CONDITIONED REINFORCEMENT WITH AN EQUINE SUBJECT

THESIS

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By

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Historically, horse trainers have relied primarily upon repetition, negative reinforcement, and punishment to teach new behaviors. Positive reinforcement has been eschewed, largely on the basis of the widespread belief that positive reinforcement is not effective with horses. Additional difficulties in the timely application of such reinforcement have further inhibited its use.

After repeated pairing of an auditory stimulus with an established primary reinforcer, the auditory stimulus was predicted to be a reinforcer. An equine subject was then successfully trained to perform five different, novel tasks using only the auditory stimulus. Subsequently, extinction of behavior was noted in the absence of the conditioned reinforcer.

Implications for many phases of horse training were discussed. Some weaknesses of the present study were noted along with suggested issues for future investigations.

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CONDITIONED REINFORCEMENT WITH AN EQUINE SUBJECT

Traditionally, horses have been trained by an often nonsystematic mixture of negative reinforcement, punishment, and a small amount of positive reinforcement. The use of positive reinforcement has been all but ignored by most professional horse trainers, possibly because of their ignorance of current research on animal learning and because of centuries-old traditions and beliefs concerning horses. Traditional methods of horse training have been effective when used by experienced, professional horse trainers. Williamson (1977) maintained that psychological procedures have always been used with horses, but only in the form of trade secrets. However, the general public has demonstrated a markedly growing interest in owning and using horses for pleasure (The American Quarter Horse Association, 1976), without having had access to systematic procedures for training and handling them.

Most training experts have agreed that negative reinforcement is the most effective method of teaching horses (Hance, 1948). Because trainers are rarely versed in psychological vocabulary, negative reinforcement has often been described in a variety of terms. Self (1952) spoke of a system of "reward and punishment" when describing negative reinforcement.

> Ask the horse to move forward, then squeeze your legs very gently, and brace your back for an instant. These movements, in asking the horse to move forward, constitute the "punishment." The instant the horse obeys, the back and leg aids are relaxed. This constitutes the reward.

In this example, squeezing the legs and bracing the back comprised the negative reinforcer, which has been defined as "an event which when removed, terminated, or postponed following a response, results in an increase in the rate of that response." Negative reinforcement, then, is "the removal or postponement of a negative reinforcer following a response" (Whaley & Malott, 1974). Other horsemen and horsewomen have spoken of responding "to get away from unpleasantness" (Hamilton, 1978), to escape the pain of the bit (Chamberlin, 1934), or to earn a respite from training (Ensminger, 1977; Wall, 1961; Young, 1979).

Hance (1948) insisted that "despite assertions to the contrary, a horse is trained by the infliction of discomfort and by instantaneous relief from the discomfort." Moving away from the tap of a whip is a method of negative reinforcement used by Deacon (1973). Miller (1975) described a method of teaching a foal to lead. A loop of rope was placed around the animal's hindquarters and pressure was applied on its buttocks until the foal moved forward, thereby earning its negative reinforcer, the cessation of pressure.

Williamson (1977), a trainer who has also studied psychology, summarized negative reinforcement, stating, "when an aid (e.g., pressure on the mouth, sides, or back of the horse) is applied, it represents an aversive stimulus. Once the horse responds to the aid, the aid stops. His obeying the cue is rewarded by avoiding the aversive stimulus."

Although some trainers have recognized the potential value of positive reinforcement, it has seldom been observed in their training methods because of the difficulty in administering a positive reinforcer to horses performing complex maneuvers, often at high speeds. Social reinforcers, such as pats and verbal praise, have rarely been as effective with horses as they are with dogs and other, more sociable animals (Jones, 1974; Miller, 1975), although many trainers have used social reinforcers in addition to negative reinforcement.

Some horse trainers have objected to the use of food as a reinforcer (Coen, 1973; Dunning, 1979). A common criticism has been the fear that the horse will become a bully and will bite or push the handler in order to obtain a reward. Young (1979) dispelled this notion, saying that such behavior occurs only when the horse is given food for doing nothing. He believed that a horse who has to earn his reinforcer will never become a "bullying beggar." Indeed, psychologists have long known that proper contingency management is essential if reinforcement procedures are to be used effectively (Karen, 1975).

Other trainers felt that horses are unable to associate edible reinforcers with a correct response (Smythe, 1977; Williams, 1977). However, it is clear from their examples that the reinforcer was not given until too long after the correct response was made, i.e., reinforcing the horse after leaving the show ring where a successful jump has been performed. "Unlike dogs, horses rarely associate the receipt of a pat, or even a lump of sugar, with the accomplishment of a clear round" (Smythe, 1977). Hamilton (1978) stressed that horses must be reinforced immediately following the desired response. Indeed, Jackson (1979) described a study in which horses were conditioned to perform a complex discrimination task using grain as a reinforcer, while access to water was used as a reinforcer in a similar study by Kratzer, Netherland, Pulse, and Baker (1977).

Miller (1975) explained the difficulties involved in using edible reinforcers with horses:

> Motivation by food can be used successfully in horse training but is limited in its practical application . . . . The big problem of using food comes while mounted. It is possible for a rider to feed a horse pellets by leaning around to the front and giving him some in his hand. However, this would not be practical on a finished western horse chasing cows, competing in the show ring or at a rodeo. To motivate a

horse to learn to stop, turn, slow lope and all other moves a western horse should do by feeding pellets and then discontinue the practice once training is completed could lead to considerable confusion for the horse. For this reason, grain is not ordinarily used in this way, although it does have some interesting possibilities.

Whether the response to be reinforced has been chasing a calf, jumping a hurdle, or racing around a barrel, the edible reinforcer cannot be administered at the exact moment the correct response was made. At least 10 seconds have passed before the horse can be stopped and reinforced. This means that the halting is more likely to be associated with a reinforcer. It is also extremely disruptive to the training session for the horse to be stopped constantly in mid-exercise.

Therefore, it was imperative that a method be found which reinforces the horse instantly and which does not disrupt the training exercises or performance. The purpose of this study was to demonstrate that this can be done with the use of a secondary reinforcer, specifically, an auditory stimulus. Such a secondary reinforcer would be an important addition to the repertoire of training skills of professional and amateur horse trainers. A secondary, or conditioned, reinforcer "is an event or object which acquires its

reinforcing property through association with other reinforcers" (Powell & Cole, 1973; Whaley & Malott, 1974).

The auditory stimulus was paired with the presentation of an edible reinforcer, until the auditory stimulus acquired the properties of the edible reinforcer. "Horses quickly learn to associate sounds with pleasure or displeasure, and such associations persist with very little reinforcement later" (Williams, 1977). This method of secondary reinforcement has been proven successful with a wide variety of animals, tasks, and stimuli, and can be expected to generalize to horses. One method of demonstrating that a stimulus has acquired secondary reinforcing properties has been to measure its effect on the process of extinction. Having been paired over a series of learning trials with a primary reinforcer, a stimulus can be said to have had secondary reinforcing properties if it maintained a response in the absence of that primary reinforcer. Hagen (1977), Davis and Smith (1976), and Mote (1942) all established secondary reinforcers on the basis of the reinforcers' effect on extinction in rats. Similar delays of extinction were generated in the absence of primary reinforcers with pigeons, by Patterson and Winokur (1973).

A second method of demonstrating that a stimulus has secondary reinforcing properties has been to use it in conditioning novel behaviors. If a stimulus, following a series of pairings with a primary reinforcer, acted in the absence

of the primary reinforcer to increase the rate of a response, it was a secondary reinforcer. This has been accomplished in studies with rats (Bellingham, Storlien, & Stebulis, 1975; Zimmerman, 1972) and in research with chimpanzees (Wolfe, 1936).

In this study, it was expected that this secondary reinforcer would serve in the conditioning of new responses. Therefore, the following hypotheses were formulated.

I. An auditory stimulus, after sufficient pairings with a primary reinforcer, will serve as a conditioned reinforcer in the training of new operant behaviors in a horse.

II. The reinforcer will be effective with a variety of operant behaviors.

Method

Subject

The subject was a 30-month-old female registered Quarter Horse. It had been handled an average of 1 hour per day for the past 12 months and had been ridden regularly for 6 months by the same handler.

Apparatus

The auditory stimulus used as a conditioned reinforcer was a small "clicker," a toy that children carry at Halloween. It was made of a 1-inch half-sphere-shaped piece of metal attached to a ½-inch tab of flexible metal. The sound was produced by flexing the tab with one's finger.

A variety of edible reinforcers was used, including pieces of carrot, Graham crackers, handfuls of grain, and horse chow pellets. A stop watch was used with Task 4.

Procedure

A pre- and posttest design was used in this study. An auditory stimulus, in the form of "clicks," was emitted upon presentation of the edible reinforcers. Approximately five rapid, continuous "clicks" were produced at each presentation of reinforcement. This approximately 5-second interval of auditory stimulation insured that the edible reinforcer was presented within 1 second of a "click." All training was undertaken no more than 2 hours before the subject's regularly scheduled feeding time, in order that the edible reinforcers had maximum effect. To test the conditioned reinforcing properties of the auditory stimulus, a session of 10 test trials was conducted. While the horse was at liberty, the handler stood between 3 and 6 feet from the horse and presented the auditory stimulus. Care was taken to present the stimulus while the horse's attention was directed away from the handler. The horse's response was recorded as positive if it directed its attention to and moved toward the handler. The response was recorded as negative if the horse's attention was not directed toward the handler and it did not move toward the handler. A second observer also recorded the horse's responses. Once the conditioned reinforcer was established, the study commenced.

Throughout every training period for each task, edible reinforcers were paired with the auditory stimulus on a ratio of three auditory stimuli to one edible reinforcer. No edible reinforcers were presented for performance of the required tasks. Edible reinforcers were paired, instead, with other previously learned behaviors. For example, after presentation of two conditioned reinforcers for approximating the head nod of Task 5, the horse was given the cue to back up, a previously conditioned response. The edible reinforcer was then presented along with the conditioned reinforcer.

The horse was taught five different tasks using conditioned reinforcement methods. Pretest data with 10 trials for each task was taken before training began, both by the handler and by a second observer. Criteria for recording the horse's responses during pretest trials are defined on the data sheet (Appendix A).

In order to avoid confusing the horse, only one task was practiced during each daily 10-minute training session. During each task's training session, tasks were performed continuously with brief intertrial intervals, but without breaks for rest. When the handler felt that the task had been learned (i.e., the horse responded correctly 9 out of 10 times during the training sessions), a test trial was conducted. The cue (discriminative stimulus) was presented 10 times, and the horses's responses recorded as positive or negative. Criteria for recording the horse's responses

during posttest trials were the same as for pretest trials. A second observer also recorded the horse's responses for each task's test trial.

Tasks

Task 1. The horse was to walk from the handler in a straight line past a marker (pylon) placed 15 feet away, turn around the marker, and return to the handler.

Task 1 training procedure. The horse was led around the required pattern, with the distance gradually reduced that the horse was actually led. The verbal command "Walk" was paired with the physical prompting, and the conditioned reinforcer presented when an approximation was performed. The procedure of shaping by successive approximation was employed.

Task 2. The horse was to open its mouth when a bridle bit touched its muzzle or teeth.

Task 2 training procedure. The bit was presented to the horse's mouth. If the jaws did not open upon presentation of the bit, light pressure was applied by the handler's fingers on the bars of the horse's mouth (the toothless area of gum behind the incisors) until the jaws were opened. Pressure was reduced as the horse opened its jaws more readily. The conditioned reinforcer was presented, initially, when the jaws were opened manually. Eventually, using shaping techniques, the secondary reinforcer was presented only when the jaws were opened without physical prompting.

Task 3. The horse was to step diagonally (half-track) to either side when standing at a 45° angle to a barrier such as a fence, while the rider applied leg pressure to the side of the horse opposite to the intended direction of movement. The horse's head and body must have remained diagonal to the fence as it made stepping movements along the length of the fence for a distance of at least 5 feet.

Task 3 training procedure. The horse was made to stand at a 45° angle to the fence. Steady, light pressure was applied by the rider's leg to the horse's left side if it was to move to the right, and to the horse's right side if it was to step to the left. The horse's head was held diagonal to the fence by means of tension on the bridle reins. The conditioned reinforcer was presented, using shaping techniques, whenever an approximation of the target response was made.

Task 4. The horse was to refrain from moving any of its legs for at least 60 seconds while the bridle reins were hanging to the ground, and the handler was standing 15 feet in front of the horse.

Task 4 training procedure. The horse's reins were made to hang from the bridle to the ground. The handler stood approximately 3 feet from the horse's head and gave the signal "Whoa" when the horse moved one or more legs. Distance from the horse and the interval required for remaining still were increased to task criteria. Presentation of the

secondary reinforcer was initially given for every 5 seconds of nonmovement. This was gradually increased to a full minute, with the handler moving away from the horse approximately 2 feet each session.

Task 5. The horse was to nod its head up and down when presented with the appropriate hand signal, while the handler was standing at the horse's head.

Task 5 training procedure. The horse's head was physically raised and lowered by steady, nonaversive pressure on the halter, while the handler simultaneously presented the hand signal, a waving motion of the hand. The conditioned reinforcer was initially presented as the horse's head was physically prompted to nod. Gradually, the prompting was faded out, and the horse had to make voluntary head movements in order to receive the reinforcer.

In order to test further the effectiveness of the secondary reinforcer, extinction procedures were utilized after the subject had completed the test-trial for Task 5. Data were recorded for the number of head-nodding responses the subject made when edible reinforcers were no longer present.

Reliability

A second observer was independently recording data for each behavior during the auditory stimulus test trial (10 responses), the pretest trials (50 responses), and during the final posttest trials (50 responses). This resulted in a total of 110 pairs of observations. A computation of the

percent of agreement between observers was made to determine reliability.

Results

Reliability

The percent of agreement between observers indicated that both observers recorded identical responses 100% of the time.

Establishment of the Conditioned Reinforcer

After approximately 140 pairings of the edible reinforcer with the auditory stimulus presented over a period of 20 days (number of presentations per day varied between 3 and 12), it was observed that the auditory stimulus had attained conditioned reinforcing properties. A test trial was conducted to determine the conditioned reinforcing properties of the auditory stimulus. While the horse was at liberty, and the handler was standing 3 to 6 feet from the horse, the auditory stimulus was presented for 10 test-trials. In each of the 10 trials, the horse directed its attention to the handler and moved toward the handler.

Conditioning of New Responses

The posttest trials demonstrated that both hypotheses can be accepted; an auditory stimulus, after sufficient pairings with a primary reinforcer, did serve as a conditioned reinforcer in the training of new operant behaviors, and the reinforcer was effective with a variety of operant behaviors.

Figure 1 offers graphic illustration of the differences between responses during pretest trials and posttest trials.

Task 1, which involved having the horse walk to a pylon placed 15 feet from the handler, walk around the pylon and return to the handler, did not occur in the pretest trial. The horse received 20 daily 10-minute training sessions, with an average of five trials per session. The trials were performed approximately 1 minute apart. After 103 training trials using only the conditioned reinforcer, the discriminative stimulus command "Walk" elicited the target behavior 10 out of 10 trials during the posttest.

Task 2 required the horse to open its mouth when the bridle bit was presented. Further, manual prompting was not permitted during the posttest trial. As in Task 1, no successful responses were emitted during the pretest trial; the horse required manual prompting before taking the bit in each case. Three daily 10-minute sessions of six trials each were then conducted, with intertrial intervals of approximately 80 seconds. After only 18 training trials using the secondary reinforcer alone, 10 successful responses were emitted for the posttest trial.

During the pretest trial for Task 3, the subject made one target response in 10 trials. The task required that the horse make side-ways steps while maintaining a 45° angle facing a fence. In this case, it was felt that the single correct response was due to some prior training for general

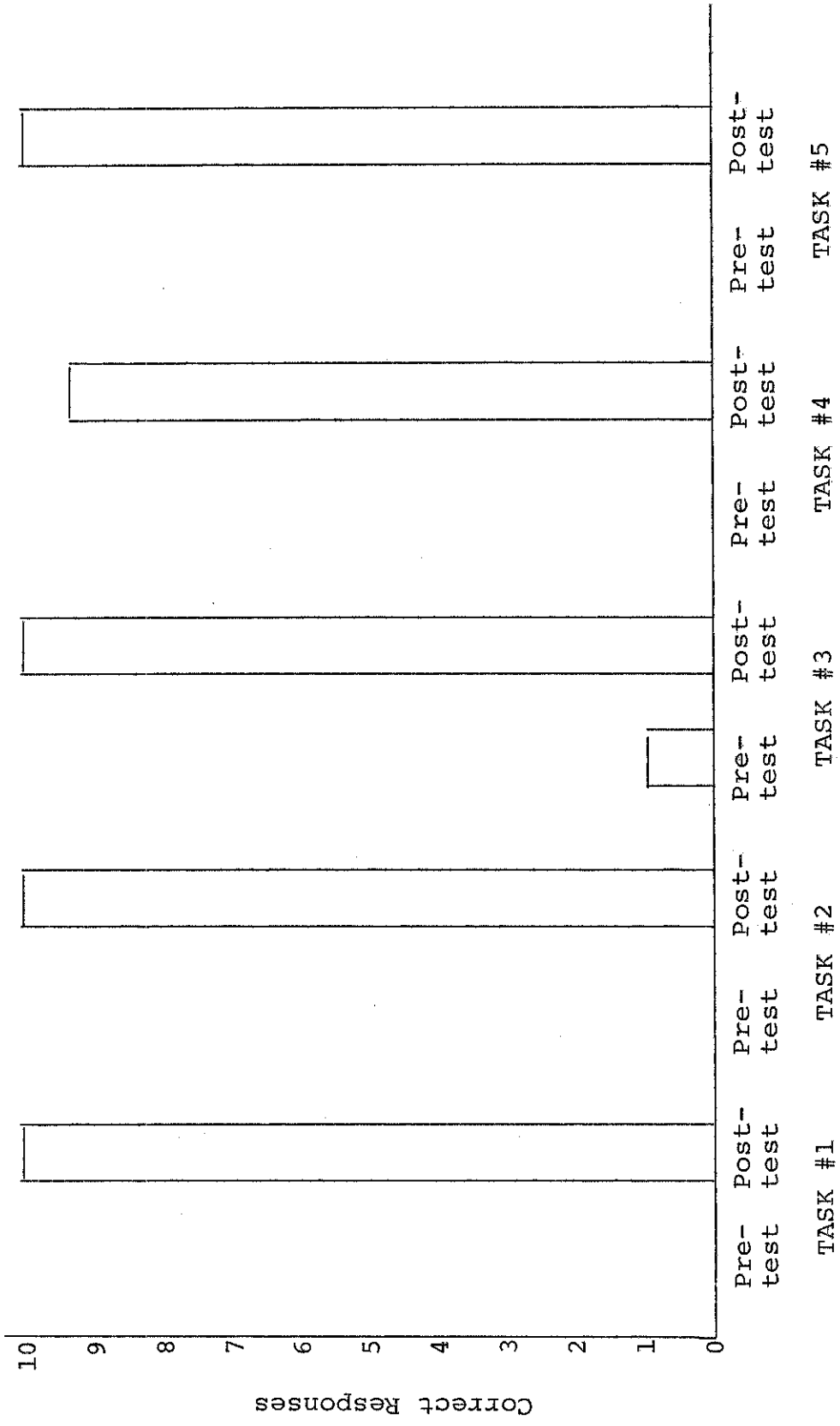

Figure 1. Comparison of tasks on pretest and posttest trials.

responsiveness to leg pressure. However, the response was not repeated during the pretest trial and was not, therefore, considered a conditioned behavior. The conditioned reinforcer was presented, using shaping techniques, during the six daily training sessions which consisted of six trials each. Approximately 1 minute elapsed between trials.

The subject failed to emit a single target response on the pretest trial of Task 4. Criteria for this task required the horse to refrain from moving any of its legs for 60 seconds while the bridle reins hung to the ground. Eleven daily 10-minute sessions of five trials each were required to elicit consistently the correct behavior. There was a 60-second intertrial interval. One incorrect response was observed during the posttest trial; the horse backed up several steps after presentation of the discriminative stimulus. It was observed that the horse was not under full stimulus control when the cue was presented and had not directed its entire attention to the handler. Successful responses were completed for the remaining nine trials when stimulus control was effectively held.

Task 5 involved the horse's nodding its head on presentation of a hand signal. No head nods were elicited on the pretest trial. However, when conditioned reinforcement was employed, the subject nodded its head consistently after 11 10-minute training sessions of eight trials each. Trials were approximately 45 seconds apart. There were 10 successful responses for the 10 posttest trials.

In addition to the conditioning of novel responses, a study was made to test further the effectiveness of the secondary reinforcer. After the posttest trial for Task 5 was completed, extinction procedures were employed and data were recorded. The hand signal for Task 5 was presented, with the conditioned reinforcer given after each correct response. However, no primary reinforcers were paired with the conditioned reinforcer during the entire extinction session. It was observed that the subject began to ignore the discriminative stimulus after the 12th trial. It responded correctly on an average of only once every four presentations after the 20th presentation, and emitted no head nods after 34 presentations of the discriminative stimulus.

Discussion

The application of conditioned reinforcement to horse training opens a great many possibilities for scientific horse training. It seems particularly useful in the conditioning of responses performed while the animal is in motion. Because these exercises cannot be halted quickly and a reinforcer presented without major disruption of the training session, conditioned reinforcement provides immediate, non-interruptive feedback.

For example, a calf roper's horse must stop instantly and with enough force to throw the roped calf to the ground. The roper must dismount quickly and run to tie the calf. He has no time to stop to give his horse a piece of carrot. A

quick presentation of the auditory stimulus as he dismounts would require very little of the roper's time and attention, but would still provide the horse with instant reinforcement for a correct response.

A common mistake made by hunting and jumping horses is the "rushing" of a hurdle, leading to an unacceptably flat jump; often even a fall. Using traditional methods, the horse trainer has considerable difficulty reinforcing the mount until well past the hurdle. The momentum required to negotiate a hurdle successfully carries the horse many yards before it can be stopped and rewarded with sugar or the cessation of training. Too much time has elapsed for the reinforcer to be associated with a correct response. However, employing conditioned reinforcement would enable the trainer to reward the horse for correct jumping form the instant the horse leaves the ground.

The training of working cow horses and other western horses demands the performance of many high speed maneuvers, including fast stops, turns, and an ability to move in any direction while remaining in balance. At present, most trainers depend largely on punishing the horse for an incorrect response, but have no practical means of reinforcing the successful maneuver. Using conditioned reinforcement in the form of an auditory stimulus, the trainer could reward the horse immediately, yet without interrupting the rhythm and balance of the horse's performance.

A wide variety of training problems could be aided by the use of secondary reinforcement. Habits viewed as unacceptable in the show ring or in the pleasure horse (e.g., head tossing, mixed gaits, excessive speed, stiffness of lateral movement, lack of collection, lugging at the bit, incorrect leads, poor flexion of the neck, getting behind or over the bit) could be improved by the systematic application of conditioned reinforcement. For example, a horse who tosses its head to evade control of the bridle could be reinforced whenever it does not toss its head upon tightening of the reins; essentially any other responses are contingently rewarded. This procedure is known as differential reinforcement of other behavior (DRO). The traditional remedy for head tossing is to tie the horse's head down. However, this increased severity of control often leads to rearing or other forms of misbehavior, and the horse reverts back to head-tossing as soon as the tie-down strap is removed. Secondary reinforcement would allow for the conditioning of a new response by means of positive reinforcement, rather than trying to control the horse by force.

In some important show events, a horse is required to perform a standard pattern of movements under saddle and the scrutiny of judges. A common problem for some horses is that the impression is given that the horse, rather than the rider is deciding upon the speed at which the pattern is traversed. Such an impression of lack of rider control costs dearly in

terms of points awarded by the judges. Current methods of training employ only punishment and negative reinforcement to maintain the rider's control of speed. It is clear that a conditioned reinforcer, applied systematically as described by the present study, could be a useful application of positive reinforcement. Applied immediately as the horse moves through the pattern, it would not be necessary to separate the reward from the task by stopping, dismounting, and feeding the animal a carrot.

The single subject design used in the present study is perhaps its most significant limitation. It was felt that analysis of results could be most effectively handled by direct, rather than statistical means. A comparison of conditioned reinforcement techniques to traditional techniques was not feasible with the single subject, because of the unavoidability of contamination by prior learning. Future investigations employing larger numbers of equine subjects would allow for meaningful analysis using statistical methods as well as comparisons of different training procedures.

The success of this study suggests several avenues for further research. Of considerable interest would be a design which would compare several training methods, including, for example, the conditioned reinforcement demonstrated by the present study, and negative reinforcement and punishment, the traditional techniques. This would require another design, using groups of several subjects.

An edible reinforcer was presented after an average of three auditory stimuli in this study. Further research might investigate the effects on equine subjects of different reinforcement schedules. Moreover, the present study used only one type of auditory stimulus as a conditioned reinforcer. Experimentation could be undertaken testing the effects of various types and intensities of auditory stimuli (bells, buzzers, whistles, etc.) as conditioned reinforcers.

Other researchers (Jackson, 1979) have compared the learning abilities of different breeds of horses. Similar investigations could be undertaken, assessing the variable effect of these conditioned reinforcement methods with different breeds of horse and with different types of training. Present methods are obviously not unsuccessful. Horses are trained to a variety of skills, but the ability to reinforce the animal while mounted, and during the flow of the task is bound to have particular implications with complex, moving tasks (e.g., jumping, working cattle). Future investigations could assess the comparative utility of conditioned reinforcement across a variety of such skills.

It must be noted that this research has shown clearly the effectiveness of systematic operant behavior principles in a field where tradition and trade secrets have been the rule of the day. For hundreds of years, horse trainers have used methods handed down from master to apprentice and jealously guarded tricks of their own. While this information is

useful in the hands of the experienced horseman, it is often confusing to today's "backyard" horse owner. Current knowledge of learning theory offers much of value to these amateur trainers in terms of a systematic approach to horse training.

This study has demonstrated that conditioned reinforcement can be effective as a horse trainer's tool. It can be used with the horse under saddle, at the end of an exercise line, or at liberty. It does not require unusual physical strength or perfect coordination. Since conditioned reinforcement has been shown to be applicable across species, it is probable that it is applicable to all breeds, ages, and abilities of horses. Understanding of learning theory will encourage horse handlers to seek more effective reinforcers, rather than relying solely on punishment and negative reinforcement, or trying to force the horse into submission, as so often happens with inexperienced horse owners. With better understanding of the horse and more systematic exploitation of its potential, the way is paved for a safer, more satisfying relationship between horse and man.

Appendix A

Data Sheet

Auditory Stimulus Test Trial

+ = Horse directs attention to and moves toward handler.
- = Horse does not direct attention to or move toward handler.

TASK #1

Horse is led to point 15 feet from pylon, released and given command "Walk,"

+ = Horse walks from handler, past pylon, turns around pylon and returns to handler.
- = Horse does not walk around pylon and return to handler.

Pretest Trial									
Posttest Trial									

TASK #2

Bridle bit is presented to horse's mouth.

+ = Horse opens mouth without physical prompting.
- = Horse does not open mouth without physical prompting.

Pretest Trial									
Posttest Trial									

TASK #3

Horse is made to stand facing fence at 45° angle while rider applies pressure to horse's side opposite direction intended.

+ = Horse makes stepping movements for a distance of at least 5 feet while remaining at a 45° angle to the fence.
- = Horse does not make stepping movements for a distance of at least 5 feet while remaining at correct angle to fence.

Pretest Trial									
Posttest Trial									

TASK #4

Horse is made to stand while bridle reins are hanging to the ground. Handler moves to a distance of 15 feet from horse.

+ = Horse does not move any of its feet within 1 minute.
- = Horse moves one or more feet within 1 minute.

Pretest Trial									
Posttest Trial									

TASK #5

Handler stands beside horse's head and presents hand signal.

+ = Horse makes nodding movement with head without physical prompting.
- = Horse does not make nodding movement without prompting.

Pretest Trial									
Posttest Trial									

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