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The effect of a feeding stress-test on the behaviour and heart rate variability of control and crib-biting horses (with or without inhibition)

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ABSTRACT

Crib-biting is a form of oral stereotypy affecting 4–5% of horses. Once fixed, crib-biting is difficult to eliminate by behaviour therapy, however, its performance can be inhibited by collar or surgery treatment (modified Forssell's procedure). Although surgical intervention is widespread, the effects on stress coping in horses have not been studied.

In the present study we evaluated changes in behaviour response and heart rate variability in 9 control, 10 crib-biting, 10 collar and 11 surgically treated horses in a feeding stress-test, in which a feeding-bowl was placed in front but out of the reach of the horses, from which tidbits were given 3 times.

We found that stress triggers high oral activity, mainly cribbing in crib-biting horses, elevates other forms of oral activities in the inhibited groups and does not affect oral activities of controls. Instead of performing oral activities, control horses tended to target an unavailable feeding-bowl by pawing or head-tossing. Changes in stress level were indistinguishable in controls and crib-biters as heart rate variability returned to baseline values in both groups. In contrast, horses inhibited to perform crib-biting showed elevated stress level throughout the test period. Our results suggest that crib-biting may develop to cope with stress, and such coping function diminishes when inhibited.

1. Introduction

Stereotypies are repetitive, relatively invariant actions considered abnormal when they occur without any primary function (Mason, 1991). Since function of any behaviour is seldom obvious, Mason and Rushen (2006) redefined stereotypy as repetitive behaviour induced by frustration, repeated attempts to cope and/or central nervous system dysfunction. This new definition poses new challenges to research: the development of stereotypies is a long process and little is know about their origin (i.e. Nagy et al., 2008). Possible central nervous system dysfunctions are difficult to study (McBride and Hemmings, 2009) and coping function of a behaviour detrimental to the health of the animal can be questionably (Cooper and Albentosa, 2005). For example, crib-biting/wind-sucking, an abnormal stereotypy in horses with prevalence of 4–5% (Pell and McGreevy, 1999; Bachmann et al., 2003a; Albright et al., 2009) is associated with tooth-erosion, weight loss, altered gut function (McGreevy and Nicol, 1998a; Clegg et al., 2008), gastric inflammation/ ulceration (Nicol et al., 2002), and epiploic foramen entrapment colic (Archer et al., 2008). Its presence may decrease the economical value of the horse, and it is also considered an unsoundness (McBride and Long, 2001; Albright et al., 2009). In this study we attempt to dismantle chronic health effects from possible coping function of crib-biting.

Crib-biting/wind-sucking usually involves seizing a projection with the incisors or supporting the chin (crib-biting), contracting the strap muscles of the ventral throat region, and emitting a grunt (wind-sucking). The 'wind-sucking' component makes crib-biting behaviour typical

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and distinguishable from wood-chewing (McGreevy et al., 1995a,b; Albright et al., 2009). Some horses would wind-suck even without the use of a solid object.

Because crib-biting can be detrimental to the animal, several methods have been worked out to diminish its occurrence. The most common treatment is the application of crib-biting strap (collar), which makes flexion of the neck difficult and therefore the terminal grunting less easy to perform. Horses often adapt to the pressure applied by the collar, which is subsequently tightened, occasionally to the extent that skin trauma becomes apparent. McBride and Cuddeford (2001) found that wearing collar increased heart rate, beta-endorphin and plasma cortisol level both in control and crib-biting horses, indicating that collar wearing per se imposes severe stress to the horse. Moreover, the first day after fitting the collar frequency of crib-biting significantly increased suggesting that the motivation to perform wind-sucking rises when prevented (McGreevy and Nicol, 1998b).

Another approach, the modified Forrsell's operation designed to treat crib-biting has been gaining popularity among horse-owners. The procedure involves the removal of a 10 cm section of the ventral branch of the spinal accessory nerves (which innervate the sternomandibularis muscles), and 34 cm sections of the paired omohyoideus and sternothyrohyoideus muscles in order to reduce the distracting forces acting on the oesophagus. Operated horses are unable to draw the larynx caudally and consequently cannot emit the grunting sound (Auer and Stick, 2006). The main complications of the modified Forssell's procedure are the development of swan-like neck or laryngeal hemiplegia. The assessment of its success-rate has revealed inconsistent results varying between 30 and 100% (Turner et al., 1984; Hakansson et al., 1992; Schofield and Mulville, 1998; Delacalle et al., 2002). Previous studies on the success-rate of the modified Forssell's procedure relied usually on the owner's reports and focused solely or mainly on the degree of stereotypy inhibition, postoperative complications and side-effects. The implications of the treatment for the general welfare of the horse have not been studied until to date, however, Schofield and Mulville (1998) noted that stereotypy elimination may increase stress. The need to evaluate the effect of a treatment on the welfare of the animal has become more apparent (Christiansen and Forkman, 2007).

The aim of the present study was to assess the success-rate of the prevention of crib-biting by the modified Forssell's procedure compared to the collar treatment and to measure stress-related behavioural and physiological variables in order to evaluate the 'quality of life' of the horses following treatment. Stereotypies may develop to cope with frustration, however, they often persist even after environmental stress is reduced thus fixed abnormal stereotypic behaviour itself may impose stress to the animal. Conversely, if stereotypies are maintained as coping mechanisms, animals may show signs of stress in a frustrating situation if execution of the abnormal behaviour is blocked by prevention methods. We hypothesised that horses prevented from performing crib-biting may either persist with the stereotypy in a modified form, or may show behavioural and/or physiological indicators of distress.

2. Materials and methods

2.1. Animals and housing

We tested 52 horses of four groups: control, crib-biting, collar-treated and surgically treated groups. Data of 12 horses were excluded from the analysis. Heart rate data of 7 individuals were not reliable or missing because of technical problems. Horses younger than 4 years of age (3 cases) were excluded from the analysis because they exhibited high stress reaction when tied with rope therefore baseline values could not be established. Data of one mare were not analysed because the attention of that horse was distracted by her foal staying in the vicinity. One horse in the control group exhibited oral stereotypies (licking the wall throughout the test) and was therefore not included in the analysis.

Sample size of the four experimental groups decreased to 9 horses in the control group without stereotypic behaviour, 10 crib-biting horses (crib-biting group) performing stereotypic behaviour since 1–2 years ($N = 4$) or more than 2 years ($N = 6$), 10 crib-biting horses that had been wearing cribbing collar continuously for at least six months ($N = 1$), between 1 and 2 years ($N = 7$) or more than 2 years ($N = 2$) before the experiment (collar-treated group), and 11 horses operated with the modified Forssell's procedure at least six months ($N = 3$), between 1 and 2 years ($N = 3$) or more than 2 years ($N = 5$) prior to the experiment (surgically treated group).

Horses had different owners and stayed at different riding schools. Behavioural tests were conducted in the familiar home environment of the horses.

2.2. Experimental design

Behavioural and heart rate variables of horses were assessed in a crib-biting triggering stress-test. The stressor was a modified version of the arousal-inducing situation applied by Bachmann et al. (2003b). The test was introduced 1.5–2 h following the morning or noon feeding of concentrates. During the whole test the box door was open. Five minutes before the test the horses were tighten to their box with a rope long enough so they could reach the ground.

The test lasted for 20 min and responses were evaluated in 9 periods (Table 1). Baseline was established in the first 5 min without any stimulus. After that, the experimenter was walking up and down in front of the box and was making noise with a bowl filled with oats (feeding-bowl) to direct attention to the bowl. Seven minutes after the start the feeding-bowl was placed in front but out of the reach of the horse. The feeding-bowl stayed there for 8 min, meanwhile tidbits were given to the horses (~5 g oats was taken from the feeding-bowl into the feed bin with delivery duration of ~10 s) three times. Two minutes after the 3rd tidbit the bowl was removed, and for 5 min no stimulus was presented, however, the horses stayed tied up.

Behaviour was videotaped and heart rates of horses were recorded continuously throughout the test.

2.3. Behaviour

Mutually exclusive behavioural elements were defined and recorded continuously with precision of 1 s (continuous