



## Original Research

## Evidence for Sire, Dam, and Family Influence on Operant Learning in Horses



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## ABSTRACT

To evaluate potential sire and dam effects on learning performance in horses, 102 ponies ranging in age from 47 days to 17 years received a single standard positive reinforcement-based operant “target training” session in their home environment. These animals were from a semi-feral herd of known parentage that had had standard minimal previous handling. Based on quantitative measures of latency to reach criterion and rate of correct responses, subjects were ranked into five levels of learning efficiency. Learning efficiency levels of various sire lines (sires and their offspring), dam lines (dams and their offspring), and sire/dam lines (mating pairs and their full sibling offspring) were compared. Learning efficiency level differed significantly among certain sire lines, dam lines, and sire/dam lines ( $P < .05$ , median test). Learning efficiency level also tended to differ among age groups as well as between males and females. Frustration/avoidance response frequency during training was negatively associated with learning efficiency and differed among sire and dam lines. Frustration/avoidance response frequency during training also differed significantly among age groups but not among males and females. These data provide evidence of sire, dam, and sire/dam effects on learning performance in horses in simple operant tasks analogous to those inherent in the training of domestic horses.

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## 1. Introduction

In recent decades, a rapidly growing number of studies have explored the characterization of cognitive ability as well as factors affecting learning in domestic horses (*Equus caballus*) [1–3]. Research in this area includes investigation of the effects of breed [4], temperament [5], social dominance [6], age, and gender [7,8] on cognitive ability. A reasonable expectation is that cognitive ability, particularly as reflected in efficiency of associative learning, varies among horses and plays an important role in the success of the human-horse relationship as well as in training for specific work and performance [9].

Sire and dam effects on learning ability in horses, including both genetic and family environmental factors, apparently have not yet been formally investigated. Currently, exploration in the area of equine genetics has been focused on the heritability of genetic diseases [10], stereotypic behavior [11], performance [12,13], as well as coat color [14], morphology [15], and temperament [16]. In their work on performance of horses in operant and spatial learning tasks, Wolff and Hausberger [7] reported an incidental finding which was interpreted as a possible sire effect. Other authors have explored potential genetic effects on particular temperament or behavioral tendencies of the horse that are suspected to influence learning ability, particularly as it relates to interactions with humans [2].

An obvious challenge to addressing various influences on cognition in domestic horses concerns considerable individual variation in previous experience with humans as well as in training styles (positive vs. negative reinforcement vs. punishment based) inherent to the domestic

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horse industry. Most horses available for testing are far from naïve with humans and are rarely handled in a manner that would be considered sufficiently consistent for ruling out experience effects on learning. Available for use in the present study were 102 Shetland-type ponies reared within sire/dam families together in a semi-feral herd with minimal and standard (reinforcement based) human interaction, and with known parentage, genetic relatedness and family composition since the inception of the herd in 1994. Within the context of their home semi-feral environment, performance on a simple operant task was used to assess learning efficiency for subsequent comparison of sire, dam, and sire/dam lines as well as to explore age and gender differences.

## 2. Methods

### 2.1. General Design

One hundred two ponies from a semi-feral herd each received a single session of operant training (OT) on a simple task to touch the muzzle to a unique object, known among animal trainers as “target training,” as an estimate of learning efficiency. To confirm that increased response during OT in fact represented learning due to reinforcement contingencies [17], a subset of animals initially served as yoked controls (YCs). Learning efficiency levels based on quantitative measures were compared among sires and their offspring, dams and their offspring, and mating pairs and their full sibling offspring. Procedures were in accordance with an institutional animal care and use committee-approved protocol.

### 2.2. Subjects

Subjects included 102 small Shetland-type ponies (48 males and 54 females) ranging in age from 47 days to 17 years. These animals were born and have been maintained within a semi-feral herd since 1994 at the University of Pennsylvania School of Veterinary Medicine in Chester County, Pennsylvania, principally for the purpose of observational study of their behavior under natural social conditions and seminatural environmental conditions. DNA-based parentage is confirmed for all offspring (Gluck Equine Parentage Testing Laboratory, University of Kentucky, Lexington, KY). All animals were reproductively intact and breeding freely. Handling by humans is limited to required preventive health care (daily observation usually at a distance, and as needed for annual vaccinations and deworming) done by highly skilled technicians experienced with these procedures and working under field conditions using positive reinforcement (food treats as needed for yearlings and adults, soothing scratching of neck, withers, chest, or rump for foals). In addition, between the age of 2 and 4 weeks, each foal receives one 30-minute “gentling” experience of positive reinforcement-based acclimation to human interaction with 21 specific compliance goals including touch all over the body, simulated veterinary examination and routine health care procedures, introduction of a halter, and introduction to leading if time allows. The animals are maintained in a

40-acre enclosure consisting of natural forages and natural water sources as well as supplementation in the deep winter with grass hay as needed to maintain reasonable body condition. Shelter consists of natural hedges and light forest within the enclosure. At the time of this work, the herd consisted of 11 harem groups and one bachelor band totaling 105 animals. Ninety-four of the 102 that were subjects of this study were still in the herd at the time. The remaining eight (four mature males and four mature females) had been removed from the herd within the last 3 years and maintained under similar environmental conditions in pasture groups. The four males that were no longer in the herd had been castrated. Each sire line included an individual sire and any of his offspring available for evaluation at the time. Each dam line included an individual dam and any of her offspring available for evaluation at the time. Each sire/dam line was a sire and dam pair and any of their full-sib offspring available for evaluation at the time. Only lines with four or more individuals were included in comparisons.

### 2.3. Operant Training Session Environment

For animals still in the herd, the OT session was conducted within their home environment. Each harem or bachelor group was first separated into a gated catch pen system within the herd enclosure. The subject was then lured or guided into a subenclosure adjacent to and within visual contact of the remainder of the family. For three mares with younger foals, the foal remained with the dam. For foal OT, their dam was positioned in an adjacent enclosure and fed grain near the separating gate. The foal and mare could maintain visual and tactile contact through the rails of the separating gate. These foals had had previous experience with such an arrangement for their initial 30-minute gentling session (see previously). Foals were allowed 5 minutes to acclimate and settle before the start of the training session. To avoid distraction of the subject from insects, insect repellent (Endure; VPL, Farnam, Phoenix, AZ) was applied to the substrate of the training enclosure and to the subject as needed. For one solitary bachelor stallion, the training was done in the open field. For the eight animals that were no longer in the herd, training was done either in their familiar pasture environment or a familiar stable adjacent their pasture. The training, viewing of video, extraction of quantitative measures, and subsequent ranking of learning efficiency were done blindly to relatedness of subjects.

#### 2.3.1. Yearling and Older Subjects

For the 80 yearling and older subjects, the subject was allowed approximately 5 minutes to acclimate to separation from their family in the subenclosure before the start of a training session. The experimenter then entered the subenclosure and offered a palatable treat while applying a halter. Using the halter and a cotton lead attached to the lower ring, the experimenter calmly positioned the subject into a smaller training enclosure (1.73 × 1.07 m, Fig. 1). The enclosure's barriers consisted of a webbed stall guard in front, straw bale on top of a large plastic storage bin behind, and wooden board fencing on either side of the pony. The

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