DISCRIMINATION LEARNING IN HORSES: EFFECTS OF BREED, AGE AND SOCIAL DOMINANCE

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Summary

The discrimination learning ability of Quarter Horses and Thoroughbreds was compared by means of visual cues in a three-choice test with food as a reward. Quarter Horses learned significantly faster than Thoroughbreds, and learning progressed more rapidly for both breeds in a second discrimination task. Significant negative correlations were observed between age and rate of learning. Quarter Horses tended to be less reactive than Thoroughbreds, but individual emotional reactivity ratings and learning scores were not correlated. No correlation was found between social dominance and learning scores. Learning studies with horses may provide a better understanding of the behavioral traits that influence trainability in this species.

(Key Words: Horses, Learning, Discrimination Learning, Age Effects, Social Dominance.)

Introduction

Learning ability of horses is of particular interest to the horse industry because of its possible relationship to trainability (Potter et al., 1977). Although a wide variety of training techniques have been used with horses (Potter and Yeates, 1977), formal investigations of equine learning potential have been neglected. Recent studies on reversal discrimination learning (Fiske and Potter, 1979), maze performance (Kratzer et al., 1977) and observational learning (K. L. Baer, personal communication) in horses are notable exceptions.

Discrimination learning has been commonly used to test the perceptual capabilities of animals. It can also be used as a general measure of learning provided that the performance of the animal is not influenced by the limitations of its sensory apparatus.

The objectives of the following study were: (1) to investigate differences in discrimination learning between Quarter Horses and Thoroughbreds and (2) to provide data on the relation of learning to age, social dominance and general emotional reactivity.

Materials and Methods

Eleven registered Thoroughbred (TB) and 10 registered Quarter Horses (QH) were used in the study. Two of the TB were yearling fillies and nine were mares ranging from 6 to 22 years of age. One QH was a yearling filly, one a yearling colt and the other eight were mares ranging from 6 to 17 years of age. The horses were housed individually or in pairs and were fed an alfalfa-grain mixture (pellets).

The test apparatus was a rectangular wooden box measuring 2.00 x .32 x .61 m (l x w x h). The box was centered on a wall, 1.5 m above the floor of a 8.5 x 4.5 x 3.6 m (l x w x h) windowless air-conditioned room. Three 30 x 45 cm doors spaced 36 cm apart were positioned at the front of the test apparatus. The doors were hinged at the top and swung inward when the horse pressed its nose against them. A diet of 46% barley (Ref. 4-00-939), 46% corn (4-02-985) and 8% molasses (4-04-696) was available behind each door and was used as a food reward during testing. Each door could be locked by the turning of a small screw.

During a 6-day pretest training period, the animals were habituated to the test room and trained to eat from the test apparatus. On days 1 and 2 of pretest training, the doors to the test apparatus were kept open, and each horse was turned loose in the test room for 15 minutes. The experimenter (E) noted the horse’s general behavior during this period.
whether it vocalized and whether its disposition was generally calm or excitable. The E remained in the rear of the test room and contacted the horse only if it had not found the test apparatus within 5 min, in which case E led the animal to a randomly selected door and showed it the food. On day 3, the doors to the test apparatus were closed. If the horse did not open a door within 5 min, E led the animal to the apparatus and held a randomly selected door open while the animal fed, slowly letting the door rest on the horse's nose. On day 4, E brought the horse to a predetermined starting point, 6 m from the apparatus, and then led the subject to a randomly selected door which it was allowed to open. After 10 such trials, the horse was returned to its paddock. On day 5, each subject was treated as on day 4 for the first five trials and then allowed to choose its own door for the last five trials (subject was released from the starting point). On the last pretest training day, the horse was allowed to select the door of its choosing in all 10 trials. If the subject appeared to develop a "position effect" (if it chose the same door repeatedly), E would lead it to a different door for the subsequent trial.

Test 1 was begun on day 7 and was conducted in the same way as day 6 pretest training, except that two of the three doors were locked and covered with plain white stimulus cards while a black and white checkerboard (5.5-cm squares) stimulus card was placed on the unlocked door. All stimulus cards were 23 x 38 cm and were held on the doors behind wire screens. Ten trials were conducted daily with the stimulus cards positioned randomly on the doors for each trial. (The same random order was used for all horses in a given trial.) A trial started when the horse was released from the starting point and finished when the animal tried to push open a wrong door or when it opened the correct door and fed for 2 to 3 seconds. At the end of each trial, the horse was led to the opposite end of the room and tied on a short lead while the test apparatus was readied for the next trial.

The criterion for learning was 80% correct responses for 3 consecutive days. Once a horse met the criterion it advanced to test 2, in which the two blank stimulus cards were replaced by silhouette drawings of a horse (15 cm long) and a heart (12 cm wide). Again, the subjects had to select the door with the checkerboard stimulus card to gain access to food.

A third test was administered to four horses (two QH and two TB) after the completion of test 2. In this test, the horses were required to discriminate between the checkerboard pattern used in tests 1 and 2 (which again signaled the open door) and two additional checkerboard stimulus cards (7.5 x 13.0 cm blocks).

Subjects were eliminated from the study after 10 days if they failed to achieve 80% correct responses on 3 consecutive days. Since not all subjects completed 10 trials on each test day and since the learning criterion could be met by achievement of a score ranging from 80 to 100% correct responses on each of 3 consecutive days, a learning score (LS) was computed for each horse which took these factors into account:

\[ LS = \frac{\text{Days} \times \text{total number of trials administered}}{3 \times \text{total number of correct responses}} \]

The constant, 3, was introduced to make a perfect score equal to 1 since each subject had a minimum of 3 days at each discrimination task. Thus, the higher the LS score, the poorer the animal's performance.

Testing was conducted between 0800 and 1200 hr daily. Subjects were fed the maintenance diet after testing and between 1600 and 1800 hours.

A TB and a QH had to be eliminated from testing because of injuries incurred in their paddocks. Another QH was eliminated during test 2 because of the effects of being unintentionally frightened in the test area.

Seven pairs of horses were ranked for social dominance on two separate occasions when they competed for food (following deprivation). Respective LS (learning score) values were then compared with dominant-subordinate relations.

Subjective ratings of emotional reactivity for each horse were determined independently by three persons who scored the animals on a three-point scale on the basis of their behavior in the study area during the first 2 days of test preparation. Scoring was as follows:

1 = Generally calm
2 = At times calm, sometimes excitable
3 = Generally excitable

Learning scores (LS values) were subjected to a two-way ANOVA for unequal sample sizes and analyzed by breed and test (test 3 excluded because of the small sample size). In addition, Spearman rank correlation coefficients (Siegel, 1956) were used to assess the relationships...
Results

Performance of QH and TB in the discrimination learning tests are summarized in Table 1. QH learned faster than TB (F = 11.3, df = 1/27, P < .01), and the second discrimination test was learned more quickly than the first (F = 25.9, df = 1/27, P < .001) by both breeds. The interaction between breeds and tests was not significant (F = 3.4, df = 1/27). The more difficult discrimination in test 3 was learned by all four test horses. The small sample size precluded statistical analyses of the data. LS of the test subjects by age are presented in Table 2. Spearman Rank correlation coefficients between age and LS values in test 1 were significant for both QH (r = .59, P < .05) and TB (r = .80, P < .01). Learning performance declined with age. Correlations between age and LS values in test 2 were not significant (QH r = .08; TB r = .51). No relationship was observed between dominance and learning ability. In four of seven randomly selected pairs, the dominant animal learned test 1 more slowly.

On the basis of the subjective rating scale, QH tended to be less emotional than TB (QH X [SD] = 1.49 ± .54; TB X [SD] = 2.03 ± .68; "t" = 1.98, df = 19, P < .06 - two tailed test). However, Spearman Rank correlation coefficients for emotional reactivity ratings and LS values were not significant for QH in test 1 (r = .03) and test 2 (r = .30), nor for TB in test 1 (r = -.03) and test 2 (r = -.29).

Discussion

Results of this study suggest that QH initially learn discrimination tasks more easily than TB. Since it is not known how well the QH and TB populations used in the present investigation represent their respective breeds (some of the QH had TB breeding in their immediate ancestry), more populations should be studied before breed generalizations are made. It also should be noted that the breed difference in learning reported here does not necessarily reflect differences in intelligence, per se, since it is possible to explain differences in rate of learning by other factors that affect performance. Potter et al. (1977) suggest that the emotional reactivity of a horse can affect its performance in a learning task. The present study provides some support for this hypothesis in that the QH used tended to be more calm than the TB subjects when first exposed to the unfamiliar study area. However, the correlation coefficients derived from comparison of individual learning scores (LS) and emotionality ratings (ER) were not statistically significant. As stated previously, the ER scores were largely subjective. Perhaps if the animals had been rated by a more objective set of criteria, the correlation coefficients would have supported the general hypothesis.

Since a food reward was offered as an incentive for opening doors, motivational factors could have influenced the breeds differently. The three TB that failed to learn test 1 were reluctant to approach the test apparatus after two or three trials each day. Although all subjects were deprived of food for

<table>
<thead>
<tr>
<th>Breed</th>
<th>Test</th>
<th>N</th>
<th>No. of Ss that met criterion</th>
<th>( \bar{X} ) (± SD) No. days to reach criterion</th>
<th>( \bar{X} ) (± SD) No. trials to reach criterion</th>
<th>( \bar{X} ) (± SD) Learning score</th>
</tr>
</thead>
<tbody>
<tr>
<td>QH</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>5.4 (± 1.2)</td>
<td>50.9 (± 10.3)</td>
<td>2.57 (± .68)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>3.8 (± .9)</td>
<td>36.8 (± 9.3)</td>
<td>1.48 (± .36)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>6.0 (± 2.8)</td>
<td>55.0 (± 21.2)</td>
<td>2.46 (± 1.32)</td>
</tr>
<tr>
<td>TB</td>
<td>1</td>
<td>10</td>
<td>7</td>
<td>8.4 (± 2.7)</td>
<td>74.6 (± 20.4)</td>
<td>4.31 (± 1.56)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10</td>
<td>7</td>
<td>4.9 (± 1.7)</td>
<td>46.4 (± 14.4)</td>
<td>1.99 (± .82)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4.5 (± 2.1)</td>
<td>45.0 (± 21.2)</td>
<td>1.94 (± 1.12)</td>
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TABLE 2. LEARNING SCORES OF QUARTER HORSES AND THOROUGHBREDS BY AGE

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Learning score</th>
<th>Age (yr)</th>
<th>Learning score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
<td>Test 2</td>
<td>Test 1</td>
</tr>
<tr>
<td>1</td>
<td>2.10</td>
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<td>1</td>
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<tr>
<td>1</td>
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<td>1.35</td>
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</tr>
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<td>9</td>
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<td>6</td>
</tr>
<tr>
<td>11</td>
<td>3.31</td>
<td>1.57</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>1.67</td>
<td>1.85</td>
<td>8</td>
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<tr>
<td>11</td>
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<td>1.69</td>
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<tr>
<td></td>
<td>D</td>
<td>...</td>
<td>22</td>
</tr>
</tbody>
</table>

*D = tests discontinued when subject failed to reach criterion after 10 days of testing.

approximately the same period of time each day, individual differences in feeding motivation (appetite) were quite probable.

Since the three TB horses that failed to learn test 1 could not be assigned learning scores, they were not included in the statistical analysis for breed and test effects. Had scores been obtained for these subjects (e.g., by testing for a longer period), the breed difference obtained would have been even greater.

From an evolutionary standpoint, one could postulate that the breed differences obtained reflect different artificial selection pressures on QH and TB horses for their respective roles in the horse industry. It seems probable that success on the track, as opposed to the tasks performed when working cattle, for example, may require different behavioral traits not unrelated to performance on a test of learning ability.

Significant negative correlations were found between age and rate of learning for both breeds. The almost equal mean ages of QH and TB subjects (9.8 and 10.1 years, respectively) ruled out age as an explanation for the breed difference in learning.

The more rapid learning by both breeds in test 2 illustrated the facilitating effect of prior learning experience ("learning to learn"). The breed difference in LS in test 2 was less than the breed differences in LS in test 1, largely because the poorer performance of the TB subjects in test 1 left them more room for improvement than the QH. Even so, the interaction between breed and test was not statistically significant.

That the subjects were capable of learning a more difficult discrimination task was demonstrated in a third test administered to four horses after the completion of test 2.

Perhaps in no other common domestic farm species does man attempt to control and modify behavior as much as he does in the horse. Considering the economic importance of trainability in horses, it seems appropriate to identify those behavioral characteristics that serve as the best predictors of training potential for the various uses served by this species. Further studies identifying individual differences in horse behavior should be coupled with exposure to suitable training programs (using young naive animals) to obtain a more direct assessment of the relationship between trainability and other behavioral traits.

Literature Cited


