—Review Article—

How to minimise the incidence of transport-related problem behaviours in horses: a review

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This review aims to provide practical outcomes on how to minimise the incidence of transport-related problem behaviours (TRPBs) in horses. TRPBs are unwanted behaviours occurring during different phases of transport, most commonly, a reluctance to load and scrambling during travelling. TRPBs can result in injuries to horses and horse handlers, horse trailer accidents, disruption of time schedules, inability to attend competitions, and poor performance following travel. Therefore, TRPBs are recognised as both a horse-related risk to humans and a human-related risk to horses. From the literature, it is apparent that TRPBs are common throughout the entire equine industry, and a YouTube keyword search of 'horse trailer loading' produced over 67,000 results, demonstrating considerable interest in this topic and the variety of solutions suggested. Drawing upon articles published over the last 35 years, this review summarises current knowledge on TRPBs and provides recommendations on their identification, management, and prevention. It appears that a positive human-horse relationship, in-hand pre-training, systematic training for loading and travelling, appropriate horse handling, and the vehicle driving skills of the transporters are crucial to minimise the incidence of TRPBs. In-hand pre-training based on correct application of the principles of learning for horses and horse handlers, habituation to loading and travelling, and self-loading appear to minimise the risk of TRPBs and are therefore strongly recommended to safeguard horse and horse-handler health and welfare. This review indicates that further research and education with respect to transport management are essential to substantially decrease the incidence of TRPBs in horses.

Key words: *horse, injury, problem behaviour, training, transportation*

J. Equine Sci.
Vol. 28, No. 3
pp. 67–75, 2017

Transporting domestic horses for recreational, sporting, breeding, and agricultural purposes is common; however, the training and management of horses for transportation presents several challenges and can result in the manifestation of what is referred to as transport-related problem behaviours (TRPBs) [41, 72]. To demonstrate the extent of this issue, a YouTube keyword search of 'horse trailer loading' produced over 67,000 results in September 2016. Subsequent review of the results revealed a diverse collection of videos uploaded by professionals and non-professionals, all of them offering solutions to TRPBs and demonstrating examples of trailer loading techniques. The recent production of a satirical trailer loading demonstration performed life by Tristan Tucker, which has received more than 70,000 views on YouTube, is a further indication of the prevalence of TRPBs during trailer loading [65]. This promotion of TRPBs as entertainment highlights the familiarity of TRPBs in horse handlers and trainers. Despite the evidence for the prevalence of TRPBs, until recently there has been scant empirical evidence to quantify the extent of the issue. Current research has investigated the prevalence of TRPBs, the identification of transport-related activities that are increased risk factors for injury, and the association between training methods employed to manage TRPBs. Their findings suggest that the implementation of appropriate training and management techniques could contribute to a reduction in the risk of injury and stress and

Received: May 8, 2017
Accepted: June 14, 2017
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contribute to improved welfare and safety of both horses and humans [41, 52, 72]. The aim of this review was to synthesise current understanding of TRPB through a critical evaluation of studies undertaken over the past four decades and to investigate the contribution of training and management strategies to the reduction of the risk of TRPBs and improved welfare for horses, horse handlers, trainers, and transport providers.

Trpbs: Current Knowledge, Definitions, Causes, and Consequences

'Behaviour' has been defined as what living animals do and their physical actions and the consequences of those actions [34]. Behaviour exhibited during each phase of the transportation process offers examples of when otherwise normal physical actions of a horse become problem behaviour that has the capacity to result in injury or fatality with respect to itself or human handlers [53, 72]. TRPB can be defined as any transport-related behaviour that impedes welfare or safety of the horse or handler during the transportation process [17].

Over the past 35 years, there has been an increasing amount of literature relating to TRPBs. In 1982, Houpt [17] described problem behaviours, including refusal to load, expressions of fear-based behaviour during travel, and an inability to stand quietly in a stationary trailer. Later, the same author differentiated between loading- or travelling-related problem behaviors [18]. In 2001, Lee and Houpt surveyed owners of 103 horses with a history of TRPBs and found that 53.4% of these horses had problems with loading and that 51.5% of the horses had problems during travel [25]. Recently, a cross-sectional on-line survey on transport issues conducted in Australia elicited a large sample size of 797 respondents across a wide demographic of participants from the racing, equestrian, and recreational equine industry sectors [43]. In this survey, TRPBs were categorised according to the four typical phases of transport: pre-loading, loading, travelling, and unloading. Almost 39% of respondents reported having one or more horses exhibiting TRBPs, with 27.8, 50.8, 42.4 and 15.5% reporting them during pre-loading, loading, travelling and unloading, respectively [41]. Despite TRBPs having been studied for over 35 years, the incidence has not decreased. This might be related to horse handlers lacking a perception/understanding/appreciation of the importance of training horses for travel (almost half of the survey respondents reported that they did not train their horses for travelling [41, 43]) or to the use of inappropriate training methods [1, 41]. Insufficient knowledge of how to manage horse-related situations has been associated with elevated risk of horse-related accidents [8].

Pre-loading problem behaviours (PPBs)

Pre-loading preparation typically involves enforced separation from familiar physical and social environments, which may induce behavioural manifestations of anxiety [39]. Further, through associative learning, horses may recognize features of the pre-loading routine (e.g. handling, grooming, fitting of protective equipment, and transport vehicle presence) and associate them with past travel experiences [70]. Consequently, animals who have previously experienced problematic travel, such as falls during transport, tend to exhibit increased problem behaviours during pre-loading [24]. PPBs frequently include signs of anxiety, such as vocalisation, pawing, heightened locomotion, and shaking [39, 67]. Unsurprisingly, as pre-loading handling is typically the moment when horses start to interact with people, the type of relationship between the horse and horse handler has been identified as a risk factor for PPBs [3]. In livestock, it has been proved that cattle previously afforded positive and humane human-animal relationships presented lower amount of shrink due to transport [56]. In order to minimise the incidence of PPBs, it is therefore important to apply an effective and humane handling routine underpinned by knowledge that both recognises and mitigates stress.

Loading problem behaviours (LPBs)

The loading phase has been consistently identified as the most stressful aspect of transportation for horses [42, 58] and also the activity most likely to involve TRPBs and injury [41, 72]. The loading process involves leading the horse into a trailer, which is inherently aversive for the majority of horses [19]. Horses may display signs of anxiety when approaching the vehicle or stepping onto the ramp, regardless of the level of experience [58]. Tateo *et al.* [63] reported an elevated packed cell volume (PCV) value, increased heart rate, and increased respiratory rate immediately after loading and demonstrated that irrespective of the distance travelled, loading was consistently stressful. The stress experienced by horses during loading has been attributed to innate characteristics of the horse, including neophobia and a natural aversion to confined spaces [9, 66]. Houpt [18] also considered the properties of the trailer to be a significant contributory factor to LPBs, suggesting that the dark interior, the hollow sound of the ramp, and the instability of both ramp and vehicle were likely to be fear-invoking stimuli for the neophobic horse. Murphy and Hennessy [35] investigated two different trailer systems, one with a spring-loaded ramp and the other having a door that swung sideways. The former required the horses to walk up the ramp and into the trailer, whilst the latter required the horses to step up from the ground into the trailer. Horses demonstrated less aversive behaviour when stepping directly into the trailer compared with walking up a

ramp [35]. Although, a limitation of this study was its small sample size (n=4), the findings appeared to support Houpt's theory of aversion to traversing a ramp [18].

LPBs frequently present as avoidance strategies such as rearing, pulling away sideways or backwards, or stress-related behaviours, including pawing, kicking out, bolting, or head-shaking [11, 25, 57, 69]. Unpredictable or elevated avoidance behaviour combined with the horse's size and proximity to humans may lead to LPBs presenting a significant risk of injury to the horses and handlers involved [27, 72]. Typically, injuries to handlers include rope burns, lacerations, lost fingers, broken bones, bruising, or bleeding; whereas, injuries to horses involve lacerations, fractures to the limbs, head, or spine, which can result in euthanasia [11, 27, 39]. In a survey conducted by Yngversson's survey, 12% of respondents reported that they (i.e., as handlers) had been injured during loading, 12% reported that horses had been injured during loading, and 5% reported that both they and the horses had been injured simultaneously [72]. In addition to the risk of injury, LPBs can result in the unintentional reinforcement of undesirable behaviour and rapidly lead to negative associations between the horse and handler [11, 57]. Common reasons for horse-related injuries have been identified including in inadequate horse training and miscommunication, often due to insufficient knowledge of horse behaviour [61].

Additionally, LPBs can cause time disruptions and frustration. In the survey conducted by Yngvesson *et al.* [72], 6% of respondents reported having had to cancel a competition due to the inability to load their horses. Another recent survey, focused specifically on LPBs, showed that of 385 appointments at an equine referral hospital in Scotland, 8.8% of horse-loading events upon discharge were associated with LPBs. Although not a large percentage in itself, 76% of these events required staff assistance, and 26% of these events caused time delays of over 30 min. These results are significant in a busy equine hospital practice, and the findings have been applied to encourage owners to address LPBs in preparation for emergency transport for veterinary treatment [73]. Collectively, research findings indicate that appropriate education with respect to horse behaviour, handling, and training can play a crucial role in efforts to minimise the incidence and consequences of LPBs.

Travelling problem behaviours (TPBs)

Although incidences of problem behaviours during transit were found to be less frequent than during loading [41], behaviours such as vocalising, head tossing, pawing, scrambling, head turning, kicking out at the vehicle, biting and kicking directed at travelling companions, and reduced feeding/drinking during transit are commonly reported [18, 22, 25, 42, 52, 68]. Such behaviours are indicative of physiological and physical stress, which may be attributed to a number of conditions experienced during transit [39].

The stress experienced by horses during loading, which has been attributed to characteristics related to the ethology of the domestic horse, including innate neophobia and natural aversion to confined spaces [9, 67], is likely to be confounded during prolonged confinement during travel. Yngvesson *et al.* [72] found that the heart rates of novice horses were consistently higher when inside a trailer compared with when outside the trailer. Though, interestingly, Stewart *et al.* [62] reported the opposite in horses transported by air, which suggested that confinement during air travel was less stressful than confinement in a trailer, supporting the hypothesis that other factors contribute to transport-related stress. Environmental conditions during transit, including fluctuations in temperature, humidity, light, and natural and chemical contaminants have been identified as additional challenges [20, 38, 50, 64]. Furthermore, horses are exposed to the following stressors during transit: unfamiliar factors such as traveling companions, movement beneath their feet, acceleration and deceleration, upward and downwards slopes, breaking, noise and vibrations, and disruptions to feeding and drinking routines [22, 26, 51]. TPBs therefore seem to be a manifestation of a very high level of stress generated by a multitude of stressors with which horses attempt to cope in transit.

Many studies relating to potential contributors to TRPBs have been conducted and have included investigations on the impacts of vehicle design, lighting, orientation, distance, isolation, driving skills, and road quality [7, 12, 13, 17, 22, 38, 41, 42, 51]. However, results are often conflicting, and more evidence-based studies are needed to understand how to minimise stress during transit and accordingly the incidence and consequences of TPBs. TPBs can lead to injuries from contact with vehicle components, such as kicking the vehicle walls or dividers, or due to loss of balance, which may result in a fall [27, 40, 54]. Recently, it has been demonstrated that more highly stressed horses tended to spend the greatest part of their journeys with the heads held in an elevated position, showing increased inflammation of the respiratory tract after transport [44]. Since the inability to cope with transport stress has been proposed as a risk factor for transport-related diseases (i.e., shipping fever, colic, heat stroke) [4, 23], it would not be unexpected to find a positive association between TPBs and the development of transport-related diseases. While an association between TPBs and transport-related injuries has already been established [41], further studies are required to ascertain the association between TPBs and the other transport-related diseases.

Unloading problem behaviours (UPB)

Unloading problem behaviours include a reluctance to exit the vehicle that manifests after prolonged immobility inside the vehicle and disembarking the vehicle at excessive speed, which has also been defined as 'running off' caused by a flight response [58]. UPBs may be exacerbated if the ramp is excessively steep or slippery, if the horse is lame or anxious about the environment into which it is being unloaded, or in vehicles which require horses to be unloaded backwards, preventing them from seeing what is behind them [6, 39]. Similar to other TRPBs, UPBs can result in negative consequences [33]. For example, Messori *et al.* [33] found that horses presented for slaughter that exhibited UPBs were subjected to positive punishment by handlers, which resulted in injuries and poor horse welfare outcomes.

Overall, TRPBs present serious risks, including the risk of physical injuries and even fatalities in horses and humans, damage to property and vehicles, negative human-horse relationships, psychological damage to humans, and the wastage of horses with unresolved problems. TRPBs also presents significant concerns for horse and human health and welfare. In a 2016 survey investigating current welfare problems facing horses in Great Britain, the results of in-depth interviews with a cross-section of 31 equine stakeholders regarding welfare problems relating to horse health, management, riding, and training were analysed. In addition to concerns related to long distance transportation of horses, approximately 33% of participants identified problems with loading practices that involve training methods or handling procedures that involve the application of physical force as being a significant welfare issue [15]. The attitude and competence of humans is of key importance in minimising the incidence of TRPBs. All handlers should be familiar with horse behaviour and be trained in effective and humane handling; they should also have the knowledge to recognise and mitigate stress in transit [70]. Horses showing TRPBs should not be forced to load or travel and should be re-trained using equine learning theory principles, restarting from in-hand control prior to introducing the transport vehicle.

Transport-related Training for Reducing the Incidence of Trpbs

Equine learning has been defined as the change in behaviour due to experience [34]. The two major categories of learning are associative and non-associative; habituation (H) and sensitisation (S) are two types of non-associative learning, while operant conditioning (OC)- incorporating positive and negative reinforcement (PR, NR) and positive and negative punishment (PP, NP)- and classical conditioning (CC) are two types of associative learning [48, 59]. The correct use of learning theory, based on an understanding of equine ethology, is essential in all horse-related activities, including transport, to reduce the incidence of unwanted behaviour and horse-related injuries [1, 30].

Operant conditioning

OC is a type of associative learning in which a voluntary behaviour is modified by its antecedent and consequence [59]. It works by giving or taking away a reward or discomfort when the horse performs a wanted/unwanted behaviour through the following chain: stimulus-behaviour-reinforcement/punishment. A reinforcer is an event that increases the likelihood that the wanted behaviour happens in the future; a punishment is the event that decreases the likelihood that the unwanted behaviour happens in the future [1].

Negative reinforcement (NR) and positive punishment (PP): NR is the removal of an aversive stimulus (e.g., pressure) as soon as the wanted behaviour is offered. In contrast, PP is the addition of an aversive stimulus (e.g., whipping) when an unwanted behaviour is offered [1]. Traditionally, NR is widely employed in horse training [29]. NR involves the removal of an aversive stimulus, typically the application of physical pressure, a visible aversive stimulus such as waving a whip, or an audible aversive stimulus such as clapping/shouting, when the horse shows the requested behaviour [29]. The use of NR is commonly advocated in relation to training horses to load and retraining horses with loading problems [19]. There are many horse training books, social media articles, blogs, and video footage providing advice on overcoming a horse's refusal to load onto a trailer. In these media, NR is the most-used strategy applied, even though their proponents do not explain their methods in accepted learning theory terminology [36, 37, 46, 47, 55]. Exceptions to this are McLean and McLean [32], who explain-with photographs- the application of learning theory principles to address reluctance to load using NR. However, effective application of NR relies on the immediate and consistent removal of the aversive stimulus, which can be difficult to apply accurately, and the boundary between NR and PP is still not well defined [1]. NR improperly applied can lead to unintended and often dangerous behaviour in horses [29]. In particular during loading, resistance behaviours, such as rearing, pulling back, or defensive behaviours such as striking or lunging forward toward the handler, can cause pressure to be removed unintentionally; thus NR occurs inaccurately, leading to reinforcement of undesired behaviour [29, 41, 60]. The implication for welfare is that in order for learning to occur, the aversive stimulus must elicit sufficient discomfort to motivate an avoidance response [2, 21]. Incorrect use of aversive pressure, including an absence of the release of pressure, release of pressure at the wrong time, opposing pressures applied simultaneously, and the

absence of shaping can result in chronic stress [31]. Additionally, continued application of the aversive stimulus may prompt insensitivity requiring stronger and more frequent stimuli to achieve the same effect, which can exacerbate any stress response and further compromise the welfare of the horse [28]. In addition to the potential welfare implications, stress reduces cognitive function and impedes learning [16, 34], which is likely to reduce efforts to rectify TRPBs. It is not surprising therefore that training based on NR and PP using whips and ropes around the back legs was positively associated with TRPBs and subsequently transport-related injuries [41]. In light of the reported welfare and safety implications, it may be suggested that alternatives to NR ought to be considered in efforts to minimise TRPBs.

Positive reinforcement (PR) and negative punishment (NP): PR is the addition of an appetitive stimulus (e.g., food) in response to the occurrence of a desired behaviour, whereas negative punishment is the removal of an appetitive stimulus (e.g., food) in response to the occurrence of an unwanted behaviour [1]. PR is recommended as an optimal training method due to its potential to enhance welfare by increasing the animal's control over its environment through choice whilst simultaneously reducing fearfulness by desensitising and counter-conditioning the animal to stressful stimuli [2, 5]. Innes and McBride [21] evaluated training strategies for rehabilitating horses through a comparison of NR and PR techniques employed on 16 rescued ponies suffering chronic stress arising from long-term neglect and/or cruelty. Two groups of eight ponies were trained to perform a range of challenges including trailer loading, with one group trained by NR and the other trained by PR. The ponies trained by PR were more motivated to participate in the training sessions and exhibited more trial and error-type behaviour than the NR group, which indicated that PR training may be of benefit to such animals from a welfare perspective. Although further empirical studies confirming its effectiveness are required, PR has been recommended as a training method during transport [39].

Classical conditioning

Classical conditioning is the process whereby an unconditioned or conditioned response becomes elicited by a conditioned stimulus [48]. Through classical conditioning, a stimulus that originally has no meaning for the animal is associated with an unconditioned stimulus that has a clear meaning for the animal (e.g., food, pressure) [1, 29].

Clicker training, target training, and self-loading: Clicker training (CT) involves both classical and operant conditioning principles [10]. Initially, classical conditioning principles are used to establish a conditioned reinforcer as an event marker; typically a handheld clicker device or alternative audible, visual, or tactile event marker is used [10]. Following the establishment of a conditioned reinforcer, principles of operant conditioning are employed to shape behaviour by marking the precise moment that a desired behaviour occurs and presenting PR as soon as practicably possible afterwards [49]. Effectively, the conditioned reinforcer facilitates accurate communication to the horse of the desired operant response [21]. Markers predicting appetitive events are believed to increase arousal and activity due to the activation of dopaminergic neurons within the seeking system, which motivates the horse to trial behaviour to gain PR [10, 45].

The principles of CT were originally employed to facilitate the training and management of marine mammals and were subsequently extended into additional contexts including laboratory animals and captive species, which required animals to be trained or managed without physical contact or close proximity [2, 49, 71]. The clicker is purported to facilitate learning, and it might be a valuable tool for transport-related training, but scientific evidence to support this claim is limited [10]. It is also important to note that although correct application of PR may result in a positive learning experience for the horse, as is consistent with inaccurate application of NR and habituation training methods, incorrect CT technique, including low predictability of PR, has been found to increase frustration [45] and can ultimately be equally aversive as NR or PP [14].

The target training method/technique was developed by Keller and Marion Breland for training chickens in the 1940s; more recently, it has become popularised through well-documented trainers such as Shawna Karrasch [49]. Target training employs concepts of both PR and CT to teach an animal to touch a target with a part of its body. The target is then used to prompt desired behaviour scheduled for reinforcement or to reduce undesirable behaviour by differential reinforcement of alternative, incompatible behaviour. Target training is differentiated from PR or clicker training by the introduction of a target that facilitates the shaping of behaviour more efficiently than waiting for behaviour to occur before positively reinforcing it. The method reduces instances of error and facilitates the placement of behaviour on cue more quickly [49].

Although research investigating target training is limited, Slater and Dymond [60] trained four horses with existing TRPBs using clicker and target training. The horses were first trained to associate a click with a food reward and then were trained to touch a target. The target was presented for a gradually shortened time and at a progressively greater distance. The horses were then trained to enter a trailer progressively with reinforcement for the desired behaviour at each stage. All four horses were successfully loaded and continued to load in the presence of a novel trailer and a novel trainer. The authors proposed these types of training

to counter TRPBs [60].

Similarities exist between the findings of Slater and Dymond's findings [60] and the investigation of Hendriksen *et al*.'s [14] of 12 horses with a history of severe trailer loading problems that were trained using either NR or PR. The NR group was trained using pressure applied in the form of a head collar with attached lead rope and a whip. The horses in the PR group were exposed to clicker training and taught to follow a target into the trailer. Heart rate was recorded at 5 sec intervals, and discomfort behaviour was observed using one-zero sampling at 10 sec intervals. Horses trained with NR displayed significantly more discomfort behaviour than horses trained with PR, even though there was no difference in mean HR between the two methods. The PR group exhibited significantly less avoidance and discomfort behaviour, including tail swishing and facial expressions indicative of stress. On average, the PR group took less time to reach the training goal of full loading. However, the authors pointed out that PR was only effective if a reinforcer deemed appetitive by the horse was offered. The unsuccessful training of one horse was attributed to a lack of interest in the food offered, which indicates that the methodology was somewhat problematic, as lack of interest in a previously appetitive reinforcer is usually considered to be a sign of conflict stress, though this was not reported in the study. Despite this, the study concluded that PR was, in general, a less stressful and more efficient transport training method. While the studies reviewed appear to support PR (applied alone or in association with target and clicker training) as being possibly the optimal horse transport training method, interestingly a survey by Padalino *et al.* [41] found that only 2% of almost 800 respondents reported using PR for transport loading training in Australia.

Self-loading occurs when a trainer is able to walk a horse to a trailer, throw the lead rope over the horse's neck or back, give a cue, and have the horse walk onto the trailer and stand still while the trailer door is secured [11]. Self-loading relies on a combination of operant conditioning and classical conditioning. At the beginning, the horse is trained using target training or PR training, and then the horse learns to load on a verbal, visual, or other classical conditioned cue on its own [41]. This method has been found to significantly reduce PPBs, to reduce LPBs when compared with training based on NR and PP [41], and perhaps unsurprisingly, this method is also featured as the ironic conclusion of the YouTube video by Tucker [65].

Habituation

Habituation training is a training program which should be completed prior to any requirement of transportation [19]. Forty years ago, Houpt [17] suggested that the best solution to loading and other trailer-related problems was prevention and advocated for the introduction of trailer loading to foals who would follow behind their mothers into the trailer. Repeated exposure as a foal was believed to make loading behaviour become as normal as walking into a stall [17]. Although circumstances might not allow for habituation of a foal to loading by following its mother, the habituation to loading and travelling prior to transportation process remains viable for yearlings or adult horses [19]. First, before exposure to the transport vehicle, pre-training of all maneuvers that will be required whilst loading (i.e., leading, backing up, side pass, and tie up) should be taught until the horse has a satisfactory understanding of what is being asked. Through this, the loading process is broken down into components for the horse to easily learn and adapt to prior to loading. Second, a series of simulations of loading, staying inside the vehicle, and unloading should be undertaken. Finally, the horse should be exposed to short journeys [19]. Horses that are habituated to new environments and objects from a young age may act in a calmer manner to new stimuli [72]. For horses showing TRPBs, Houpt and Wickens suggested first to desensitise them to the trailer by positioning a trailer in the paddock and feeding them in it; pre-training should then be applied, and ultimately, the horses should be exposed to transport phase simulations [19].

Habituation training was found to be associated with the lowest incidence of all TRBPs (pre-loading, loading, travelling, and unloading) and related injuries, and thus it has been recommended to safeguard horse welfare [41]. This view is shared by Yngvesson *et al.* [72], whose work with habituating Icelandic horses before travel showed that the time taken to load decreased significantly with the number of times attempted, when this type of prior training was performed. Even if habituation was proposed more than 35 years ago, it was only applied by one out of five of the respondents in Australia [41]. Based on the evidence of its effectiveness in the prevention of TRPBs and related injuries [41, 72], habituation is strongly recommended and may be widely applied in the future.

While there was no significant difference between self-loading and habituation in terms of the odds of pre-loading and loading problem behaviors [41], it is important to note that self-loading is underpinned by both OC and H. The key distinction is that the horses are permitted sufficient time for familiarization before transportation, thereby allowing them to gain confidence that their trailer loading and transportation experiences will not adversely challenge their ethology. It therefore seems that the time spent to habituate the horses to loading and travelling or to train them to self-load will be repaid by a lower incidence of TRPBs and their consequences.

Conclusions

Overall, TRPBs remain a problem affecting the equine industry worldwide, causing health and welfare issues in both horses and horse handlers. TRPBs present both a horse-related risk to humans and also a human-related risk to horses; however, it is difficult to quantify the real impact of TRPBs because data on their incidence are limited and collected primarily through surveys, which as data collection instruments introduce limitations of self-selection and self-reporting bias. Moreover, the financial implications of TRPBs are currently under-represented in the literature; thus, more extensive sound research data are needed. A longitudinal study recording the incidence of TRBPs associated with multidimensional concepts including road accidents, damage to vehicles, the economical values of injuries to horses and horse handlers, and financial and welfare implications of the wastage of horses due to TRBPs is warranted.

It is evident from the literature that a positive horse-human relationship, habituation training, and horse-handler education with respect to horse handling, training, and driving are vital to minimise the incidence and consequences of TRBPs. However, the main conclusion is that there is an apparent lack of peer-reviewed literature focused on methods to develop the expertise of horse handlers with respect to loading horses, driving horse transport vehicles, and managing transportation. In light of this, there would be considerable merit in undertaking a well-designed industry-wide survey of horse handlers for the purpose of obtaining measurable baseline information from which transport-related horse handling skills founded on accepted principles of learning theory could be taught, applied, and evaluated.

Acknowledgments

The authors would like to thank Dr. Hayley Randle for for suggesting stylistic improvements to the text.

References

1. Baragli, P., Padalino, B., and Telatin, A. 2015. The role of associative and non-associative learning in the training of horses and implications for the welfare (a review). *Ann. Ist. Super. Sanita* **51**: 40–51. [Medline]
2. Bassett, L., and Buchanan-Smith, H.M. 2007. Effects of predictability on the welfare of captive animals. *Appl. Anim. Behav. Sci.* **102**: 223–245. [CrossRef]
3. Casamassima, D., Palazzo, M., Presutti, T., and Cinone, M. 2008. Effects of two tame systems on physiological parameters of Arab horses subjected to load in the trailer. *Ippologia* **19**: 13–19.
4. Christley, R.M., Hodgson, D.R., Rose, R.J., Hodgson, J.L., Wood, J.L.N., and Reid, S.W.J. 2001. Coughing in thoroughbred racehorses: risk factors and tracheal endoscopic and cytological findings. *Vet. Rec.* **148**: 99–104. [Medline] [CrossRef]
5. Coleman, K., Pranger, L., Maier, A., Lambeth, S.P., Perlman, J.E., Thiele, E., and Schapiro, S.J. 2008. Training rhesus macaques for venipuncture using positive reinforcement techniques: a comparison with chimpanzees. *J. Am. Assoc. Lab. Anim. Sci.* **47**: 37–41. [Medline]
6. Cregier, S.E., and Gimenez, R. 2015. Non-commercial Horse Transport: New Standard for Trailer in Canada. Cregier S, Montague.
7. Cross, N., van Doorn, F., Versnel, C., Cawdell-Smith, J., and Phillips, C. 2008. Effects of lighting conditions on the welfare of horses being loaded for transportation. *J. Vet. Behav.* **3**: 20–24. [CrossRef]
8. DeAraugo, J., McLaren, S., McManus, P., and McGreevy, P.D. 2016. Improving the Understanding of Psychological Factors Contributing to Horse-Related Accident and Injury: Context, Loss of Focus, Cognitive Errors and Rigidity. *Animals (Basel)* **6**: 12–22. [Medline] [CrossRef]
9. Fazio, E., and Ferlazzo, A. 2003. Evaluation of stress during transport. *Vet. Res. Commun.* **27**:(Suppl 1): 519–524. [Medline] [CrossRef]
10. Feng, L.C., Howell, T.J., and Bennett, P.C. 2016. How clicker training works: Comparing Reinforcing, Marking, and Bridging Hypotheses. *Appl. Anim. Behav. Sci.* **181**: 34–40. [CrossRef]
11. Ferguson, D.L., and Rosales-Ruiz, J. 2001. Loading the problem loader: the effects of target training and shaping on trailer-loading behavior of horses. *J. Appl. Behav. Anal.* **34**: 409–423. [Medline] [CrossRef]
12. Gibbs, A., and Friend, T. 1999. Horse preference for orientation during transport and the effect of orientation on balancing ability. *Appl. Anim. Behav. Sci.* **63**: 1–9. [CrossRef]
13. Giovagnoli, G., Trabalza Marinucci, M., Bolla, A., and Borghese, A. 2002. Transport stress in horses: An electromyographic study on balance preservation. *Livest. Prod. Sci.* **73**: 247–254. [CrossRef]
14. Hendriksen, P., Elmgreen, K., and Ladewig, J. 2011. Trailer-loading of horses: Is there a difference between positive and negative reinforcement concerning effectiveness and stress-related signs? *J. Vet. Behav.* **6**: 261–266. [CrossRef]
15. Horseman, S.V., Buller, H., Mullan, S., and Whay, H.R. 2016. Current Welfare Problems Facing Horses in Great Britain as Identified by Equine Stakeholders. *PLOS ONE* **11**: e0160269. [Medline] [CrossRef]
16. Hothersall, B., and Casey, R. 2012. Undesired behaviour in horses: A review of their development, prevention, management and association with welfare. *Equine Vet. Educ.* **24**: 479–485. [CrossRef]
17. Houpt, K. 1982. Misbehavior of horses: Trailer problems.

Equine Pract. **4**: 12–16.
18. Houpt, K.A. 1986. Stable vices and trailer problems. *Vet. Clin. North Am. Equine Pract.* **2**: 623–633. [Medline]
19. Houpt, K.A., and Wickens, C.L. 2014. Handling and transport of horses. *In*: Livestock Handling and Transport, 4th ed., CABI, Boston.
20. Iacono, C., Friend, T., Keen, H., Martin, T., and Krawczel, P. 2007. Effects of density and water availability on the behavior, physiology, and weight loss of slaughter horses during transport. *J. Equine Vet. Sci.* **27**: 355–361. [CrossRef]
21. Innes, L., and McBride, S. 2008. Negative versus positive reinforcement: An evaluation of training strategies for rehabilitated horses. *Appl. Anim. Behav. Sci.* **112**: 357–368. [CrossRef]
22. Kay, R., and Hall, C. 2009. The use of a mirror reduces isolation stress in horses being transported by trailer. *Appl. Anim. Behav. Sci.* **116**: 237–243. [CrossRef]
23. Kohn, C.W. 2000. Guidelines for Horse Transport by Road and Air. AHSA/MSPCA, American Horse Association, New York.
24. Leadon, D., Waran, N., Herholz, C., and Klay, M. 2008. Veterinary management of horse transport. *Vet. Ital.* **44**: 149–163. [Medline]
25. Lee, J., Houpt, K., and Doherty, O. 2001. A survey of trailering problems in horses. *J. Equine Vet. Sci.* **21**: 235–238. [CrossRef]
26. Mal, M., Friend, T., Lay, D., Vogelsang, S., and Jenkins, O. 1991. Physiological responses of mares to short term confinement and social isolation. *J. Equine Vet. Sci.* **11**: 96–102. [CrossRef]
27. Mansmann, R.A., and Woodie, B. 1995. Equine transportation problems and some preventives: A review. *J. Equine Vet. Sci.* **15**: 141–144. [CrossRef]
28. McGreevy, P. 2012. Equine Behavior: A Guide for Veterinarians and Equine Scientists. Saunders/Elsevier, New York.
29. McGreevy, P.D., and McLean, A. 2011. Equitation Science. Wiley, Hoboken.
30. McGreevy, P.D., and McLean, A.N. 2007. Roles of learning theory and ethology in equitation. *J. Vet. Behav.* **2**: 108–118. [CrossRef]
31. McLean, A.N. 2005. The positive aspects of correct negative reinforcement. *Anthrozoos* **18**: 245–254. [CrossRef]
32. McLean, A.N., and McLean, M. 2008. Academic Horse Training. Australian Equine Behaviour Centre, Clonbinane.
33. Messori, S., Ouweltjes, W., Visser, K., Dalla Villa, P., Spoolder, H., and Baltussen, W. 2016. Improving horse welfare at transport: definition of good practices through a Delphi procedure. pp. 404–404. *In*: Book of Abstracts of the 67th Annual Meeting of the European Federation of Animal Science, Belfast.
34. Mills, D.S., and Nankervis, K.J. 1999. Equine Behaviour: Principles and Practice. Blackwell Science, Malden.
35. Murphy, J., and Hennessy, K. 2007. Trailer for horses: some transport systems may be less problematic for the naive horse during loading. *In*: 3rd International Equitation Science Conference, East Lansing.
36. Myers, J. 2005. Horse Safe, Landlinks Press, Collingwood.
37. Nudo, M. 1995. Trailer loading. *Horse Rider* **34**: 59–65.
38. Oikawa, M., Hobo, S., Oyamada, T., and Yoshikawa, H. 2005. Effects of orientation, intermittent rest and vehicle cleaning during transport on development of transport-related respiratory disease in horses. *J. Comp. Pathol.* **132**: 153–168. [Medline] [CrossRef]
39. Padalino, B. 2015. Effects of the different transport phases on equine health status, behavior, and welfare: A review. *J. Vet. Behav.* **10**: 272–282. [CrossRef]
40. Padalino, B., Hall, E., Raidal, S., Celi, P., Knight, P., Jeffcott, L., and Muscatello, G. 2015. Health problems and risk factors associated with long haul transport of horses in Australia. *Animals (Basel)* **5**: 1296–1310. [Medline] [CrossRef]
41. Padalino, B., Henshall, C., Raidal, S.L., Knight, P., Celi, P., Jeffcott, L., and Muscatello, G. 2017. Investigations into equine transport-related problem behaviors: survey results. *J. Equine Vet. Sci.* **48**: 166–173. [CrossRef]
42. Padalino, B., Maggiolino, A., Boccaccio, M., and Tateo, A. 2012. Effects of different positions during transport on physiological and behavioral changes of horses. *J. Vet. Behav.* **7**: 135–141. [CrossRef]
43. Padalino, B., Raidal, S.L., Hall, E., Knight, P., Celi, P., Jeffcott, L., and Muscatello, G. 2016. Survey of horse transportation in Australia: issues and practices. *Aust. Vet. J.* **94**: 349–357. [Medline] [CrossRef]
44. Padalino, B., Raidal, S., Knight, P., Celi, P., Jeffcott, L., and Muscatello, G. 2017. Associations between behavioural and clinical responses to 8 hour transportation in horses. *PLOS ONE* (In submisson).
45. Panksepp, J. 2005. Affective consciousness: Core emotional feelings in animals and humans. *Conscious. Cogn.* **14**: 30–80. [Medline] [CrossRef]
46. Parelli, L. 2015. Q & A: Trailer Loading Dilemma Article. http://www.parelli.com/trailer-loading-dilemma.html [accessed May 8, 2017].
47. Parelli, P., Kadash, K., and Parelli, K. 1993. Natural Horse-man-ship. Western Horseman, Colorado Springs, Colorado.
48. Pavlov, I.P. 1941. Lectures on Conditioned Reflexes. Vol. II. Conditioned Reflexes and Psychiatry, Oxford University Press, Cambridge.
49. Pryor, K. 2009. Reaching the Animal Mind: Clicker Training and What It Teaches Us about All Animals. Simon and Schuster, New York.
50. Purswell, J.L., Gates, R.S., Lawrence, L.M., and Davis, J.D. 2010. Thermal environment in a four-horse slant-load trailer. *Trans. ASABE* **53**: 1885–1894. [CrossRef]

51. Riley, B.C. 2016. Mechanical & behavioral responses of horses during non-commercial trailer transport−a pilot study. *In*: 42nd Animal Transport Assciation Conference, Lisbon.
52. Riley, C.B., Noble, B.R., Bridges, J., Hazel, S.J., and Thompson, K. 2016. Horse injury during non-commercial transport: findings from researcher-assisted intercept surveys at southeastern Australian equestrian events. *Animals (Basel)* **6**: 65–77. [Medline] [CrossRef]
53. Riley, C.B., Liddiard, J.R., and Thompson, K. 2015. A cross-sectional study of horse-related injuries in veterinary and animal science students at an Australian university. *Animals (Basel)* **5**: 951–964. [Medline] [CrossRef]
54. Roy, R.C., Cockram, M.S., and Dohoo, I.R. 2015. Welfare of horses transported to slaughter in Canada: assessment of welfare and journey risk factors affecting welfare. *Can. J. Anim. Sci.* **95**: 509–522.
55. Schramm, J., and Schramm, D. 2013. How to load a horse on a trailer. http://www.youtube.com/watch?v=vhBXYeoe7oA [accessed August 8, 2016].
56. Schwartzkopf-Genswein, K., Ahola, J., Edwards-Callaway, L., Hale, D., and Paterson, J. 2016. Symposium Paper: Transportation issues affecting cattle well-being and considerations for the future. *Prof. Anim. Sci.* **32**: 707–716.
57. Shanahan, S. 2003. Trailer loading stress in horses: behavioral and physiological effects of nonaversive training (TTEAM). *J. Appl. Anim. Welf. Sci.* **6**: 263–274. [Medline] [CrossRef]
58. Siniscalchi, M., Padalino, B., Lusito, R., and Quaranta, A. 2014. Is the left forelimb preference indicative of a stressful situation in horses? *Behav. Processes* **107**: 61–67. [Medline] [CrossRef]
59. Skinner, B.F. 1938. The Behaviour of Organisms: An Experimental Analysis, D. Appleton-Century Company Inc., New York.
60. Slater, C., and Dymond, S. 2011. Using differential reinforcement to improve equine welfare: shaping appropriate truck loading and feet handling. *Behav. Processes* **86**: 329–339. [Medline] [CrossRef]
61. Starling, M., McLean, A., and McGreevy, P. 2016. The contribution of equitation science to minimising horse-related risks to humans. *Animals (Basel)* **6**: 15. [Medline] [CrossRef]
62. Stewart, M., Foster, T.M., and Waas, J.R. 2003. The effects of air transport on the behaviour and heart rate of horses. *Appl. Anim. Behav. Sci.* **80**: 143–160. [CrossRef]
63. Tateo, A., Padalino, B., Boccaccio, M., Maggiolino, A., and Centoducati, P. 2012. Transport stress in horses: Effects of two different distances. *J. Vet. Behav.* **7**: 33–42. [CrossRef]
64. Thornton, J. 2000. Effect of the microclimate on horses during international air transportation in an enclosed container. *Aust. Vet. J.* **78**: 472–477. [Medline] [CrossRef]
65. Tucker, T. 2016. Brett Kidding's trailer loading demonstration at TRT live 2016. https://www.youtube.com/watch?v=3yfvocbWteQ [accessed May, 8, 2017].
66. Waran, N. 2007. The Welfare of Horses, Springer, Dordrecht.
67. Waran, N., Leadon, D., and Friend, T. 2007. The effects of transportation on the welfare of horses, *In*: The Welfare of Horses, Springer, Dordrecht.
68. Waran, N.K. 1993. The behaviour of horses during and after transport by road. *Equine Vet. Educ.* **5**: 129–132. [CrossRef]
69. Waran, N.K., and Cuddeford, D. 1995. Effects of loading and transport on the heart rate and behaviour of horses. *Appl. Anim. Behav. Sci.* **43**: 71–81. [CrossRef]
70. Weeks, C.A., McGreevy, P., and Waran, N.K. 2012. Welfare issues related to transport and handling of both trained and unhandled horses and ponies. *Equine Vet. Educ.* **24**: 423–430. [CrossRef]
71. Westlund, K. 2015. Training laboratory primates – benefits and techniques. *Primate Biol.* **2**: 119–132. [CrossRef]
72. Yngvesson, J., de Boussard, E., Larsson, M., and Lundberg, A. 2016. Loading horses (Equus caballus) onto trailers—Behaviour of horses and horse owners during loading and habituating. *Appl. Anim. Behav. Sci.* **184**: 59–65. [CrossRef]
73. Zancock, E., and Pearson, E. 2014. A pilot study investigating the prevalence of loading problems at an equine referral hospital. Proceeding of the 10th International Equitation Science Conference, Denmark.