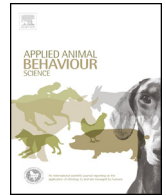




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Horses can learn to use symbols to communicate their preferences

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ABSTRACT

This paper describes a method in which horses learn to communicate by touching different neutral visual symbols, in order to tell the handler whether they want to have a blanket on or not. Horses were trained for 10–15 min per day, following a training program comprising ten steps in a strategic order. Reward based operant conditioning was used to teach horses to approach and touch a board, and to understand the meaning of three different symbols. Heat and cold challenges were performed to help learning and to check level of understanding. At certain stages, a learning criterion of correct responses for 8–14 successive trials had to be achieved before proceeding. After introducing the free choice situation, on average at training day 11, the horse could choose between a “no change” symbol and the symbol for either “blanket on” or “blanket off” depending on whether the horse already wore a blanket or not. A cut off point for performance or non-performance was set to day 14, and 23/23 horses successfully learned the task within this limit. Horses of warm-blood type needed fewer training days to reach criterion than cold-bloods ($P < 0.05$). Horses were then tested under differing weather conditions. Results show that choices made, i.e. the symbol touched, was not random but dependent on weather. Horses chose to stay without a blanket in nice weather, and they chose to have a blanket on when the weather was wet, windy and cold ($\chi^2 = 36.67$, $P < 0.005$). This indicates that horses both had an understanding of the consequence of their choice on own thermal comfort, and that they successfully had learned to communicate their preference by using the symbols. The method represents a novel tool for studying preferences in horses.

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1. Introduction

Horses have been utilised by humans for a variety of tasks, e.g. traction power in agriculture and forestry, sports and leisure. The behavioural flexibility of horses, their ability to cope with different uses and their ability to learn and obey signals given by humans have been crucial for this success in the domestic context (McGreevy, 2008). The training of utility skills is traditionally achieved by one way communication; from the human to the horse. The human gives the cue, most often a vocal or tactile signal, and the horse learns to respond. Principles of learning theory is increasingly being implemented in equitation (Murphy and Arkins, 2007; Baragli et al., 2015) and in a scientific context various training techniques have been used to explore cognitive abilities and prefer-

ences of horses. Examples are using Y-mazes (Kratzer et al., 1977; Heird et al., 1986; Murphy, 2009), and more complex labyrinths (Marinier and Alexander, 1994) to test learning ability and memory. Y-maze choice has been used to test acceptance or avoidance of the roll-kür riding style (von Borstel et al., 2009), preference for shorter or longer riding bouts (von Borstel and Keil, 2012), and stall or treadmill training (Lee et al., 2011). Animals may also be trained to perform a task, for example to operate a lever or push a button, in order to gain access to a resource or avoid something unpleasant (Skinner, 1953). The value of a resource as regarded by the animal, and thereby its motivation to work for it, can be measured as the number of times the animal is willing to repeat the task (i.e. pay a “price”) before being rewarded (e.g. Dawkins, 1983). In horses, such operant techniques have been used to investigate the preference for a light source during night (Houpt and Houpt, 1992), the strength of horses’ need for social contact (Sondergaard et al., 2011), and the motivation for release into a paddock (Lee et al., 2011).

The ability of horses to discriminate between visual cues and learn the relevance of one stimulus over another is well demonstrated in horses (see reviews by Nicol, 2002; Hanggi, 2005). This

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ability comprises discrimination of stimuli of both two- and three-dimensional shape (Hanggi, 2003), also when rotated (Hanggi, 2010), and for some individuals recognising categories such as triangular shape as opposed to a variety of geometrical patterns (Sappington and Goldman, 1994). More arguably, horses may possess concepts formation such as relative size, i.e. picking the larger (or smaller) of different objects (Hanggi, 2003) and sameness, i.e. selecting two matching stimulus cards (Flannery, 1997). However, none of the four ponies in a study by Gabor and Gerken (2010) learnt a “matching to sample” visual discrimination task, and the four horses in a study by Leeson (2015) failed to learn to pick “the bigger”.

We wanted to explore whether the ability of horses to discriminate simple visual symbols could be extended with associations between specific symbols and corresponding outcomes, and furthermore the consequences for own comfort as perceived by the individual horse of these outcomes. If so, symbols could guide appropriate decision-making behaviour and be utilised as a communication tool in preference testing of horses. A very common but still disputed management routine in the Nordic countries is to equip horses with blankets (rugs). Our aim was thus to develop a tool to “ask” horses whether or not they prefer to wear a blanket under different weather conditions. In this paper, we describe the method by which horses are taught to touch visual symbols on a display board to communicate their preference to humans.

2. Materials and methods

2.1. Horses and daily management

Twenty-three horses kept on two neighbouring premises in mid Norway, one private stable (Nypan) and one stable at an agricultural high school (Skjetlein) were included in the training programme. Horses comprised 13 cold-blood horses (7 Norwegian trotters, 3 Norwegian dølhest, 2 Fjord horses, 1 Icelandic horse) and 10 warm-blood horses (6 Danish, German, or Swedish warmblood riding horses, 3 Arabian or Arabian crossbreds, and 1 Thoroughbred), whereof 18 were geldings and five were mares. Age varied from 3 to 16 years (average 9.8, median 10). All were kept as riding horses for leisure activities, dressage, or show jumping, and some were in addition used as carriage horses. All individuals were accustomed to wear a blanket, but the daily management routine regarding blanket use was decided by the owners and thus varied among horses. Some horses routinely wore a blanket when turned out in a paddock during the non-summer seasons, while others did only wear a blanket under extreme weather conditions (very cold, very wet, or very windy). At night, all horses were stabled in standard single boxes bedded with wood-shavings, allowing visual and nose contact with other horses. During daytime, they were kept in outdoor paddocks in groups of 2–3 except for one horse which was kept singly. Horses were fed roughage (hay or haylage) three times per day and concentrates twice daily, with the amount depending on individual workload.

All the horses which were kept on the two premises were included in the training program except for three; one due to advanced age (38 years), another due to a tendon injury, and the third for safety reasons as it was flighty and difficult to handle.

Horses were kept and handled according to the Norwegian Animal Welfare Act, the Horse Welfare Directive and the Use of Animals in Research regulation. Training methods included solely positive reinforcement, never putting animal welfare at stake. The owners of the 13 privately owned horses and the person responsible for the 10 school horses all gave permission to conduct the study.

Table 1

Training procedure with goals for the 10 hierarchical steps to achieve free choice learning.

Category	Step	Goal for the step
Operant reward based behaviour	1–4	
	1	Introduce display board. Horse touches the display board with muzzle
	2	Horse touches the display board independently of board position (plasticity)
	3	Horse moves towards the display board and touches it with muzzle
Symbol learning	4	Horse moves towards the display board and touches it with nose independently of board position (plasticity)
	5–8	
	5	Horse learns the difference between symbols “blanket on” and “blanket off”
	6	Assessment: Check that the horse understands of the difference between symbols “blanket on” and “blanket off” in repeated exposures, by touching the display board with relevant symbol with its muzzle
Introducing free choice	7	Assessment: Check that the horse will touch the relevant symbol with muzzle after switching display board position
	8	Assessment: Check if horse understands the difference between “blanket on” and “blanket off” symbols independent of position of display boards and context (plasticity)
	9–10	
	9	Introduce “no change” symbol. Couple “no change” symbol with relevant change symbol, i.e. “blanket on” or “blanket off” depending on initial blanket state in a free choice setting. The horse is rewarded regardless of choice of display board touched
	10	Assessment: Check the horse’ understanding of choice

2.2. Trainer skills

Positive reinforcement training (e.g. Lindsay, 2000; Pryor, 2002) was performed by a highly skilled professional animal trainer and her two experienced assistants, working two in a team throughout the training period. These trainers had a broad knowledge of training animals and many years of practical experience with clicker training and the use of reward criteria. Their skills included knowing exactly which initial behaviours must be rewarded to develop the final behaviour, appropriate timing of reinforcer delivery, optimal frequency and quality of rewards, an understanding of the level of difficulty of each step in the learning process for the horse. The trainers also had the ability to tailor the training sessions to the individual horse.

2.3. Training

The aim of the training was that the horse, when later placed in a free choice situation, would be able to communicate whether it wanted a blanket put on or taken off or that it preferred to stay unchanged. A successfully trained free choice behaviour implies that the animal has learned and understands the options available and the consequences, and makes its choice based on own motivation, independent of the trainer. For communication, the horses had to learn to use symbols. Three different symbols presumed to be non-aversive and unambiguous to horses were used. They were presented on white wooden display boards, measuring 35 × 35 cm,

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