Relationship between human safety and horse handling

Samband mellan människors säkerhet och hantering av hästar

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Uppsala 2014

Bachelor Program in Animal Science

Studentarbete
Sveriges lantbruksuniversitet
Institutionen för husdjurens miljö och hälsa

Nr. 604

Student report
Swedish University of Agricultural Sciences
Department of Animal Environment and Health

No. 604

ISSN 1652-280X

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Student report 604, Uppsala 2014

D-level, 15 ECTS, Bachelor Program of Animal Science, Degree project in Animal Science (EX0704)

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Key words: horse-related injuries, accident risk factors, horse behaviour, safe horse handling, training

Serie: Studentarbete/Sveriges lantbruksuniversitet, Institutionen för husdjurens miljö och hälsa, nr. 604, ISSN 1652-280X

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1. Abstract

This report reviews the current scientific results on the interaction between human safety and horse handling practices. It gives suggestions to and support riding instructors, riders, horse handlers and farriers how to build up a training programme which is safer for the human and safeguarding horse welfare at the same time. The discussion emphasises the common injury patterns and risk factors that need to be taken into consideration. The human-horse interaction has been looked at from the animal and the human viewpoint separately: not only the perception, learning abilities and personality of the horse but also the human comprehension and their behaviour towards the animal have been reviewed. The report gives suggestions on how these factors can be implemented in training/handling practices to reduce the injury risk of humans while horse welfare is safeguarded.

2. Introduction

Horse-related injuries are relatively common and can be quite serious and even fatal (Hawson et al., 2010). The common cause of human injuries is claimed to be the unpredictable nature of horses. However, the relative size difference between humans and horses might also be of great importance. Riders are elevated well above the ground when sitting on a horse and the kicking force of the horse and their speed should be taken into consideration, as well. Horse-related injuries to humans can vary from mild contusions to death. Among children, one quarter of all lethal sport injuries occurs during horse riding (Kiss et al., 2008 cited in Hawson et al., 2010). Moreover, riders has been reported to be involved in an accident once in every 350 hours of contact time (Ceroni, 2007 cited in Hawson et al., 2010). Comparing these data with motor cycling, horse riding seems to be 20 times more dangerous. All in all, the need to reduce mortality and injuries significant which can be achieved through investigating preventative strategies and safer horse handling techniques.

To be able to reduce the injury risk of horses and riders, not only the physical needs but also the behavioural requirements of horses need to be taken into consideration (Waran, 2002). It is essential to fulfil the housing, nutritional, management requirements and species-specific behavioural needs. Before riding we need to make sure that the animal is healthy, does not suffer from any physical pain and that the rider is fit enough and has all essential theoretical and practical knowledge.

Equitation science faces a great challenge of trying to reduce the injury risk by explaining and clarifying human-horse relationships, improve training methods and reduce communication problems (Keeling et al. 2009; McGreevy, 2004). Hausberger et al. (2008) emphasise the need for helping riders to develop their observational skills. It is crucial to make sure that these findings are available for riding instructors and horse riders from all levels.

Riding instructors need to consider many factors at a time to be able to reduce the injury risk. They need to be familiar with the training level of the horse and the riding skills of the human. Taking the personality traits of the animal into consideration seems to help to match the right horse for a specific role, and in turn, are very important when a purchase decision is made (Graf et al., 2013). The character of the horse has been found to have a great impact on the level of safety and health risks for humans as well as horses. Not only the personality of the horse but also giving clear explanations to the riders about the main differences between the perception of the human and the horse before they actually contact the animal is important. These explanations should be given by the instructors. Riders need to learn not only the riding technique itself but also how to read the body signals of horses to be able to reduce the injury risk. Investigating and observing intra-species communication might help to understand even the subtle cues of the animal (Hausberger et al., 2008). Training techniques might vary according to the individual differences between horses, including the applied stimuli and the reinforcement method. It has been shown that low stress handling (positive interactions) might help the animals to remain calm in potentially aversive situations (e.g. isolation, tethering, rectal palpation, insemination) and in turn, might reduce the risk of injuries to the animals themselves, other animals and their human handlers (Waiblinger et al., 2004). Furthermore, as a result of positive handling, less handlers and/or less time seems to be needed to carry out routine handling procedures, which might lead to reduced financial investments, as well. In practice, it seems to be a good advice to

look for the signs of a relaxed horse (Seaman, 2002) and try to behave more "horse-alike" (Summerhayes, 1975).

Safer handling methods might also lead to improved welfare of the horse. Horses are quite expensive animals, especially the high-level competition animals, and injuries may undermine the animal's performance at a competition. Stressful handling procedures might have a negative impact on the animal's immune function which may imply a lowered resistance to diseases and reproductive success (Price, 2008). Medication, veterinary costs, missed competitions all may lead to substantial financial loss for the horse owner (Clarke et al., 2008). To be able to reduce accidents and injuries of riders, handlers and horses, it is important to make sure that injury preventing strategies are investigated properly and the results are available and well-circulated among instructors and within the entire equestrian society.

3. Aims

My aim was to review the current scientific knowledge on the interaction between human safety and horse handling and how these findings can be implemented in the everyday training sessions. The present report is aiming to support riding instructors to be able to plan safer horse training programmes and to reduce accidents with horses based on scientific background.

My questions were:

1) Which are the common injury patterns of humans and the related significant risk factors of equestrian accidents?
2) How is human safety affected by the perception, learning abilities and personality of the horse?
3) How can human comprehension of horse behaviour and human behaviour around horses be improved to reduce the risk of incidents?
4) How can the understanding of the above mentioned horse- and human-related factors be used in training programmes in order to increase human safety?
5) What are the positive animal welfare implications of safer handling/training techniques?

4. Human injuries, risk factors and causes of accidents

4.1. Human injuries

Horse-related injuries are relatively common and might have long term negative impact on the quality of human life. The most common cause of injury was found to be falling or being thrown from the horse (46-83% of incidents, Hawson et al., 2010). Injuries in veterinarians were most often caused by kicks (79% of all injuries). Kicking is one of the active defence mechanisms of horses to prevent or stop aversive stimuli. Kicking also seems to be a response to unidentified or alarming stimuli (Waring, 2003). Horses might need to learn to suppress this natural behaviour through habituation or operant conditioning. Of course riders and horse

handlers should also try to reduce the occurrence of situations in which the animal tend to show aversive responses.

The most vulnerable areas of the human body when it comes to horse riding are the head, hand and wrist, foot and ankle and spinal cord or vertebral column (Hawson et al., 2010). Fractures, contusions and abrasions have been reported as the most common injuries. Brain injuries occur more often when a helmet is not used (Ueeck et al., 2004). However, the number of incidents did not decrease just because the riders wore helmets, protective vests or protective footwear (Hawson et al., 2010). The effectiveness of these personal protective equipment needs more investigation and based on my personal horse-riding and training experience it is more effective to concentrate on building up a good level of communication and understanding between the horse and the rider. Hawson et al. (2010) suggested the main challenge regarding horse-related incidents is to find ways for how the animal's behaviour can be altered so that it becomes more predictable and shows less flight and defence responses. On the other hand, understanding even the subtle body cues of horses and changing the human behaviour accordingly is a key element in safe horse handling (Seaman et al., 2002).

4.2. Risk factors and causes of accidents

Jagodzinski and De Mura (2005) has reported several risk factors including being a female and riding 15-24 hours per month. The gender difference is interesting considering that male riders tend to take more risks or ride more unpredictable animals in general. It has been reported that incidents tend to happen most within three years of the rider's first horse-riding experience. The highest frequency of injuries has been found in the fourth and fifth decades of life (Hawson et al., 2010). Novice riders with less than 100 hours riding experience have been reported to be more vulnerable to accidents than riders with greater experience (Clarke et al., 2008). Contrary to this, Abu-Zidan and Rao (2003) found no association between the rate of hospital admissions and the level of riding experience (leisure or professional). Although these findings might seem contradictory, it should not be forgotten that more experienced riders and handlers tend to ride or handle more reactive horses, which elevates the injury risk. Young horses and horses which were taller than 148 cm were associated with a higher risk of injury (Hawson et al., 2010). Lower risk has been observed during trotting than cantering obviously because of the lower velocity and also because of the different forces that the riders experience in canter. Furthermore, younger horses have been observed to be more commonly associated with accidents which probably means that these horses are more reactive, more fearful and have a higher tendency to show unpredictable responses.

The horse's behaviour has been reported to be the main factor in horse-related incidents and in most cases the cause was the horse showing fear responses (e.g. spooking), not being trained properly or having bad temperament (Ball et al., 2007). Unwanted horse behaviours and related accidents might stem from confusion in the horse caused by the rider. Improper body control, loss of balance, inappropriate application of pressure signals might influence the horse's stability and balance (Symes and Ellis, 2009). Disturbing the animal's balance might result in stumbling or being less predictable in gaits.

Unwanted horse responses might also derive from inappropriate level of training of the animal (Hawson et al., 2010). For instance, the fact that the rider is physically able to control the

reins does not necessarily mean that he/she can control the horse. The animal needs to be taught to respond to the rein pressure first. As a result of improper training techniques, horses tend to habituate to milder bits and more effective and bigger bits need to be applied. Unfortunately, while horses become habituated to bits, they also tend to show more and more unpredictable responses. The occurrence of unpredictable fear responses seem to increase once the animal has poor acceleration and deceleration responses (Hawson et al., 2010).

Horses have been found to be influenced by the arousal state of riders/handlers. Keeling et al. (2009) reported that the increase in the rider's heart rate was followed by an increase in the horse's heart rate while the animal was being led and also during riding. The authors emphasised the importance of unconscious signals given by humans to the horse, especially those signals that are related to nervousness or anxiety.

5. Equine perception, learning and personality in relation to human safety

5.1. Perception of horses

The horse's appropriate response to environmental challenges is a key to its survival (Christensen et al., 2005). They are well equipped to flight to avoid danger or fight when they feel threatened and there is no clear exit or when they are defensive (e.g. mare defending a foal). The safety of human-horse interactions might be increased through understanding of the sensory systems and related behavioural responses. It is most likely that horses use a combination of visual, auditory and olfactory cues to detect danger (Christensen et al., 2005). The authors found that the auditory or visual senses might be the ones that are primarily used for immediate predator detection and might have crucial roles in forming flight responses. In the experiment of Christensen et al. (2005) significantly increased heart rate (HR) responses were recorded in the case of novel visual (traffic cone) and auditory stimuli (white noise, perfectly audible to horses) compared to the control (without novel stimuli). Horses were found to be more alert in the visual and auditory tests and during the olfactory test (eucalyptus oil) they seemed to be more vigilant. Since smell travels slowly in the air (no sense to run away immediately after it was perceived), these cues did not seem to trigger immediate physiological response to localise danger and prepare the animal for flight. Being vigilant e.g. increased sniffing, corresponds to the results of Terlouw et al. (1998) in which cattle responses to odours of urine and blood from conspecifics and faeces of carnivores were observed. The importance of visual cues was also emphasised in the study of Stone (2010). The author found that horses were able to discriminate even between photographed human faces (using facial characteristics), which seems to be the result of the combination of behavioural and cognitive processes.

Saslow et al. (2002) concluded that the sounds made by humans, their movements, the way of tactile interaction and the odours they might emit or carry on their clothes (e.g. odours of mares in oestrus when handling a stallion) might be of great importance from the viewpoint of horse perception. They also emphasised that riders usually assume that horses see what humans see and tend to ignore the fact that the horse's retina has a different construction. Consequently, horses do not have the human's daytime capacity to resolve detailed images or recognise objects by vision only. Horse vision has evolved for predator detection and not for accurate visual

identification of stationary objects. This might have serious implications on the safety of humans and horses, especially during riding. Hangi et al. (2007) suggested that horses' ability to see colours are similar to human colour vision. They also indicated that horses respond to colour vision testing in the same way as some green/red colour deficient humans. Timney (1992) found that the visual acuity of horses is better than that of dogs and cats, what is more, it is close to standard human acuity. Hanggi et al. (2010) investigated the reason why horses startle at objects they have already seen earlier. After the animals were thought to discriminate between two objects (children's toy, a plastic wheelbarrow, grass moaner, tractor and truck), the objects were rotated front to right, front forward, upside down etc. In certain rotations horses had no problem to choose the right object but in other rotations they completely failed suggesting that the perspective of the object does make a difference from the horse's point of view. Animals could recognise more easily when the top of the objects was visible compared to when they saw only the bottom. These results might answer the question why horses hesitate at objects they are familiar with during riding, however there were only four objects observed, thus the small sample size question whether it is applicable to the whole species as a whole.

Thanks to the olfactory structures, the density and structure of olfactory receptors, the nasal structure and breathing patterns, horses are able to move large volumes of air and trap large numbers of molecules. Moreover, their prominent vomeronasal organ helps them to respond to non-volatile, species-specific molecules (pheromones). From the human safety viewpoint, Saslow et al. (2002) imply that the olfactory messages e.g. the human sweat might transfer information about the human's frustration or negative emotional state, which in turn might upset the animal as well. Most articles on horse olfaction abilities are focusing on the role of pheromones in mating behaviour rather than investigating the roles and consequences of chemical sensitivity in horse behaviour.

As for the tactile sensation of horses, it has been shown that horses respond to pressures that are too light for the human to feel (Saslow et al., 2002). Consequently, during riding, it is quite easy to give unintended tactile signals, especially when the rider is instable in the saddle. This might lead to a misunderstanding during the teaching process as the animal cannot understand which signals are meaningful. Appropriate tactile contact can be used for positive reinforcement in training, for desensitisation to phobic stimuli, for improving bonding between the horse and the human (just like mutual grooming used for social bonding between horses) and might be even useful for improving health. Feh and de Mazieres (1993) investigated the experimental imitation of grooming on the lower neck (around the withers), which was previously found to be the preferred site for allo-grooming in a herd of Camargue horses. Allo-grooming has been shown to have an important social function, it is found to be a tool for reducing stress between individuals, e.g. stallion-mare pairs groom each other most often in the breeding season when the social tension is higher (Feh and de Mazieres, 1993). The authors found that the HR of adult horses and foals dropped while they were groomed around the withers. There is a lack of information on the possible difference in the calming effect between being groomed by an unknown person and a known person.

Understanding horse perception and what cues they use for communication might have an essential role in decreasing the occurrence of incidents and injuries. The communication cues are further discussed in this report under the 'Implementation of human and horse factors in training programmes' section.

5.2. Equine learning ability

Ever since horses were domesticated, humans have been trying to train these animals to receive fast and correct responses to human signals to perform specific tasks and build up communication. Despite the status and importance of horses in human society, equine learning ability and its implications have received surprisingly limited investigation in the scientific literature Also training strategies and how they match the mental ability of the horse need further examination (Nicol, 2002).

Equine learning ability has been shown to be impaired by high level of fearfulness, which can be induced by isolation from conspecifics, exposure to novel object or conditions e.g. an unknown environment (Lansade et al., 2005). When it comes to horse handling and training, the first step is to make sure that the animal is not afraid of the human. It is suggested that the best period to reduce the animals' fear of human beings is in early life. Early handling has been reported to affect horse behaviour positively, however the results regarding the effectiveness and the long-term effects are sometimes contradictory (Lansade et al., 2005).

Learning behaviour of horses, and any other species, is determined by the timing of exposure to the stimulus and the introduction of the associated reinforcement method. The reinforcement has to follow the desired behavioural pattern immediately or as close as possible. Delayed, conflicting or meaningless cues undermine the success of training. Hull (1943) pointed out that two simultaneous intensive stimuli might result in 'blocking' and the animal would not learn either of the cues correct. Learning behaviour seems to be influenced by repetitions, temporal distribution and duration of training sessions as well. Extended sessions of concentrated training schedules might impair learning ability. Interestingly, Nicol (2002) reported that horses probably cannot be classified as 'poor learners' or 'good learners' based on different learning tests as only a few correlations have been observed between the learning ability of individual horses in different tasks. Horses seem to be more successful in spatial discrimination tasks (food reward placed at the end of alternate arms of a two-arm maze) compared to stimulus discrimination (the presence of food was indicated by a black-yellow striped panel randomly allocated to one arm of the maze). It has also been reported that once they learnt the location cue (which arm hides the food reward), it was difficult for them to swap strategy for the second test and learn that the yellow-black panel (stimulus cue) showed the way to the food reward. The reason has been showed to be that the animal had to cope with two cues at the same time in the second test and needed to learn that the stimulus cue was relevant and the location cue was irrelevant.

Although the learning performance of the individual animal seem to vary depending on the task, naturally calm animals (Quarter horses) have been reported to show better performances compared to more reactive animals (Thoroughbreds) (Mader and Price, 1982). Consequently, reduced reactivity levels might facilitate learning processes regardless of the nature of the task.

5.3. Personality of horses

Temperament, personality, emotionality, fearfulness all reflect the individual differences which might help to draw reliable conclusions regarding the suitability of the horse for a specific discipline (e.g. dressage, show jumping, leisure) (Waran, 2002). Matching the animals for specific sports could contribute to saving time and money which is wasted when an animal turns out to be unsuitable for the chosen role. Temperament and personality is used interchangeably in

the scientific literature (Hausberger et al., 2004). However, it gives a better picture if we make a distinction between these two concepts. Hausberger et al. (2004) described temperament as the basic response of an individual, which is stable over time and situations, while personality represents the behaviour which is modified by experience (environment).

The animal's personality traits determine its quality as a riding partner and it has a crucial effect on the human safety (Graf et al., 2013). Personality traits and willingness to work seem to be way more important for riders and breeders than the actual performance traits e.g. the quality of trot or show jumping. According to the riders and breeders in the survey of Graf et al. (2013) horses' personality was most important as it was found to be strongly related to the simplicity of daily work with the animals, to the human-horse relationship and to the safer and more comfortable handling.

5.4. Assessing personality

To assess personality, scientists have developed different behavioural tests. In the open-field test (arena test) a single animal is usually placed in a familiar/unfamiliar indoor or outdoor arena and the responses to social separation is observed (Seaman et al., 2002; Le Scolan 1997). Le Scolan et al. (1997) highlighted that in an unfamiliar environment horses' responses to social separation might be altered by the fear reactions shown to the novel environment instead of the social separation itself. The results of open-field tests might raise the question whether training in social isolation or surrounded with conspecifics leads to better learning and more successful training. This question should be taken into consideration by instructors when they plan the training sessions.

Personality can also be assessed through novel object tests (Visser et al., 2003) or a stationary (unfamiliar) person tests (Seaman et al., 2002). The aim of these tests is to assess the animal's fear reactions to novelty. Seaman et al. (2002) found that the behavioural responses in the person test and the novel object test were similar to each other. However, these responses seemed to be inconsistent over trials. When a human is involved in a personality test, animals might generalise between the test person and humans/handlers they had interacted with earlier (Hausberger and Muller, 2002; Henry et al., 2005). In these experiments, the horse's responses can be highly influenced by its general relationship or previous experience with humans. A previous negative experience with a handler or an environmental factor e.g. bad experience in an unfamiliar riding arena might alter the horse's responses in the temperament tests. Even a calm and confident horse can suffer from a bad experience caused by an unknown handler e.g. aggressive behaviour of a blacksmith or bad experiences at an unknown competition site. These experiences might alter the horse's responses displayed in a temperament test. Tests of fearfulness should reflect the horse's ability to cope with new challenges but these responses are usually altered by previous positive/negative experiences. Consequently, it seems to be quite hard to standardise the personality tests (Waiblinger et al., 2006).

Seaman et al. (2002) has reported that behaviour shown in the arena test cannot be used to predict the behaviour in the person test or novel object test and vice versa. However, the results of the open field test are likely to be indicative of temperament. The authors concluded that horses that were overtly active in the open field test tended to respond more actively to social isolation (e.g. during training). Moreover, further advantage of the open field test is that it might be a good 'tool' to habituate the subjects to the observation environment before other

behavioural assessments are carried out (Maros et al., 2010). Contrary to Seaman et al. (2002), Le Scolan et al. (1997) reported some correlation between behaviours (fear responses) shown in the open field test and in other fear tests (open field test, novel object test, instrumental learning task). They suggested that there are behavioural predispositions that are stable across situations. They concluded that these behavioural tests seem to be useful to predict the temperament in untrained animals.

In order to assess individual differences in horses, the ratings of experienced riders (line rating method) have been used, as well (Visser et al., 2003). In the experiment of Visser et al. (2003) students rode a standardised track including jumping, a slalom and passing by the noise of a chainsaw. Right after the track riders had to score the animal (10 temperamental traits). The authors found agreement among the riders' rankings and that objective measures from behavioural tests (level of patience when standing in a box and responsiveness to the environment) correlated with these ratings.

During the experiments, heart rate and heart rate variability might help to be able to quantify temperamental traits (Visser et al., 2002). On the other hand, the physical activity might result in an increase in mean heart rate. Visser et al. (2002) emphasised the difference between this value and the nonmotor heart rate, which might refer to the animal's emotional reactivity.

All in all, it is interesting that it is considered important to be able to assess the animals' personality, and yet, the some of the existing ethological tests seem to be unreliable (Forkman et al., 2007). There is a great need to have assessments that help to determine which horse is suitable for children, for a handicapped rider, for school or for shows. The solution might be a combination of uniform tests (Houpt et al., 2002). For instance, to be able to make predictions about the performance of a show-jumper, the horses should go through a novel object test, handling, avoidance learning, reward learning and technique in free jumping assessments (McGreevy, 2004) possibly combined with the above mentioned line rating assessment by riders (Visser et al., 2003).

6. Human comprehension and behaviour

When interacting with horses, several factors should be considered regarding the human behaviour such as the human's posture, vocal and olfactory signals and focus of attention (direction of eye gaze). There have been famous horses (e.g. Clever Hans) who amazed spectators by answering mathematical, spelling and other tasks through head movements and leg gestures (Pfungst cited in Waring, 2003). Eventually, it turned out that humans were using slight gestures to make the animals answer the questions correctly. Thus, it seems horses are able to detect even subtle visual information displayed by humans.

Position of the approaching human seems to be of importance because of the lateralised perceptual responses of horses to a novel object (Larose et al., 2006). They found that the more responses the animals showed to a novel object (the more scared they were), the more they tended to use their left eye (which is controlled by the right hemisphere). De Boyer Des Roches et al. (2008) further investigated this area to reveal if the perceptual laterality is influenced by the emotional valence of the stimulus. Their data confirmed that processing negative emotional responses appear to be lateralised, and the right hemisphere seems to be involved in the process. Positive emotions, on the other hand, have been found to be less lateralised: the authors concluded that both hemispheres might have an important role. Birke et al. (2011) investigated

the flight responses of horses to direct (vigorous, with a swinging rope and eye contact) and indirect approach styles (relaxed, without rope and no eye contact). The speed of approach did have an influence: moving slowly was preferable and seemed to have a clear positive effect on horse's avoidance behaviour. Contrary to the results of Larose et al. (2006) and De Boyer Des Roches et al. (2008) (lateralised negative emotions), the data of Birke et al. (2011) showed no significant effect of the direction of approach on the animals' flight distance. Even though direct eye contact is said to be a sign of dominance within the equine language and it is used in training to drive the horses away from the trainer (Krueger, 2007), in the experiment of Seaman et al. (2002) the eye contact had no effect on the approach times horses needed to go up to the test person.

Emotional cues of people might also influence the animals' reactions. Hama et al. (1996) found that horses' heart rate increased in the first few minutes when they were stroked by people with negative feelings towards the animals, compared to neutral or positive test persons. Moreover, Keeling et al. (2009) indicated that the nervousness of the rider or handler tend to increase the anxiety and reactivity of the horse. In feral horses, higher level of alertness (being prepared to react to any potential danger) is shown to be an adaptive response to signals from another horse within the group (Boissy, 1995). This is supported by the observation of Feist and McCullough (1976), who reported a significant impact of the stallion behaviour. When the stallion in the group remained calm, the rest of the group seemed to stay calm or calmed down soon even if they were originally alarmed. Keeling et al. (2009) emphasised the importance of unconscious signals of riders and handlers. They suggested that people should pay more attention to what signals they are giving to a horse to reduce injury risk.

When interacting with horses, the reactions of the animal are the result of the interplay between the temperament of the horse and the human. Scientists have observed individual differences in young untrained horses raised in similar conditions in their willingness to approach or avoid human contact (Lansade and Bouissou, 2005). Moreover, there are individual differences in human behaviour, as well. As a result of these individual differences in both species, there is no recipe-based method how to interact with horses (Hausberger et al., 2008). However, scientific knowledge and experience is available that might help to improve the attention and observational skills to be able to read the animals' signs and body language more effectively, build up safer human-horse communication and develop safer training techniques, which in turn, help to prevent accidents.

7. Implementation of human and horse factors in training programmes

In order to reach successful human-horse cooperation equine perception, learning and personality have to be taken into consideration. First, I investigated the scientific papers on essential aspects of effective and efficient training. These advices should be taken into account throughout every training session. Later on, various training strategies are discussed in my review to demonstrate and support instructors and all horse people how they can improve their training methods.

7.1. General training advices

Throughout the entire training session the rider/handler needs to be in control of his/her own body and deal with the horse's character (Meyer et al., 1999). The human needs to be able to stay calm, focused, alert and positive at the same time and needs to be able to communicate with the horse effectively, which can be learnt from experienced instructors.

Before the training starts, gaining the horse's trust and letting the animal be relaxed around the trainer need to be the first steps. This can be achieved through physical contact (rubbing, stroking the horse) or special sounds. As mentioned earlier in the current report, stroking at the site of preferred allo-grooming (the lower mid-neck) led to reduced HR in horses (Feh and de Mazieres, 1993) and in turn might be considered to have a calming and stress-reducing effect. Reduction in HR and positive behavioural traits has been reported by McBride et al. (2004) as a response to massage at the withers, mid-neck and croup (preferred sites of allo-grooming). Although horse training strategies are usually based on tactile perception, e.g. pressure from the bit or the rider's legs, weight change in the saddle, the auditory sensitivity of horses should not be neglected either. It has been confirmed that horses are able to learn and memorize human words and make associations between those words and specific tasks (Sankey et al., 2010). In a learning test, yearlings were taught to stay immobile without being held as a response to a simple vocal command ('Stay!') and accepting handling or veterinary procedures, for instance, brushing, picking up feet, fitting a surcingle, fitting tendon/protection boots, inserting thermometer in the rectum, applying vapour spray on the body. Each test animal managed to learn the tasks within 5 days (5 min training/day). During the process only positive reinforcement was applied, no punishment or negative reinforcement. As a result, learning and memorisation of the task were enhanced, horses showed positive reactions, increased contact and interest towards the human. This 'positive memory' of humans was clearly observed even months later and seemed to be extended to novel persons. The importance of positive situations in training has been also emphasised in the study of Hockenhull and Creighton (2013). The authors suggested that horses should be taught using more rewarding techniques because higher proportion of rewarding responses seem to result in fewer behavioural problems when ridden (e.g. bucking, moving off while being mounted, refusing to move forward, bolting, tripping, dropping behind the bit). Moreover, they also reported that the application of rewarding methods when undesired behaviour problems occur can be more successful than responding to the unwanted behaviour with a punishment. The success relies on using the reward to calm the horse down, and in this way they actually respond to the animal's emotional state rather than to its behaviour per se.

To be able to maintain the horse's trust and build up clear communication with the horse, commands should be specific for each desired response. The signals should be clear and concise so the animal is able to distinguish between the signals (Waring, 2003). The training success depends on the appropriateness, contiguity and contingency in the training method (Fraser, 1992). The associations between the cues and the outcomes need to be solid and predictable otherwise acute or chronic stress responses might develop, as the animal does not understand the task (McLean, 2005). Fear responses and unpredictable behaviour arising from exposure to aversive stimuli can reduce the learning ability and might jeopardize the safety of both the human and the horse (Waran et al., 2002). Frustration might also derive from the rider's unrealistic expectations of the learning ability of the animal and its capacity to understand the requirements during the training (Waran et al., 2002).

Horses usually go through the training sessions alone, they are separated from the group members, which might cause stress for them already before the session starts. Hartman (2010) indicated that stress symptoms deriving from social separation can be alleviated by the presence of a companion horse during the training situation. However, there are situations when horses need to be able to cope with social separation in their lives, so training the horse alone might be beneficial as well. Of course, gradual habituation to the situation is needed so that stress associated with social separation is minimised.

7.2. Training strategies to be safer

A number of training strategies have been developed with the aim of manipulating the behaviour of horses and building up communication with them. However, the effectiveness might be questioned. Generally, it can be said that a training method is good once it helps to achieve success and minimise stress for both the horse and the human (Waring, 2003). Gradual exposure to new stimuli and situations seem to help keeping stress to a minimum level (Borstel et al., 2009). Repeated stimulation facilitates habituation and easier adaptation to subsequent new situations. When training horses, the innate tendencies, previous experiences and learning skills of the horse and horses' perception abilities should always be considered (Hanggi, 2005).

7.2.1. Habituation and desensitisation

As the first step of human-horse communication, the horse needs to become accustomed to the environment, the human's presence and the human's approach (Waring, 2003). Habituation helps the animal to filter out non-vital information in its environment and to focus on the significant stimuli instead (Hanggi, 2005). Repeated, slower approaches will result in diminished flight response (e.g. training of police and stunt horses to get used to frightening stimuli McGreevy, 2004). The horse needs to be taught that the approaching human means positive experiences. Once the horse associates the human with unpleasant experiences, its flight responses and avoidance behaviour might become more intensive. To overcome this problem, counterconditioning is needed with positive reinforcement. A horse trainer (Honza Bláha, Line Free Collection, personal communication, 2006) said that it is always easier to teach naïve horses using proper training methods (straightforward and clear signals) from the very beginning than to correct the mistakes and unwanted associations later on.

When a sensitised or hyper-sensitised animal displays unwanted behaviours (e.g. overly sensitive or not responding at all when it is asked to carry out a task), desensitisation (a process to extinguish a response to a stimulus) might be a good 'remedy' (Hanggi, 2005). For instance, head shyness due to negative experiences during being bridled can be altered through desensitisation. It can be such a time consuming process as the trainer needs to approach the horse's head gradually and retreat until the animal willingly accepts gentle bridling. By combining habituation, sensitisation and desensitisation horses might get used to all sorts of sights, sounds and contacts (e.g. bouncing beach ball, multi-coloured balloons, bobbling umbrella, plastic tarp, pylons). As a result of correct trainings, horses are more able to handle novel events in a calm way and they become responsive to riding and handling aids.

7.2.2. Conditioning

Classical conditioning in training can be used quite effectively (Hanggi, 2005). Trainers can teach the animals to pair an initially meaningless word, e.g. “trot” with the flick of a whip (which was previously associated with moving forward) immediately before the animal changes gait to trot. Consistency will help the animal to learn to respond to the verbal cue (and no whip is needed as a reinforcer). The same thing seems to work with the word “good” to indicate correct responding. In this case a food reinforcer can be applied.

In general, trainers tend to apply negative reinforcement strategies to teach the desired responses, e.g. relieving pressure by the legs from the saddle or using the whip at the flank until the horse start to move forward (Murphy et al., 2007). The idea is that the rider removes the aversive stimulus as soon as the horse performs the desired behaviour. On the other hand, scientific experiments to test learning abilities are usually based on the positive reinforcement techniques (e.g. food reward for performing appropriate behaviours). As a result, the learning abilities of horses might be misinterpreted and misunderstood. One thing is apparent, successful training depends on appropriate timing of the reinforcement/punishment (Murphy et al., 2007). Reinforcement needs to be applied as close as possible to the appearance of the desired behaviour. This is the basis of the operant conditioning training. Applying delayed or conflicting cues and reinforcements might hinder the success of the learning process. Already Hull (1943) found that the learning process might be influenced by the motivational level as well, thus both the need of the animal and the value of the reward need to be taken into consideration.

The learning situation might also determine the training technique. Trailer loading can be one of the most dangerous situations for both the animal and the human (Ferguson and Rosales-Ruiz, 2001). Resistant or frightened horses can pull back, kick, paw, rear etc. and all these unwanted behaviours are reinforced when the trainer gives up the loading. Traditional loading methods are based on negative reinforcement. On the other hand, researchers have found that positive reinforcement and target training can be much more effective, as improper behaviours might disappear and the animals learn to go up on the trailer willingly. On top of it, these effects seem to be generalized to novel situations. Positive reinforcement and target training can also be used to teach the animal to lift its feet, stand quietly for grooming and veterinary handling, etc.

Punishments techniques can also be effective if applied correctly (McGreevy and McLean, 2010). Riders tend to use negative punishment inadvertently and it is quite hard to use effectively in training. The main difference between negative reinforcement and positive punishment is that the former allows some control for the horses while the latter allows no control. When a horse is kicked until it moves forward for instance (negative reinforcement), it learns responses that end the aversive stimulus. When an animal is smacked or being told off when showing unwanted behaviour (positive punishment), it learns to make an association between a past event and the aversive stimulus. This technique can be very powerful but it is very easy to misuse, as the level of punishment tends to be out of proportion to the behaviour it is intended to change (McGreevy and McLean, 2010). It is extremely important that the horse understands how to avoid punishments, otherwise it might become frustrated, and in turn behavioural problems can develop.

More research and observation is needed to clarify these techniques and the efficacy to be able to integrate positive and negative reinforcement into a balanced training programme. It might also be interesting to investigate the impacts of different types and intensity of rewards and punishments on the learning processes.

7.2.3. Discrimination and generalisation

There are several studies that have tried to find out if horses make a distinction between familiar and unfamiliar people or if they actually generalise. Stone (2010) has indicated that horses are able to discriminate between photographs of different humans. As a consequence, the author suggested that photographs of the trainer should be hanged in the barn for the horse to observe and get acquainted with the unfamiliar human, in order to shorten the bonding period and the amount of time needed to train the horse. As for the behavioural responses to human contact, horses have been shown to generalise between the unfamiliar test person and humans they had interaction with earlier (Hausberger and Muller, 2002; Henry et al., 2005). However, it has also been reported that these generalised reactions might be situation-specific (e.g. horses displaying following behaviour towards the human in the round pen but not on the pasture, Krueger, 2007).

Generalisation is quite regular among riding school horses as they need to understand the inexact hand, leg and seat cues from different riders with different skills and abilities (Hanggi, 2005). In dressage horses, generalisation is unwanted, as those animals are required to discriminate between highly precise cues from their riders. Contrary to this, horses that are specialised in one discipline, like dressage horses, go through mechanical motions and are trained to perform sophisticated, precise behaviours, and as a result their cognitive skills are hindered. The study of Hausberger et al. (2004) seems to be an evidence for that. The scientists compared the learning abilities of high-level dressage horses and horses that were involved in other disciplines and the results showed that dressage horses displayed the lowest level of learning performance in simple tests. All in all, there are numerous advantages of generalisation, such as helping the horse when it has to cope with a new stimulus or new situation, especially during inclement weather conditions.

7.2.4. Early training

The process of training of horses can be started right after the birth of the animal. In order to ease training and handling, human contact early in life has been shown to have remarkable positive effects on horse behaviour. Waring (2003) compared the effect of various degrees of human contact with neonatal foals. The author compared the impacts of active handling (short separation from mother and human fondling in the first hour post-partum), passive handling (person sitting in the foaling stall) and a mannequin. The effects seem to be clear and obvious, the more handled foals performed better. The initial avoidance behaviour seemed to appear in foals with no continued exposure to a human form. Interestingly by the time the foals became 3 months old, the advantage of early handling diminished. The author emphasised that the quality and the quantity of socialisation during the sensitive period are both important to build up long-term associations. Unhandled foals were found to be less willing to leave the side of their mother compared to the handled ones, which seemed to be more confident, more curious and more willing to explore. Early handling has been found to facilitate communication and learning in horses. The positive impacts of early handling involve being able to control fear responses, habituate to new situations, have more self-confidence and interacting more with the

surroundings. Contrary to Waring´s (2003) findings, Williams et al. (2002) have found no difference between controls (foals reared on pasture with no training) and trained animals (foals receiving trainings within 48 hours after parturition) at three months of age and as a consequence, they found that imprint training have a limited and temporary effect. It should be noted though that when they tested the effect of early handling, only 20 foals were available at the age of two months, and only 9 at the age of three months, which might have had an impact on the results. Although the authors have not found significant effects of early handling, their results showed that trained foals tended to require less time to complete exposure to the stimulus and had lower heart rates during the exposure to the stimuli at 1 and 2 months of age. The authors noted that to be most effective with early handling, the training sessions probably need to be carried out closer to weaning and more frequently than in their study (at 2, 12, 24 and 48 hours after birth).

7.2.5. Conventional vs. natural training techniques

Effective training cannot be carried out without considering the human-horse relationship from the viewpoint of the horse. Domesticated horses usually must suppress instincts and learn tasks that are far from natural behaviours and must live together with humans who might display inconsistent behaviour (Hanggi, 2005). Riders need to consider the environment more from the horse's point of view to be able to understand the animals' responses better.

Currently, interest in natural horse handling (hereafter referred as 'NHH') strategies seems to be growing among riders. The foundation of this training programme is the natural ethogram of the horse (McGreevy, 2009). Wild horses use visual cues, e.g. body language for intra-species communication. In NHH techniques, the visual and gestural cues of the human are highly important. Although negative reinforcement is a key element in both styles of training, NHH involves visual signs and postures while in conventional strategies more vocal instructions tend to be used. In NHH the animals are exposed to a range of visual, auditory, olfactory and tactile stimuli to habituate and desensitise them to these stimuli.

The number of studies observing NHH is quite limited. Krueger (2007) observed horses' responses in the round pen technique, which is the basis of most of the NHH trainings. In this training process the horse is chased away from the trainer until it shows specific behaviours such as turning the ear towards the handler, chewing, licking and stretching head downwards. Afterwards, the trainer stops chasing the horse, turns his back to the animal, which stops, and the trainer offers the option to follow him. As soon as the horse leaves, the procedure starts all over with the chasing phase.

Fureix et al. (2009) also used the chasing phase, however they did not make the animal join-up (follow the trainer). They compared the effects of conventional (traditional) and natural horsemanship strategies on horses' emotional reactivity and on the human-horse relationship. They reported less head movements (jerk/shake) and whinnying in horses in the NHH group than horses which were trained with traditional methods. The NHH involved desensitisation, yielding to body pressure, lunging and free-lunging, whereas the traditional training included halter-leading, grooming/brushing, lifting feet, lunging and saddling using a girth and a saddle pad. The authors suggest that the less frequent head movements and whinnying indicated a reduction in anxiety as horses do often whinny to maintain or regain contact with other horses when socially isolated. Head movements have been described as a threat behaviour between horses and it seems it might be related to conflict-handling in the study of Fureix et al. (2009). This suggestion

is supported by the fact that horses trained in the NHH group not only performed significantly less head movements but also spent less time trotting/galloping, more time exploring the novel object in the test situations and approached the motionless test person voluntarily more rapidly. It is important to note though that there was significant difference between the two types of training. Horses in the NHH group were taught to stop the movement by returning to stand in front of the trainer (similar to join-up in the round pen technique, Krueger, 2007). Consequently, it is possible that the difference between the two groups in voluntary approach originate from the fact that the horses in the NHH group learnt this behaviour while horses trained with traditional techniques did not receive this kind of training. A further advantage of NHH training is that the animal is encouraged to remain close to the humans and its focus on the handler is reinforced.

The efficiency of and differences between the two training styles (NHH vs. traditional methods) should be further investigated and the results should be integrated in professional training programmes. To be able to do so, determining the detailed description of NHH is necessary.

8. Animal welfare implications of horse handling

Extending our knowledge on natural behaviour and cognitive abilities of horses might help riders, handlers and trainers to build a co-operative relationship with the animals and in turn reduce the rate of accidents (Pickett, 2009). The author emphasised that human-horse interactions should be based on the pair bonds that free-ranged horses tend to form between each other and not on the traditional 'master-servant' relationship. Mimicking the intra-species behaviour patterns of horses and using positive reinforcement seem to boost the efficacy of human-horse communication. Allowing the animals to observe positive human-horse interactions can also promote safety through reducing fearfulness of the animals. Foals of mares which had received gentle handling (soft brushing, feeding from hand) have been shown to be less fearful and more co-operative (in accepting saddle pads on their backs) compared to control animals (Henry et al., 2005). Harmonious human-horse co-operation is a result of the rider's ability to show consistent and clear cues that the animal can understand and recognise from its training history and its correct response to these cues (Pickett, 2009). Application of correct and efficient training techniques might prevent the 'wastage' of animals.

Improving the knowledge and skills of horse enthusiasts is a key to increase the level of animal welfare. However, Visser et al. (2012) found that the theoretical (conceptual or "knowing that") knowledge tend to be ignored or is simply not built into daily practices because of the lack of procedural knowledge ("knowing how"). For instance, 98.3% of the respondents knew what weaving was and most of them associated it with frustration, still approximately half of them found antiweave grill and social isolation as the most convenient solution for this problem. It seems even though riders are aware that these solutions are only partly or not at all treating the symptom or might even result in higher stress levels, they simply don't know any other, more successful methods to overcome this problem. Horse enthusiasts seem to investigate animal behavioural issues and the most important sources of information are the veterinarians and farriers because of their knowledge and experience. Therefore, particular attention should be paid within these professional education programmes.

McLean and McGreevy (2010) revealed that incorrect teaching methods and restraining techniques might create confusion in the animal and compromise welfare. The authors emphasise

the welfare implications of hyperflexion of the neck during riding. In this position the horse's neck is dorsoventrally over-bent as a result of bit pressure and the chin might even touch its pectoral region (the nasal plane carried behind the vertical). Interestingly, penalty points are given in dressage competitions for this posture, however it is widely used in training and warming-up before competitions to force "on the bit" rein contact and achieve improvement in athletic or behavioural responses. It has been shown that riders tend to use increasingly strong rein pressure, to cause pain in the mouth, until the animal moves its mouth towards the rider's hands in an attempt to relieve the bit pressure (McLean and McGreevy, 2010). Even though it the authors showed that this technique induce discomfort to the animal and provide riders with complete domination, creates hollow loins and jerkiness of the hind legs and create physical stress at the level of the intervertebral discs, in the nuchal ligament and in the withers it is still widely used on a daily basis. The use of rein tensionmeters might be a good solution, however, first, there should be an agreement on what is considered to be excessive and acceptable level of rein pressure and how the level of discomfort and pain can be measured. As a consequence of hyperflection the horse might lose some of its stop response which, in turn, might undermine human safety. It is questionable what correct rein contact is and how it can be achieved in a less aggressive way. In dressage competitions, unfortunately, the training process and how the final results are achieved are not taken into consideration. Regular use of tensionmeters might help the riders to control the rein pressure they use during the training process. Moreover, these devices might give supply more information for the judges at the competitions, as well. The misuse of side-reins, martingales, tie-downs, nosebands, shock-collars, whips and spurs might all cause pain in the animal which has been shown to lead to hyper-reactivity, increased vigilance (e.g. bucking, rearing and shying), raised heart rate and raised blood pressure (McLean and McGreevy, 2010). If the animal suffers from pain in a long period, the active coping mechanisms can turn to learnt helplessness for instance, in which the animal shows hypo-reactivity, apathy, decreased vigilance, lowered heart rate and blood pressure while showing physiological signs of chronic stress. Sedation and nerve blocks are used to manipulate the behaviour of the horse to make the animal more manageable and eliminate undesirable responses e.g. tail movement (Houpt, 2002), even though it is well-known that these practices can affect the horse's ability to move safely. Using pharmaceuticals to manipulate the behaviour is unethical and monitored by the FEI (Fédération Equestre Internationale). With regard to the nerve blocks detection is quite difficult and the electric activity of the muscles need to be measured.

Several practices are highly questionable when it comes to equine handling and training. More scientific evidence is needed to be able to make a decision about which methods should be abandoned or changed and how to achieve success and safeguard horse welfare simultaneously.

9. Discussion

Since horse-related activities are among the most dangerous recreational activities, it is essential to investigate factors that can lead to reduction of the injury risk of both humans and animals. As a result of accidents humans and horses can suffer from severe, long-term injuries and the injuries can even be fatal. In the current project I reviewed the scientific literature on the relation between human safety and horse handling and revealed ways to support riding instructors, riders, handlers, farriers and veterinarians to be able to reduce the injury risk.

9.1. Human injuries and risk factors

When it comes to injury risk related to horse riding three factors can be emphasised for riders to think about (Medical Equestrian Association, the UK). These are human behaviour, horse behaviour and equipment. The use of personal protective equipment such as helmets, vests and protective footwear is highly recommended, however they will not reduce the number of incidents. Of course, once the incident is inevitable protective equipment can reduce the level of injury. The effectiveness of this equipment requires further scientific examination. As for human behaviour, it is very important to understand that proper knowledge and experience are essential and this can be gained through experienced trainers. For a rider, especially if he is a novice one, it can be quite difficult to decide which trainer meets the individual needs best. The current review is aiming to help equestrian people to understand the world of horses, how they perceive their environment, their learning abilities and personality traits. Important aspects of human behaviour have also been discussed to raise awareness about how essential it is to improve attention and observational skills of humans. Observing and being able to read the body cues of the horse is essential for an effective two-way communication to be built up between the handler and the animal. Training strategies based on effective communication contribute to more predictable horse behaviour, which in turn leads to decreased injury risk of humans and safer horse handling.

9.2. Equine perception, learning and personality

With regard to equine perceptual world, horses have been found to use auditory and visual senses primarily for immediate predator detection. How and what exactly horses can see seems to be controversial in the scientific world. Some people state that horses do not have the human's daytime capacity to resolve detailed images or recognise objects by vision only. Contrary to this, horses have been found to be able to discriminate even between photographed human faces, using facial characteristics. With regard to their colour vision, horses tend to respond in the same way as some green/red colour deficient humans. It has also been revealed that the perspective of the object may matter. After rotating known objects, recognition was easier for the animals once they saw the top part of the objects compared to when the bottom part was visible. The different perspective seems to give an answer to why horses hesitate at objects they have seen before. Because of the small sample size, further investigation would be beneficial. Regarding equine auditory abilities the availability of scientific experiment is limited. Compared to humans high-frequency hearing of the horse extends far above what humans can hear, but horses seem to be less able to localize the point of origin of brief sounds. It would be interesting to investigate the response to different stimulus intensities and find out the level of intensity to receive vigilant postures to be able to see how intensive stimulus is needed for the horse to show certain behavioural patterns, especially vigilance.

The main route of communication of the rider is the touch. Over the years, I observed that horses tend to swish their tails, flick their ears, stomp their foot, shake their heads and bite during training sessions and even at competitions. This is quite controversial considering that training sessions are used for developing and improving the communication between the human and the animal and competitions are supposed to measure the success of the training. The importance of these behavioural responses were emphasised by Saslow (2002) who investigated how horses

detect a fly landing on the animals' body and how they try to get rid of unpleasant stimuli. Whether these behaviours correspond with those avoidance patterns shown by horses during handling, training and competitions should be further investigated. These cues might help to reduce the risk of human injury as long as the human is able to interpret them successfully and change the training/handling strategy accordingly so that the stimuli become more pleasant for the animal. It should be a warning sign for the humans when the intensity of these indications of avoidance behavioural increase. It is questionable though, at what level these cues become too intensive and exactly when the human should change the handling method in order to reduce the risk of injuries.

In the scientific literature, it seems to be controversial whether dominant teaching strategies (human dominance, equine submission) should be used and if so, in which situations it could be useful to improve the success of equine learning. Subordinate horses in established groups tend to respond with avoidance to the dominant animals when it comes to resources. On the other hand, horses have been shown to copy the follow behaviour towards the human if they had the chance to watch a dominant horse executing the task. Using the social learning skills of horses can be useful when the animal has to face a new situation e.g. new place, using the automatic drinker. As in any other species, the timing of exposure to the stimulus and the introduction of the associated reinforcement method determines equine learning behaviour. Delayed, conflicting, meaningless cues confuse the animal and, in turn, increases equine and human injury risk. How good learner a horse is cannot be categorised by observing the animal in different learning tests. It seems it highly depends on the type of task they have to learn. In general, it seems that calmer animals are more successful in learning compared to the more reactive subjects. In learning tests, usually food reward is used as reinforcement. McCall (1989) also found correlation between the body condition and learning performance, which might purely reflect the fact that fatter horses are less motivated to receive food reward compared to skinnier animals. Nicol (2002) emphasised that fearfulness and attention are further factors that might determine success or failure of the learning process.

Personality of the horse reflects the behaviour which is modified by its experience. It is not stable over time and situations. Riders and breeders seem to be more concerned about the personality of their horses and their willingness to work compared to their actual performance traits e.g. quality of trot, show jumping. Personality traits have been found to strongly relate to the daily work with the animal and safer and more comfortable handling. Personality of the horse is of great importance, however, scientific results on these traits seems to be slightly unreliable as horses' responses seem to be inconsistent over the trials. Considering the variability of horses' behaviour in the novel object test (which is widely used to describe personality) I believe, it would be interesting to observe if horses differentiate between novel objects with different shape, colour and size. According to Christensen et al. (2008) horses are able to generalise between visual objects. As a consequence, some horses might make associations between the novel object and objects they had seen earlier in their lives and in turn, the novel object might be familiar for the animal during the test situation. In this case, the original fear responses might be altered by the previous positive/negative experiences of the animal. Moreover, the results of Seaman et al. (2002) show that horses actually needed more time to approach the novel object over the trials, which I claim, might have been the result of habituation (no significant differences have been reported though). Consequently, horses were probably less and less interested in investigating the novel object. The main concern is that non-curious animals and fearful animals will both show long latency to approach the novel object, and that is why it is probably not a reliable way to

make conclusions regarding the animal's personality. Since the existing personality tests seem to be controversial, it raises the questions whether they should be used exclusively on untrained/unbroken animals.

9.3. Human behavior and comprehension of horse behavior

In order to be able to reduce injury risk, human comprehension is a key element. Human behaviour, posture, vocal signs, focus of attention and movement are all of importance. Negative emotional responses in horses have been found to be lateralised and the right hemisphere seems to process these responses. Visual and olfactory laterality have been emphasised by researchers, however in the experiments a similar T-shirt (similar to what was worn by the stud farm veterinarians) was used. De Boyer Des Roches et al. (2008) presumed that it was potentially associated with stress-inducing situations. As for the latency to approach the object, horses did not need significantly more time to approach the negative stimuli (T-shirt) compared to the neutral stimuli (cone), which I believe reflects that horses either did not consider the T-shirt as a stress inducing stimuli or they considered the cone just as stressful. Even though the proper direction of approach is controversial, the speed of approach has been detected to make a difference on the animal's avoidance behaviour. Moving slowly was clearly preferable. Emotional cues also have an obvious effect on horse behaviour. Negative feelings towards the animal and nervousness of the rider (detected by HR and HRV) tend to increase the anxiety and reactivity of the animal. Because of the differences in human and equine personalities and the interaction between the two, there is no recipe-based information available on optimal human behaviour. However, scientific observations can help to improve attention and observational skills to be able to understand the body cues of horses more easily.

9.4. Implementation of human and horse factors in training programmes

In order to be safer around horses effective cooperation between the horse and the rider is needed. To be able to build up this cooperation, equine perception, learning abilities and personality needs to be taken into account. Before the training session the instructor needs to make sure that the animal feels comfortable physically and emotionally. It is crucial to gain and maintain the animal's trust and ensure that it has a 'positive perception' towards the handler. This can be reached through successful regular training only. Horses are similar to humans: they seem to learn and memorise more easily when the process is associated with a positive situation. In contrast, the foundation of conventional training is negative reinforcement and punishment. Hanggi (2005) highlighted that some horses tend to learn better through positive reinforcement, whereas others performed better when they needed to avoid a negative stimulus. It has also been emphasised that some learning abilities are similar under positive and negative reinforcement conditions; ponies that showed better learning performances in the positive reinforcement single-choice maze test also performed better in a shock avoidance test (Hanggi, 2005). When negative reinforcement is applied, the horse might give a flight response to the rider's aversive stimuli, and if that occurs often, riding behaviour problems might develop. More scientific research would be essential to reveal how to develop training programmes based on positive situations and to make the animal actually enjoy the learning process. Training right after birth (early/imprint training) has been found to be a good 'tool' to facilitate human-horse communication and to improve equine learning. It is questionable whether it is possible to build

up a long-term training programme based solely on positive perception, and if so, how exactly and what level can be reached. Would it be a quicker, more effective way in a long run even in the case of professional athletes?

In order to reduce the injury risk of the rider, instructors prefer to train the horses on the ground first before mounting. I believe all horses should be taught to move forward, stop and turn on the ground first effectively to make sure that the animal understands these basic commands before the rider tries to control them from the saddle. I believe, this should be the foundation of all training strategies. The training programme should progress gradually from basic familiar tasks to more difficult. At the same time the foundation always have to be solid and checked, no matter how high level the training or specific task is.

Even though so many aspects of efficient and effective training are controversial in the scientific world and the strategies might involve habituation, conditioning, discrimination or generalisation, there is a consensus of opinion on certain human behaviour patterns. Signals and commands should be clear, response-specific so that the animal can easily distinguish. Solid and predictable associations between the cues and outcome are needed otherwise the animal might become frustrated, which might undermine the learning ability and increase injury risk. A training method is claimed to be good once it helps to achieve success and minimise stress for both the human and the horse. Gradual and repeated exposure to new stimuli have been shown to alleviate unwanted stress responses.

When a horse is frightened by another horse, it might display similar body signals when it is frightened during a veterinary check. I believe these intra-species signals should be further investigated and the results should be built into the horse riding sessions. Horses usually perform slight body signs (‘subtle warning signs”) that we, humans tend to ignore. Probably the rate of accidents could be reduced if humans were able to read these initial subtle signs and respond accordingly. Regardless of the training techniques, I believe the key to the successful training strategy is being able to understand the body cues of the horse and respond accordingly. Looking for the signs of a relaxed horse e.g. licking the lips, chewing, lowered head position and signs of focusing attention on the trainer e.g. head, ears, eyes point towards the human (Seaman et al., 2002) might be signs that show that the animal understands the tasks and is comfortable during the interaction with the human.

9.5. Animal welfare implications of horse handling

The key to improve animal welfare is to develop the knowledge and skills of horse enthusiasts. Scientific knowledge should be available for everyone in the equestrian world and it needs to be implemented in training programmes and even in FEI competition rules regardless of the level or the discipline. When an unwanted behavioural problem appears, even though riders are aware that certain solutions are only partly or not at all curing the problem or might even result in higher stress levels, they simply do not know any other, more successful methods. The most important sources of information for riders have been shown to be the instructors, veterinarians and farriers because of their knowledge and experience. Therefore, education programmes need special attention. Continuous scientific work is needed to enable decisions on which training strategies should be supported, and which need to be amended or abandoned.

10. Further Research

Recently, natural horse handling (NHH) strategies have started to be more and more popular in the equestrian world. Even within the NHH training, different approaches are available. Some of the NHH trainings are based on the join-up process in the round pen technique. Other NHH instructors claim that the chasing phase is unnecessary and the horse only need to be sensitised to the neck, shoulder and hindquarters on the ground first before the first mounting to make sure that the animal is able to go forward, stop and turn. After the horse learnt to respond properly, it needs to be taught to respond from the saddle, as well (Honza Bláha, Line Free Collection, personal communication, 2006). It is suggested that if these sensitisation trainings are carried out properly, it is much easier to control the horse's movements even during a flight response as the head, neck or hindquarters are responsive (the horse can be turned) which helps to block the flight movements (e.g. running away). As a result the animals' behaviour can be controlled much more effectively which in turn reduces the injury risk. In feral groups, the following behaviour between horses is displayed as a sign of social attachment. There is no need for the animals to chase each other to gain attention or show following behaviour. Whether horses respond in a different way if the chasing phase of the NHH is left out, what other NHH strategies are effective and efficient and how it can be built in professional training programmes need further scientific investigation.

I believe investigating the differences between the short-term and long-term effects of conventional (traditional) versus NHH techniques is essential. This could be observed in a test situation in which two groups of horses (NHH vs. conventional) are trained to carry out exactly the same target movement. After the initial training sessions, the animals could be tested in further tasks in which they are required to perform movements other than the ones they learnt during the preliminary training session. In this way the lack of training would not influence the results as it did in the study of Fureix et al. (2009). For instance, the effects of the first training sessions of naïve horses could be compared. One group of animals would be trained with NHH techniques while the other group with conventional methods by the same trainer to prevent confounding between method and trainer. After the preliminary training on the ground e.g. for 5 days (15 min per day), horses could be tested during their first riding experience. In this way the effects of NHH compared to conventional methods on the horses' responses to their first riding experiences could be compared. The behaviour through the training sessions could be monitored, as well, to see whether there is any difference in the cooperative behaviour. The time and financial investment and long-term effects need further investigation, as well.

Based on the current project a check list might be useful to build up for training instructors as a guide towards safer training strategies. The check list could be based on the knowledge on horse behaviour, equine perception and learning abilities, equine personality and human perception. It could help instructors assess the abilities of the humans and horses, finding the best animal for each and every discipline/purpose. The list could cover three main areas. First, it would include questions that refer to the efficiency and effectiveness of the training strategies. The second stage would be used to check the theoretical knowledge of riders/handlers on equine behaviour before mounting. Last but not least questions would refer to the body cues of the animals to see how much the instructor/rider is aware of these cues, how much he can understand them and change his behaviour accordingly. I believe a check list, through educating equestrian people, would effectively contribute to reduced injury risk and safer horse handling.

11. Conclusion

The current project supports riding instructors, riders and all horse enthusiasts to see how safety can be increased through understanding the injury patterns and risk factors of accidents, the perception, learning abilities and personality of the horse. According to the scientific literature the most common injury pattern is falling or being thrown from the horse. The primary risk factor of equine related accidents seems to be the flight responses of the animals (e.g. spooking). Significant risks factors involve being a female and riding in English style. The level of experience of the rider and the age of the animal also seem to be of importance (older animals seem to be less reactive). Not only the horse perception but also the learning abilities and personality of the horse seem to have an impact on human safety. Horses perceive the world differently compared to humans. Their auditory, tactile and olfactory receptors are more sensitive and their perspective of objects matters, which provides a possible answer to why they startle even though the object is familiar to them. Learning abilities of horses has been shown to depend on the individual and the type of task. However, calm animals show better learning performance compared to more reactive animals. The personality of the horse seems to have a crucial impact on human safety, however the reliability of the personality tests is questionable. A combination of these uniform tests might be a solution to be able to match the animal to a specific role. Even though there is no recipe-based method how to interact with horses, through improving our observational skills the risk of accidents can be reduced. All the above mentioned human and horse related factors should be implemented in training programmes to be able to reduce injury risks of both humans and animals. Regular and gradual training is needed and the 'positive perception' of the animal towards the handler needs to be maintained. The instructor needs to make sure that the animal feels physically and emotionally comfortable and that the signals and commands are clear and response-specific. The foundation of successful training lies in understanding the body cues of horses including even the subtle warning signs that we humans tend to ignore. Being able to behave according to these cues might lead to better human-horse communication, which in turn increases human safety. The animal's behavioural responses throughout the training session needs be taken into consideration and the signs of a relaxed horse (e.g. licking the lips, chewing, lowered head) seem to confirm that the animal understands the task. It is clear that more scientific evidence is needed to describe which handling and training strategies should be supported, altered or even banned to be able to improve human safety and safeguard horse welfare. Particular attention needs to be paid to the education programmes of horse enthusiasts.

12. Acknowledgement

I would like to thank Professor Lena Lidfors for her help and support and Dr Katalin Maros for her comments and suggestions. I am also grateful to Honza Bláha, Gyula Mészáros and Mónika Boross for their comments on the current project, their training sessions and advices.

13. References

Abu-Zidan, F. M., Rao, S., 2003. Factors affecting the severity of horse-related injuries. Injury, 34, 897-900.

Ball, C. G., Ball J. E., Kirkpatrick, A W., Mulloy, R. H., 2007. Equestrian injuries: incidence, injury patterns, and risk factors for 10 years of major traumatic injuries. The American J. Surg., 193, 636-640.

Birke, L., Hockenhull, J., Creighton, E., Pinno, L., Mee, J., Mills, D., 2011. Horses' responses to variation in human approach. Appl. Anim. Behav. Sci., 134, 56-63.

Boissy, A., 1995. Fear and fearfulness in animals. Quarterly Review of Biology, 70, 165–191.

Christensen, J.W., Keeling, L.J., Nielsen, B.L., 2005. Responses of horses to novel visual, olfactory and auditory stimuli. Appl. Anim. Behav. Sci., 93, 53-65.

Christensen, J.W., Zharkikh, T., Ladewig, J., 2008. Do horses generalise between objects during habituation? Appl. Anim. Behav. Sci. 114, 509-520.

Clarke, C. N., Tsuei, B. J., Butler, K. L., 2008. Equine-related injury: a retrospective analysis of outcomes over a 10-year period. The American J. Surg., 195, 702-704.

Csapó, G. 1972. Szopós csikók fokozatos elválasztása. Állattenyésztés, 21, 279–288.

De Boyer Des Roches, A. De B., Richard-Yris, M-A, Henry, S., Ezzaouïa, M., Hausberger, M., 2008. Laterality and emotions: Visual laterality in the domestic horse (*Equus caballus*) differs with objects' emotional value. Physiol. & Behav., 94, 487-490.

De Boyer Des Roches, A. De B., Richard-Yris, M-A, Henry, S., Ezzaouïa, M., Hausberger, M., 2008. Laterality and emotions: Visual laterality in the domestic horse (*Equus caballus*) differs with objects' emotional value. Physiol. & Behav., 94, 487-490.

Feh, C., de Mazières, J., 1993. Grooming at a preferred site reduces heart rate in horses. Appl. Anim. Behav. Sci., 46, 1191-1194.

Feist, J.D., McCullough, D. R., 1976. Behavior patterns and communication in feral horses. Z. Tierpsychol. 41, 337–371.

Ferguson, D.L., Rosales-Ruiz, J., 2001. Loading the problem loader: the effects of target training and shaping on trailer-loading behaviour of horses. J. Appl. Behav. Anal., 34, 409-424.

Forkman, B., Boissy, A., Meunier-Salaün, M-C., Canali, E., Jones, R.B., 2007. A critical review of fear tests used on cattle, pigs, sheep, poultry and horses. Physiol. & Behav,, 92, 340-374.

Fraser, A. F. 1992. The behaviour of the horse. CABI Publishing, Wallngford, UK.

Fureix, C., Jego, P., Sankey, C., Hausberger, M., 2009. How horses (Equus caballus) see the world: humans as significant “objects”. Anim. Cogn., 12, 643–654.

Graf, P., von Borstel U.K., Gauly, M., 2013. Importance of personality traits in horses to breeders and riders. J. Vet. Behav: Clinical Appl. and Research, 8, 316-325.

Hama, H., Yogo, M., Matsuyama, Y., 1996. Effects of stroking horses on both humans’ and horses’ heart rate responses. Jpn. Psychol. Res., 38, 66–73.

Hanggi, E. B., 2005. The Thinking Horse: Cognition and Perception Reviewed. In-Depth Behav., 51, AAEP Proceedings (accessed on 08.27.2014)
http://www.equineresearch.org/support-files/hanggi-thinkinghorse.pdf 16.08.2013

Hanggi, E. B., 2010. Rotated object recognition in four domestic horses (Equus caballus). J. Equ. Vet. Sci., 30, 175-186.

Hanggi, E. B., Ingersoll, J.F., Waggoner, T.L., 2007. Color vision in horses (Equus caballus): defciencies identified using a pseudoisochromatic plate test. J. Comp. Psychol., 121, 65–72.

Hartman, E., 2010. Managing Horses in Groups to Improve Horse Welfare and Human Safety - Reactions to Mixing and Separation, Doctoral Thesis, Swedish University of Agricultural Sciences, Uppsala.

Hausberger, M., Muller, C., 2002. A brief note on some possible factors involved in the reactions of horses to humans. Appl. Anim. Behav. Sci., 76, 339–344.

Hausberger, M., Roche, H., Henry, S., Visser, E., 2008. A review of the human–horse relationship. Appl. Anim. Behav. Sci., 109, 1–24.

Hawson, L.A., McLean, A.N., McGreevy, P.D., 2010. Clinical Applications and Research, J. Vet. Behav., 5, 324-338.

Hemsworth, P. H., Barnett, J. L., Hansen, C., 1981. The influence of handling by humans on the behavior, growth, and corticosteroids in the juvenile female pig. Hormones and Behavior, 15, 396-403.

Henry, S., Hemery, D., Richard, M.-A., Hausberger, M., 2005. Human–mare relationships and behavior of foals toward humans. Appl. Anim. Behav. Sci., 93, 341–362.

Hockenhull, J., Creighton E., 2013. Training horses: Positive reinforcement, positive punishment, and ridden behaviour problems. J. Vet. Behav., 8, 245-252.

Houpt, K. A., Rudman, R., 2002. Foreword to special issue on equine behaviour. Appl. Anim. Behav. Sci. 78, 83–85.

Hull, C.J., 1943. Principles of Behaviour. D. Appleton Century, New Haven, USA.

Jagodzinski, T., DeMuri, G.P., 2005. Horse-related injuries in children: a review. Wisconsin Med. J. 104, 50-54.

Keeling, L.J., Jonare, L., Lanneborn L., 2009. Investigating horse–human interactions: The effect of a nervous human. The Vet. J. 181, 70-71.

Krueger, K., 2007. Behaviour of horses in the "round pen technique". Appl. Anim. Behav. Sci., 104, 162-170.

Krueger, K., Heinze, J. 2008. Horse sense: social status of horses (Equus caballus) affects their likelihood of copying other horses' behaviour. Anim. Cogn., 11, 431-439.

Lansade, L., Bertrand, M., Bouissou, M-F., 2005. Effects of neonatal handling on subsequent manageability, reactivity and learning ability of foals. Appl. Anim. Behav. Sci., 92, 143-158.

Larose, C., Rogers, L. J., Richard, M-A., Hausberger, M., 2006. Laterality of horses associated with emotionality in novel situations. Laterality, 11, 355–367.

Le Scolan, N., Hausberger, M., Wolff, A., 1997. Stability over situations in temperament traits of horses as revealed by experimental and scoring approach. Behav. Proc. 41.

Mader, D.R., Price, E.O., 1982. Discrimination learning in horses: effects of breed, age and social dominance. J. Anim. Sci. 50, 962-965.

Maros, K., Boross, B., Kubinyi, E. 2010. Approach and follow behaviour – possible indicators of the human–horse relationship. Interaction Studies. John Benjamin's, 11, 410-427.

McBride, S. D., Hemmings, A., Robinson, K., 2004. A preliminary study on the effect of massage to reduce stress in the horse. J. Equ. Vet. Sci., 24, 76-81.

McCall, C.A., 1989. The effect of body condition of horses on discrimination learning abilities. Appl. Anim. Behav. Sci. 22, 327-334.

McGreevy, P., 2004. Equine Behavior: A Guide for Veterinarians and Equine Scientists. Saunders Elsevier. 85-135.

McGreevy, P., McLean, A. 2010. Equitation Science, Wiley-Blackwell, Chicester, UK.

McGreevy, P.D., Oddie, C., Burton, F.L., McLean, A.N., 2009. The horse–human dyad: Can we align horse training and handling activities with the equid social ethogram? Vet. J. 181.

McLean, A. N., 2005. The positive aspects of correct negative reinforcement. Anthrozoos. 18, 245-254.

McLean, A.N., McGreevy, P.D. 2010. Horse-training techniques that may defy the principles of learning theory and compromise welfare. J. Vet. Behav., 5, 187-195.

Medical Equestrian Association. Risk of Injury & Risk Management. (Accessed on 11.10.2014) http://www.medequestrian.co.uk/rider-safety/benefits-and-risks-of-riding/risks-of-injury-risk-management/

Meyers, M.C., Bourgeois, A. E., LeUnes, A., Murray. N. G., 1999. Mood and psychological skills of elite and sub/elite equestrian athletes. J. Sport Behav. 22, 339-409.

Mills, D. S., 1998. Personality and individual difference in the horse, their significance, use and measurement. Eq. Vet. J.: Behaviour supplement 27.

Murphy, J., Arkins, S., 2007. Equine learning behaviour. Behav. Proc., 76, 1-13.

Nicol, C.J., 2002. Equine learning: progress and suggestions for future research. Appl. Anim. Behav. Sci., 78, 10, 193-208.

Pickett, H., 2009. Horses: Behaviour, Cognition and Welfare. https://www.ciwf.org.uk/includes/documents/cm_docs/2009/h/horse_behaviour_cognition_welfare_may09.pdf (Accessed on 10.10.2014)

Price, E.O., 2008. Principles and applications of domestic animal behaviour. Cambridge University Press. Cambridge, UK. 51, 227-247.

Sankey, C., Richard-Yris, M-A., Leroy, H., Hausberger, M., 2010. Positive interactions lead to lasting positive memories in horses, Equus caballus. Anim. Behav., 79, 869-875.

Saslow, C.A. 2002. Understanding the perceptual world of horses. Appl. Anim. Behav. Sci. 78, 209-224.

Seaman, S. C., Davidson, H P B., Waan, N. K., 2002. How reliable is temperament assessment in the domestic horse (Equus caballus)? Appl. Anim. Behav. Sci., 78, 175-191.

Stone, S. M. 2010. Human facial discrimination in horses: can they tell us apart? Anim. Cogn., 13, 51–61.

Summerhayes, R.S., 1975. The Problem Horse. J.A. Allen & Co. 89-92.

Symes, D., Ellis, R., 2009. A preliminary study into rider asymmetry within equitation. The Vet. J., 181, 34-37.

Terlouw, E.M.C., Boissy, A., Blinet, P., 1998. Behavioural responses of cattle to the odours of blood and urine from conspecifics and to the odour of faeces from carnivores. Appl. Anim. Behav. Sci. 57, 9–21.

Timney, B., Keil, K., 1992. Visual acuity in the horse. Vision Research, 32, 2289-2293.

Ueeck, B. A., Dierks, E. J., Homer, L. D., Potter, B., 2004. Patterns of Maxillofacial injuries related to interaction with horses. American Association of Oral and Maxillofacial Surgeons J Oral Maxillofac Surg., 62, 693-696.

Visser, E. K., Van Reenen, van der Werf, J. T. N., Schilder, M. B. H., Knaap, J. H., Barneveld, A., Blokhuis, H. J. 2002. Heart rate and heart rate variability during a novel object test and a handling test in young horses. Physiol & Beh. 76, 289-296.

Visser, E. K., Van Reenen, C. G., Rundgren, M., Zetterqvist, M., Morgan, K., Blokhuis, H. J. 2003. Responses of horses in behavioural tests correlate with temperamnet assessed by riders. Equ. Vet. J. 35, 176-183.

Visser, E. K., Van Wijk-Jansen, E. E., C., 2012. Diversity in horse enthusiasts with respect to horse welfare: An explorative study. J. Vet. Behav.: Clinical Appl. And Res., 7, 295-304.

Waiblinger, S., Boivin, X., Pederson, V., Tosi, M. V., Janczak, A., Visser, K., Jones, R. B., 2006. Assessing the human–animal relationship in farmed species: a critical review. Appl. Anim. Behav. Sci., 101, 185–242.

Waiblinger, S., Menke, C., Korff, J., Bucher, A., 2004. Previous handling and gentle interactions affect behaviour and heart rate of dairy cows during a veterinary procedure. Appl. Anim. Behav. Sci., 85, 31–42.

Waran, N., 2002. The Welfare of Horses. Kluwer Academic Publishers, Dordrecht, Netherlands.

Waring, G.H., 2003. Horse Behaviour. Second Edition. Noyes Publications. William Andrew Publishing, Norwich, New York, USA.

Warren, J.M., Warren, H.B., 1962. Reversal learning by horse and raccoon. J. Genet. Psychol. 100, 215–220.

Williams, J. L., Friend, T. H., Toscano, M. J., Collins, M. N., Sisto-Burt, A., Nevill, C. H., 2002. The effects of early training sessions on the reactions of foals at 1, 2, and 3 months of age. Appl. Anim. Behav. Sci., 77, 105–114.

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