A Thesis Presented to

The Faculty of Alfred University

The effects of enrichment items on cribbing in *Equus caballus*

By

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In Partial Fulfillment of

The Requirements for

The Alfred University Honors Program

April 20, 2018

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Honors Program Introduction:

Compulsive behaviors can occur in many species. Horses (*Equus caballus*) are not immune to these behaviors. One of the most common compulsive behaviors, often referred to as a stereotypy, is cribbing (Whisher et al. 2011). Like all stereotypies, cribbing is repetitive and functionless. When a horse cribs it grips a horizontal surface with its incisors and pulls back, flexing its neck and often emitting a grunting noise in the process. Domestic horses can develop this behavior; however, it has not been documented in wild horses (Winskill et al. 1995). One possible reason for this may be due to the management of domesticated horses.

Not much is known on why horses develop this behavior. Research has been published on possible causes, although none have agreed on what truly causes cribbing (Clegg et al. 2008, Houpt and McDonnel 1993, Whisher et al. 2011). Until recently, it was widely accepted that cribbing was a learned behavior (Albright et al. 2009). Foals born to mothers that cribbed tend to also develop the behavior. This led other researchers to believe that genetics plays a role in cribbing development (Galizzi-Vecchiotti and Galanti 1986). Management style could be the reason that the offspring of cribbers develop the same behavior. Cribbing could also be the result of stressful living conditions but mistaken as a learned behavior or the result of genetics. Either way, a horse that cribs will have a lower economical value.

One of the more popular causes of cribbing is diet. Cribbing increases after a horse eats grain (Mazzola et al. 2016). This observation has led researchers to believe that what a horse consumes or how it digests its food plays a role in whether a horse will crib. Gastrointestinal pain is believed to be relieved through the act of cribbing (McGreevy and Nicol 1998). While there is no information on how exactly cribbing relieves pain from digestion, it is assumed that the physical act moves the digestive organs in a way that eases pain. Cribbing may even stretch the abdomen, facilitating digestion for some horses (McGreevy and Nicol 1998). Similarly, horses

with low saliva production tend to crib more (Mazzola et al. 2016). Cribbing may stimulate saliva production. Saliva is produced when a horse chews. Horses that have an overall decreased amount of saliva may experience drier mouths. In the absence of food, a horse with low saliva levels may crib as a means of producing more saliva. Sweet grain is a type of feed that is typically used to increase saliva production (Mazzola et al. 2016). Sweet feed needs to be chewed more than regular grains. Increased chewing time produces more saliva. This similarity between cribbing and sweet feed have caused the two to become associated. Horses with low saliva production may crib as a means of alerting owners about their problem. These horses are then put on sweet grain but continue to crib. Sweet grain is made of easily digestible carbohydrates such as starch (Mazzola et al. 2016). Horses that have difficulty with digestion may crib when on sweet feed to relieve pain caused by digestion.

About half of a horse's diet is composed of forage such as hay. As a result, horses spend most of their time foraging or grazing (Whisher et al. 2011). Forage contains high amounts of fiber which can be difficult to digest. Horses have microbes in the cecum of their large intestine that are able to break down fiber for the horse to use. Due to the slow digestion rate of fiber, hay takes a longer time for horses to consume. Hay is generally provided continuously throughout the day; however, some stables may restrict the amount of hay horses receive. The lack of hay, and thereby a lack of foraging opportunities, could contribute to cribbing. Foraging, like grazing, is a natural behavior for horses (Whisher et al. 2011). Frustration may develop as a result of decreased foraging opportunities and be expressed through the act of cribbing.

Boredom is one of the most popular and accepted causes of cribbing. Studies have shown that cribbing occurs the most during the night (Whisher et al. 2011). At night there are few activities and not much food for the horse. Cribbing can be a form of entertainment during the

night. Horses that are kept in stalls for long periods with little time outside may also crib out of boredom and frustration. High stress living environments, such as the conditions racing horses are kept in, may also result in horses that display this behavior (Whisher et al. 2011). Race horses are typically kept in a stall for the majority of the day, only being let out to exercise. A mix of fatigue, boredom, and stress may be the reason many racing breeds, specifically Thoroughbreds, develop stereotypies. Studies have found that horses used for predominantly English disciplines, such as jumping and eventing, are more likely to begin cribbing (Normando et al. 2011). These disciplines tend to be more competitive and high stress. Cribbing in these scenarios may act as a coping mechanism to high stress lifestyles.

Cribbing does not come without consequence. The most common health problem associated with cribbing is colic, which is another term for abdominal pain. There are many different types of colic. Horses that crib are more susceptible to gas colic and impaction colic (Escalona et al. 2014). This may be the result of altered intestinal function. Cribbing can also lead to entrapment of the epiploic foramen. This condition occurs when the small intestine becomes trapped in an opening in the abdomen wall (Escalona et al. 2014). Entrapment prevents normal digestion and could result in death if not treated. Another common health problem is the wearing down of the incisors (Archer et al. 2004). The repeated gripping of objects with their incisors during the act of cribbing can wear down a horse's front teeth. This in turn makes grazing more difficult, preventing horses from getting the nutrients they require.

If the major influence for cribbing can be determined, then more effective means of prevention can be created. There is no data supporting a single factor as the sole cause for cribbing. This could mean that cribbing is caused by a mix of factors which could be different for individuals, making the study of cribbing difficult. Management styles vary among stables,

which could be a cause in the frequency of cribbing seen in horses. More stressful and restricting living environments could result in a horse developing this behavior (Normando et al. 2011). Horses may be predisposed to cribbing as a result of their breed or their heritage. More research still needs to be done to determine if there is a relationship between these factors and the development of cribbing.

The idea for this study came about through the observation of a horse cribbing while being tacked up in its stall. The horse was cribbing on its grain dish as the girth for the saddle was being tightened. This sparked the question of what causes cribbing. Most of the horses that crib at the Alfred University equestrian center do so during lull periods, when there is not much going on in the barn. Research on the possible causes of cribbing would help to solidify a question that could be tested. My research question was whether enrichment items could reduce cribbing frequency. The idea behind this was that the items would prevent boredom, thus resulting in less time spent cribbing. A Jolly Ball was selected as one of the enrichment items for this study due to its popularity among horse owners. Most of the horses at Alfred University have been exposed to Jolly Balls, although none of the horses in the study had one in their stall. A feed dispenser was chosen as the other enrichment item in order to determine if a food-related enrichment item was more effective at reducing cribbing than a non-food item such as a Jolly Ball.

The two enrichment items were expected to decrease cribbing frequency by reducing boredom in the stall. Before being introduced to the items, a baseline cribbing frequency was determined for each horse. Each enrichment item was placed in the stall of a cribber and a non-cribber for three weeks each. During this time cribbing frequency and the amount of time each horse spent with the items was recorded. Diet was also explored as a possible cause of cribbing.

The feed of cribbers and non-cribbers was compared to determine if there was a relationship between diet and cribbing. Horses that were fed predominantly sweet grain were expected to crib more than those on regular grain.

This study found that enrichment items were not able to significantly reducing cribbing in horses. The feed dispenser was more popular among the horses than the Jolly Ball. This item was believed to be more interesting due to the food reward that accompanied it. The feed dispenser was able to reduce cribbing more than the Jolly Ball but not by a significant amount. Diet was not confirmed as a cause of cribbing. There was no relationship between feed type and the presence of the behavior. These findings were not fully expected. It was expected that the feed dispenser would work better than the Jolly Ball; however, both were expected to significantly reduce cribbing.

During the course of this study there were a few drawbacks. One particular horse cribbed so often that he tore the grain dish off the wall of the stall. This resulted in less surfaces for the horse to crib on, meaning a lower cribbing frequency. Moving the horse to another stall with a grain dish helped resolve this problem. At the start of the study another horse was in poor condition due to a reoccurring health problem. This horse was on stall rest and was hardly worked. Over the course of the study this horse regained his health and was slowly put back to work. As the horse improved health-wise his cribbing frequency increased, suggesting that boredom may not have as much of a role in cribbing as originally believed. This caused all of the cribbing frequencies with either enrichment item to be higher than the baseline cribbing frequency. The amount of times the horses were turned out kept changing during this study as well. There was no real change in cribbing frequency for most of the horses as a result with the exception of one horse. This horse went from being turned out three days a week to no turn out.

There was an increase in his cribbing frequency after this change. Horse shows provided another challenge as the horses were used for long periods of time, some with very few breaks. There were only two horse shows held at Alfred University during the course of this study. A concern was that the fatigue would alter cribbing frequency. To prevent this, only the horses that were not used or who were only used for one class were observed.

Conducting this study was an interesting experience. I found that I thoroughly enjoy doing research like this. Observing these horses crib for weeks made me more curious about this behavior. Finding articles for my literature review only helped me form more questions. If I was able to further research my question I would add to the number of enrichment items used. I have read studies that have found certain enrichment items that have a good flavor significantly reduce cribbing. I am curious to see if I would get similar results if I used the same enrichment items as these studies with the subjects there were available to me. Similarly, I would love to do more research on the effectiveness of cribbing collars. Being part of the Honors Program gave me the opportunity to conduct research on something that I am very interested

Compulsive Behaviors in *Equus caballus*

I. Introduction

Animals, like humans, have the ability to develop compulsive behaviors. Often referred to as stereotypies, these compulsive behaviors are recognizable as being repetitive and fixed in form (Luescher et al. 1998). Stereotypies are seen most frequently in caged animals. Horses (*Equus caballus*) typically spend a lot of time enclosed in a stable and have a tendency to display stereotypies. As of 1995, about 15% of domestic horses displayed at least one stereotypy (Winskill et al. 1995). Feral horses have not been documented as performing stereotypies. This led stereotypies to being associated with domestication during the 1800s (Marsden 2002). The breed, age, and discipline of the horse does not appear to have a strong effect on whether a stereotypy will form (Marsden 2002). Horses as young as eight weeks have been known to display stereotypies. As age increases, the prevalence of stereotypies is believed to increase. Although breed does not determine if a stereotypy will develop, Thoroughbreds are more likely to display compulsive behaviors (Albright et al. 2009). This link is believed to be due to the conditions Thoroughbred racehorses are kept in and the fact that this breed has a tendency to be more nervous and high-strung than other breeds. Horses involved in English disciplines, such as jumping and dressage, tend to crib more than those in western disciplines (Normando et al. 2011). Western disciplines tend to be more relaxed and do not have the same amount of stress associated with them.

Stereotypies have no apparent function. They can be classified into two categories: locomotor and oral stereotypies (Houpt and McDonnell 1993). Locomotor stereotypies involve the movement of the entire body. Commonly seen locomotor stereotypies are stall-walking and weaving. Oral stereotypies are repetitive movements involving the mouth. Common oral

stereotypies are cribbing, wind-sucking, and wood chewing. Most owners consider these behaviors to be undesirable (Houpt and McDonnell 1993). Certain stereotypies such as weaving and cribbing can cause damage to the horse itself. Other stereotypies such as wood chewing can damage property. While stereotypies may seem to have no obvious goal, these repetitive actions may be a comfort to the horse (Marsden 2002). The repetitiveness of the behaviors can have a calming effect on the horse. Neurotransmitters are released when the horse performs a stereotypy, creating neural feedback (Marsden 2002). The neurotransmitters released are β-endorphins. These neurotransmitters are released in the brain which stimulates the release of dopamine (Rendon et al. 2001). The release of dopamine is what calms the horse. A stereotypy is formed when the action becomes separated from the stimulus (Mason 1991). In other words, a stereotypy starts off as a behavior stimulated by an external factor. Over time the pattern of the behavior becomes detached from the original external stimulus, meaning that the behavior no longer needs a stimulus in order to be performed. At that point, the behavior can be classified as a stereotypy.

II. Cribbing

Arguably the most common stereotypy in horses is cribbing. When a horse cribs, it grasps a flat surface with its incisors and flexes its neck muscles. Air is sucked into the esophagus as the horse arches its neck (Albright et al. 2009). This causes a grunting noise, which is characteristic of cribbing. Since the horse uses its mouth when performing this behavior, cribbing is considered an oral stereotypy. This behavior is unique to horses (Whisher et al. 2011). Cribbing is most common among Thoroughbreds. As of 2009, approximately 13.3% of Thoroughbreds in the United States cribbed on a daily basis (Albright et al. 2009). A horse that cribs will have a much

lower economical value due to the property damage that can be caused by the horse and the risk of health issues manifesting in the future.

The diet of a horse may influence whether a horse develops this stereotypy. Mazzola et al. (2016) suggest that a horse that does not produce enough saliva to meet digestive needs could crib to increase saliva production. The physical act of arching the neck and sucking air into the esophagus could stimulate the salivary glands and oral tissues in a way that eating may not. Another reason why a horse would want to increase saliva flow is that the pH of their gastrointestinal tract is too acidic (Mazzola et al. 2016). Saliva acts like a buffer and would help raise the pH of the gastrointestinal tract. A horse that cribs may have difficulty with digestion (McGreevy and Nicol 1998). Cribbing could ease pain that comes with digestion. It could also help improve digestion in some horses. The act of cribbing could stretch the intestinal tract in a way that allows food to flow through more easily than if the horse did not crib.

Many health concerns can develop as a result of cribbing. Most notably, cribbing is associated with colic. Colic is a disorder of the digestive system that creates abdominal pain (Escalona et al. 2014). It was originally believed that the act of sucking in an excessive amount of air when cribbing caused colic. However, recent studies have shown that horses do not actually ingest an abnormal amount of air when they crib (Albright et al. 2009). The connection between colic and cribbing may be a result of the physical act of cribbing, which may put strain on the abdomen. Despite this, horses that crib seem to be more likely to colic than horses that do not display this behavior (Escalona et al. 2014). This could be because horses that crib have a different intestinal function that makes them more likely to colic or have repeated colic episodes. Another health concern that can accompany cribbing is the entrapment of the small intestine in the epiploic foramen. The epiploic foramen is a structure that is found in all animals, although

only horses experience entrapment (Freeman and Pearn 2015). This structure is an opening between the peritoneal cavity and the omental bursa, which is located ventral to the lesser curvature of the stomach. The epiploic foramen itself is located on the right side of the abdomen (Freeman and Pearn 2015). During entrapment the intestine enters the foramen from the left and moves to the right. It is believed that the physical act of cribbing alters the intra-abdominal pressure (Archer et al. 2004). This, in turn, could push the small intestine towards the epiploic foramen, causing it to become trapped.

In addition to this, cribbing has also been associated with gastric inflammation, ulceration, equine motor neuron disease, and colonic impaction (Archer et al. 2004). These health issues are often seen in young horses that display cribbing behavior. More effective means of prevention are needed to stop young horses from developing serious health issues. Since cribbing involves a horse gripping a flat surface with their incisors, dental problems among cribbers are very common. Most horses that crib wear down their incisor teeth (Archer et al. 2004). This can make grazing more difficult, since horses use their incisors to grip grass. Wood is a horse's preferred material to crib on. As a result, stall doors and fences are often the victims of cribbing. The repetitive action of gripping the wood and pulling back can cause the wood to chip. After a while, if the action occurs frequently and with enough force, the wood can even break.

Horse owners most commonly use cribbing collars as a prevention method. A cribbing collar is a leather strap that is placed around the horse's neck. The positioning of the collar interferes with the horse's ability to flex its neck (Winskill et al. 1995). The straps of the cribbing collar sit behind the horse's ears and under the horse's neck. This prevents the neck muscles from fully contracting. Cribbing collars can effectively reduce cribbing (McBride and Cuddeford

2001). This prevention method, however, is not guaranteed to completely inhibit cribbing. Many horses will still crib even if they are wearing a cribbing collar. Removing cribbing collars may also result in a sudden increase in cribbing frequency (Henderson 2007). This prevention method causes the problem to become worse. The absence of the strap physically preventing the action of cribbing only increases a horse's motivation to crib. Over time horses can become accustomed to the cribbing collar, resulting in an increase in cribbing frequencies. In response, horse owners will tighten the collars which causes skin irritation and, in severe cases, interfere with respiration (Winskill et al. 1995). Cribbing collars can be dangerous if not used correctly. They also are not effective for every horse and can cause a horse to crib more once removed.

III. Weaving

When horses are confined in a stable, it is possible for them to display the stereotypy called weaving. Weaving is when a horse shifts its weight while standing in one spot (Houpt 1986). Essentially, when a horse is weaving, it will move its head and neck from side to side in a repetitive manner. Horses have also been observed to move their forequarters and hindquarters when weaving (McAfee et al. 2002). Weaving should not be confused with pacing, as a horse will not move around the stall when expressing this stereotypy. This behavior is classified as a locomotor stereotypic activity since when performing this behavior a horse will move its body from side to side (McAfee et al. 2002). Weaving is a common stereotypy, especially in breeds associated with racing. Thoroughbreds are reported as the breed that weaves the most (McAfee et al. 2002). Horses that are used for dressage, eventing, or show jumping may also be more likely to weave.

Weaving does not have one universal cause that is agreed upon. One popular theory is that it is a direct result of anticipation. Horses that have set routines are reported to weave often (Mills 2005). It is observed mainly before an event such as feeding or pasture time. If a horse is fed or let out at the same time every day, they then fall into a schedule and know when to expect these events and the horse's anticipation results in weaving. Clegg et al. (2008) found that weaving occurs the most before feeding and turnout. While waiting to be fed, a horse may weave to relieve some of the frustration it feels at having to wait. Excitement may also be a cause (Clegg et al. 2008). A horse can weave out of excitement for an event the same as a dog may wag its tail out of excitement before going for a walk.

Another popular theory is that weaving occurs due to lack of social contact. A horse that cannot see or interact with other horses may begin to weave (Mills and Davenport 2002). This weaving becomes a way for the horse to express its frustration. Being pack animals, horses feel the most comfortable when with others in a group. Leaving a horse alone in a stall all day deprives that horse of its basic need to have social contact. A horse that is confined to a stall may attempt to make contact with another horse, only to fail (McAfee et al. 2002). This failure to connect adds to the frustration, resulting in the horse beginning to weave. Ninomiya et al. (2007) conducted a study in which a mirror or window was placed in the stalls of horses with a history of weaving. The presence of a mirror in the stall fulfills the need for social contact, as it gives the horse a sense of not being alone. A window in between two stalls allows the horses in the stalls to interact with each other, lessening their frustration and thus decreasing the amount of time spent weaving.

In addition to anticipation and loneliness, a horse may weave due to poor diet. If a particular nutrient is missing from a horse's diet, they might weave as way of compensation.

Ninomiya et al. (2007) stated that a lack of dietary fiber could cause a horse to start weaving due to frustration. Weaving can also increase if not enough forage is provided or if hay is the only forage provided (Mills 2005). Foraging for food is a natural instinct for horses. A lack of foraging opportunities could frustrate a horse, causing them to weave. Horses that are in their stall for the greater part of the day are typically occupied by the presence of hay. Those who are fed more concentrate than forage will not spend as much time eating. Grain tends to only be given once or twice a day and does not last for very long. Depending on the management style, hay can be given multiple times a day so that there is always hay in the stall. A large supply of hay will keep horses occupied if they have to spend a long time in their stall. Not being put out to graze on pasture may frustrate a horse. The presence of hay can act as a substitute for grazing in that the mannerism of foraging is still virtually the same. A variety of foraging options would keep a horse busy longer than feeding just hay. With only one type of forage, a horse may become bored and start to weave.

Horses may be predisposed to weaving based solely on their breed. Depending on temperament, some breeds may display weaving more often than other breeds. Breeds prone to nervousness may weave in response to stress (Ninomiya et al. 2007). Thoroughbreds can be very nervous horses, which could be an explanation as to why a portion of the breed displays this stereotypy. Breed type may not be the only factor. What a horse is used for could contribute to if a horse weaves (Mills and Davenport 2002). Racing and other highly competitive sports may cause a horse to become nervous, resulting in weaving. As breeds are often used for specific purposes, such as Thoroughbreds and racing, these two factors overlap as a cause for weaving.

Weaving does not have any serious diseases associated with it. However, weaving is not harmless. Horses that display this behavior tend to have irregular wear of the hooves (Ninomiya

et al. 2007). As a result of the horse shifting its weight from side to side, the horse puts more pressure on its front hooves than its back hooves. The sides of the front hooves become worn down since the horse is placing its weight in an unusual way. In addition to irregular hoof wear, weaving can also cause uneven muscular development or muscle fatigue in the neck (McAfee et al. 2002). Swinging the neck causes the muscles to develop more on one side, as horses typically weave in one direction. Constant weaving uses a lot of the muscle in the neck, leading to muscle fatigue. This can also lead to weight loss (Mills and Davenport 2002). When a horse weaves, it is using up most of its energy. Typically, weavers are not fed enough grain to compensate for the energy they expend when weaving. This means that weavers end up being underfed, causing weight loss as the horse's body will use stored fat as an energy source instead of the nutrients from grain.

IV. Wood Chewing

Another common stereotypy seen in horses is wood chewing. A horse that displays this stereotypy will consume wood from a horizontal surface (Houpt 1986). Fences and stall doors are the most popular surfaces a horse may chew on. Wood chewing is different from cribbing since horses will actually ingest the wood. With cribbing, horses will simply grip a flat surface but with wood chewing the horse will bite off chunks of wood and swallow it. This stereotypy is unlike other stereotypies, as horses have been reported to chew wood both in a stable and in a field (Mills 2005). Horses in fields may be seen chewing on tree branches if there are no wooden fences available. Since wood chewing is one of the few stereotypies that occurs in a pasture, some view it as a normal behavior for horses. Nonetheless, horse owners still consider wood chewing to be an undesirable habit due to the property damage that accompanies the stereotypy.

About one third of Thoroughbreds have been reported to wood chew at an early age (Mills 2005). Thoroughbreds as a breed are most likely to exhibit a compulsive behavior, so it is not surprising that many of them develop the stereotypy of wood chewing.

The most agreed upon cause of wood chewing is the diet of a horse. Houpt (1986) states a lack of roughage will cause a horse to chew wood. Roughage is the classification for hay and grass. A horse that does not have enough roughage in its diet may turn to wood chewing to compensate for the lack of fiber. Horses that are fed pellets show an increase in wood chewing as well (Houpt 1986). This coincides with a lack of roughage, as horses on pellets may not get as much hay. Wood chewing might also be the result of skewed lactate, propionate, or acetate levels in the hindgut (Green and Tong 1988). A decrease in the levels of these three substances means that a horse is more likely to chew wood. Non-normal levels of lactate, propionate, and acetate may change the pH of the cecum, the organ where fiber digestion occurs in horses. Green and Tong (1988) found that if cecal pH is increased, wood chewing decreases. This suggests that a horse's need to chew wood could be derived from an imbalance in pH in their hindgut, where most of their digestion takes place. It was also found that a more concentrated diet alters the pH of the cecum (Nicol 1999). A more concentrated diet involves a horse being fed pellets rather than roughage. This goes back to the idea that a lack of roughage leads to wood chewing. Hunger in general may also be a cause. An empty gut may trigger wood chewing (Mills 2005). A hungry horse with no roughage available could ingest wood in an attempt to ease its hunger until its caregiver can provide actual food.

Well-fed horses have been observed to wood chew despite having adequate amounts of fiber in their diets. Boredom may cause these well-fed horses to chew wood. This idea is backed up by the fact that horses tend to chew wood in cold and wet weather (Houpt 1986). Bad weather

decreases the amount of activities that could be done in a day. A horse may be forced to stay inside if it is too cold or too wet outside. Inside a stall, the horse may become bored and chew the wood on the stall door to pass the time. Likewise, wood chewing peaks at night (Krzak et al. 1991). At night there is little to do and little to see. A significant lack of distractions may lead a horse that is bored during the night to chew on its stall door or on a wooden fence if it is in a pasture.

While wood chewing is not associated with any disease, it can lead to some health concerns. Horses that ingest wood may develop an obstruction of the small intestine (Green and Tong 1988). The obstruction is caused by wood splinters becoming packed together during digestion to form a solid ball that blocks the intestine. In order to form a wood splinter mass large enough to obstruct the small intestine, a horse must first ingest a large amount of wood. As wood chewers only ingest small quantities at a time, it is likely to take a long period of time before an obstruction may occur. Green and Tong (1988) suggest that the mass of wood splinters begins to form in the stomach. This would explain why the mass is not discovered until after an obstruction occurs. There would be no sign of the impending blockage in the stomach. Horses are also unable to digest wood (Houpt 1986). The inability to digest wood is why obstructions are likely to occur if a horse is a habitual wood chewer. Wood chewing could also determine if a horse will develop another oral stereotypy later in life (Nicol 1999). Some horses that crib were reported to have chewed wood before they began displaying cribbing behavior. As cribbing may be an indicator of intestinal pain, a horse that chews wood may start to crib in response to an obstruction forming from the wood splinters it ingested (Nicol 1999).

In addition to health problems, property damage accompanies wood chewing. Owners of horses that chew wood have to replace damaged fences and stalls that fall victim to their horse

(Krzak et al. 1991). Some horse owners spend a lot of money in an attempt to prevent their horses from wood chewing. This involves covering all wooden surfaces with either metal or plastic. There are also taste repellents that can be sprayed on wooden surfaces (Krzak et al. 1991). The taste repellents cause the wood to take on an unpleasant taste. When the horse attempts to chew the wood, they instead are met with a horrible taste that will hopefully become associated with wood. Ideally, this would cause a horse to stop chewing wood. Prevention of wood chewing may be another reason as to why some wood chewers begin to crib. If a horse is no longer able to chew wood but still has the urge, they may crib or develop another oral stereotypy out of frustration.

V. Wind-Sucking

The stereotypic behavior wind-sucking is often confused with cribbing. Wind-sucking is also known as aerophagia (Houpt 1986). Both behaviors involve a horse flexing its neck and inhaling air (Kennedy et al. 1993). As wind-sucking involves air being inhaled, a grunt often accompanies the behavior, similar to cribbing. While wind-sucking and cribbing appear very similar, the act of wind-sucking does not include a horse grasping an object with their incisors (Houpt 1986). A horse that wind-sucks will simply flex its neck and swallow air while emitting a grunting noise. This grunting noise is most likely caused by air passing through the esophagus sphincter (McGreevy et al. 1995). When air is sucked into the mouth by the horse during the act of wind-sucking, it will move through the upper esophagus. The air then passes the vocal cords when being expelled from the lungs, creating a noise. The noise is only produced when the vocal cords are partially adducted (McGreevy et al. 1995). This means that the vocal cords are close together,

so the air that passes through them will cause them to vibrate, which produces a sound. Some believe that a horse that displays wind-sucking behavior may later develop cribbing behavior.

There is no clear reason as to why horses develop wind-sucking behavior, however it may be a result of an altered digestive tract. Some horses that display this stereotypy have abnormal intestinal function (Escalona et al. 2014). In these horses the intestinal tract may have abnormalities which causes it to not function in as effective a manner and be uncomfortable or even painful. A horse in pain may turn to wind-sucking in order to distract themselves. It may also relieve some of the pain from digestion. The physical act of this behavior could slightly shift the intestinal tract in a way that could not only ease the pain but cause digestion to proceed in a smoother manner. Examples of abnormal intestinal tracts in horses are ones where the intestine is beginning to push through the ileocecal valve (Escalona et al. 2014). The ileocecal valve separates the small intestine from the large intestine. If blocked, food cannot easily pass through the valve into the large intestine where microbial fermentation occurs. As a result, the digestive process becomes backed up, causing discomfort. Horses with misplaced colons may experience pain and develop wind-sucking in an attempt to ease the pain of digestion.

An insufficient diet may also be a cause of wind-sucking. Horses that receive little or no forage have a higher tendency to develop wind-sucking behavior (Escalona et al. 2014). During down time throughout the day and night there is often not much to do other than consume forage which is typically always present in stalls. Foraging is a stimulating activity for horses. If no forage is present a horse may turn to other activities such as wind-sucking to entertain themselves. A lack of dietary forage could also result in a lack of fiber (Cooper and Mason 1998). Horses that are not given adequate amounts of forage do not always get the necessary nutrients through other means. To clarify, grain or supplements would not be added to a horse's

diet to make up for the nutrients lost due to lack of forage. A lack of fiber could cause digestive problems which could in turn cause a horse to begin to display wind-sucking behavior.

Wind-sucking most commonly results in colic. Not every horse that displays this stereotypy will develop colic but many are susceptible to it. Two types of colic are associated with windsucking, simple colonic obstruction and distention (Escalona et al. 2014). Simple colonic obstruction is also known as impaction colic. With this type, a blockage develops in the large intestine, such as food moving too slowly through the gut and if a large amount of water is reabsorbed, drying out the soon to be feces. Distention colic is known more commonly as gas colic, which involves an excess of gas becoming trapped in the intestinal tract. This then causes the intestines to become distended; the intestines become swollen, causing abdominal pain. Wind-sucking is also related to a loss in condition (Firth 1980). Wind-sucking uses up energy that a horse may have stored. Horses that display this behavior are not always given enough feed to make up for this extra energy consumption. As a result, energy is taken from fat stores. Over time these stores become depleted, leading to significant weight loss and an inability for the horse to keep a desirable weight. Like cribbing, wind-sucking can also lead to epiploic foramen entrapment (Escalona et al. 2014). This is another form of blockage that could be caused by the physical act of wind-sucking. Flexing the neck could cause the digestive tract to be stretched in such a way that the small intestine is forced towards the epiploic foramen.

VI. Stall-Walking

Stall-walking, also known as box-walking, is a locomotor stereotypy. A horse that displays this behavior will repeatedly circle its stall (Redbo et al. 1998). Essentially, stall-walking is

compulsive pacing. Horses that stall-walk generally follow the same path in one direction. While most horses pace in a circle, some will pace in a figure-eight pattern. The breeds that are most often seen displaying stall-walking behavior are Thoroughbreds and Warmbloods (Bachmann et al. 2003). These two breeds are used often in eventing and can have nervous dispositions that can lead to the development of stereotypies such as stall-walking. This behavior is similar to weaving in that it is a repetitive locomotor behavior (Winskill et al. 1995). With stall-walking, the horse will actually move around its stall instead of just shifting its weight in one spot. The pattern that a horse will follow when it performs this stereotypy rarely changes (Redbo et al. 1998). Once a horse has developed a fixation, they will not stray form that path. It is difficult to prevent a horse from stall-walking (McBride and Cuddeford 2001). This is because in order to prevent a horse from compulsively pacing its stall, one would need to immobilize the horse. Immobilization is both impractical in the stall and inhumane.

Contrary to popular belief, stall-walking does not result from a stall that is too small. Horses that display stall-walking behavior have been observed circling one small area despite having access to an entire field or barn (Houpt 1986). Since stall-walking is compulsive pacing, the horse rarely strays from its path. A horse that develops this behavior will find a particular pattern to follow whenever it performs the behavior and then stick to the pattern no matter what size enclosure it is in. A horse that stall-walks when inside will follow the same pacing pattern when placed in a large paddock. Horses have been shown to increase stall-walking behavior during times before feeding (Winskill et al. 1995). Feeding time can cause frustration, which a horse may express through stall-walking, if it has to wait for others to be fed before it can receive its grain. The longer a horse waits the more frustrated it could become at having to wait.

Another cause of stall-walking is lack of exercise. Horses that are not used often or turned outside enough develop stall-walking behavior (Cooper and Mason 1998). This results from the horse being stuck in its stall for hours at a time. A horse cannot adequately release all of the energy it has if it is in a stall. To release some of this energy, the horse will pace the stall which can quickly become a compulsion that could continue even if the horse is turned out or used more frequently. In some cases, stall-walking has been reduced through frequent exercise or more frequent turn out (Cooper and Mason 1998). Exercise will make a horse too tired to pace its stall. Turn out gives the horse space to run around and release some of its stored energy. However, not much research has been done on the causes of stall-walking (Winskill et al. 1995). The most commonly agreed upon causes are lack of exercise, boredom, and frustration. Boredom can cause stall-walking if there is little variety in a horse's environment (Winskill et al. 1995). Essentially, if a horse is in its stall for most of the day it does not have a change of scenery nor does it have the chance to interact with new things.

Stall-walking does not cause any diseases. It is often considered more of a minor annoyance. The most common problem that results from stall-walking is irregular wear of the hooves, due to the horse constantly moving in a circle in the same direction (Ninomiya 2007). The hooves will get worn down on the side that is on the inside of the circle. Irregular wear of the hooves could lead to lameness if not treated. Stall-walking does expend a lot of energy. Horses that display this behavior may experience weight loss or an overall loss of condition (Winskill et al. 1995). A horse's body may not be able to keep up with the energy demands of this stereotypy. Stall-walkers will use up the energy gained from food as well as stored energy. These horses do not receive enough energy in their diets to compensate for what is used when displaying this behavior. As a result, fat stores are depleted and the horse could undergo

noticeable weight loss if the problem continues. Stall-walking can also cause muscle fatigue (Cooper and Mason 1998). Since the horse is constantly moving, its muscles do not have time to relax and replenish oxygen stores. This causes the cells to switch to the process of fermentation. When oxygen is present cells are able to carry out aerobic respiration in order to convert glucose to energy. The products of aerobic respiration can be used by the body for other processes. In the absence of oxygen, cells are forced to use anaerobic fermentation to convert glucose to energy. A byproduct of fermentation is lactic acid, which can build up in the cells if oxygen is not introduced to convert it to carbon dioxide and water. A build-up of lactic acid is what ultimately causes muscle fatigue.

VII. Conclusion

Understanding how stereotypies develop is important in the treatment and prevention of these behaviors. Knowing the source of a behavior may allow for stopping the behavior before it can even start. At this time there are only speculations on what causes each of these five stereotypies. More research still needs to be done in order to determine the actual causes. Stereotypies are repetitive behaviors that have become separated from an external stimuli. Studying stereotypies may be difficult, however, in that a single stereotypy may have multiple causes. Causes may also differ for each individual, which makes determining a single cause difficult and almost unlikely.

Currently, few prevention methods exist for each of these stereotypies. Only cribbing is commonly controlled by horse owners through the use of cribbing collars. It is difficult to prevent stall walking and weaving as these are both locomotive stereotypies. The only way to

prevent them with what is currently known is by restricting the movement of the horse. Some of these products are considered to be inhumane and are typically frowned upon by horse owners. Wood chewing is often prevented through the use of a spray which has a bitter or unpleasant taste. The idea behind the spray is that the horse will associate wood with a bad taste and will stop chewing on it; however, this does not always work. The severity of the stereotypy depends on the individual. As a result, horses respond to preventative measures differently. Cribbing collars are used to control cribbing and can also be used to prevent wind-sucking as the two behaviors are similar. In the case of cribbing collars, there is a spectrum of effectiveness. At one end of the spectrum the collar works perfectly whereas at the other end the collar does nothing to prevent the horse from cribbing. Horses in the middle of the spectrum will have reduced cribbing but will not show a complete absence of the behavior. Some believe that cribbing collars are counter-productive in that they cause the horse to crib more once removed. More research should be done on the effectiveness of cribbing collars in controlling cribbing behavior. An issue that could result is that since each horse responds to cribbing collars differently, it would be difficult to find a single cribbing collar that works for all horses. There are currently different types of cribbing collars which are meant for different severities of the stereotypy; however, there are horses where even the best cribbing collars on the market do not actually work. Other methods to reduce or stop cribbing should also be looked into.

Abstract:

The purpose of this study was to determine how a Jolly Ball, a Feed Dispenser, and diet affected the compulsive behavior cribbing in horses. It was hypothesized that the presence of a Jolly Ball or a feed dispenser in the stall reduce cribbing frequency due to their ability to eliminate boredom. It was also hypothesized that a diet composed of sweet feed would increase cribbing frequency. Fourteen horses were used in total, seven were know cribbers while the other seven showed no stereotypies. Each horse was observed using focal sampling method for three weeks with a Jolly Ball present in their stall. After that, each horse was observed in the same manner for another three weeks except there was a feed dispenser present instead of a Jolly Ball. The diets of all fourteen horses were recorded and compared. Neither enrichment item significantly reduced cribbing (Jolly Ball, W= 51 P=0.898; feed dispenser, W= 64 P= 0.159). There was also no correlation between feed type and cribbing frequency (H= 4.57 P= 0.206). A Jolly Ball and a feed dispenser cannot be used as a substitute for a cribbing collar in the prevention of cribbing.

Experimental Introduction:

Horses (*Equus caballus*) can develop compulsive behaviors that are commonly referred to as stereotypies. These behaviors are repetitive and fixed in form (Luescher et al. 1998). Cribbing is one of the most common stereotypic behaviors in horses, with an estimated 4.4% of all horses in the United States being active cribbers (Whisher et al. 2011). This stereotypy is not seen in wild horses; however, domestic horses that live outside can develop this behavior (Winskill et al. 1995).

Cribbing is considered an oral compulsive behavior. When a horse cribs, it grasps a flat surface with its incisors and flexes its neck muscles. Air is sucked into the esophagus as the horse arches its neck, causing a grunting noise (Albright et al. 2009). Cribbing is considered by owners and veterinarians as unnecessary as it does not serve any type of function that allows the horse to survive (Whisher et al. 2011). Classified as an unsoundness, a horse that cribs will have a much lower economical value due to the property damage that cribbing can cause. The risk of health issues manifesting in the future is another reason why horses that crib will have a lower economical value.

Cribbing was originally believed to be caused by environmental factors. It was a widely accepted notion that horses learned to crib by observing other horses (Galizzi-Vecchiotti and Galanti 1986). In recent years, Albright et al. (2009) found evidence that did not support this notion. When horses with no history of cribbing were exposed to those who did, very few actually began to crib. Bachmann et al. (2003) hypothesized that cribbing has either genetic or neurological origins, but more research is still required to determine if there is a significant relationship between these factors and cribbing. Diet may be a factor, as cribbing tends to increase after eating (Mazzola et al. 2016). Horses fed sweet grain, a feed consisting of oats or corn, may crib more often (Whisher et al. 2011). Sweet grain is often used to stimulate saliva production to improve digestion. There may be a connection between sweet feed and cribbing, as studies have shown that cribbing also helps with the production of saliva (Mazzola et al. 2016). Horses that naturally have decreased saliva production may crib more and may be more likely to be put on sweet grain. Another possibility is that the sweet feed does not increase saliva production enough and the act of cribbing makes up for what the sweet feed cannot do. Cribbing is also believed to relieve gastrointestinal pain caused by digestion (Mazzola et al. 2016).

Horse owners assume that boredom is the sole cause of cribbing. The reasoning for this is that horses crib the most at night (Whisher et al. 2011). During the night, there is a lack of distractions. Horses do not have grain at night, and may not have any hay either. This leaves very little to do. Cribbing may be an entertaining activity for a bored horse. Cribbing has also been found to increase after extended exercise (Whisher et al. 2011). This suggests that fatigue may contribute to a horse's need to crib. Horses that are used in relaxed settings, as in pleasure riding, do not crib as much as horses used in more competitive settings (Whisher et al. 2011). A more competitive setting, such as racing, has a higher amount of stress associated with it. As

Thoroughbreds are most commonly used for racing, it is plausible that the extra stress of this activity causes them to crib more than other breeds.

Health problems, such as colic and epiploic foramen entrapment, can result from cribbing. The epiploic foramen is an opening between the omental bursa and the peritoneal cavity (Freeman and Pearn 2015). Entrapment occurs when the small intestine is forced through the foramen. One reason for this is the idea that cribbers have different intestinal function which makes them more susceptible to different types of colic (Escalona et al. 2014). In addition to colic and entrapment, dental problems such as the wearing of incisor teeth can occur. Incisor wear results from the horse gripping a surface while cribbing (Archer et al. 2004). Worn down incisors can make grazing more difficult for horses since these are the teeth used to grip grass.

The purpose of this study was to explore the role of boredom and type of feed on cribbing. It was believed that cribbing increases with boredom. Boredom, for the purpose of this study, was defined as the lack of stimulation. To determine if there was a relationship between boredom and cribbing frequency, two different enrichment items were placed in the stalls of horses that cribbed on a daily basis. The presence of an enrichment item should decrease cribbing frequency.

In order to investigate how diet affects cribbing, the type of feed received daily was compared between the horses that crib and the control group. Sweet grain was expected to increase cribbing frequency due to the amount of sugar in these grains which makes them easily digestible. If the major influence for cribbing can be determined, then more effective means of prevention can be created.

Methods:

Study Site and Subjects

This study was carried out at the Alfred University Bromeley-Daggett Equestrian Center, which is home to about sixty horses. Seven of the horses crib on a regular basis (Table 1). Five of the cribbing horses are used for either western horsemanship or reining. The remaining two cribbers are used in the English disciplines, including flat work and jumping. These horses are all around the same age and are all used in the Alfred University equestrian program. General frequency of use for the horses at the time of the study was about one to two hours of riding a day, five days a week.

Table 1: List of cribbing and non-cribbing horses used in the study, includes breed and age.

Crib	**Sex**	**Breed**	**Age (years)**	**Horse Name**
Yes	Male	Appendix QH	19	Archer
	Male	Quarter Horse	10	Kody
	Female	Appaloosa	15	Spider
	Male	Paint	8	Strider
	Male	Quarter Horse	11	Sunny
	Male	Hanoverian	16	Wilbur
	Male	Quarter Horse	21	Wyatt
No	Male	Paint	14	Ben
	Male	Quarter Horse	15	Frank
	Male	Quarter Horse	16	Henry
	Male	Trakhener	19	Merlot
	Male	Quarter Horse	26	Mister
	Male	Appendix QH	10	Parker II
	Male	Quarter Horse	21	Willie

Data Collection

Data were collected from the end of September through December. Horses were observed using scan sampling with one minute intervals, three days a week for one hour each time for a total of thirty six hours per week. Behavior was observed in the presence of two different enrichment items, a Jolly Ball and a feed dispenser, to determine if either affects cribbing frequency or the latency period. Latency is the period of time after the stimulus is removed and before the behavior in question begins again. Baseline behavior was gathered initially for two weeks by removing cribbing collars and any items from the stalls. Non-cribbing horses were also observed in all treatments.

Enrichment items were added to reduce boredom. For the purpose of this study, a toy was defined as a non-food object that occupies the horse's mouth. The toy used for this study was a scented rubber ball that comes in various sizes, called a Jolly Ball. The Jolly Ball was hung in the stall of each horse that cribs, as well as in the stalls of seven non-cribbing horses. The amount of time spent with the toy was recorded. Each horse was observed for cribbing behavior for one hour per week for a total of three weeks in the presence of the Jolly Ball (Table 2). During this time, any interaction with the toy was recorded. For two days after each week of observation, the toy was removed to determine if a latency period developed.

Table 2: Ethogram for weeks observing with Jolly Ball.

Behavior	Definition
Sniff (SN)	Nose makes contact with object, nostrils may flare
Lick (LI)	Tongue is extended through teeth and border of mouth, tongue makes contact with object before being retracted back into mouth
Mouth (MO)	All or part of an object is taken into mouth with upper and lower lips, tongue placed between lips, head is elevated once object is in mouth
Nibble (NB)	Jaws closed, upper lip moves upwards and downward against an object, no dental contact of object
Chew (CH)	Object is taken into mouth with side-to-side grinding motion of upper and lower jaw, may include head tossing and/or forward movement of tongue through front teeth, ends with object falling out of mouth
Pick up (PU)	Object held between lips/front teeth/molars, head is elevated with object in mouth so that object is lifted from ground
Shake (SH)	Following pick up, object may be moved in a side-to-side, up-and-down, or circular motion
Cribbing (CR)	Horse latches onto a solid object with its incisors, arching its neck and pulling backwards, grunting noise may be present, each single repetition of behavior is one event
Resting (RE)	Horse is standing or laying down, relaxed, not doing anything else
Foraging (FR)	Head is down, actively looking for food, lips may be moving
Other (OT)	Behavior not listed in ethogram

Another enrichment item tested was a feed dispenser, called a Nose-It-Ball, in the stall. A feed dispenser is designed to slow a horse down when it is eating and can act as a form of enrichment that will keep the horse occupied while it is in the stall. Cribbing frequency of each horse in the presence of a feed dispenser was measured as with the Jolly Ball. Any interaction with the feed dispenser during this time was noted to determine the interest level of the horse. For two days after each week of observation, the feed dispenser was removed to determine if cribbing frequency changed in the absence of the dispenser.

Table 2: Ethogram for weeks observing with feed dispenser.

Behavior	Definition
Sniff (SN)	Nose makes contact with object, nostrils may flare
Lick (LI)	Tongue is extended through teeth and border of mouth, tongue makes contact with object before being retracted back into mouth
Mouth (MO)	All or part of an object is taken into mouth with upper and lower lips, tongue placed between lips, head is elevated once object is in mouth
Nibble (NB)	Jaws closed, upper lip moves upwards and downward against an object, no dental contact of object
Nose (NO)	Horse moves ball with nose, effectively rolling ball to release grain
Cribbing (CR)	Horse latches onto a solid object with its incisors, arching its neck and pulling backwards, grunting noise may be present, each single repetition of behavior is one event
Resting (RE)	Horse is standing or laying down, relaxed, not doing anything else
Foraging (FR)	Head is down, actively looking for food, lips may be moving
Other (OT)	Behavior not listed in ethogram

In order to determine the effect of diet on cribbing, a comparison of the type of feed each horse in the study commonly consumes was conducted. The type of feed the control group horses received daily was also compared to the type of feed the cribbers consumed. All of the horses received hay three times a day. Each of the horses received either Safe Choice, Fuel, Sentinel Senior, or a mix of these grains. Safe Choice and Sentinel Senior both contain 14% crude protein. Fuel contains only 12% crude protein. The grain with the highest amount of crude fiber was Safe Choice at 20% crude fiber whereas Fuel had the least amount with 10% crude fiber. Fuel contains the highest amount of crude fat with a concentration of 13% crude fat. Both Safe Choice and Sentinel Senior had less than 10% crude fat. All three feeds have similar calcium concentrations. Each feed contains about 0.65% to 1.15% of calcium. Both Fuel and Sentinel Senior contain 55ppm of copper while Safe Choice only contains 24ppm. Safe Choice and Fuel

have similar ingredients. Two of the first three ingredients in both feeds are grain products and processed grain by-products. Fuel contains plant protein products as its first ingredient. Safe Choice also contains roughage products as the third ingredient listed, the first ingredient being grain products. The main ingredient in Sentinel Senior is soybean hull with alfalfa meal and wheat middlings being listed as the second and third ingredient.

Data Analysis

All data were analyzed using Minitab 17 (Minitab 17 Statistical Software 2010). A confidence interval of 95% and a significance level of 0.05 was used. A non-parametric t-test, the Wilcoxon Mann-Whitney test, was used to compare the time cribbers spent with either enrichment item vs the time non-cribbers spent with either enrichment item. This test was also used to see how the time the horses that crib spent cribbing compared to the time they spent with the enrichment items. The likeliness of a latency period developing as a result of either enrichment item was determined using a non-parametric ANOVA test, the Kruskal-Wallis test. Kruskal-Wallis was also used to compare feed type and the presence of cribbing. When comparing the feed of cribbers and non-cribbers a Wilcoxon Mann-Whitney test was used. A Kruskal-Wallis test was also done to determine if there is a relationship between feed type and cribbing frequency. This test was used to determine the relationship between age and cribbing frequency as well.

Results:

Overall, neither enrichment item was effective at reducing cribbing frequency (Figure 1). There was a large range for baseline cribbing frequencies, with no significant difference between age or discipline. The highest baseline recorded was a frequency of 466 times/hr (Figure 2). The lowest baseline recorded was a frequency of 14 times/hr. Combining the baselines of all seven

cribbers resulted in an average baseline frequency of 147.9 times/hr. Four of the seven horses had a baseline frequency greater than 100 times/hr. The horses used in English disciplines had an average baseline of 163 times/hr while the horses used for Western disciplines had an average baseline of 142 times/hr. There was no significant difference in baseline frequency between the two disciplines (W= 17, P= 0.333). Cribbing frequencies did not change much over the course of the study. There was a decrease in cribbing frequency for many of the cribbers, however this was not a significant reduction. There was no significant relationship between age and cribbing frequency (H= 6.00, P= 0.423).

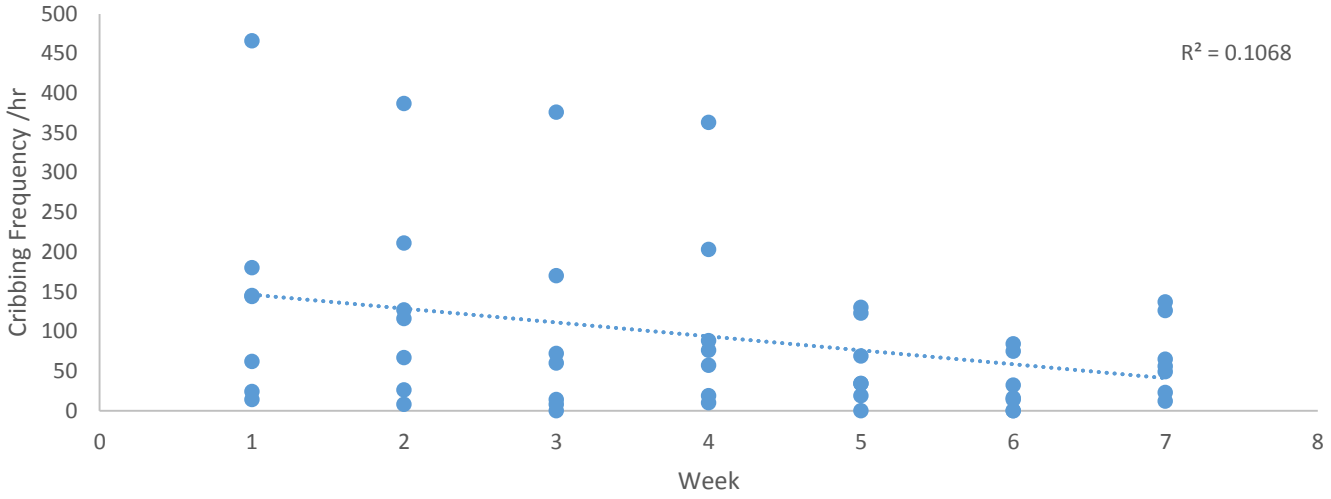

Figure 1: Change in cribbing frequency over time for all seven horses. Week 1 is the baseline frequency. Weeks 2-4 are when the Jolly Ball was present. Weeks 5-7 are when the feed dispenser was present.

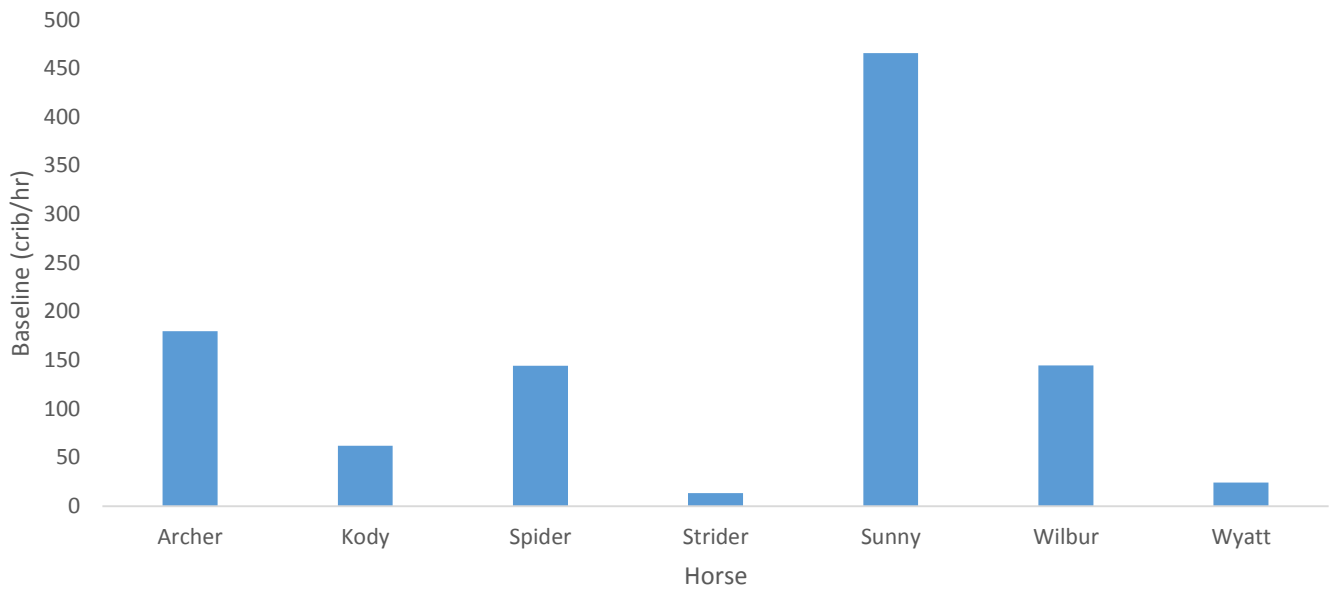

Figure 2: Baseline cribbing frequency for the seven cribbers.

Jolly Ball

The Jolly Ball did not have a significant impact on the horses that crib (W= 51, P= 0.898). All seven of the horses in the cribbing group spent more time cribbing than interacting with the Jolly Ball. Of these horses, four spent 1.67% of their time with the Jolly Ball. The other three spent more than 1.67% of their time with the Jolly Ball; however, the maximum time spent did not exceed 3.90%. Only two of the cribbers spent most of their observed time in the stall cribbing. None of the horses in either group spent the majority of their time interacting with the Jolly Ball. Most of the horses in the non-cribbing group spent most of their stall time foraging, whereas most of the cribbing horses spent the majority of their stall time resting. There was no significant difference in the time cribbers and non-cribbers spent with the Jolly Ball (W= 51, P=

0.898; Figure 3). Neither group used the Jolly Ball much. The Jolly Ball did not significantly reduce cribbing (Figure 4).

The comparison between the baseline cribbing frequency and the cribbing frequency with the Jolly Ball was not significant (W= 51, P= 0.898). When looking at the experimental group, the time spent cribbing was significantly more than the time spent interacting with the Jolly Ball (W= 77, P= 0.002; Figure 5). Five of the horses that crib showed a latency period after the Jolly Ball was removed from the stall (Figure 6). Overall there was not a significant change in cribbing frequency when the Jolly Ball was present in the stall.

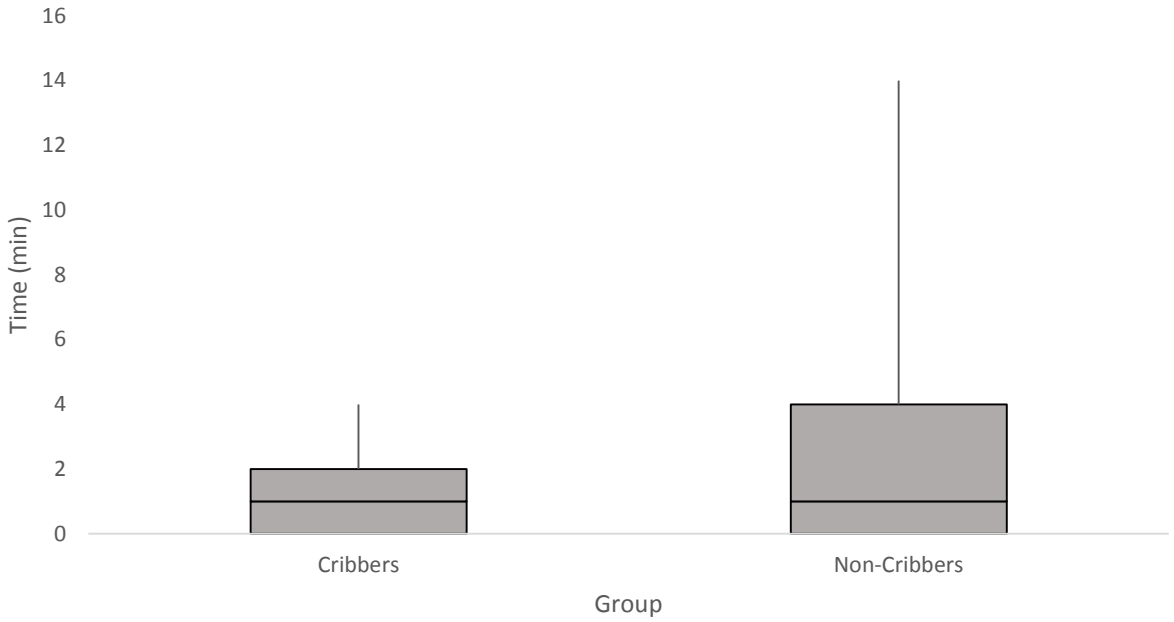

Figure 3: Difference in time both groups spent interacting with the Jolly Ball.

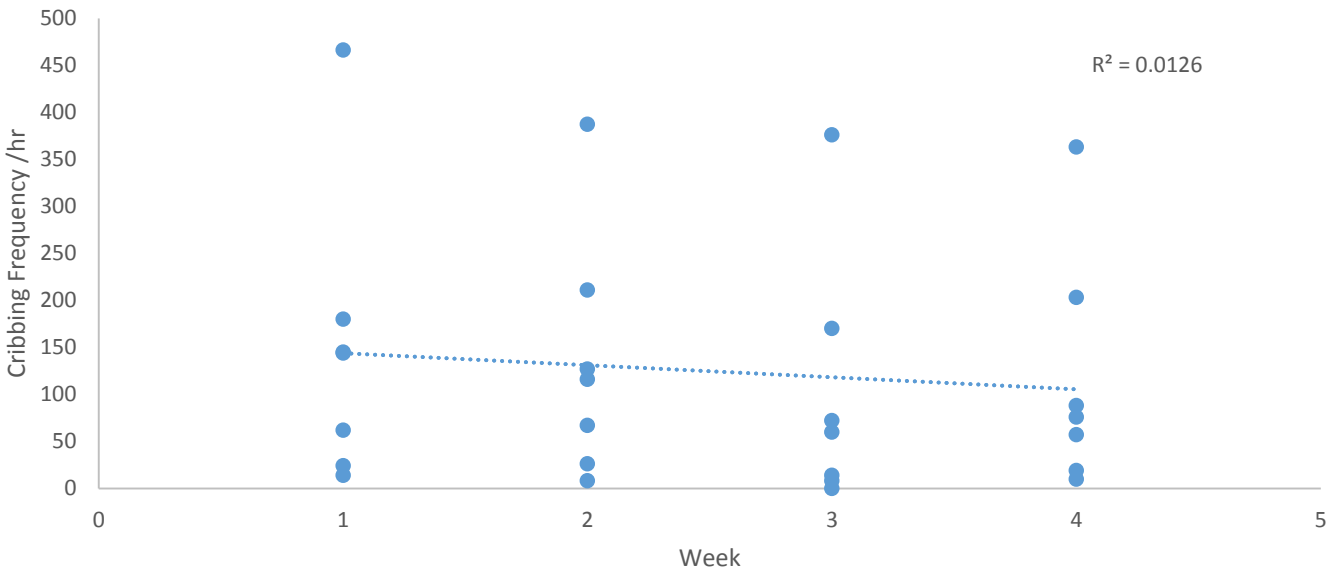

Figure 4: Change in cribbing frequency with a Jolly Ball present. Week 1 represents baseline frequency.

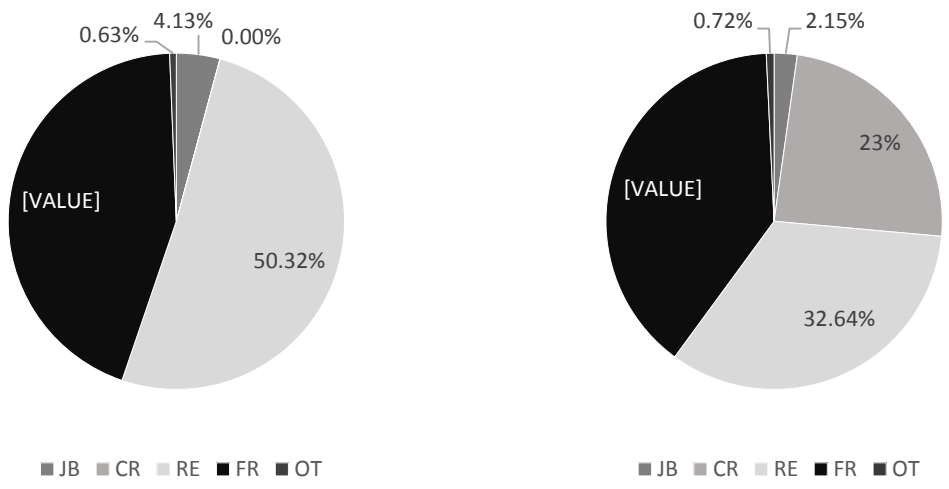

Figure 5: Time budget of non-cribbers (left) and cribbers (right) when Jolly Ball was present. JB= Jolly Ball, CR= Cribbing, RE= Resting, FR= Foraging, OT= Other behavior.

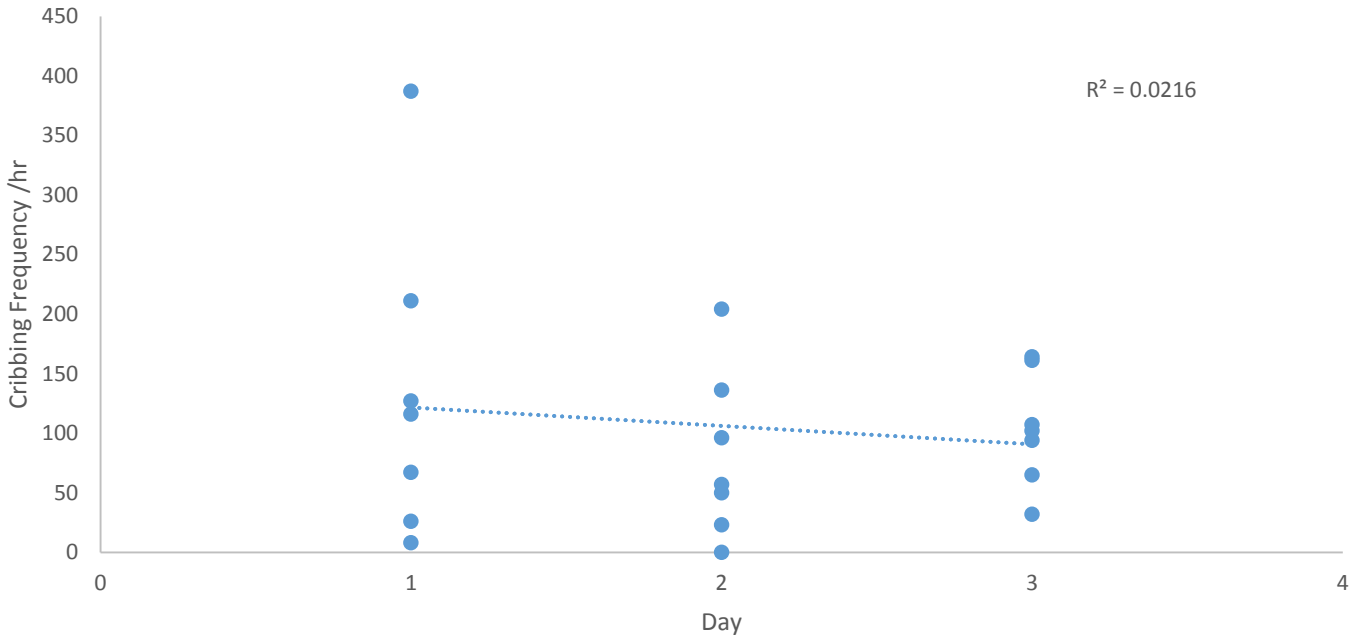

Figure 6: Cribbing frequency during latency period. Day 1 represents cribbing frequency when Jolly Ball was present. Jolly Ball was not present during days 2 and 3.

Feed Dispenser

All of the horses in the study spent more time interacting with the feed dispenser than with the Jolly Ball. Although, the feed dispenser did not significantly reduce cribbing frequency (W= 64, P=0.159; Figure 7). For two of the horses in the cribbing group, cribbing frequency increased when the feed dispenser was present. Because little time was spent engaging in either activity, there was no significant difference between time spent cribbing and time spent interacting with the feed dispenser (W= 54.5, P=0.848). Of the horses that crib, four spent more time interacting with the feed dispenser than cribbing. None of the cribbers spent the majority of their time in the stall cribbing, unlike when the Jolly Ball was introduced. All of the horses used the feed dispenser significantly more than the Jolly Ball (W= 129, P= 0.007).

When compared individually, cribbers used the feed dispenser less than the non-cribbers; however, the difference was not significant (W= 42.5, P= 0.225; Figure 8). The majority of horses from both groups spent the most time foraging (Figure 9). Of the cribbers, only one spent more than 15% of their time in the stall interacting with the feed dispenser.

Cribbing did not significantly decrease with the use of the feed dispenser (W= 64, P= 0.159). Of the seven horses that crib, only two showed a latency period after the feed dispenser was removed from the stall (Figure 10). For the other five horses, cribbing frequency increased the day after the feed dispenser was removed from the stall. Neither enrichment item had an effect after it was removed (H= 1.80, P= 0.180).

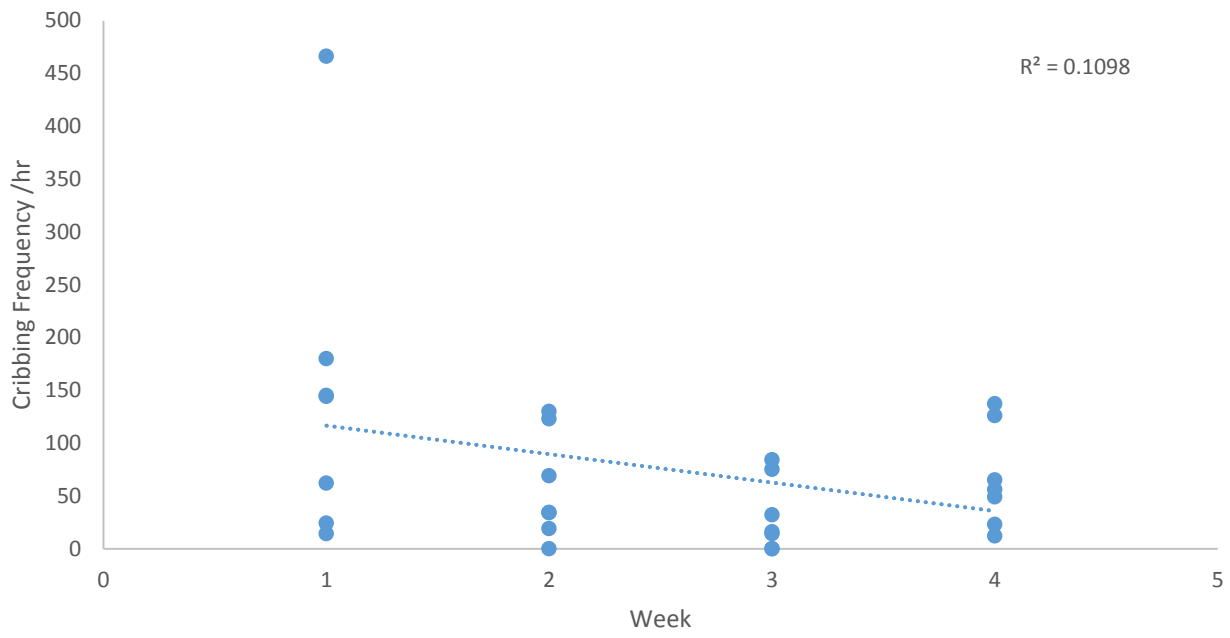

Figure 7: Change in cribbing frequency with feed dispenser present. Week 1 represents baseline frequency.

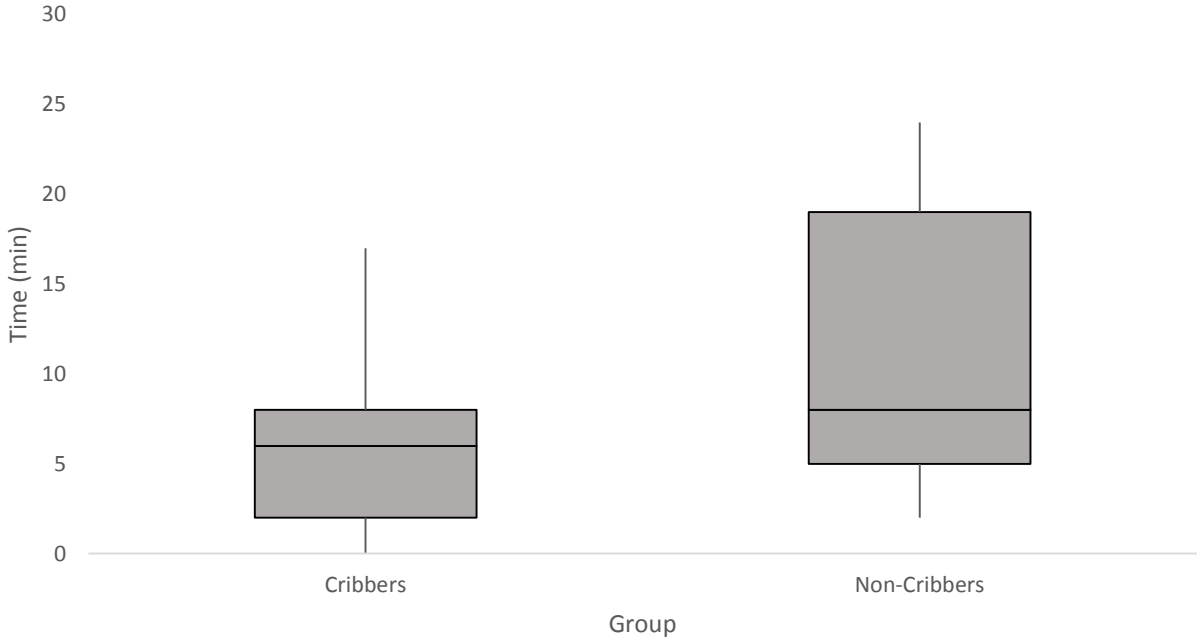

Figure 8: Difference in time both groups spent interacting with the feed dispenser.

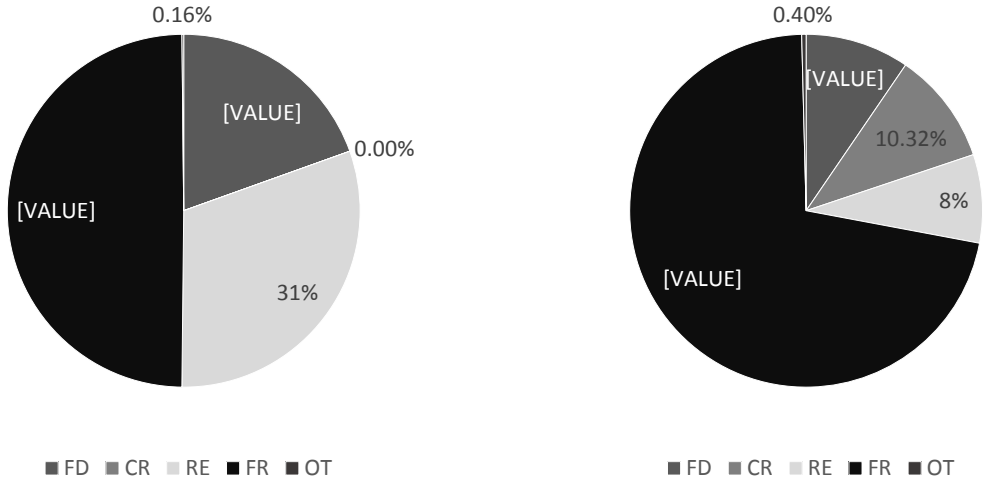

Figure 9: Time budget of non-cribbers (left) and cribbers (right) when feed dispenser was present. FD= Feed dispenser, CR= Cribbing, RE= Resting, FR= Foraging, OT= Other behavior

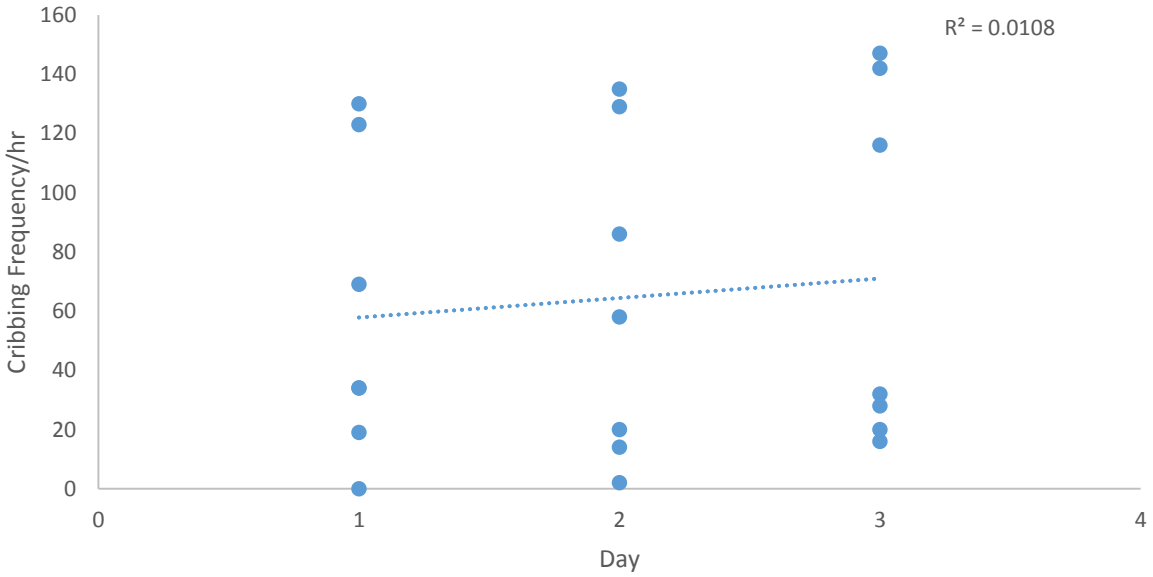

Figure 10: Cribbing frequency during latency period. Day 1 represents cribbing frequency when feed dispenser was present. Feed dispenser was not present during days 2 and 3.

Diet

Diets were compared in order to determine if there is a relationship between feed type and cribbing. Most of the horses received Safe Choice grain, although there is some variation (Figure 11). Feed type did not make a difference in whether a horse was more likely to crib ($P > 1.000$). There was also not a significant difference in the type of feed each horse commonly received ($H= 3.20$, $P= 0.525$). There was no significant relationship between cribbing frequency and feed type ($H= 4.57$, $P= 0.206$). Feed type did not appear to have any impact on cribbing frequency or on the development of cribbing.

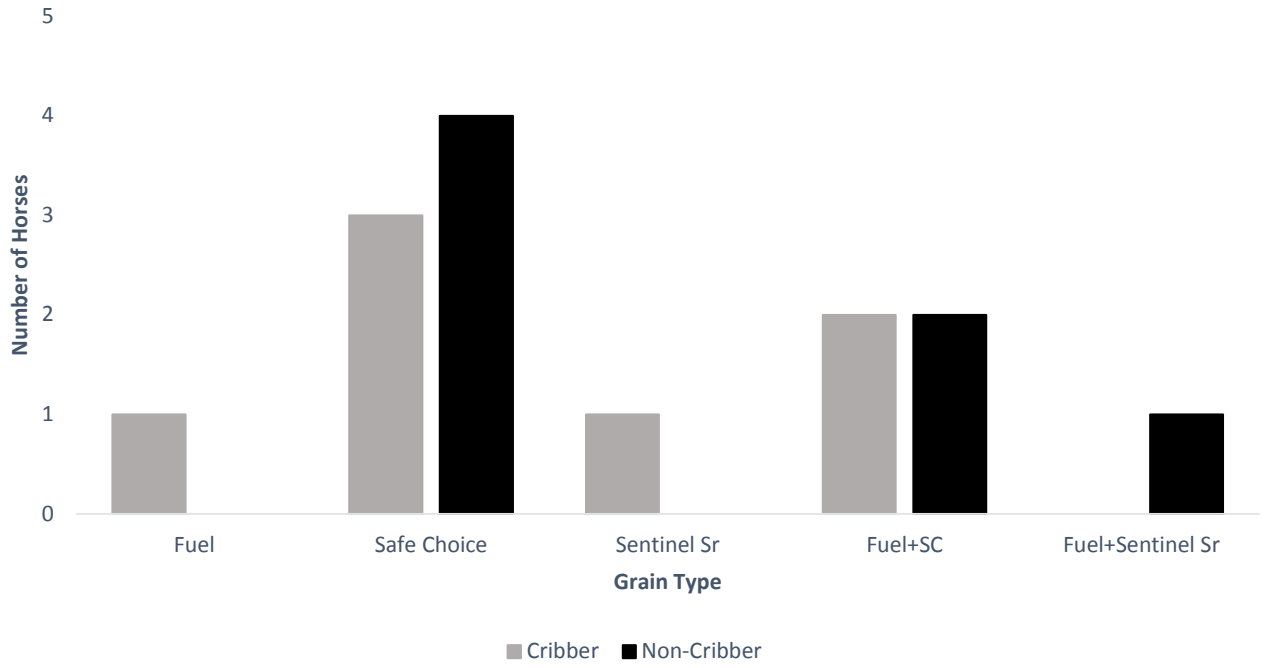

Figure 11: Number of horses on each feed type.

Discussion:

Cribbing is a compulsive behavior that was believed to increase when the horse is bored. Enrichment items were expected to reduce cribbing frequency as they were meant to combat boredom in the stall; however, neither item significantly affected cribbing frequency. Sweet feed was also believed to increase cribbing frequency. There was no significant difference between feed type and whether a horse cribbed regularly. A recent study found that the time budget of cribbers and non-cribbers do not significantly vary (Whisher et al. 2011). Most horses spend the majority of their time consuming hay, which matches the time budgets for the two groups of horses used in this study. Hay makes up about 50% of a horse's diet and, due to fiber quantity, takes longer to digest than grain. Typically, horses receive hay two or more times a day, meaning

that they normally have a near constant supply of hay to consume. The most frequent activities for both groups were foraging and resting. The results of this study suggest that enrichment items cannot be used as alternative methods of cribbing prevention.

A Jolly Ball was not an effective alternative method of preventing cribbing. None of the horses used for the study interacted with the Jolly Ball for an extended amount of time. None of the cribbers spent more than 3.90% of the observation time interacting with the Jolly Ball. Many only sniffed the ball a few times before ignoring it. On the other hand, a few horses in the non-cribbing group actually interacted with the ball further than just sniffing it. The non-cribbers still spent less than 10% of their time interacting with the ball. One reason the non-cribbers may have spent more time with the Jolly Ball is due to the lack of stereotypies they display. This reduces the amount of behaviors they display in the stall, so the presence of a Jolly Ball is more enticing than not doing anything. With the cribbing horses, their stereotypy already occupies them. Perhaps if the Jolly Ball had a better scent or molasses rubbed on it, the horses would be more interested in interacting with it. Whisher et al. (2011) conducted a study to determine if different enrichment items influenced cribbing frequency and found that the horses only spent 1-5% of their time interacting with the items. This is similar to the time the horses in this study spent interacting with the Jolly Ball, which was a range of 3-9% of their time.

When the Jolly Ball was present, the most common stall activity for both groups was tied between foraging and resting. Only two horses spent the majority of their stall time cribbing. The cribbers were significantly more interested in cribbing than in using the Jolly Ball. To a horse with a stereotypy, it is more rewarding to perform the stereotypy (Marsden 2002). The horses in this study most likely found it more rewarding to crib than to play with the Jolly Ball. Whisher et al. (2011) found that hanging toys were not frequently used by horses when placed in the stall.

As the Jolly Ball was hung in the stall of each horse, that could have resulted in the item being less enticing. Although Jolly Balls tend to be less expensive than cribbing collars, they are not a good substitute, since cribbing is hardly reduced in the presence of a Jolly Ball.

Placing a feed dispenser in the stall of horses that crib also did not reduce the frequency. When compared to the Jolly Ball, the horses in the study interacted with the feed dispenser significantly more. An explanation for this is that the feed dispenser contains food. The scent of the grain would attract the horse. There was more of a reward for the horse with the feed dispenser because moving it around not only entertained the horses but gave them grain. A similar study found that an enrichment item similar to the feed dispenser used in this study did not have a significant effect on cribbing frequency (Whisher et al. 2011). The researchers, however, found that an enrichment item which contained a sugar gelatin mixture the horses could lick did significantly reduce cribbing. None of the cribbers spent the majority of their time cribbing. Four of them interacted with the feed dispenser more often than they cribbed; however, this difference was not significant. Of the cribbers, only one spent about 18% of its time interacting with the feed dispenser. The most any of the non-cribbers interacted with the feed dispenser was 39.44% of their time. This is more than previous studies have found. When a similar feed dispenser was present, horses only spent 3.4% of their time interacting with it (Whisher et al. 2011). This is from a study where the item was kept in the stall for a twenty-four hour period, meaning that the results of this study are not on the same scale so comparisons cannot be easily made. With the feed dispenser present, the most common stall activity for the combined groups was foraging because they were also searching for any grain that may have fallen out of the feed dispenser. However, there was no noticeable latency for the majority of the cribbing horses; only two had actual latency periods. This suggests that the feed dispenser does

not have any lasting effects once removed from the stall. This enrichment item appeared to interest the horses as long as there was food in the dispenser. Once the horses removed all of the grain they could, they lost interest and went back to cribbing. There was no significant effect on cribbing frequency, meaning a feed dispenser is not an effective alternative prevention method. Feed dispensers are also impractical since a horse should not receive a constant supply of grain while stalled. Horse owners could, however, feed a horse's normal grain ration in a feed dispenser during feeding times. This would increase the amount of time it would take the horse to eat. Even in this manner, cribbing would not be completely reduced, as some horses still crib while eating.

Neither enrichment item significantly reduced cribbing; however, that does not mean that either item could not be used to prevent cribbing. Cribbing collars are more effective at preventing cribbing than enrichment items (Winskill et al. 1995). Statistically, the feed dispenser did not significantly reduce cribbing; however, there was a reduction in cribbing frequency for most of the horses. There was not an extensive change in cribbing frequency with the feed dispenser present but this item could be used as a prevention method for horses that do not crib excessively. Giving a horse its grain ration in a feed dispenser will increase its feeding time. Horses that do not crib often could benefit from an increased feeding time in that it would give them more to do in the stall. The Jolly Ball was not as effective as the feed dispenser. This item could be beneficial if used with another prevention method such as a cribbing collar. The added enrichment could reduce cribbing frequency in a horse that cribs despite wearing a cribbing collar. In order for this to work, the horse must actually interact with the Jolly Ball. Currently, the best prevention method for cribbing is a cribbing collar.

The three grain types consumed by the horses in this study are composed of similar ingredients. Safe Choice and Fuel are not sweet feeds, as they do not contain oats or corn. Both feeds do contain molasses products but not in enough quantity to make the sugar content increase drastically. Sentinel Senior can be called a sweet feed, as it is made up in part by corn. Overall, feed type did not make a significant difference in the presence of cribbing. A study conducted by Whisher et al. (2011) determined that diet did have a significant impact on cribbing frequency. They found that horses fed a diet comprised of oats cribbed significantly less than those fed sweet grain. As no horses in this study were fed oats, it is reasonable that no significant relationship was found. Most of the horses in this study were on Safe Choice, as it is a common feed that includes everything a healthy horse requires. There is no significant relationship between feed type and cribbing frequency, meaning that diet does not dictate how often a horse may crib. Diet is often cited as a cause of cribbing (Mazzola et al. 2016). More research needs to be done to determine the actual role diet has in the development of this behavior.

Enrichment items do not have an effect on cribbing frequency. A feed dispenser was used significantly more than a Jolly Ball; however, neither significantly reduced cribbing frequency. Diet does not appear to be a cause of cribbing. The findings of this study suggest that feed type does not affect cribbing frequency. Not many alternative methods of cribbing prevention exist. Most horse owners rely on cribbing collars to reduce or prevent this behavior. These collars can be very expensive, depending on the severity. More research should be done to find cheaper, effective prevention methods. The horses in this study were all around the same age. Abdominal function decreases with age. As a result, cribbing may increase with age due to this decrease in function. No significant relationship between age and cribbing frequency was found. A study

comparing the cribbing frequency of horses with a wide range of ages would be beneficial in determining if age affects cribbing.

More studies should be conducted exploring the role of enrichment items on cribbing. Instead of hanging the Jolly Ball in the stall, as was done in this study, the toy could be placed on the floor of the stall. Perhaps if the Jolly Ball is placed on the ground horses will interact with it more, causing it to be a more effective mean of preventing cribbing. Another area that still needs more research is the effectiveness of cribbing collars. A comparison study of the different types of cribbing collars would be beneficial to horse owners struggling to control their horse's cribbing. This type of study could inform owners of which brands or styles of cribbing collars are the most effective and the most cost efficient. Studies exploring how cribbing changes with different quantities of nutrients such as protein, fiber, or minerals could help explain the role diet plays in cribbing.

Works Cited

Albright, J.D. Mohammed, H.O. Heleski, C.R. Wickens, C.L. Houpt, K.A. 2009. Crib biting in US horses: Breed predispositions and owner perceptions of aetiology. *Equine Veterinary Journal*. 41 (5): 455-58.

Archer, D.C. Freeman, D.E. Doyle, A.J. Proudman, C.J. Edwards, G.B. 2004. Association between cribbing and entrapment of the small intestine in the epiploic foramen in horses: 68 cases (1991-2002). JAVMA. 224 (4): 562-64.

Bachmann, I. Audige, L. Stauffacher, M. 2003. Risk factors associated with behvaioural disorders of crib-biting, weaving and box-walking in Swiss horses. *Equine vet J*. 35 (2): 158-63.

Clegg, H. Buckley, P. Friend, M. McGreevy, P. 2008. The ethological and physiological characteristics of cribbing and weaving horses. *Applied Animal Behaviour Science*. 109 (1): 68-76.

Cooper, J. Mason, G. 1998. The identification of abnormal behaviour and behavioural problems in stabled horses and their relationship to horse welfare: a comparative review. *Equine Vet. J*. 27: 5-9.

Escalona, E.E. Okell, C.N. Archer, D.C. 2014. Prevalence of and risk factors for colic in horses that display crib-biting behaviour. *BMC Veterinary Research*. 10 (Suppl 1): S3.

Firth, E. 1980. Bilateral ventral accessory neurectomy in windsucking horses. *Veterinary Record.* 106 (2): 30-32.

Freeman, D. Pearn, A. 2015. Anatomy of the vestibule of the omental bursa and epiploic foramen in the horse. *Equine Veterinary Journal*. 47 (1): 83-90.

Galizzi-Vecchiotti, G. Galanti, R. 1986. Evidence of heredity of cribbing, weaving and stall-walking in Thoroughbred horses. *Livestock Production Science*. 14 (1): 91-95.

Green, P. Tong, M. 1988. Small intestinal obstruction associated with wood chewing in two horses. *Veterinary Record*. 123 (8): 196-198.

Houpt, K. 1986. Stable vices and trailer problems. *The Veterinary Clinics of North America.* 2 (3): 623-33.

Houpt, K. McDonnell, S. 1993. Equine stereotypies. *The Compendium*. 15 (9): 1265-1271.

Kennedy, M. Schwabe, A. Broom, D. 1993. Crib-biting and wind-sucking stereotypies in the horse. *Equine vet. Educ.* 5 (3): 142-47.

Krzak, W. Gonyou, W. Lawrence, L. 1991. Wood chewing by stabled horses: diurnal pattern and effects of exercise. *J. Anim. Sci*. 69 (3): 1053-1058.

Luescher, U.A. McKeown, D.B. Dean, H. 1998. A cross-sectional study on compulsive behaviour (stable vices) in horses. *Equine vet J., Suppl.* 30 (S27): 14-18.

Marsden, D. 2002. A new perspective on stereotypic behaviour problems in horses. *In Practice*. 24 (10): 558.

Mason, G. 1991. Stereotypies: a critical review. *Animal Behaviour*. 41 (6): 1014-1037.

Mazzola, S. Palestrini, C. Cannas, S. Fè, E. Bagnato, G.L. Vigo, D. Frank, D. Minero, M. 2016. Efficacy of a feed dispenser for horses in decreasing of cribbing

behaviour. *Veterinary Medicine International.* 1-6: doi: 10.115/2016/4698602.

McAfee, L. Mills, D. Cooper, J. 2002. The use of mirrors for the control of stereotypic weaving behaviour in the stabled horse. *Applied Animal Behaviour Science*. 78 (2-4): 159-73.

McBride, S. Cuddeford, D. 2001. The putative welfare-reducing effects of preventing equine stereotypic behaviour. *Animal Welfare*. 10 (2): 173-189.

McGreevy, P. Nicol, C. 1998. Physiological and behavioral consequences associated with short term prevention of crib-biting in horses. *Physiology and Behavior*. 65 (1): 15-23.

McGreevy, P. Ricardson, J. Nicol, C. Lane, J. 1995. Radiographic and endoscopic study of horses performing an oral based stereotypy. *Equine Vet J*. 27 (2): 92-95.

Mills, D. 2005. Repetitive movement problems in the horse. In: Mills D, McDonnell S, editors. The domestic horse: the evolution, development and management of its behaviour. Cambridge (UK): Cambridge University Press. p. 212-23.

Mills, D. Davenport, K. 2002. The effect of a neighboring conspecific versus the use of a mirror for the control of stereotypic weaving behaviour in the stabled horse. *Animal Science*. 74: 95-101.

Minitab 17 Statistical Software (2010). [computer software]. State college, PA: Minitab, Inc (www.minitab.com)

Nicol, C. 1999. Understanding equine stereotypies. *Equine Vet J.* 31 (28): 20-25.

Ninomiya, S. Sato, S. Sugawara, K. 2007. Weaving in stabled horses and its relationship to other

behavioural traits. *Applied Animal Behaviour Science.* 106 (1-3): 134-43.

Redbo, I. Reddbo-Torstensson, P. Ödberg, F. Hedendahl, A. Holm, J. 1998. Factors affecting behavioural disturbances in race-horses. *Animal Science*. 66: 475-481.

Rendon, R. Shuster, L. Dodman, N. 2001. The effect of the NMDA receptor blocker, dextromethorphan, on cribbing in horses. *Pharmacology Biochemistry and Behavior*. 68 (1): 49-51.

Whisher, L. Raum, M. Pina, L. Pérez, L. Erb, H. Houpt, C. Houpt, K. 2011. Effects of environmental factors on cribbing activity by horses. *Applied Animal Behaviour Science*. 135 (1): 63-69.

Winskill, L. Waran, N. Channing, C. Young, R. 1995. Stereotypies in the stabled horse: causes, treatments and prevention. *Current Science*. 69 (4): 310-316.