ARTICLE IN PRESS

Applied Animal Behaviour Science xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Food motivation in horses appears stable across different test situations

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ARTICLE INFO

Keywords:
Horse
Behaviour
Food motivation
Operant response

ABSTRACT

Food motivation may influence an animal's performance in food-rewarded learning tasks. Nevertheless, food is often used as a positive reinforcer in learning tasks to investigate cognitive abilities of farm animals, and to test effects of various treatments, such as environmental enrichment, on animal cognition. However, any treatment that affects food motivation may also influence performance in food-rewarded learning tasks. Assesment of individual food motivation is therefore relevant for many studies where cognitve abilities are measured through food-rewarded tasks. This study is an initial attempt to assess food motivation in horses. Twenty-three horses were tested in two experiments designed to evaluate food motivation. The first test was a lever test (LT) where the horses had to press a lever for a food reward with an increasing work ratio of three presses after each two trials. In the second test, the horses were required to cross a barrier to reach a food bucket (CB). The height of the barrier was increased (5 cm) after each trial. The results were compared with the time used to eat 1.5 kg oats (free feeding, FF). The highest achieved workload in LT (i.e. number of lever presses) and CB (i.e. height of barrier), latency to finish eating (min:sec) in FF, as well as behavioural (e.g. nibbling, pawing, alertness) and physiological parameters (heart rate) and salivary cortisol) were analysed. Positive correlations were found between maximum workload in LT and CB ($r = 0.49$, $p = 0.02$). The latency to finish eating in FF correlated negatively with maximum workload in LT ($r = -0.47$, $p = 0.02$), i.e. fast feed consumption corresponded to a high workload. There were no statistical differences between pre-test and post-test levels of salivary cortisol, suggesting that the test situations were not perceived as stressful by the horses. The results indicate correlations in horses' food motivation across different test situations and thus the simple free feeding test appears to be the easiest way to assess individual food motivation in horses in comparison to time-consuming operant tests.

1. Introduction

In human psychology it is known that motivation plays a crucial role for learning (DeCaro et al., 2015) and it is likely that motivation also affects learning in non-human animals. Two main types of reinforcement are used in animal training to reward desired responses: positive reinforcement (i.e. addition of a pleasant stimulus, such as food) and negative reinforcement (i.e. removal of an unpleasant stimulus, such as tactile pressure). Both types of reinforcers influence the reward system in the brain by increasing the level of dopamine (Berridge, 2001). Traditional horse training is based on negative reinforcement whereas positive reinforcement in terms of food is commonly used in behavioural tests (Nicol, 2002; Murphy and Arkins, 2007; Brubaker and Udell, 2016). There are several variables that can influence the strength of reinforcers, e.g. age and physiological state of an animal, life experience and chemical factors (Toates, 2004; Berridge, 2001). For instance, the motivational value of food is stronger when an animal is hungry. On the other hand, when nutritional needs are met, but water is withheld, water will be a stronger motivator than food (Berridge, 2001). As a consequence, food motivation may affect the willingness of animals to work for food (McClelland, 1987) and thus it may also affect their performance in behavioural tests which apply food as a positive reinforcement.

Patterson-Kane et al. (2011) argues that no single method exists that can measure the exact level of motivation in animals. Nevertheless, it has been suggested that operant responses can be used to estimate animals' motivation for various resources (Dawkins, 1988; Ninomiya et al., 2007a, 2007b; Matthews and Ladewig, 1994; Søndergaard et al., 2011). There is a huge variety of methods used to assess motivation for important needs in different species. For instance, operant tasks have been used to assess motivation for different diet types in horses (Elia et al., 2010), the influence of social isolation on motivation to work for food in pigs (Pedersen et al., 2002); social contact in horses (Søndergaard et al., 2011) and rabbits (Seaman et al., 2008); and access

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https://doi.org/10.1016/j.applanim.2018.04.006
Received 8 December 2017; Received in revised form 5 April 2018; Accepted 8 April 2018
0168-1591/

Please cite this article as: Olczak, K., Applied Animal Behaviour Science (2018), https://doi.org/10.1016/j.applanim.2018.04.006

to a running wheel or a water bath in mink (Hansen and Jensen, 2006). The tested animals are exposed to different challenges e.g.: pressing a lever/button with different work ratios (Ninomiya et al., 2007a, 2007b; Pedersen et al., 2002), pushing through weighted doors (Seaman et al., 2008), or jump over a barrier (Salamone et al., 1994). In horses, Søndergaard et al. (2011) used a specially designed panel that opened a door by a set number of muzzle presses to measure motivation for social contact. Ninomiya et al. (2007a, 2007b) also used a device operated by muzzle pressing to measure the effect of reward palatability and satiation in horses.

Despite the potential relevance of individual food motivation for animals' performance in positively reinforced behavioural tests, there is currently no 'golden standard' for assessment of food motivation in horses and it is unknown whether food motivation is consistent across different test situations. The aim of this study was to: (i) investigate if food motivation is consistent within animals across different test situations; and (ii) explore the effect of increasing workload on horses' behavioural and physiological responses.

2. Materials and methods

The experiment was conducted in The National Research Institute of Animal Production from February to April 2015 with approval of local Ethics Committee on Animal Experimentation KRA1_188_2015.

2.1. Animals

Twenty-five, untrained Hucul horses (age 15–26 months) were used in this study (13 fillies and 12 colts). All horses were born to the same stud and received only standard management. Fillies were kept on the paddock from 7:30 a.m. to 2 p.m. and tested in the afternoon. Colts were tested in the morning (8 a.m. to 2 p.m.) and released on paddocks after testing. At night, the horses were kept in a stable; all colts were kept in group boxes whereas fillies were kept in a group tie stall that allowed lying down and body contact with other horses. Fillies and colts were kept in different facilities but both groups received the same management. The horses had *ad libitum* access to water and hay on the paddocks and in the stable. In the stables, fresh hay was supplied at 4 p.m. Horses were fed with oat once a day after testing, colts about 2 p.m., fillies about 7 p.m.

Prior to testing, all horses were habituated to the handler and heart rate monitor. During habituation and testing, oat was used as a reward as it was familiar to all horses. The initial habituation was completed when the horses ate oat from the handler's hand and stood still when the heart rate monitor was attached. The next step involved habituation (10 min sessions) to social isolation in the outdoor testing arena (11.5 × 7 m), placed next to the stables. A bucket with oats was placed in one end of the arena, opposite the entrance, and training was considered completed when the horses walked calmly to the bucket and ate three mouthfuls of food. Even though all horses passed the initial habituation process, two fillies were excluded from the analysis as their behaviour was too nervous during the testing procedures, i.e. n = 23 (11 fillies and 12 colts). Training and testing was conducted at the same time every day for each individual horse.

2.2. Methods

All training and testing procedures were conducted in a testing arena next to the stables, without the presence of conspecifics.

2.2.1. Experiment 1–lever test (LT)

A lever (15 cm) was attached to a wooden stool 43 cm × 39 cm × 52 cm (W x L × H). Before testing, the horses were allowed to eat from the stool, and the reward (a small handful of oat) was always placed at the same point (Fig. 1).

Training was performed in daily 20 min sessions (1–5 training sessions per week). The horse was led on rope by a handler to the apparatus. The rope was loose and tension was used only to stop horses from walking away. The training procedure was divided into three stages (Table 1).

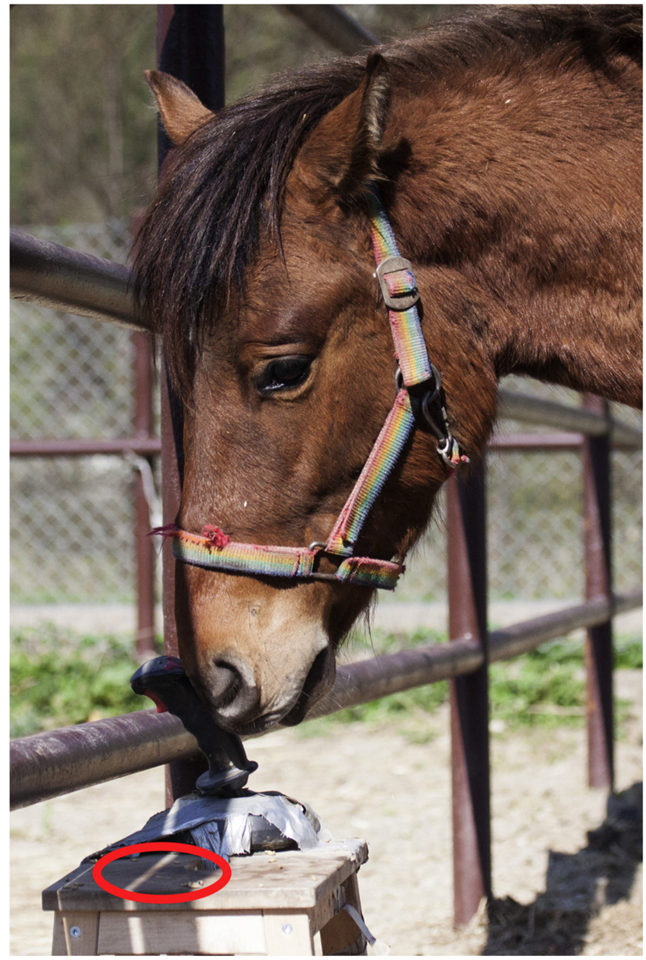

Fig. 1. The device used in the lever pressing test. The food reward was placed manually within the red circle. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

When one stage was completed, the horse went on to the next stage until the daily 20 min training session ended. If the horse did not complete stage 1, this stage was continued on the next training day. If the horse was working on stage 2 or 3, the next training session started with two repetitions from stage 1 after which the horse continued with the stage it was working on the previous day. All horses completed the training procedure within 5 days.

2.2.1.1. Testing procedure. Testing was carried out on two consecutive days. The horses were led to the device by the handler and released. On the first day of testing, the horse initially had to press the lever three times to receive a reward. After every two rewards the number of required presses (workload) was increased by 3 (i.e. 3, 3, 6, 6, 9, 9, 12, 12 etc.). If the horse did not press the lever for more than 1 min it received a 'reminder' (the horse was led to the device and encouraged to press the lever once with immediate reward) and the trial continued. After three such reminders the test was terminated (the test duration varied from 5 to 19 min). To avoid the risk of losing interest due to satiety, each horse started the subsequent test day on 50% of the workload it ended with on the previous test day (i.e. horses on workload 18 on a given test day started on workload 9 the following test day). Further procedures were the same as for the first day of testing.