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Social contact in horses: implications for human-horse interactions

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Abstract

The ancestors of the domestic horse were important prey species for many predators, including humans. Equids possess few physical defence mechanisms, relying on survival strategies centred on the formation of cohesive social bonds within stable groups. Mutual grooming is common between these individuals, maintains bonds and can be a source of reassurance following social conflict. Disruption of these bonds is associated with great social stress. Social isolation is uncommon in natural horse society.

Around 6000 BC the history of human-horse interactions began to change as the Eurasian wild horse population dwindled, threatening an important food resource. Early domestication processes began with human groups maintaining associations with free-ranging groups of mares and geldings, that were ridden, herded and harvested as meat, milk and hides. Cultural differences in approach to the human-horse relationship have been evident from ancient and classical history. These differences persist to the present day. There are two main approaches, a co-operative approach based upon understanding the behaviour of the horse, and an alternative approach based on human dominance and equine submission. Social interactions and contact between humans and horses have reflected these differences in approach.

Current management practices for horses are driven by human requirements and costs limitations, but often ignore basic equine needs. Intensive management of performance and leisure horses is frequently associated with social isolation, considerable alterations of feeding and foraging practices and confinement. These have behavioural and physical consequences for the health and welfare of horses. Preventive and curative behavioural solutions offer welfare, practical and financial advantages

Keywords: Horses; social behaviour, human-horse interactions, domestication, husbandry practices

1 Social behaviour of ancestral, feral and free-ranging horses

1.1 Social organisations in feral horses

Feral equids are adaptable, ranging from high to low altitudes and inhabiting northern boreal plains, temperate forest, semi deserts and salty ocean shores. Despite this large variety, the social and spatial organisation of all studied feral populations are remarkably similar. Feral equid societies are mainly large, homomorphic and polygynous. Linklater (2000) compared the social and spatial organisation of 19 feral populations. He concludes, that, in areas with an unmanaged sex ratio, horses are generally organised in discrete, long-term stable, non-territorial reproductive associations. These usually comprise one (or occasionally a few) stallion(s), several adult mares and their offspring. These groups are referred to as harems, multiple male or family bands (Linklater et al., 2000; Berger, 1986). In most cases there is a skewed, mare biased, sex ratio within a reproductive band, resulting in surplus stallions who often congregate in less stable bachelor bands (Duncan, 1991; Linklater, 2000; Waring, 2003). Occasionally authors describe the aggregation of family and bachelor bands into multilevel societies (herds). These do not only exist among zebra (sub) species (*Equus quagga spp*) but also occur within several feral domesticated horses (Wernicke & Van Dierendonck, 2003; MvD *pers. obs.*: Mongolian ponies). It is likely that herds were the predominant social organisation of Eurasian feral horses, since older textbooks refer to 'aggregation of family bands into herds of 600-1000 horses', possible due to large predation threats (Schimmel, 1914). Within these herds there is clear interaction between bands, as well as coordinated escape in predation attacks. Both inter and intra band spatial and dominance relations occurred. Variations of this social organisation develop in areas where humans manage sex ratios (Linklater, 2000).

1.2 Social life history of feral horses

Horses are precocial developers and thus develop rapidly during their first few hours and days of life. Within hours they perform a range of instinctive and learned behaviours, which they need to successfully bond with their dam and learn to recognise other natal band members. Within days foals assimilate with their natal band and interactions increase with their peers, siblings and other herd members (Waring, 2003; Weeks et al., 2000; Houpt, 2002; Van Dierendonck unpub. data). They learn the social codes, develop physical abilities and explore their physical environment (Mills & Nankervis, 1999). Approximately a month before the birth of a new sibling the dams gradually wean their foals (Waring, 2003; Apter & Householder, 1996). In temperate areas, most mares are seasonal breeders typically producing 4 foals in 6 years (Tyler, 1972) (depending on the quality of the habitat).

Contrary to many species, in equids both sexes usually disperse between 1 and 3 years of age (Monard et al., 1996; Khalil & Kaseda, 1997). To avoid inbreeding,

juvenile mares prefer to move to groups with familiar residential mares but no familiar stallions, while juvenile stallions prefer bands with unfamiliar conspecifics (Monard & Duncan, 1996). A bachelor unit facilitates a second phase of physical and social development of young stallions in a socially 'less-serious' environment (Hoffman 1985 in (Waring, 2003). Stallions gain their own mares by several strategies, including abduction and duelling, and start establishing heterosexual relationships when approximately 5-7 years (Kaseda et al., 1997). Feral horses are seldom solitary during their life neither during a change of band, nor when aging, but social isolation is always associated with social stress.

1.3 Social and physical contact in feral horse societies

Social behaviour is essential to minimise conflict and in promoting stability within a group (Goodwin, 2002). An equine social unit can only act cohesively when individuals recognise each other and have predictable responses during social interactions, reducing the risk of injury through affiliative and agonistic (offensive, defensive and submissive behaviours) communication (Tyler, 1972; Van Dierendonck et al., 1996).

Social relations can be characterised in relation to areas of personal space that individuals perceive around themselves (Rees, 1984, Mills & Nankervis, 1999). The flight zone is that distance an individual actively maintains between itself and a perceived threat. In cases when there is neither a strong positive nor negative relationship, individuals are tolerated within another's tolerance zone. Personal space differs from the flight zone and tolerance zone in distance and, social function. Generally, lower ranking animals respect the personal space around a higher-ranking individual, while preferred partners often associate within each other's personal space. During affiliative interactions, individuals are actively encouraged to enter each others' personal space.

1.4 Social positive (affiliative) relations

Social affiliation is essential to keep a social society together (Lindberg, 2001). Preferred attachment between certain individuals is recorded in almost all systems at various levels, not only between dam and foal, but also among peers of all ages, genders and between species. During the first years of the reintroduction of Takhi (Przewalski's horses: *Equus przewalskii*) in Hustain Nuruu, Mongolia, the first-born colt foal had neither peers nor siblings. He was the first to disperse but, as being the first, there were no equine bachelors to associate with. For several weeks at a time, he was recorded as within a herd of young red deer (*Cervus elphus*). Only a year later, when younger peers also dispersed they formed a bachelor group together (MvD *pers. obs.*). It is interesting to note that until the present, this stallion has not been able to control his own mares, in contrast to many of his younger peers or siblings, possibly because he has not adequate learned the essential social skills for this task. Social facilitation / group living gives young animals social models, first from

the dam then peers and other group members, that help to learn appropriate behaviour for each role (Dumont & Boissy, 1999).Equine affiliative relations are mainly evidenced by three reciprocal behaviours: allogrooming, social play and anti-parallel standing rest / mutual insect pest control (McDonnell, 2003). Allogrooming does not only have a function in cleaning, removing hairs or relieving an itching skin, but when directed at certain locations it lowers the heart rate and cortisol levels (Feh & Mazieres, 1993; Haverbeke et al., 2002). In this respect it is assumed to reduce social tension between group members and is used as a source of reassurance following social conflict.

For many years researchers could not agree whether spatial relations were an active process between individuals, similar to allogrooming relationships, or they were simply tolerating each other. Van Dierendonck et al. (submitted) have shown that preferred social relationships are also the result of active individual initiatives. Moreover, spatial relationships are not only between individuals of the same sex-age, but also are related to the reproductive state of adult mares (barren, pregnant or lactating).

Social play is mainly performed between two or more foals, juveniles, bachelors or sometimes stallions. Play across these lines is also not uncommon. In the domestic setting, play is performed between adult geldings up to ages of great maturity (Siguónsdóttir et al., 2003). Play is usually characterized as activities having no immediate use or function and involves a sense of pleasure (Mcdonnell & Poulin 2002). However, social play also serves a range of adaptive functions including musculo-skeletal development and maintenance, cardiovascular fitness, practicing reproductive and survival skills and building social and communication skills (Mcdonnell, 1999; Zharkikh, 1999; Mcdonnell & Poulin, 2002; Brama et al., 2001).

1.5 Social negative (dominance) relations

In general if an animal ignores subtle offensive signals when within the personal space of another, and the other horse is dominant, there is often an offensive response towards the intruder causing the intruder to quickly leave the personal space of the dominant (Mills & Nankervis, 1999; Van Dierendonck et al., 1995). In free ranging horses, unsettled dominance relationships are usually only found between young horses, thus in a feral society, dominance mainly seems to control space and avoid conflicts (Goodwin, 2002). Stallions especially, have a large range of ritualised behaviours assessing each other's strength and avoiding direct contact and thus risk on injury.

A dominance relationship between two individuals is always a dynamic process, but not always clearly visible for the human eye. Van Dierendonck et al. (1995) statistically analysed interactions within domestic herds to determine which behaviours would best characterise a dominance relation between two individuals. One of their conclusions was that care should be taken to distinguish between offensive and defensive behaviours. In general, offensive behaviours are performed with the head, while threats with the hindquarters can be used both

offensively as well as defensively. Thus, threats with the hindquarters are less suitable for determining a dominance relation. This agrees with the suggestion by Fraser (1992) that avoidance is a better measure of individual position in a social system, than aggression. Van Dierendonck et al. (1995) concluded that the combination of a few specific offensively used behaviours combined with submission give the best characterisation of a dyadic dominance relationship.

All dyadic dominance relations together can be used to construct a rank order of the whole band/herd. It is not clear whether such a rank order means something for a horse, or whether he only judges its own position towards other herd members. Rank orders within feral horses may be linear, at least at the top or bottom end, though they are also frequently circular. In general the position of the (α) stallion is context dependant: in case of male-male competition or predation he is dominant over all other band members, while in other situations e.g. food, water, saltlicks he can be submissive towards some mares (Houpt & Keiper, 1982). A rank order often correlates with several factors, including; age, residence time, weight and aggressiveness, although there is some disagreement in the literature. This disagreement can largely be attributed to the difference in methods and whether or not the rank order is tested for linearity before testing co-factors. Mares are often ranked according to age or residence time. Interestingly there are indications that the top ranking mares are not the oldest, while these oldest mares are ranked just below (Van Dierendonck et al., submitted).

2 History of human–horse interactions

The earliest evidence that we have of the importance of horses to human culture in Eurasia comes from faunal remains and cave paintings around 15,000 years ago from the South of France and Spain (Clutton-Brock, 1992). Faunal assemblages of equids at Solutré, in the Mâcon region of France, indicate three separate populations of horses were predated by humans, but at very different times: Aurignacian, Upper Perigordian and Magdalenian periods (Levine 2002 *pers comm.,* 1983, 1979). At this site wild equids were hunted co-operatively by humans and in large quantities, though kills were probably of small bands or groups driven into a geographical cul-de-sac on the site. They were then skinned and some butchered on site (Olsen, 1989). By 9000 years ago a combination of climatic change and an expanding human population appears associated with a reduction of the numbers of equids in the faunal record. There is a complete absence of equids at this time at sites associated with humans.

The first evidence of domestication of sheep, goats and cattle appears around 9000 years ago. The first indication of horse domestication does not appear until around 6000 years, ago at a small number of sites in the Ukraine, Western Europe and Asia. However, the domestication process probably proved problematic due to the difficulty of restraint and captive breeding. For example, recent evidence (Levine, 2002) suggests that the horses at Dereivka in the Ukraine and Botai in Kazakhstan were probably tamed captives rather than truly domestic. At these sites most of the horses died during their most

productive years, which is considered evidence of hunting. The presumed difficulty of keeping horses captive limited their early use in human culture and so Levine suggests that taming was probably a bi-product of hunting. Foals orphaned during the hunt could have been raised as pets and later found to be capable of functions other than food. The development of horse handling skills does not appear to have begun to influence human social culture until some time between the Neolithic and early Bronze age (Levine, 2002). Evidence from the Plains tribes of 18th Century North America that capturing wild horses and stealing tamed or domestic ones was considered preferable to breeding them supports this argument (Levine, 1999a). There could, therefore, have been a relatively long period during which horses were captured by chasing, driving and trapping as documented from Mongols and Plains Tribes (Levine, 1999a).

There is some historical evidence that 'wild' horses were widespread in Eurasia until the Middle Ages (Levine, 2002 *pers.comm*), though whether they were really wild, feral or a mixture of both is unclear. Recent mDNA sequencing data suggests that several distinct populations were involved in the domestication of the horse (Jansen et al., 2002).

2.1 History of social horse management

Due to the difficulty of keeping horses captive and breeding from them, and the difficulty of distinguishing domestic, tame and wild horses morphologically it is very difficult to postulate how early populations were managed. Evidence from Dereivka suggests that mares and castrated males may have been herded by riders mounted on tamed individuals (Levine, 1999b); however, mares may have been covered by wild stallions (Levine, 2002 pers comm.). Evidence that the broodmare was the foundation of Eurasian horse culture can be gained from classical through to recent history in Celt, Basque, Mongol, Bedouin, Khazakh and Gypsy sources. Here the bloodline of the mare is most highly regarded, as it was they and their foals that had to be lived with and that remained with nomads and farmers (Bennett, 1992).

The horse has been domesticated in China since approximately 3000BC. They were highly prized and some were obtained by brute force from outside China, e.g. the Ferghana horses that were derived from the Tarpan and prized for 'sweating blood' (producing sweat that was blood coloured), though this is probably evidence of infection with *Parafilaria multipapillosa* (Epstein, 1969). There is limited information about how they were managed, though evidence from Chinese Bronze Age burials indicate a gradual increase in height from 133 cm to 149 cm at the withers (Ben-Shun, 1989).

The Sythian horse cultures used their understanding of horse behaviour, gleaned from their nomadic existence with their horses, to become feared horsemen in conflicts throughout Eurasia from 1000 BC to the middle ages. Their horses were their most treasured possessions, they were furnished with gold inlaid saddles and bridles, had their tails plaited and were sacrificed and interred as grave goods of the nobility (Clutton-Brock, 1992). The Sythian horse

culture was probably the origin of the Greek myth of the Centaur. Unusually in the Classical world, the Sythians castrated their male horses to make them easier to manage. Consequently these geldings grew approximately 10 cm taller than the rest of the population and were used exclusively by the nobility (Rudenko, 1970).

2.2 Cultural differences in approach to the human-horse relationship

2.2.1 Horses in European/Western societies

There appear to have been two main approaches to the horse-human relationship since the Classical period. One is based on co-operative understanding of the behaviour of the horse, the other based on human dominance over the horse (Goodwin, 1999). Barclay (1980) considered that these differences originated in the type of mounted combat that different cultures employed. Both approaches were probably used then, as now, to different extents depending on the trainer and the purpose of the mount. For example, a war-horse is required to be obedient to his rider and suspend intra-specific agonistic interactions in order to mount an effective cavalry charge. It is, however, unlikely that all Roman cavalrymen were skilled horsemen (Hyland, 1990), though many of the tribes they engaged in combat, including the Celts and Huns, were part of ancient horse cultures and so were likely to have become adept horsemen during childhood.

Early handling and training in the Classical world was described by the writings of the Greeks Simon and Xenophon, and although the Romans employed some of these principles there is no corresponding work in Latin on horsemanship (Hyland, 1990). However, there are guidelines on housing horses in the Roman period attributed to Pelagnious, who paid particular attention to housing horses in dry stables with good floors to avoid problems associated with infections of thrush in the feet. Pelagonius and Columella both recommended keeping sick animals on deep beds of straw or chaff. Stabling at the Roman estate described by Varro comprised separate stalls for mares and in cold weather stables were shut and a brazier lit for warmth. At Pompeii stables with four stalls each with masonry partitions have been excavated and at sites in Syria stables have been located with tie rings and mangers. Several methods of housing horses indoors were evident from Latin texts which included references to loose boxes, stalls and racing stock housed in groups of hundred. Cavalry horses at temporary camps were tethered in picket lines as today. The Roman authors Pelagonius, Varro and Columella also described horse management requirements, handling skills and measures ensuring that horses did not become ill through unreasonable and avoidable stresses (Hyland, 1990).

As in Classical times a range of horse-human relationships exist in current society, from lifelong companion to sporting utility vehicle (Endenburg, 1999). This is accompanied by a spectrum of attitudes regarding these interactions ranging from co-operation to dominance/submission (Goodwin, 1999). Even within equestrian disciplines that may appear as superficially similar as Classical Dressage and Competition Dressage, the attitude to the horse and the means of accomplishing results may be diametrically opposed (Ödberg & Bouissou, 1999).

2.2.2 Horses in nomadic societies

There is evidence of strong feelings of identity with horses in many nomadic societies, ranging from the Mongols to North American Plains Indians (Lawrence, 1988). These nomadic peoples often consider their fate intertwined with their horses (Robinson, 1999). Many of the horse cultures have been characterised as proud, defiant and aggressive when challenged. The horses of North American Crow Indians were highly esteemed and represent measurements of wealth and prestige (Robinson, 1999), as did ancient Sythians (Clutton-Brock, 1992). A wealthy North American Blackfoot named Many Horses (*circa* 1900) was reported to be able to describe a missing horse in great detail to boys sent to find it, though there may have been thousands of horses around the encampment (Ewers, 1955). Though Blackfoot owners of large herds were able to identify individuals by markings and colour, they generally only named their horses when they were trained to be ridden plus a few prized mares and stallions. Blackfoot Chiefs selected campsites based on the abundance of species of grass that their horses preferred, however, individual families tended their own herds (Ewers, 1995). In Blackfoot families care of the horse herds was entrusted to young adolescents. Their duties included driving the horses from their overnight pasture to water at daybreak and then driving them to new pasture near camp before breakfast. The owner of the horses would then select his mount(s) for the day. These buffalo hunting, war or racehorses were picketed (tethered) by the neck or foreleg close to the tipis overnight, where the wives were expected to keep watch over them. At midday the boys drove the herds to water again. The watering process was repeated a third time in early evening before driving them to their scattered night pastures, whereupon the lead mare was hobbled by the forelegs to prevent straying overnight (Ewers, 1995) and the lads returned to camp. The Cree tribe practiced winter hobbling by the hind legs, leaving the front legs free to dig for grass through snow, though the Blackfoot did not hobble in winter. The horses received no supplementary feed and no hay was provisioned in winter prior to the establishment of Reservations. When grass in the vicinity of winter camps was consumed the camp was moved a few miles to new pasture. In severe snowfalls Cottonwood bark was stripped and fed to the horses (Ewers, 1995).

2.3 Working horses and human interactions

In many cultures, those who work with horses develop a close bond and affinity with them based on mutual regard. This relationship is frequently functional, though open to abuse when economic drives combine with the less talented/empathetic members of human society. American mounted police officers report a close relationship with their horses based on spending many hours a day together. They consider this essential to developing mutual trust and being able to predict how their horses will behave in most situations (Lawrence, 1988)

The ability to work with horses has frequently been ascribed mystical, occult or religious connotations in many societies throughout history. In Celtic nations this is often associated with the pagan horse cult and Epona, the goddess of the horse and fertility, from the pre-Roman period till present. In the UK and particularly in England and Scotland a secret society of horsemen, akin to Freemasonry, exist(ed); members included farriers, carters, ploughmen and ostlers (grooms caring for horses at inns). Initiation ceremonies were associated with pagan rituals that included the preparation of frog breast bones (symbolic of the frog in a horse's hoof) and communication of the 'Horseman's Word'. This was said to endow mystical powers over horses when whispered into the horse's ear and is probably the source of the term for Natural horsemanship trainers as Horse Whisperers. The collection of narratives, by oral historian George Ewart Evans (1960), from elderly horsemen who had worked the land prior to mechanisation described rituals and many traditional practices employed by men who had lived with, worked with and had taken great pride in their horses. Many folk remedies and control techniques appeared centred around detailed knowledge of the horse's olfactory preferences and responses to dietary supplements. Evidence that the relationship was not always unidirectional was provided in several accounts of draft horses successfully negotiating busy London streets to return an unconscious driver to the Brewery; First World War soldiers being saved from drowning by their mounts and of a horse lying down next to his collapsed groomsman overnight to keep him warm until help arrived (Denham, 1970).

2.5 Social interactions and contact between humans and horses

Though the number of people currently interacting with horses professionally and recreationally is large, the variety and disparity of these interactions has rendered them easily overlooked. Consequently the contribution to the economy is also often ignored (Suggett, 1999) and there has been little scientific enquiry into the nature of the relationship (Endenburg, 1999, Robinson, 1999).

Endenburg (1999) considers that the importance of the horse to many private owners is more emotional than economic, and that the attraction and attachment to horses is linked with the large number of voluntary workers in this sector. Many private individuals report a close relationship and bond with their horse and report great distress during illness and grief over the death of the horse (Lawrence, 1993). In this respect the relationship with the horse can be compared to that between humans and dogs. However, it also differs in some respects, for example horses rarely share our homes and unlike the dog the bond may often not last for the lifetime of the horse, if the horse is outgrown, physically or aspirationally. The relationship between some riders and competition horses may be one that is deliberately held at a distance by the rider to enable them to push the animal to perform at its maximum potential, or due to the requirement to continually change mounts. However, even amongst sport horses close human relationships may develop, and these are not only limited to that between a horse and its groom.

Riding has been linked with human social status throughout history, and for some the horse is seen as a passport to a social group that might otherwise be unattainable (Robinson, 1999). There appears an interesting dichotomy between human genders and their interactions with horses in current society. Most leisure and amateur riders are female, whilst most professional riders are male. The relationships reported between men and women and their horses also vary. Robinson (1999) reports that women are frequently more affectionate with their horses, while Brown (1984) described men as more punitive with their horses than with dogs and postulated that this was due to a greater perceived dominance threat from a larger animal.

Unlike to human-cattle handling (Grignard, 2001) and perhaps due to its diversity and complexity current research in human-horse relationships is scarce but would benefit from further enquiry, particularly in terms of cost-benefit analysis and effects of the relationship on human and equine health. The research can be subdivided into a) indirect handling: husbandry and management, b) direct handling: training methods; and c) research related: to early handling or imprint training and the assessment of temperamental traits. The assessment of temperamental traits is only just starting to give insights in the mechanisms which could be used for better matching between horse-rider-discipline-level thus limiting mismatches and therefore welfare issues (Visser, 2003).

In an excellent recently presented review book (Waran, 2002) human horse conflicts in different life stages are reviewed. Unfortunately, many social conflicts arise from handling, usually due to misunderstanding the horse's behaviour and during social isolation though individual confinement

3 Behavioural and physical consequences of social isolation and confinement

3.1 Theory and practice concerning equine abnormal and redirected behaviour

Current management practices for horses are driven by human requirements and costs limitations, but often ignore basic equine needs. In developed countries most performance and leisure horses are intensively managed. They are predominantly confined and socially isolated in a stable. Compared to the feral situation three aspects are altered:

Socially:

- most domesticated horses are either socially isolated, or have very limited possibilities for social contact using only a few senses.

Locomotory behaviour:

- most domesticated horses are confined to their stable for more than ¾ of the day.

Feeding and foraging practices:

- quantitatively.
  - batch feeding 2-3 times a day (instead of 24 hr ad libitum feeding)
  - use of bedding which does not allow foraging behaviour
- qualitatively
  - limited amounts of roughage combined with relatively high amounts of concentrates (instead of large quantities of low quality roughage).

Feral horses spend approximately 60-80% a day on feeding, during which they walk 5 -10 km a day. In stabled horses this are both significantly reduced (Waring, 2003; Mills & Clarke, 2002; Sweeting et al., 1985; Vervuert & Coenen, 2002). When there is a high motivation for a stabled horse to perform behaviours, but expression is restricted due to environmental factors this can lead to frustration and hence to abnormal behaviour (Mills & Clarke, 2002; Rushen et al., 1993).

Though some papers focus on the impact of alterations in feeding, foraging and confinement on behaviour (Mills & Clarke, 2002; Davidson & Harris, 2002; Goodwin et al., 2002), there is less literature specifically about the desirability of social contact. For example, there are currently no consumer demand studies about the desirability of social contact between horses. However, many indirect results indicate the high motivation for physical social contact of horses, leading to the supposition that social contact is a highly motivated behaviour within domestic horses (Mills & Clarke, 2002; Cooper & McGreevy, 2002).

Abnormal behaviour can be categorised in four major groups: pathologies, stereotypes, learned behaviours and dietary deficiencies (Marsden, 2002). Between 10 and 40% of stabled horses perform a stereotypic behaviour pattern e.g. box walking, weaving, crib-biting, tongue play, self-mutilation, (Nicol, 1999 in Cooper & McGreevy, 2002). Performing stereotypic behaviour is often regarded as a way of coping with the environment, since it has been shown that both opiate and super sensitisation of dopaminerge systems are involved in the performance of a stereotypy. In stereotypic horses a decrease in heart rate, heart rate variability, respiration rate and cortisol levels as well as an increase in β endorphin levels have been identified (Lebelt et al., 1996; Pell & McGreevy, 1999; Bagshaw et al., 1994; Marsden, 2002; Mcbride & Cuddeford, 2001; Rendon et al., 2001; McGreevy & Nicol, 1998; Gillham et al., 1994; Bachmann et al., 2003).

Since feral as well as domestic horses live in a continually changing environment, they are capable of learning in many contexts. Moreover domesticated horses are artificially selected to be able to learn stimuli given by a handler quickly and to learn the desired response (Mills & Clarke, 2002). Therefore, they are also capable of quickly learning behaviours to temporarily relieve highly motivated desires.

4 Welfare issues of preventive measures

In horses emphasis is traditionally given to physical, chemical or surgical interventions – not alterations of the human behaviour – to extinguish undesired behaviour (Waring, 2003; Mills & Nankervis, 1999; Cooper & McGreevy, 2002). Physically preventing a stereotypic behaviour may, in itself, lead to increased stress reactions (McGreevy & Nicol, 1998; Cooper & McGreevy, 2002), because the stereotypic behaviour is either a general coping response or its prevention frustrates a highly motivated response to specific challenges encountered in the domestic environment (Cooper & McGreevy, 2002 pg 117). When preventive measures alone are taken, other stereotypic behaviours frequently emerge in order to cope with the environment. There is currently no scientific evidence indicating that horses can learn from observational learning (Lindberg et al., 1999), thus social isolation of a stereotypic horse – because of a perceived high possibility of mimicking by other horses – can be considered detrimental to the welfare and possibly even contra-productive to the affected horse. Many authors currently argue that the best prevention and treatment of undesired behaviours is to adapt the management, housing, training, feeding and foraging practices to enable the horse to react to the underlying social, locomotory or dietary motivations. Stereotypic behaviour has never been observed so far in feral or free ranging horses.

5 Solutions accommodating equine social requirements

5.1 Pragmatic solutions: advantages and points of attention

Several solutions have been proposed that deal with the social requirements of horses without actually increasing physical social contact between horses, these include the use of mirrors (Mills & Davenport, 2002; Cooper et al., 2000; McAfee et al., 2002; Cooper & McGreevy, 2002). However, these are unlikely to prove a universal panacea and ethical judgement is required regarding the use do these devices. There are indications that abnormal behaviours also can be prevented by husbandry systems which provide extensive possibilities for social contact and free ranging activities (e.g. Cooper et al., 2000; McBride & Long, 2001; Bashaw et al., 2001, Lebelt, 1998, McGreevy, 1997). However, loose house as well as pasture systems also require welfare considerations e.g. increased risk of spread of infectious diseases, increased risk of individually acquired pathologies, as well as risks related to increased social contact at a small open area. These can include injury from aggression due to changes in social composition and/or overcrowding, food restriction or reduced resting times for subordinate individuals (Zeitler-Feicht & Prantner, 2000; Mills & Clarke, 2002; Vervuert & Coenen, 2002). Van Dierendonck et al. (submitted) have shown that in mixed sex-age domestic herds natural (feral) social processes take place, without any indication of a deviation of the natural behaviour even around parturition of newborn foals.

Unfortunately, there is limited research on innovative stable / paddock designs or combinations of solitary housing with periods of social interaction in pastures or paddocks, thus incorporating the advantages of the loose house systems, while decreasing some if its disadvantages. Innovations in stable designs include half stable walls or partitions that allow more physical contact within individual stables; outside stable feeding systems allowing more natural feeding postures combined with more natural horizons and parallel contact with neighbours; loose house systems with adjustable barriers, allowing physical isolation of lower ranking/injured individuals at periods for additional rest or feeding (Vervuert & Coenen, 2002; Ventorp & Michanek, 2001). Technological approaches are currently emerging (Vervuert & Coenen, 2002); MvD unpublished results) in which housing and feeding management are supported by computer technology, in so called 'social-locomotion stables' or 'multi-room-group-stabling' systems.

6 Enhanced human-horse relationships

Since recent research (Søndergaard & Halekoh, 2003) reveals that the social environment affects the way horses react to humans in their home environment, but not in a novel environment, handling and husbandry practices can not be considered independent of each other. Therefore, regular handling is necessary to avoid potential dangerous situations.

In order to bridge the gap between traditional horse husbandry and training practices on one side and the evolutionary needs of horses on the other, the following issues are highlighted

- Knowledge of species specific, highly motivated behaviours;
- Knowledge of important transition periods in horse life histories;
- Knowledge of the causative factors of performed undesirable behaviours;
- Knowledge of learning theories and learning capabilities of horses;
- Openness to innovative practices in management, housing, and training.

From the above requirements, an action plan can be constructed for those seeking to develop more welfare centred human-horse interactions that could also achieve better performance at lower costs.

- Horses are kept in stable social and challenging environments throughout life;
- Horses are managed more in accordance with their evolutionary needs;
- Adoption of adaptive feeding and foraging practices;
- Improved socialization of horses, both towards co specifics and humans;
- Handlers acquire knowledge of species specific behaviour;
- Handlers understand ways that horses communicate;
- Handlers acquire better knowledge of learning processes;

- Handlers are open minded towards innovation in husbandry and training techniques.

Human culture has benefited greatly though its interactions with horses over the last 6000 years, and our history would have been very different without them. We are now developing knowledge to eliminate some of the detrimental consequences that domestication has imposed on the horse. The horse is powerless to implement these advances, that responsibility is entirely ours.

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