



Special Section on Stereotypic Behavior

Causal factors of oral versus locomotor stereotypy in the horse

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ABSTRACT

Stereotypic behaviors are commonly observed in domestic equids as they are in a range of captive nondomesticated species. Estimates suggest that 19.5%–32.5% of horses perform a stereotypy. The presence of these behaviors is thought to indicate suboptimal welfare status and can result in secondary physical pathologies, such as colic, ligament strain, and incisor wear. Relatively little is understood about the etiologies of oral and locomotor stereotypies. Seemingly disparate causal factors have been proposed, including gastric pathology, neural adaptation, and genetic predisposition. In this review, we propose a model of causality that presents separate pathways to the development and continuation of oral behaviors such as crib-biting, compared with locomotor alternatives (i.e., weaving). The word stereotypy has alarmingly negative connotation among horse keepers. Stereotypic behaviors are often viewed as vices, and therefore, a number of horse owners and establishments attempt to physically prevent the behavior with harsh mechanical devices. Such interventions can result in chronic stress and be further detrimental to equine welfare. Stereotypy has been proposed to be a stress coping mechanism. However, firm evidence of coping function has proven elusive. This review will explore management options directed at both prophylaxis and remediation.

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Introduction to equine stereotypy

Stereotypic behaviors are repetitive, invariant (Pell and McGreevy, 1999; McBride and Hemmings, 2005; Ninomiya et al., 2007), idiosyncratic (Parker et al., 2009), and induced by motivational frustration (Mason, 2006), repeated attempts to cope, or central nervous system dysfunction (McBride and Hemmings, 2009; McBride and Parker, 2015). Crib-biting is an oral stereotypy, in which the animal grasps a surface at chest height with the incisors, pulling back creating an arch with the neck (Moeller et al., 2008; McBride and Hemmings, 2009; Wickens and Heleski, 2010) accompanied by the sucking of air into the proximal esophageal region, creating an audible grunting sound (Nicol et al., 2002; Moeller et al., 2008; McBride and Hemmings, 2009; Wickens and Heleski, 2010). Weaving is a locomotor stereotypy, defined as the repetitive weight shift from one forelimb to the other, often

combined with lateral swaying of the head (Cooper et al., 2000; McBride and Hemmings, 2005). Box-walking, also a locomotor stereotypic behavior, is the repetitive circular walking of the stable (McBride and Hemmings, 2009).

The extent of stereotypy manifestation would appear to differ between studies dependent on factors, such as stereotypy type, breed, and performance discipline. For example, using a questionnaire-based methodology, McGreevy et al. (1995) reported that the prevalence of stereotypy ranged from 19.5% to 32.5% in horses from dressage, eventing, and endurance backgrounds. A previous review calculated that 4.3% of horses perform the oral stereotypy, crib-biting, compared with 3.25% and 2.2%, respectively, of horses that perform the locomotor stereotypies weaving and box-walking based on the previous published study (McBride and Hemmings, 2009). Direct observations indicate that questionnaire-based estimates of stereotypy may be conservative (Cooper et al., 2000). Furthermore, certain breeds are more susceptible to stereotypy than others, indicating a genetic component to the development of these behaviors in the horse (Bachmann et al., 2003a; Albright et al., 2009; Wickens and Heleski, 2010). Thoroughbred horses are thought to be 3.1 times (Bachmann et al., 2003a) and warmbloods 1.8 times (Wickens and Heleski, 2010)

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more likely to perform crib-biting behavior than other breeds. The thoroughbred is also thought to be more at risk of performing weaving behavior (Ninomiya et al., 2007). It could be argued, however, that thoroughbred and warmblood horses are used more greatly in performance disciplines, and that the increase prevalence of stereotypy observed in these breeds is a manifestation of their more intense management regimes.

Other abnormal behaviors of the horse that by some are considered stereotypic include oral behaviors such as tongue-flicking and wind-sucking, and locomotor behaviors, for instance, pawing (Marsden, 2002; Cooper and Albentosa, 2005). Prevalence estimates for these behaviors remain largely unknown, and further investigation is warranted. Whether these abnormal behaviors can strictly be classified as stereotypic according to the widely accepted definition of stereotypy (aforementioned) is questionable; therefore, this review will focus primarily on the 3 motor anomalies (crib-biting, weaving, and box-walking) that reliably fit the commonly held definition.

Stereotypic behaviors are often viewed as vices (McBride and Long, 2001) and are associated with health complications. For example, crib-biting results in excessive wear of the incisors (McBride and Hemmings, 2009) and has been proposed by some authors to increase the likelihood of colic (Archer et al., 2008), although the underlying pathologic mechanisms are unknown. Weaving and box-walking have been associated with secondary muscle fatigue (Ninomiya et al., 2007). Weaving is linked to weight loss (Mills and Davenport, 2002) and leg swelling and may ultimately result in lameness (Cooper et al., 2000). It is perhaps because of these health effects that there is a 37% reduction of monetary value of stereotypy performing animals (Marsden, 2002; see also Williams and Randle, 2017). Establishments, including riding schools, racing, and competition yards, do not allow stereotypy performing animals onto the premises because of unsubstantiated anecdotal belief that these behaviors are copied from stereotypy performing neighbors (Cooper and Albentosa, 2005). As such, 74% riding schools, racing, and competition yards investigated attempt to physically prevent the behavior (McBride and Long, 2001). Surgical procedures, such as a neurectomy or a myectomy, or the use of crib-straps or cribbing rings, are designed to prevent crib-biting behavior (McBride and Long, 2001; McBride and Hemmings, 2009; Albright et al., 2015). Despite their severity, these preventative measures are not always effective (McBride and Hemmings, 2009), although in some cases, can result in a reduction in crib-biting behavior (Albright et al., 2015). Owners of weaving horses often use antiweaving bars (McBride and Long, 2001), so the horse is unable to put the head outside the stable to conduct the behavior (McAfee et al., 2002; McBride and Hemmings, 2009). This is often unsuccessful as horses continue to weave within the confines of the stable (McBride and Hemmings, 2009). Should the purpose of stereotypy be to provide a coping mechanism for the individual, the physical prevention of these behaviors could lead to further stress-induced pathology (McGreevy and Nicol, 1998; McAfee et al., 2002; Hemmings et al., 2004; Houpt, 2012; Freymond et al., 2015). Indeed, after restriction of oral stereotypy with the use of a cribbing collar or surgical methods, crib-biting horses were less able to cope during a stress test in comparison to their counterparts who were not restricted from performing the crib-biting response (Nagy et al., 2009). Underlying causal and contributory issues for stereotypic behavior, for example, poor environmental conditions, are seldom addressed and may not be known (Cooper and Mason, 1998; Cooper and Albentosa, 2005; Nagy et al., 2009). We consider putative causal factors leading to stereotypy manifestation and suggest separate developmental mechanisms for oral and locomotory stereotypy of the horse.

Equine oral stereotypy: the gastric hypothesis

Gastric inflammation is common in crib-biting horses (Nicol et al., 2002; Cooper and Albentosa, 2005), suggesting that gastrointestinal discomfort may be linked to the development of this behavior. Lending credence to this notion is the finding that crib-biting is a predominantly postprandial response (McBride and Hemmings, 2004). Horses evolved to consume a forage-based diet, with approximately 16–18 hours of the 24-hour time budget used for mastication in the wild (Cooper et al., 2005), during which 35–40 L of alkaline saliva are produced (Nicol et al., 2002; Moeller et al., 2008; Nagy et al., 2010). Domesticated horses tend to be fed highly palatable cereal-based concentrate feeds to meet high energy requirements (Hemmings et al., 2007; Albright et al., 2009; McBride and Hemmings, 2009; Whisher et al., 2011), which reduce mastication, resulting in decreased saliva production and increased acidity in the foregut (Nicol et al., 2002; Cooper and Albentosa, 2005; Hemmings et al., 2007). This increased acidity may result in gastric discomfort. Indeed, Nicol et al. (2002) examined the equine gastric environment endoscopically, comparing those which crib-bite and those who did not exhibit oral stereotypy. Those who performed crib-biting demonstrated more stomach ulceration. Further study may wish to examine the gastric lining of crib-biting animals and non-crib-biting animals kept under the same management and feeding regimes, to truly dissect the gastric hypothesis of oral stereotypy. Thus, it has been hypothesized that the crib-biting response may attempt to replicate the mastication process to stimulate salivary production (Nicol et al., 2002; Hemmings et al., 2007; Moeller et al., 2008; Hothersall and Casey, 2012). Saliva produced during crib-biting is similar in pH to saliva produced during mastication (Moeller et al., 2008), which supports this idea. The function of crib-biting could be to buffer the stomach in an attempt to counteract gastric pain (Moeller et al., 2008) or acidosis of the hindgut, and such a mechanism would be consistent with the significant increase in crib-biting response 2–8 hours after feeding (Clegg et al., 2008).

Evidence for this hypothesis includes that the addition of antacids to feed to modulate gastric pH resulted in a significant reduction of observed crib-biting (Mills and MacLeod, 2002; Nagy et al., 2010) and improved stomach lining condition (Nicol et al., 2002). These positive results could also be attributed to increased mastication of a feed, given a lower palatability after the addition of powdered supplement; this theory does require confirmation however. Resultant increases in saliva would then lead to more effective gastric buffering (Johnson et al., 1998). Cooper et al. (2005) found that increasing meal frequency also resulted in a significant reduction in the crib-biting response, perhaps because of the increased time taken to consume the ration, allowing a more effective buffering effect of the saliva. Ad lib feeding studies have also produced mixed results (Fenn et al., 2008; McCall et al., 2009) suggesting that the role of feeding regime in stereotypy development requires further research.

Archer et al. (2008) provided support for the gut-based hypothesis of crib-biting. Indeed, Archer et al. (2008) identified a strong positive association between the presence of crib-biting and risk of developing colic. Whether this relationship is causal or correlational is unknown (Cooper and Mason, 1998). An episode of colic may result in chronic stress, an area of study that certainly requires further investigation. Chronic stress in rodents contributes to sensitization of the dopaminergic midbrain and striatum in a genotype-dependent manner (Cabib et al., 1998), which has been hypothesized as a precursor for stereotypy manifestation (McBride and Hemmings, 2005). Colic could be an initiating factor rather than an effect of crib-biting if the same processes occur in horses.

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