

Christina Perez
Zoology 567

The following ten annotated bibliography entries are organized according to primary and secondary articles respectively and are then further arranged chronologically under corresponding headings. Primary articles are subdivided into headings according to type of study method employed for the investigation of stall weaving behavior, while the secondary articles provide similar methods of research and instead are organized by date of publication to keep record of previous research compiled on the general topic of stereotypic behavior.

Christina Perez
Zoology 567

Primary Articles

Studies that evaluate horse (*Equus caballus*) stereotypies via a survey method

Luescher, U. A., McKeown, D. B., & Dean, H. (1998). A cross-sectional study on compulsive behaviour (stable vices) in horses. *Equine Veterinary Journal*, 30(S27), 14–18. <https://doi.org/10.1111/j.2042-3306.1998.tb05138.x>

Summary: This article investigated the effects of both individual and stable level factors on the prevalence of horse stereotypic behavior. Previous research had revealed that stable level factors limit a horse's natural grazing and herd behavior, increasing the probability of stereotypy development. If such behavior is displayed in a horse, it is suggestive of low animal welfare conditions and can lead to euthanasia at owner's discretion. Luescher et al. (1998) set out to provide epidemiological information regarding the development of stereotypies and determine potential risk factors for horses. In order to collect this data, a survey of 769 horses was conducted, specifically including individuals of different breeds from various stables. Behavioral stereotypies as well as the individual and stable factors for each horse were obtained from a questionnaire interview with each stable manager. Individual factors included breed, sex and age while stable factors included stable type, breeding technique, amount of human contact, frequency of roughage or grain, exercise amount, contact with conspecifics etc. The relationship between the two variables was then analyzed using a Chi-square analysis and a *t*-test as well as a logistic regression analysis for confounding factors. The results indicated that stall weaving is significantly more likely in older, Thoroughbred stallions while stable factors did not statistically affect weaving prevalence; other stereotypies such as cribbing, stall kicking and stall walking yielded similar or insignificant results. This study remains critical in the investigation of horse stereotypies as it provides information on factors that may predispose a horse to compulsive behavior. Nonetheless, further research must be conducted to fully understand and explain this relationship between individual factors, such as age, sex and breed, and the prevalence of stereotypic behavior. Furthermore, future studies are required to properly evaluate the impact of stable management factors on the development of stereotypic behavior in horses.

Contribution: Building upon previous research in the field, this article provides insight into the risk factors associated with stereotypic behavior in various stables. As such, it produces an epidemiological synthesis regarding the appearance of stereotypies for better horse management and mitigation. This study is included into my literature review as it provides a complete analysis of the confounding factors that impact stall weaving behavior, narrowing down the specific factors that significantly influence my behavior of interest. However, the findings contradict previous studies regarding stable-level impact on stereotypies and require further investigation to conclusively state that there is no causation-effect relationship.

Christina Perez
Zoology 567

Waters, A. J., Nicol, C. J., & French, N. P. (2002). Factors influencing the development of stereotypic and redirected behaviours in young horses: Findings of a four year prospective epidemiological study. *Equine Veterinary Journal*, 34(6), 572–579.
<https://doi.org/10.2746/042516402776180241>

Summary: This article investigated the developmental factors involved in stereotypic occurrence of Thoroughbred horses. Previous research has revealed that equine stereotypy development is correlated with specific individual factors such as breed and gender as well as restrictive stable designs and low foraging opportunities. However, Waters et al. (2002) argued that this retrospective equine data is not substantial to evaluate cause-effect relationships as it can only demonstrate influences at that given point in time. In order to properly establish the developmental factors that allow for stereotypic behavior, 225 young Thoroughbred foals were studied during their developmental stage throughout a four-year prospective study. Focal animal sampling was used for the behavioral observations collected throughout the study; mares were observed to determine social rank while foals were categorized by individual factors (sex, rank of mare, weaning method etc.) and observed during the weaning period to record onset of abnormal behavior. The results reveal that stereotypies develop in the majority of foals between birth and nine months of age. Additionally, foals of high-ranking mares, foals that were box- or barn-weaned and foals housed after weaning posed a higher risk of developing stereotypies. This study is of significant importance as it provides crucial information regarding equine developmental factors that lead to stereotypic behavior, hence pinpointing the original motivation for the behavior. Further prospective studies must be conducted to support the results obtained and conclusively establish the cause-effect relationship of influential factors for stereotypic behavior development. Additionally, future research could investigate the development of locomotory stereotypies in foals in order to understand the underlying cause of the common behavior.

Contribution: Being the first of its kind, this prospective study provided critical insight into the factors affecting the development of stereotypic behavior in foals. As such, it presented substantial evidence into the cause-effect relationship of stereotypies that was not previously known. Furthermore, the results provide explanation and support patterns of abnormal behavior previously recorded in mature horses. I included this article for my literature review as it extensively evaluates developmental impacts of stereotypic behavior in order to determine its origin. By doing so, preventative measures can be devised, and mitigation strategies can be developed to ensure equine well-being.

Christina Perez
Zoology 567

Christie, J. L., Hewson, C. J., Riley, C. B., McNiven, M. A., Dohoo, I. R., & Bate, L. A. (2006). Management factors affecting stereotypies and body condition score in nonracing horses in Prince Edward Island. *Canadian Veterinary Journal*, 47(2), 136–143.

Summary: This study investigated the impacts of management practices on equine body condition score (BCS) and occurrence of stereotypic behavior. Previous research has discovered underlying reasons that may lead to increased stereotypic behavior in addition to reduced BCS, both of which are indicative of reduced animal welfare. Former studies have recorded the management and welfare of registered organization Prince Edward Island nonracing horses. Christie et al. (2006) took this one step further by incorporating horses from all PEI households and organizations for a better representation of equine management factors that influence welfare. This objective was accomplished by randomly selecting 312 horses from households listed in a PEI phone book. Horse owners were interviewed with a questionnaire to determine individual management practices and stereotypic behavior occurrence. A veterinarian was recruited to perform a physical examination and designate a BCS for each horse. Data was then subjected to univariable analyses for each management factor (Chi-square and *t* tests), as well as multifactorial analyses with all variables (linear regression). The findings revealed that BCS in PEI is relatively high and is correlated to membership of equine organizations. Furthermore, the study demonstrated that equine stereotypic behavior was significantly dependent on the number of hours worked, age and breed; wherein increased levels of forced exercise, older horses and light horse types are predisposed to stereotypic weaving. These factors reveal a reduced control over the environment by the animal, which can be a source of stress and frustration, and consequently results in stereotypic behavior appearance as a coping mechanism. Further research is required to establish the effect of several confounding factors discovered in the present study, such as the risk associated with the use of a nonsnaffle bit.

Contribution: The present study builds upon the previous research conducted in the field to obtain a more accurate sample of the nonracing horses in PEI and determine which management factors affect equine welfare. The data presented in this study supports previous findings by concluding that age, breed and forced exercise impact the stereotypic behavior occurrence. I included this article into my literature review as it emphasizes these factors as having a distressing effect on the horse, providing an extensive explanation regarding the development of equine stereotypies. Nonetheless, future studies remain necessary to understand additional impact of bit type on weaving behavior.

Christina Perez
Zoology 567

Studies that investigate (*Equus caballus*) horse stereotypic behavior mitigation strategies via experiments

Cooper, J. J., McDonald, L., & Mills, D. S. (2000). The effect of increasing visual horizons on stereotypic weaving: Implications for the social housing of stabled horses. *Applied Animal Behaviour Science*, 69(1), 67–83. [https://doi.org/10.1016/S0168-1591\(00\)00115-5](https://doi.org/10.1016/S0168-1591(00)00115-5)

Summary: This article investigated the impact of differing stable designs on the frequency of stereotypic weaving behavior. Stall weaving is a locomotory stereotypy that involves the horse shifting its weight and swaying its head and neck from one side to the other. Previous research has revealed that weaving can deteriorate a horse's shoes and cause leg inflammation, leading to lameness. Practices are being developed to provide stabled horses with foraging and exercise enrichment as alternative stimulation to reduce stereotypic activity. Past epidemiological studies have demonstrated that social isolation contributes to stereotypy development. Cooper et al. (2000) designed stalls with differing levels of visual contact with the environment and neighbors to evaluate the effect of social interaction on stereotypy frequency. Ten horses were selected from a stable in the UK and individual information was recorded. An observation schedule was developed to ensure random stable design and location designation for each horse. The following stable designs were used for the experiment: front half-door, front and rear half-door, rear half-door, front and one side grill and front, rear and both side grills open. Observations were conducted through scan sampling and recorded both horse position and behavior during five weeks. The experiment found that stable design significantly impacted stereotypic behavior, wherein weaving was reduced with increased visual horizons. In fact, the all-four door open stall design had no recorded behavior of weaving in all horses. This study is significant as it demonstrates the importance of visual enrichment and social interaction on the exhibition of stall weaving behavior. For this reason, the study provides a feasible mitigation strategy that addresses the underlying motivation for weaving and can be implemented to improve equine health overall. Future research continues to be required to properly evaluate the efficacy of the stable design strategy over a longer period of time.

Contribution: This study further advances knowledge regarding the underlying motivation for stall weaving behavior and provides a notable mitigation technique for chronic weavers. The present findings support previous research conducted on the impact of social interaction on equine stereotypies, wherein increased social behavior decreases frequency of stereotypies. This article is included in my literature review as it provides insight into potential mitigation strategies to reduce stereotypic behavior without pharmacological intervention. Nonetheless, future studies must be conducted to assess the stable design's long-term effectiveness seeing as the novelty of the design may be biasing results.

Christina Perez
Zoology 567

McAfee, L. M., Mills, D. S., & Cooper, J. J. (2002). The use of mirrors for the control of stereotypic weaving behaviour in the stabled horse. *Applied Animal Behaviour Science*, 78(2), 159–173. [https://doi.org/10.1016/S0168-1591\(02\)00086-2](https://doi.org/10.1016/S0168-1591(02)00086-2)

Summary: This article examines the impact of stall mirrors on the frequency of stall weaving stereotypic behavior. Previous research has demonstrated that stall weaving is a common stereotypy exhibited by domesticated horses, particularly horses involved in competitive events such as dressage and show jumping. In their natural environment, horses are social animals that remain with their herd for much of their lifetime. Weaving is thought to be the horse's response to stall restrictions and an attempt to socially interact with their neighbors. A former study had investigated the provision of mirrors and discovered that stereotypic behavior decreased accordingly. McAfee et al. (2002) further investigated this proposition by studying the long-term impact of mirrors on weaving behavior. This was accomplished by observing six horses from a UK stable, who were known to display stall weaving for the past two years; observations were carried out through scan sampling and recorded both position in the stall and corresponding activity according to a pre-established ethogram. Throughout the first week, no mirrors were provided to establish a baseline weaving frequency. Afterwards, each horse was alternatively exposed to a stall mirror for a five-week period and finally a week of no mirror for post-treatment analysis. The findings indicate that mirrors significantly reduce the occurrence of stall weaving in the sampled horses. This shows that weaving behavior is associated with the importance of social behavior in horses as the mirror mimics social contact with conspecifics and reduces the animal's need to weave. Therefore, the provision of mirrors results to be a feasible treatment of undesired weaving behavior in stabled horses, providing an alternative solution to damaging weaving bars and pharmacological intervention. Future research continues to be required regarding potential reduction in mirror impact over time in addition to its impact on other aggressive behaviors such as head threats.

Contribution: This research further advances knowledge in the field by exploring the long-term effects of stall mirrors on stall weaving behavior. The findings support previous investigations conducted in the field and promotes the underlying relationship between social interaction and weaving behavior. As such, the article is included into my literature review as it provides insight into the effectiveness of implementing a mirror mitigation strategy to reduce stereotypic weaving. Additionally, the article demonstrates further indication of the horse's motivation to perform stall weaving behavior which can inspire future designs and tools to prevent its occurrence.

Christina Perez
Zoology 567

Bulens, A., Van Beirendonck, S., Van Thielen, J., & Driessen, B. (2013). The enriching effect of non-commercial items in stabled horses. *Applied Animal Behaviour Science*, 143(1), 46–51. <https://doi.org/10.1016/j.applanim.2012.11.012>

Summary: The goal of this study was to determine if the addition of simple objects that enrich a horse's environment can have a positive impact on horse behavior by decreasing stereotypic frequency. Previous research has shown that environmental enrichment, defined as the modifications made to a captive environment, can lead to improvements in stereotypic behavior. In horses, enrichment can include stimulating foraging behavior by presenting food frequently in different ways, such as hay nets or on the ground, in addition to "feeding balls" that the horse can interact with and occupy their time. However, it is not always feasible to provide a horse with additional edible material as it can lead to unwanted weight gain. Bulens et al. (2013) aim to investigate whether the simple objects, without roughage reward, can invoke horse interest and decrease stereotypic occurrence alone. This was accomplished by selecting 35 random horses from stables in Belgium and entering them into a rotation schedule, wherein one group would receive a bottle filled with sand for one week, the second group a rope and a control group received no item. Observations were recorded via scan sampling method and recorded both position and behavior of each horse according to a pre-existing ethogram. The findings revealed that stereotypic frequency of behaviors such as stall weaving, licking and wind-sucking did not significantly reduce after one week of interacting with each item. Nonetheless, this article remains significant as it reveals that item usage was more prevalent when no roughage was available, indicating a source of frustration for the horse. Further research could be conducted upon these findings to evaluate long-term effects. Similarly, an investigation can be conducted into the effectiveness of incorporating an alternative liquid forage into the items to evaluate if the reward has a corresponding positive impact of decreasing stereotypic behavior.

Contribution: The study builds upon previous knowledge of horse enrichment and provides a potential solution to managing stereotypic behavior occurrence without the provision of typical roughage. The findings presented support past studies regarding the need for foraging enrichment to decrease stereotypic behavior occurrences; a simple object will not entice the horse enough to affect the frequency of stereotypies. Although the experiment did not yield simple objects as a possible solution, I included the article in my review as it provides a foundation upon which future research can generate improvements to the objects and accomplish the task at hand.

Christina Perez
Zoology 567

Stanley, S. O., Cant, J. P., & Osborne, V. R. (2015). A pilot study to determine whether a tongue-activated liquid dispenser would mitigate abnormal behavior in pasture-restricted horses. *Journal of Equine Veterinary Science*, 35(11-12), 973–976. <https://doi.org/10.1016/j.jevs.2015.08.016>

Summary: This article investigated the impact of a tongue-activated liquid dispenser on the stereotypic behavior of horses. Previous research has linked repetitive, invariant stereotypic behavior to horses that remain in stalls for much of the day. While stalled, horses are unable to graze in pasture, limiting their fiber intake which has been proven to aggravate stereotypies. Stanley et al. (2015) aimed to determine if a feeding behavioral tool could mitigate stereotypic behavior as it provided increased feed availability that has previously proven to reduce stereotypies. In order to research this question, four horses that exhibit chronic stereotypic behavior, two of which are cribbers and the other two weavers, were studied for an hour at a time over the course of three days. Each horse was randomly assigned to a treatment stall, which contained the tongue-activated liquid dispenser, or to the control stall. Behavior was recorded continuously according to a pre-established ethogram. The experiment found that the tongue-activated liquid dispenser had no significant difference on the total time spent performing stereotypic behavior. However, this study remains significant as it provides insight into the implementation of behavioral tools to mitigate stereotypic behavior in horses. Modifications can be made to improve the efficacy of the liquid dispenser. Nevertheless, future studies are required to determine if increasing the fiber content in the liquid with different soluble forages could entice the horse to use the tool and decrease stereotypies. Additionally, research must be conducted to uncover new methods of providing foraging opportunities for developing, stalled horses.

Contribution: This article provides insight into innovative behavioral tools that can be utilized to mitigate stereotypic behavior in stalled horses. I chose this article because it provides strategies and tools to mitigate pre-existing stereotypies in horses. The research conducted in this article serves as a “stepping-stone” on which to build upon in order to accomplish the tool’s purpose of reducing stereotypic behavior; possible suggestions include experimenting with different soluble forages and teaching the horse how to use the liquid dispenser. Future research can pertain to investigating such modifications and determining their efficacy in reducing stereotypic behavior exhibited in stalled horses.

Christina Perez
Zoology 567

Secondary Articles

Reviews that provide a generalized context of stereotypic behavior

Mason, G. J. (1991a). Stereotypies and suffering. *Behavioural Processes*, 25(2), 103–115. [https://doi.org/10.1016/0376-6357\(91\)90013-P](https://doi.org/10.1016/0376-6357(91)90013-P)

Summary: This article reviews research conducted on the investigation of various animal's stereotypies, with a particular focus on evaluating the relationship between stereotypic behavior and the state of animal welfare. Previous research conducted on stereotypic behavior among species has indicated that stereotypies develop and arise in poor animal welfare conditions. As a result, studies have determined that any continuation of stereotypic behavior indicates animal suffering. Mason (1991a) aimed to prove this assumption inaccurate by presenting evidence from ninety-one articles. These articles that Mason compiled research from focused on the development of stereotypical behavior without the corresponding decreased animal welfare conditions. For instance, some studies exhibit that stereotypies arise without aversive conditions and, conversely, that a sub-optimal environment does not equate to displaying stereotypic behavior. In fact, many studies indicate that stereotypies may arise due to other factors such as excitement and even social facilitation, wherein an individual is more likely to perform a stereotypy if neighboring animals do so. Stabled horses have even been proven to display stereotypic behavior before urinating or defecating, utilizing the behavior as an anticipatory state of raised activity rather than associated with a negative emotion. Nonetheless, established stereotypies can be correlated to the lack of activity occurring in an animal's environment, indicating a sign of boredom. However, Mason (1991a) quickly refutes this assumption by presenting further investigations which demonstrate that enriching an animal's environment does not correspond to decreased frequency of stereotypical behavior. The review concludes that stereotypic behavior is similar to a scar; it can provide information about an animal's past condition, but it does not necessarily correspond to the current welfare or indicate suffering. Future research continues to be required for further understanding of the environmental, social, and biotic factors that allow for stereotypic development.

Contribution: I included this article because it provides an in-depth overview into the development of stereotypical behavior in many animal species. Additionally, the review provides insight into alternate explanations for the presence of stereotypical behavior, such as utilizing it as a coping mechanism, rather than simply as an indication of poor animal welfare. The information presented in the review expands the knowledge known about stereotypies and debunks the existing assumption that stereotypies are necessarily associated with animal suffering. This encourages further investigation into the field of animal behavior regarding stereotypic behavior within differing environments and promotes the development of mitigation strategies.

Christina Perez
Zoology 567

Mason, G. J. (1991b). Stereotypies: A critical review. *Animal Behaviour*, 41(6), 1015–1037.
[https://doi.org/10.1016/S0003-3472\(05\)80640-2](https://doi.org/10.1016/S0003-3472(05)80640-2)

Summary: This article reviews research conducted on stereotypic behavior of numerous animal species in order to understand the relationship between stereotypies and welfare as well as its reinforcement in improved conditions. Previous research has established stereotypies as “abnormal” behavior that is indicative of reduced animal welfare. As a result, many stereotypical behaviors exhibited by animals in captivity have been characterized as costly to the animal and are all treated for prevention. Mason (1991b) compiled research from 198 articles to demonstrate that all stereotypies are not the same and cannot be treated as such. Firstly, not all stereotypies are necessarily abnormal behavior. In fact, Mason (1991b) refutes that stereotypies resemble normal behavior in the respect that “normal” behavior can also be resistant to change, have no functionality and no longer rely on the original motivation to be performed. Additionally, developmental reasons for stereotypies are variable including, but not limited to, stress, frustration or lack of control. However, stereotypic behavior can continue regardless of environmental conditions and, therefore, is not an accurate indication of current suffering. Furthermore, stereotypic behavior is naturally reinforced by the animal themselves. As an animal performs a stereotypy, it becomes a persistent part of their behavioral repertoire, simply performing the behavior strengthens its occurrence by sensitizing the neuronal pathway for that behavior and acting as a reward within the brain. The review concludes by stating that stereotypic behavior is inherently heterogeneous in many aspects and although similarities may exist, stereotypies cannot be generally characterized. Each stereotypy is an individual case-by-case basis that must be assessed before applying general knowledge of the behavior to each treatment. Further research remains necessary to fully understand the stereotypic reinforcement pathway within the brain to deduce whether stereotypies can provide emotional or physiological benefit to the animal and refine current stereotypy assumptions.

Contribution: I included this article into my literature review as it addresses the topic of stereotypy performance becoming a rewarding behavior for the animal. This provides explanation to stereotypic continuation following the removal of the original motivation for behavior. Furthermore, the review article synthesizes information presented in several other articles chosen such as background regarding general causes for stereotypic development and stereotypic behavior consequences for animal physiology. The review expands upon the previous research conducted in the field and encourages further investigations into understanding the nature of stereotypic behavior in various species.

Christina Perez
Zoology 567

Cooper, J. J., & Mason, G. J. (1998). The identification of abnormal behaviour and behavioural problems in stabled horses and their relationship to horse welfare: A comparative review. *Equine Veterinary Journal*, 30(S27), 5–9.
<https://doi.org/10.1111/j.2042-3306.1998.tb05136.x>

Summary: This article reviews research conducted on the underlying motivation for horse abnormal behavior, with a particular focus on evaluating the costs and benefits of providing treatments. Previous investigations on stereotypic behavior have revealed that stereotypies are labeled as such due to inconvenience, misperception or economic reasons for the human observer, not necessarily due to the animal's welfare. As a result, many horses are subject to unnecessary treatment for behaviors that did not negatively impact their quality of life. Cooper and Mason (1998) aim to assess the causes of stereotypic behavior in horses in order to determine if treatment is necessary to address the problem. This was accomplished by summarizing evidence from 51 articles that address the stereotypic mistreatment in horses. For instance, some studies present evidence that stereotypies are mislabeled as abnormal behavior, given that the term "abnormal" has different definitions by field of study and is subjective to human perception. In fact, many studies indicate that human perceived "abnormal" behaviors are actually adaptive mechanisms to cope in captive environments. As a result, stereotypic behavior is not an accurate indicator of captive animal welfare and may not require treatment to prevent its occurrence. Cooper and Mason (1998) support previous research regarding the treatment of harmful behaviors but only to a given extent. The reasoning that all stereotypic behavior is indicative of low animal welfare is inaccurate and must be thoroughly investigated for harm before providing treatment. If prevention is necessary, Cooper and Mason (1998) recommend addressing the underlying motivation for behavior rather than the behavioral response as it may further frustrate the animal and redirect their behavior elsewhere. In terms of horse weaving, this could mean increasing foraging opportunities, social contact and exercise. Further research remains necessary to disprove the assumption that stereotypic behavior equates to low animal welfare.

Contribution: I included this article because it provides in-depth explanations regarding treatment costs and benefits to evaluate its necessity in individual cases. Furthermore, the article synthesizes previous knowledge about causes of stereotypic behavior, debunking many assumptions that stereotypies can be used to indicate animal welfare. Cooper and Mason (1998) contradict previous research to some extent by indicating that treatment is not necessarily the only route for stereotypic behavior, but rather the behavior can exist on its own as it is not harmful and is only displeasing according to human needs and perception; nonetheless further research is required to reinforce this viewpoint.