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Commentary

Learning about horses: What is equine learning all about?

Filipa Heitor, Luís Vicente *

Centro de Biologia Ambiental, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, Edifício C2, 1749-016 Lisboa, Portugal

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Murphy and Arkins (2007) provide an extensive and comprehensive review of the research that has been conducted on equine learning processes and cognition and its application in horse training and management. The authors discuss the problems that researchers have faced when applying and interpreting results of experimental tests to measure learning ability, intelligence and memory in the horse. Their review provides detailed description of the studies conducted on equine learning processes and proximate mechanisms of learning and suggests promising avenues for future research. As Murphy and Arkins (2007) emphasize, it is surprising that research on equine learning is scant when compared to studies on other species, despite the historical relationship between humans and horses, and the potential application of such research to improve horse training, management practices and welfare.

Nevertheless, Murphy and Arkins (2007) paper covers mainly the psychological dimension of learning, which has been the most studied dimension of equine learning. Biological aspects such as function and adaptive value were briefly addressed and it seems the lack of research in this area is even more striking. Relevant questions which could have been discussed are, for example: 'What is equine learning about?', 'What kind of information about the environment do horses perceive and use?', 'What is the adaptive value of learning?', 'What are the benefits and costs of learning?', and 'Which environmental contexts facilitate learning?' Our commentary will expand on these questions and suggest avenues for future research on equine learning that stem from field studies of horse social behaviour and from studies about learning in other species.

1. Learning in the natural environment: placing learning into context

Extensive research has been conducted during the past decades on the behaviour of feral and domestic horses under different ecological, demographic and management conditions. Nevertheless, there has been limited interplay between these studies and equine learning studies.

Most equine learning studies have been conducted under artificial experimental conditions to measure specific abilities or to test the relationship between learning abilities, manageability and performance during training. The underlying expectations were that individual learning abilities would remain stable across time and situations. Nevertheless, as Murphy and Arkins (2007) noted in their review, several studies reported high variability in both intra- and inter-individual learning performance and poor correlations between ability to learn different tasks and between learning abilities and trainability (see also Nicol, 2002).

These results from experimental studies seem to support Bekoff's (1995) view that one should be careful in making generalizations about the cognitive skills of a species based on data from a small number of individuals, who have been exposed to a limited array of behavioural challenges. Moreover, these results suggest that learning performance is very context-specific. As Lefebvre and Helder (1997) pointed out, learning should not only be seen as a capacity that an animal may or may not have, but also as an option that an animal may or may not use. Therefore, learning performance should be distinguished from learning ability. If one is to maximize equine learning performance, it is also necessary to investigate which contexts facilitate development and expression of learning abilities.

Although the complex social relationships of horse groups are suggestive that social learning could play an important part in equine learning, experimental studies have failed to demonstrate this. Nicol (2002) and Murphy and Arkins (2007) argued that experimental sets might have failed to replicate the contexts in which social learning would be most likely to occur because the subjects were somewhat unfamiliar to each other. These authors suggested that the 'observer' horse could be more attentive and motivated to learn a novel task demonstrated by a familiar dominant horse than from an unfamiliar one. We agree with this argument and also believe it would be interesting to investigate the influence of affiliative relationships, kinship, social motivation, emotional state of the demonstrator (Veissier et al., 1998)

* Corresponding author. Tel.: +351 217524311; fax: +351 217500028.
E-mail address: lmvicente@fc.ul.pt (L. Vicente).

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and number of demonstrators (Lefebvre and Helder, 1997). Identifying the factors that promote social learning would allow us to know which animals could be better demonstrators, and train them to serve as models to improve learning of novel tasks by others (Veissier et al., 1998).

Learning is a process by which animals can adapt their behaviours to suit the environment through experience. Studies of equine learning and perception have reflected mainly human perception, rather than that of the horses. Most research has used visual stimuli, despite the fact that olfactory, auditory and tactile stimuli also play an important part in horse perception of the environment (Saslow, 2002). Moreover, visual stimuli often consisted of objects and figures not commonly found in their environment. The sensory, perceptive and cognitive capacities of a species are adapted to the complexity of their environment and social behaviour (Piggins and Phillips, 1998). Therefore, horse's performance may be better at tasks that require them to learn associations, discriminations or concepts similar to those which increase reproductive success in their natural environment. For example, learning the category 'water' may be easier than learning the category 'triangle' (Sappington and Goldman, 1994). This may partly explain why horses were reported to perform some tasks and not other tasks that seemed to require similar learning abilities.

We believe that equine learning abilities would be most successfully investigated under the conditions that most resemble those of the environment where natural selection 'shaped' them (Bekoff, 1995). Field studies including observation, description and experimentation could be carefully designed to assess what horses perceive and learn about their ecological and social environment and how they use that information. Perceptual and learning abilities of feral and free-ranging horses can be examined by observing their use during daily activities, such as feeding, communication, developing bonds, establishing dominance relationships, or movements through the home range.

Gregarious species with complex intra-specific communication patterns are likely to have the ability to discriminate or categorize conspecifics (Veissier et al., 1998). Therefore, we believe the interesting question is not 'whether' horses have these abilities, but 'which' categories they form and use. The influence of age, dominance rank, kinship and familiarity on horse social behaviour suggests that horses may be able to discriminate and categorize other horses on the basis of these factors. Dominance hierarchies in horse groups are based primarily on age (Wells and von Goldschmidt-Rothschild, 1979; Sigurjónsdóttir et al., 2003; Heitor et al., 2006a). Group stability is maintained by long-term affiliative bonds, and new members of a group receive increased aggression (Linklater et al., 1999; Heitor et al., 2006a). Affiliative relationships were observed to be stronger among horses with similar age, close dominance rank, close relatives and genetically related individuals outside the family unit (Wells and von Goldschmidt-Rothschild, 1979; Sigurjónsdóttir et al., 2003; Heitor et al., 2006b). Therefore, it would be interesting to test whether horses are able to categorize conspecifics as familiar/unfamiliar, older/younger, dominant/subordinate, kin/non-kin or to discriminate between close/distant ranking horses and close/distant relatives.

The ontogeny and mechanisms of conspecific individual recognition have been extensively studied in other domestic species, such as sheep (Veissier et al., 1998), cattle (Hagen and Broom, 2003), pigs (Kristensen et al., 2001) and hens (Hauser and Huber-Eicher, 2004). In contrast, little is known about the relative role of the senses in individual recognition among horses. The few existing studies were focused mainly on mare-foal recognition (Wolski et al., 1980). Furthermore, it has been reported that cattle and pigs can discriminate between people (Rybarczyk et al., 2001; Koba and Tanida, 2001) and it would be interesting to examine this ability in horses as well. One could test horse's ability to discriminate familiar from unfamiliar people or discriminate between human emotional states (e.g. anxiety) on the basis of visual, olfactory and acoustic cues. We believe the results of such studies could be of great use in 'real life' situations such as horse training.

2. Adaptive value, benefits and costs of learning

The adaptive value of learning may be greater in environments where important resources can be associated with simple cues than in environments where access to resources is unpredictable (Dukas and Duan, 2000; Shettleworth, 2001) or unrelated to learning performance. Comparative studies of learning abilities in horses living under different levels of human intervention, as well as experimental manipulation of resources and environmental stimuli, could shed further light into the adaptive value of equine learning abilities.

In feral and free-ranging horse populations, learning the significance of behavioural signs (e.g. postures and vocalizations) ensures efficient communication among group members and promotes group cohesion. For example, horses learn early in life to respond to threats from dominants through avoidance, after threats have been repeatedly paired with aggression. Learning to discriminate dominants from subordinates allows horses to adjust behaviour accordingly, thereby reducing aggression. Mother–offspring recognition is essential for maternal care and foal survival, and discrimination of kin could also be used to avoid mating with relatives and prevent inbreeding. Discrimination of group members from non-group members ensures coordination of movements and group cohesion, which affords protection against predators. Some prey species learn to adjust antipredator responses according to the risk posed by the predator, through association with its odour (Ferrari et al., 2006). The role of learning in predator avoidance could also be explored in the horse.

Horse domestication involved genetic and environmental changes that may have affected equine learning abilities. Genetic changes induced by artificial selection and natural selection in captivity (Price, 1999) may have led to reduced awareness (Piggins and Phillips, 1998) and decreased learning abilities, compared to feral horses. Moreover, relaxed selection under domestic conditions may be responsible for increased variability in equine learning abilities, because these are no longer essential for life-sustaining activities, such as finding food and avoiding predators (Price, 1999). Management conditions in which most domestic horses are kept offer limited opportunities for contact

with conspecifics and reduced exposure to stimuli, which may have negative impact on their learning abilities. Husbandry systems where horses are allowed social contact with conspecifics, such as pasture or group housing, could improve social and individual learning skills and trainability (Søndergaard and Ladewig, 2004). It would also be important to identify sensitive periods and key stimuli for development of learning abilities and to use that information to provide domestic horses with a social environment that maximizes learning performance.

Learning is metabolically costly and subject to a trade-off with other components of life history (Barnard and Luo, 2002). Benefits and costs of learning may depend on factors such as horse's age, dominance, body condition and reproductive state, as well as on the environment. Older horses have lower residual reproductive value (Cameron et al., 2000) and may have less to gain by learning new behaviours than younger horses. Barnard and Luo (2002) reported that dominance affected learning performance of laboratory mice in a maze-learning task. Pairs of mice that did not initially differ in learning performance, showed significant differences after dominance relationships were established, with the dominant of the pair performing better than the subordinate. In contrast, Mader and Price (1980) found no correlation between dominance and learning scores in horses. Mares in poor body condition and lactating mares may have less energy available for learning. Therefore, it would be interesting to examine whether there is a decrease in learning performance coincident with foaling. Barnard et al. (2006) showed that learning effort could increase susceptibility to infection in laboratory mice, due to a trade-off between learning and immune function. Similar trade-offs between learning and other components of life history could account in part for the reported inconsistencies in equine learning performance across time, and deserve further investigation.

3. Final remarks

This commentary intended to stress the importance of integrating psychological and biological dimensions of cognition (Shettleworth, 2001). We believe that such integrated research would provide a more complete and contextualized understanding of equine learning and aid the interpretation of the apparently contradicting results of experimental studies reviewed by Murphy and Arkins (2007). Moreover, a contextualized analysis of learning would help us provide domestic horses with an appropriate environment and opportunities to develop and fully express their potential learning abilities and also to improve their welfare.

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References

Barnard, C.J., Luo, N., 2002. Acquisition of dominance status affects maze learning in mice. Behav. Process. 60, 53–59.

Barnard, C.J., Collins, S.A., Daisley, J.N., Behnke, J.M., 2006. Odour learning and immunity costs in mice. Behav. Process. 72, 74–83.

Bekoff, M., 1995. Cognitive ethology, vigilance, information gathering, and representation: Who might know what and why? Behav. Process. 35, 225–237.

Cameron, E.Z., Linklater, W.L., Stafford, K.J., Minot, E.O., 2000. Aging and improving reproductive success in horses: declining residual reproductive value or just older and wiser? Behav. Ecol. Sociobiol. 47, 243–249.

Dukas, R., Duan, J.J., 2000. Potential fitness consequences of associative learning in a parasitoid wasp. Behav. Ecol. 11, 536–543.

Ferrari, M.C.O., Capitania-Kwok, T., Chivers, D.P., 2006. The role of learning in the acquisition of threat-sensitive responses to predator odours. Behav. Ecol. Sociobiol. 60, 522–527.

Hagen, K., Broom, D.M., 2003. Cattle discriminate between individual familiar herd members in a learning experiment. Appl. Anim. Behav. Sci. 82, 13–28.

Hauser, J., Huber-Eicher, B., 2004. Do domestic hens discriminate between familiar and unfamiliar conspecifics in the absence of visual cues? Appl. Anim. Behav. Sci. 85, 65–76.

Heitor, F., Oom, M.M., Vicente, L., 2006a. Social relationships in a herd of Sorraia horses: Part I. Correlates of social dominance and contexts of aggression. Behav. Process 73, 170–177.

Heitor, F., Oom, M.M., Vicente, L., 2006b. Social relationships in a herd of Sorraia horses: Part II. Factors affecting affiliative relationships and sexual behaviours. Behav. Process 73, 231–239.

Koba, Y., Tanida, H., 2001. How do miniature pigs discriminate between people?: discrimination between people wearing coveralls of the same colour. Appl. Anim. Behav. Sci. 73, 45–58.

Kristensen, H.H., Jones, R.B., Schofield, C.P., White, R.P., Wathes, C.M., 2001. The use of olfactory and other cues for social recognition by juvenile pigs. Appl. Anim. Behav. Sci. 72, 321–333.

Lefebvre, L., Helder, R., 1997. Scrounger numbers and the inhibition of social learning in pigeons. Behav. Process. 40, 201–207.

Linklater, W.L., Cameron, E.Z., Minot, E.O., Stafford, K.J., 1999. Stallion harassment and the mating system of horses. Anim. Behav. 58, 295–306.

Mader, D.R., Price, E.O., 1980. Discrimination learning in horses: effects of breed, age and social dominance. J. Anim. Sci. 50, 962–965.

Murphy, J., Arkins, S., 2007. Equine learning behaviour. Behav. Processes 76, 1–13.

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

Piggins, D., Phillips, C.J.C., 1998. Awareness in domesticated animals—concepts and definitions. Appl. Anim. Behav. Sci. 57, 181–200.

Price, E.O., 1999. Behavioral development in animals undergoing domestication. Appl. Anim. Behav. Sci. 65, 245–271.

Rybarczyk, P., Koba, Y., Rushen, J., Tanida, H., de Passillé, A.M., 2001. Can cows discriminate people by their faces? Appl. Anim. Behav. Sci. 74, 175–189.

Sappington, B.F., Goldman, L., 1994. Discrimination learning and concept formation in the Arabian horse. J. Anim. Sci. 72, 3080–3087.

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

Shettleworth, S.J., 2001. Animal cognition and animal behaviour. Anim. Behav. 61, 277–286.

Sigurjónsdóttir, H., van Dierendonck, M.C., Snorrason, S., Thórhallsdóttir, A.G., 2003. Social relationships in a group of horses without a mature stallion. Behaviour 140, 783–804.

Søndergaard, E., Ladewig, J., 2004. Group housing exerts a positive effect on the behaviour of young horses during training. Appl. Anim. Behav. Sci. 87, 105–118.

Veissier, I., Boissy, A., Nowak, R., Orgeur, P., Poindron, P., 1998. Ontogeny of social awareness in domestic herbivores. Appl. Anim. Behav. Sci. 57, 233–245.

Wells, S.M., von Goldschmidt-Rothschild, B., 1979. Social behaviour and relationships in a herd of Camargue horses. Z. Tierpsychol. 49, 363–380.

Wolski, T.R., Houpt, K.A., Aronson, R., 1980. The role of the senses in mare-foal recognition. Appl. Anim. Ethol. 6, 121–138.