear of horses, or (4) CONTROL: no human present. Treatments were fully randomized for each horse, with each horse receiving 2-4 treatments each day at approximately the same time with at least 60 minutes in between treatments.

A round pen (15.2 m diameter) was set up inside an indoor arena familiar to the horses. A video camera (Panasonic HC-X900; Panasonic Canada Inc., Mississauga, Ontario, Canada) was placed at a distance of at least 20 m from the round pen to continuously record each trial. Inside the round pen, pylons marked the center and a radius 3 and 6 m away from the center (Figure 1) as a visual aid to determine the distance between horse and human.

Horses were taken from their paddock and led individually into the round pen by 1 neutral person who was experienced in handling horses, blind to the ensuing treatment, and did not participate in the tests. The trial started when the gate was closed after the handler released the horse in the pen.

After being released, the horse was free to move about the round pen as it chose while being observed for 5 minutes. After 5 minutes of baseline (CONTROL) recording, the test subject entered the round pen, stood in the center as marked by the pylon, and placed a

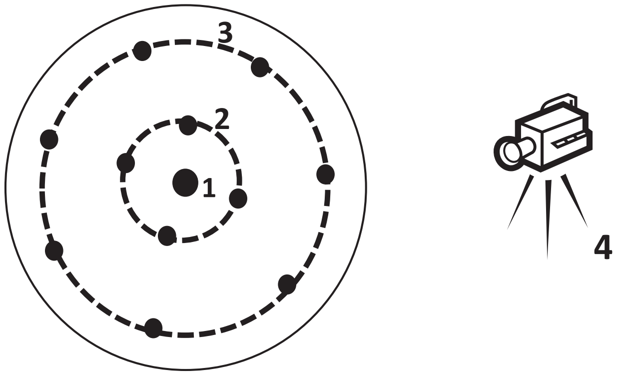

Figure 1. Structure of the round pen used for all trials: 1 = center, that is, position of the human; 2 = 3 m radius from the center; 3 = 6 m radius from the center; 4 = placement of video camera, 20 m from round pen (total pen diameter = 15.24 m). Observers were located by the video camera.