

## Annotated Bibliographies

### **Stress behaviour in horses focusing on behaviour induced by handling stress**

The first two annotated bibliographies introduce the reader to the coping mechanisms that horses may use to deal with handling stress, and the following three bibliographies explore the stress behaviours of horses when exposed to novelty during handling. The final five annotated bibliographies explore behaviour resulting from more specific handling stressors, such as familiar versus unfamiliar handlers, sex differences, and prior handling experience.

Budzynska, M. (2014). Stress reactivity and coping in horse adaptation to environment. *Journal of Equine Veterinary Science*, 34(8), 935-941. <https://doi.org/10.1016/j.jevs.2014.05.010>

**Summary:** This review assessed different stress management strategies in horses, and how their ability to tolerate intimidating situations depends on the techniques they use to deal with stress. It is known that a horse's physiology and behaviour will rapidly change to help it cope with perceived stressors. The behaviours that horses have been known to display during stress can endanger themselves and their handlers, such as sudden efforts to escape from the stressor. Therefore, the main objective of this review was to examine numerous physiological and behavioural responses that may occur because of a horse's stress management strategy. In terms of physiological responses towards stress, specific changes were found to occur based on the horse's stress management strategy. Horses with proactive strategies were found to have lower cortisol and increased sympathetic nervous system activity. In contrast, horses with reactive coping strategies were found to have increased cortisol and decreased sympathetic nervous system activity. The stress management strategy also impacted immune responses, as proactive horses harboured reduced immunity in response to environmental stressors. Regarding behaviour, proactive horses managed their stress by behaving more dangerously towards stressors. Conversely, horses with reactive coping strategies exhibited fewer dynamic behaviours, like freezing and unresponsiveness. Horses that were known to display oral stereotypies showed fewer active behaviours towards stressful stimuli. In contrast, horses that were not known to utilize oral stereotypies behaved more actively towards stress in their environment. These outcomes are important because they improve our understanding regarding the impact of a horse's coping strategy on their biological stress responses and behaviour. The results solidify the importance of monitoring multiple internal and external parameters of the horse when assessing stress levels. Future work may be conducted to apply this understanding of coping strategy towards selective breeding and the application of horses for specific jobs.

**Contribution:** This review article summarizes stress responses using physiological and behavioural parameters of the horse, to compare proactive and reactive coping strategies. This research advances knowledge by exploring how physiological and behavioural changes in a horse depend on its individual stress management strategy. Understanding coping mechanisms can provide horse handlers with insight into the manifestation of certain stress behaviours. Valuable information that supports previous research regarding coping strategy is provided, which can help improve safety during horse handling. This is relevant for emergency response situations, as horses with different coping strategies will elicit different types of behaviour towards stressful stimuli.

Squibb, K., Griffin, K., Favier, R., & Ijichi, C. (2018). Poker face: Discrepancies in behaviour and affective states in horses during stressful handling procedures. *Applied Animal Behaviour Science*, 202, 34-38. <https://doi.org/10.1016/j.applanim.2018.02.003>.

**Summary:** This article investigates the impact of stress management strategies on horses during novel situations. Humans often gauge a horse's ability to cope with stress by observing its behaviour. However, it is established that a horse's tactic for managing stress can result in visible behaviours that do not align with the intensity of its internal stress levels. It is known that proactive stress management strategies result in dynamic behaviours like fighting or fleeing, and reactive strategies result in less dynamic behaviours like becoming unreactive to the handler's commands. The researchers' main goal was to compare the connections between a horse's coping strategy, behaviour, and physiological changes that occur because of handling stress. The researchers tracked physiological stress levels in 46 horses during two handling situations. After being haltered and equipped with heart rate monitors, horses were prompted by their handlers to cross a tarp and walk underneath streamers. Physiological measurements were recorded for parameters such as heart rate and eye temperature. Horses were videotaped to record completion time and denial behaviours towards the handler's prompts. The results showed proactive and reactive horses had similar physiological stress levels and took similar amounts of time to complete the tests. This signifies that a horse's coping mechanism does not dictate its overall success when conducting stressful handling manoeuvres. While proactive horses showed more dangerous stress behaviours during handling, the intensity of their internal stress did not differ from reactive horses. This is significant because it exemplifies that proactive and reactive horses can handle tasks they find threatening, regardless of their coping mechanism. This also suggests handlers should be able to manipulate a horse and overcome its behaviour irrespective of coping strategy. The authors recommend future research that focuses on the impact of handler pressure on a horse's ability to deal with stress.

**Contribution:** This article reveals the impact of a horse's coping strategy on its physiological stress. The results advance knowledge by clarifying the relationship between a horse's coping strategy and ability to endure handling stress. This research supports previous findings that coping strategy can result in stress behaviours that do not coordinate with a horse's physiological stress levels. This is relevant for horse and handler safety during stressful situations, as horses exhibiting fewer stress behaviours may still be experiencing high levels of internal stress. The ability of horses to complete threatening tasks when prompted by their handlers is also relevant information.

Grandin, T. (1999). Safe handling of large animals. *Occupational Medicine*, 14(2), 195-212.

**Summary:** This review investigates large animal handling and the behaviours that large animals may direct towards environmental stressors. It is known that stress behaviours in prey animals, including horses, are primarily driven by fear. As a result, fear may compromise handler and animal safety during specific interactions. This review aimed to examine the common fear behaviours large animals display during handling, to help improve human and animal safety. The researcher focused on several physiological and behavioural aspects of large animals that impact their fear behaviours during handling. In terms of sensory perception, horses' eyesight grants them a vast field of vision with a rear blind spot. Their keen hearing ability is hyper-sensitive between 1000 and 16000 Hertz, so loud and high-pitched sounds are threatening. Therefore, the researcher postulates the importance of talking to horses in a calm talking voice when asserting one's presence, to avoid alarming the horse. As herd animals, horses may also become unnerved when isolated. This is significant because horses that have been separated from their conspecifics may attempt to return to their herd without human assistance once they have calmed down. In terms of physiology, horses with increased heart rates were more difficult to control. Escaped horses that were chased and yelled at displayed increased fear reactions, rendering them more difficult to calm down. This finding is significant because it suggests that a stressed horse should be left alone to restore a normal heart rate before being handled. Training horses with unfamiliar objects may help reduce stress behaviours in horses over time. However, trained horses have still been known to startle at new objects unexpectedly. Overall, these findings suggest that calm and steady handling during stressful situations can help reduce handling risks. Future work should be conducted to determine how to eliminate handling stressors further.

**Contribution:** This advances knowledge by outlining the behaviours of large animals in response to environmental stressors, and potential mitigation methods for the handler. The review also presents the notion that certain handling risks can never be fully eliminated. An insight that supports previous findings regarding the dangers of handling large animals is provided, indicating that calm handling around frightening stimuli is essential. This information can expand our understanding of stress behaviour in horses and prevent handling accidents. It is relevant for emergencies, where handlers need to determine the best ways to handle, capture, or calm stressed horses.

Christensen, J.W., Keeling, L.J., & Nielsen, B.L. (2005). Responses of horses to novel visual, olfactory and auditory stimuli. *Applied Animal Behaviour Science*, 93(1-2), 53-65.  
<https://doi.org/10.1016/j.applanim.2005.06.017>

**Summary:** This research explores the horse's physiological and behavioural stress response when exposed to different types of sensory stressors. It is known that bodily changes in response to stressful stimuli can prepare an animal to deal with danger. It is also known that horses have evolved attuned senses, allowing them to exhibit stress behaviours towards unfamiliarity and recognize threats in their environment. Therefore, the objective of this research was to study the connection between horses' physiological changes and behaviour during stressful situations involving their senses. Twenty-four two-year-old stallions were exposed to stressful stimuli located near their food for two minutes. Each of these stressors targeted a specific sense. Horses were first equipped with heart rate monitors before being exposed to visual stress in the form of an orange cone. They were subsequently exposed to a strange smell in the form of essential oil. Finally, horses listened to chaotic sounds in the form of white noise. The researchers recorded the horse's behaviour on a computer as they underwent testing. The results showed that all three of the different types of stressful stimuli induced a reduction in feeding behaviour. The visual and audio stressors resulted in similar physiological and behavioural profiles, including increased heart rate and alert behaviours. However, horses demonstrated more avoidance behaviours towards the audio stressor. In contrast, the essential oil stressor did not impact the horse's heart rate but instead resulted in increased attentiveness. This is significant because it demonstrates the connection between stress behaviours and physiological changes such as heart rate. It also shows how horses may exhibit a more robust stress response to stressors involving their eyes and ears compared to their sense of smell. Future work should be conducted to clarify the impact of different aromas on a horse's stress response.

**Contribution:** This article provides insight into the relationship between physiology and behaviour concerning exposure of horses to three different types of sensory stressors. The findings support previous research that has identified an association between increased heart rate and stress behaviours. The outcome of horses displaying more caution towards an unfamiliar smell while feeding aligns with previous research conducted on other large animals. These findings are helpful for individuals that may be handling horses, as it outlines their physiological and behavioural responses to several types of sensory stressors that may be encountered during a stressful situation.

Leiner, L., & Fendt, M. (2011). Behavioural fear and heart rate responses of horses after exposure to novel objects: Effects of habituation. *Applied Animal Behaviour Science*, 131(3), 104-109. <https://doi.org/10.1016/j.applanim.2011.02.004>

**Summary:** This article explores the biological and behavioural changes that occur in horses during situations involving strange objects. It is recognized that horses have developed the propensity to exhibit extreme caution towards stimuli they deem as intimidating or potentially dangerous. Therefore, horses may exhibit stress responses towards new objects in their environments, even if they are not a threat to their survival in a modern-day setting. The objective of this research was to use multiple parameters of the horse to evaluate their fright responses towards strange stimuli and determine the effect of repeated exposure. Throughout seven testing events, 18 two-and-a-half-year-old stallions were video-recorded, haltered, and equipped with heart rate monitors before being guided around unfamiliar objects. During four of the tests, horses were exposed to the same object twice to encourage habituation. Handlers escorted horses towards the strange objects until they appeared stressed or refused to continue, and the physiological and behavioural signs of stress were noted. Physiological responses included an elevated heart rate, which was found to increase when the horses were displaying stress behaviours. This is significant because it illustrates a correlation between physiological stress levels and the occurrence of certain stress behaviours. Significantly, the habituation training elicited fewer stress responses towards one of the objects, showing that repeated exposure can reduce stress around specific objects. Additionally, stress behaviours followed a particular order including facial gestures, vocalizations, and attempts to retreat or escape. This demonstrates that the manifestation of stress starts with minor indications before developing into dangerous flight behaviours. Overall, the findings signify that heart rate is an appropriate measure for gauging the intensity of fear that a horse is experiencing. Future work should be done to clarify the impact of previous training experience pertaining to specific objects on stress responses.

**Contribution:** This research enhances understanding regarding the connection between physiology and behaviour during novelty, and the impact of previous training experience on stress reactions. The results support prior research on horses that describes similar manifestations of stress during threatening situations. Results from the habituation test also support previous findings that habituation occurs on specific types of stressors instead of generally. This information is vital for individuals working with horses in stressful environments who need to be aware of the order in which stress behaviours may arise. Knowledge of the behavioural manifestations of stress can help keep horses and humans safe.

Ijichi, C., Griffin, K., Squibb, K., & Favier, R. (2018). Stranger danger? An investigation into the influence of human-horse bond on stress and behaviour. *Applied Animal Behaviour Science*, 206, 59-63. <https://doi.org/10.1016/j.applanim.2018.05.034>

**Summary:** This research explores the impact of a human handler on horse behaviour during stressful handling situations. It has previously been found that familiar handlers improve the behavioural outcomes of horses during handling, because horses can discern between strangers and their owners. It is also understood that some species of animals will experience decreased physiological and behavioural levels of stress during frightening situations when in proximity to their human masters. Therefore, the researcher's objective was to explore the extent to which the handler can influence a horse's physiology and behaviour during stressful handling situations. To assess the power of handler familiarity on stress responses, 46 horses were equipped with heart rate monitors while they completed handling tests with and without their owners. The sessions were video-recorded, so that finishing time and abidance behaviours could be tracked. Biological parameters relating to heart rate and eye temperature were monitored to determine the physiological impacts of handler familiarity on stress. The results demonstrated that horses did not display physiological or behavioural differences towards stressors when handled by strangers compared to their owners. This finding is significant because it insinuates that the handler's disposition is more important than familiarity. Therefore, strange humans who are confident and composed can handle a horse just as successfully as its owner, even when the owner is not present. Since horses did not display a significant difference in physiological or behavioural stress between the two handler types, familiarity does not critically influence stress during handling. Overall, these results suggest that the relationship between humans and horses does not impact their stress behaviour as significantly as other species. Future research should be conducted to discern other influences of humans on horse behaviour during handling and stressful situations.

**Contribution:** This research provides new insight into the link between a horse's handler and their stress responses from a physiological and behavioural perspective. The results support previous knowledge suggesting the connection between humans and horses is not the most critical factor for achieving abidance during handling. The outcome that horses can be handled just as effectively by strangers as their owners is valuable information, particularly for emergency handlers and veterinarians. This also provides potential for follow-up research regarding how specific components of the horse-handler relationship impact stressful handling situations.

Hartmann, E., Rehn, T., Christensen, J.W., Nielsen, P.P., & McGreevy, P. (2021). From the horse's perspective: Investigating attachment behaviour and the effect of training method on fear reactions and ease of handling- A pilot study. *Animals*, 11, 457. <https://doi.org/10.3390/ani11020457>

**Summary:** This article examined the relationship between horses and their handlers, and the impact a handler can have on horse obedience during stressful handling conditions. It is known that both owners and unfamiliar handlers can elicit similar behaviours from a horse during handling. Therefore, this research aimed to utilize several types of training methods on horses to examine their stress response and success during handling with different humans. Researchers fitted 12 horses with heart rate monitors and video-recorded them as they completed multiple rounds of handling tests. The first round of tests involved strange humans being present as horses were released to explore unfamiliar objects in a test arena. Subsequently, horses were halter led around the objects by a strange human. One of the unfamiliar handlers then assumed the role of a trainer and worked with half of the horses during ten training sessions. Training sessions involved utilizing three different types of negative reinforcement, two of which incorporated positive rewards in the form of food or physical touch. The horses that received training underwent a second round of handling tests involving both the known trainer and a strange human. The results revealed similar completion times among all horses, indicating that neither the type of handler nor training method influenced the horse's ability to complete the handling tests. Additionally, handler familiarity resulted in no significant difference regarding the manifestation of denial behaviours during handling. Overall, these results are significant because they demonstrate that training and the establishment of a personal relationship with a horse is not necessary for effective handling during stressful situations. Future studies should be conducted to further break down the key elements of the bond between horses and their handlers, to understand and dissect the impact on stress behaviour during handling.

**Contribution:** This article advances knowledge in the field by exploring the extent that a handler influences handling compliance during novelty and stressful situations. This research supports previous work, which found that both familiar and unfamiliar handlers could effectively lead horses. This work also supports previous findings in which horses did not respond differently towards handlers with which they had no previous relationship. The finding that horses had similar completion times with familiar and unfamiliar handlers provides relevant information for handlers who are dealing with unfamiliar horses from diverse training backgrounds, especially within novel situations.



Wulf, M., Aurich, J., May, A., & Aurich, C. (2013). Sex differences in the response of yearling horses to handling by unfamiliar humans. *Journal of Veterinary Behaviour*, 8(4), 238-244. <https://doi.org/10.1016/j.jveb.2012.09.002>

**Summary:** This article investigated the variations between male and female horse responses when exposed to handling stress. It is known that sex influences adult horses' behaviors, with some studies suggesting that male horses generally have more laid-back dispositions than females. Considering this knowledge, the researchers speculated that young male horses would exhibit less signs of stress during handling than their female counterparts. The objective of this research was to explore the impact of a young horse's sex on their behaviour during handling situations involving unfamiliar humans. The researchers subject 15 yearlings equipped with heart rate monitors to a variety of stressful handling activities over the course of five days. The tasks that the horses had to endure included exposure to strange humans, haltering, and manipulations of various regions of the body. During the second and fifth days of testing, handlers attempted to approach, halter, and manipulate the horses all in the same session. The results indicated that it initially took the handlers significantly more time to approach and halter male horses compared to females. The researchers also found that male horses were less interested in the handlers and displayed more disobedient and aversive behaviours when their bodies were manipulated. Heart rate in both sexes was elevated, but decreased throughout the duration of the study, suggesting that young horses can quickly adapt to stressors after repeated exposure. These findings are significant because they show that sex differences can impact a horse's behaviour during handling, with male horses exhibiting more suspicious and wary behaviours towards unfamiliar humans. Overall, these outcomes for the young horses contradict previous findings regarding sex differences in adult horses. Future studies should be conducted to clarify the role of sex hormones and age on horse behaviour during stressful handling procedures.

**Contribution:** This research article advances knowledge in the field, as it provides insight into the influence of age and hormones on behaviour of young horses during handling. Males exhibited more suspicious behaviour towards humans but were able to habituate quickly to handling stress. The increased heart rate towards handling and habituation to novel situations support previous research conducted in young horses. This research provides valuable information for handlers that may need to work with young and unfamiliar horses of different sexes. This knowledge applies to stressful situations, in which horses need to be approached, haltered, and manipulated by handlers.

Marsboll, A.F., & Christensen, J.W. (2015). Effects of handling on fear reactions in young Icelandic horses. *Equine Veterinary Journal*, 47, 615-619. <https://doi.org/10.1111/evj.12338>

**Summary:** This article examined the influence of fear and training on the horse's stress response during various handling situations. In particular, the researchers were interested in clarifying the impact of a horse's previous training and manipulation experience on their outcomes during handling. It is already known that new experiences in a horse's environment may trigger various fright behaviours, which can be shaped by their previous life experiences. Therefore, the main goal of this research was to illustrate the influence of past training experience on a horse's stress response towards handling related stressors. The researchers' video-recorded and rigged 24 horses with heart rate monitors while they completed various types of handling tests with familiar and unfamiliar humans. Half of the horses were designated to receive eight sessions of training, where they practiced skills relevant to handling situations such as haltering and responding to prompts by the handler. The remaining horses did not receive any training prior to the tests. Testing involved handlers prompting horses to walk around and underneath strange objects. Important results included both training groups exhibiting similar physiological and behavioural responses during the handling tests. This is significant because it demonstrates that handler familiarity is not essential for reducing stress responses and increasing success during handling. Interestingly, the researchers found that horses presented fewer aversive behaviours with increased physiological stress levels during the handling test with the familiar handler. This is important because it implies that physiological measures such as heart rate may be more trustworthy indicators of stress than visible behaviours. The researchers recommend that future work be conducted to replicate this experiment using more horses and types of handlers.

**Contribution:** This research advances knowledge in the field by assessing the importance of previous training on stress behaviours in horses. The finding that physiological responses did not differ between the trained and untrained horses during handling is relevant for humans working with horses from unknown backgrounds. The results also support previous studies that found a horse's heart rate to be a more accurate representation of stress than their outward behaviour. The findings that familiar handlers can cause horses to hide stress behaviours are also pertinent to horse owners who use visible behaviour to gauge a horse's anxiety levels.

Jeziński, T., Jaworski, Z., & Gorecka, A. (1999). Effects of handling on behaviour and heart rate in Konik horses: Comparison of stable and forest reared youngstock. *Applied Animal Behaviour Science*, 62(1), 1-11. [https://doi.org/10.1016/S0168-1591\(98\)00209-3](https://doi.org/10.1016/S0168-1591(98)00209-3)

**Summary:** This article investigated the impact of handler type and prior handling experience on a horse's physiological and behavioural response to stress. It is known that animals who have experienced positive interactions with humans will display calmer temperaments and less anxiety in new situations. It has also been shown that horses who have received more practice with training will perform and learn better during handling situations. Therefore, this research aimed to study the differences in physiological and behavioural responses of horses that had received various amounts of handling. To do this, the researchers focused on Konik horses that had not experienced extensive selective breeding for specific traits. Thirty horses were selected from stables and a wilderness area, and equipped with heart rate monitors before being subject to four handling tests involving various manipulations. The horses' behaviours during handling were quantified on a scale from very obedient to dangerous. Some of the horses experienced handling training prior to testing, where they could practice being haltered and manipulated by a handler. The rest of the horses received no handling training prior to testing. The results from the handling tests demonstrated that the horses that had received handling prior to testing displayed lower physiological indications of stress, and more manageable behaviour. This is significant because it presents the potential positive impacts that training can have on a horse's stress response during handling. The results also showed a correlation between physiological stress levels such as heart rate and more dangerous stress behaviours. This is significant because it implies that temperamental horses achieve worse outcomes when coping with handling stress. The researchers suggest future research be conducted with more horses to determine any genetic influences on behaviour during handling.

**Contribution:** This article advances knowledge in the field by exploring how experience with handling can impact horse behaviour and stress during handling manipulations. The researchers filled a gap in the literature by studying a breed of horse without extensive artificial selection for certain behaviours. The findings that prior handling experience positively affects behaviour during handling tests contradict previous research on different breeds of horses, which found training to have no impact on manageability. The results of this study provide insight into how contact with humans may impact the physiological and behavioural reactions of handled and unhandled horses.