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FREQUENCY AND CORRELATES OF EQUINE BEHAVIOR DISORDERS AND A BEHAVIOR MODIFICATION PROGRAM FOR CHRONIC CRIBBERS

By

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ABSTRACT

FREQUENCY AND CORRELATES OF EQUINE BEHAVIOR DISORDERS AND A BEHAVIOR MODIFICATION PROGRAM FOR CHRONIC CRIBBERS

By

Andrea S. Doughty

Very little research has been conducted on behavioral disorders in horses. Phase one of this study was conducted to obtain baseline data on the frequency and demographic correlates of 12 common vices including weaving, cribbing, wood chewing, and several under saddle vices. Data on 843 horses was obtained through questionnaire distribution at several large clinics and meetings sponsored by the Michigan 4-H Horse Program and the Midwest Dressage Association.

It was found that general temperament, amount of stall confinement, amount of human handling, and various other equine lifestyle factors were generally uncorrelated with individual vices or the total number of vices. Small, commonsensical correlations were found between confinement and stall kicking ($r = .17$, $p < .01$), confinement and kicking horses ($r = -.11$, $p < .01$), stumbling and human handling ($r = -.08$, $p < .05$), and handling and weaving ($r = .06$, $p < .05$).

A multivariate analysis of variance using the total number of vices as the dependent variable revealed a mild main effect for age with older horses having more vices. There was no main effect for breed or gender although there was a significant interaction. The interaction revealed that finely bred mares had more vices than geldings of the same breed.

The second phase of this research utilized a single-case experimental design. The subject was a 14 year old registered quarter horse gelding used as a school horse. Two major independent variables were examined: continuous haying (B) and cribbing-contingent electric shock (C). One day (15 hour) units were used for each treatment session. The first series was an ABAB design. Three days later, the second series was begun using an ACAC design with a one week limited follow-up. The dependent variable was the number of cribs per unit of time. Major co-variants included time spent eating hay, time spent grazing in the absence of food, and body orientation within the stall.

Analysis revealed an average decrease of 83% in the rate of cribbing under the continuous haying procedure. The shock paradigm suppressed the cribbing rate to near zero.

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CHAPTER I

INTRODUCTION

Throughout recorded history, horses have served humans as a performance animal. Whether at the plow, at war, or on the race course, the horse's trainability and athletic potential have made him a highly valued domestic animal. It is somewhat surprising that so little research has been done on the areas which make horses so valuable: learning ability and soundness.

Until recently, most large animal veterinary research has focused on the better developed area of meat producing animals. What research was done on horses paralleled research lines on cows, hogs, and sheep. Thus, research results involving reproduction, nutrition, and immunization have dominated the literature. Although this research is greatly valued, it has not touched areas of primary concern to today's horse owner.

The equine population of the United States is once more on the increase, but the horse has changed its role from a working necessity to a leisure time activity. This change is reflected in an increase in amateur owners and professional

trainers willing to invest their time and money on equine sports. As a reflection of these changes, equine behavioral research has again made an appearance in the literature after an absence of 40 years. Courses on equine management are now being offered at more universities and degrees in horse science are becoming more common. In addition, a first of its kind research facility exclusively for equine research is being opened in New Bolton, Pennsylvania. There is little doubt that equine research is expanding and reaching a place of greater prominence in the literature.

This paper examined equine behavior disorders with special emphasis on cribbing behavior. In the following pages, the research on equine intelligence and learning capacity will be reviewed and an overview of this small body of research will be made. We will then turn to the popular literature to examine the folkmyths concerning cribbing. Finally, all this information will be related to laboratory research on learning and perseveration in other species. The present study's research hypotheses will be based on the outcome of these comparisons.

Equine Behavior Literature

The small body of research on equine behavior falls into three main areas; sensory research, mare/foal behavior, and learning capacity studies. The bulk of the sensory and physiological psychology research has been conducted in Russia, consequently access to this information has been

limited. However, in an article by Popov (1956), a reward contingent discrimination task found horse's to have "acutely sensitive" (p. 51) sight and hearing. His subjects could differentiate between 96 and 100 beats of a metronome, between a frequency of 1,000 and 1,025 cycles per second, and between 69 and 70 decibels. They could differentiate visually between light stimuli of 87 and 90 watts. In addition to these threshold studies, Popov had success teaching third-order conditioned responses. The horse responded to three separate stimuli in three modalities (sound, sight, touch) with three different chained responses based on the previously completed correct response. This evidence like the case of Clever Hans (Chevalier-Skolnikoff, 1981) who could discriminate on the basis of very subtle postural cues made unconsciously by his owner, suggests that the horse is capable of fine discriminations and chained responses. It shifts the culpability of a poorly trained horse from the "stupid" animal to the ineffective stimuli provider, the handler or trainer.

The second body of equine research is in the area of mare/foal recognition and communication, and procedures for raising orphaned foals. Houpt and Wolski (1979) examined mare/foal recognition by blocking first visual cues, then olfactory cues, and finally both modalities at once to see if a mare could locate her foal without them. Visual cues were blocked by blanketing the foal and hiding him from view. Olfactory cues were blocked by using mentholated ointment in the mare's nostrils. It was found that both sight and

vision were used in recognition and blocking both had an additive effect.

The literature on orphaned foals is primarily anecdoctal case studies (Williams, 1974) or a case report combined with a report on mechanical developments to reduce labor costs (Glendinning, 1974). These case studies have found that the physical health of the foal can be maintained by human providers but in order to acquire proper vocalizations, snapping postures, feeding techniques, and social behavior, the foal must be accompanied by other horses when it is very young. Foals raised in isolation have social deficits around other horses for the rest of their lives, and their maternal behavior will be adversely effected (Houpt & Wolski, 1979).

Several studies have been done on the grazing pattern of horses in captivity. It was found that given a large enough field, horses develop three types of areas (Odberg, 1976). One is bare patches near gates and troughs. These patches are located in high traffic areas and are used primarily for rolling and dozing. The second type of area is called a lawn, and is composed of short grass used for grazing. The third area is the rough, an area of high grass cut by periodic paths. This area is used for defecation and urination. The researcher found that adult horses honored the different uses of the areas while the foals were less consistent. This indicates a learning component in land use.

Direct research into learning in the horse was formally reported as early as 1911 by Hamilton. Unfortunately, the

history of this third research area has been characterized by false starts and abrupt ends. This disjointed approach has had the expected result of producing isolated studies which do not allow methodological or theoretical refinement. This paper will simply review some of the procedures and results found by these isolated ventures.

The earliest published research was an interspecies comparison of humans, cats, dogs, monkeys, and a horse on the searching pattern used in problem solving (Hamilton, 1911). The procedure involved entry into a room with four doors, behind one of which was a reward. Hamilton found that on successive trials, the human subjects would avoid the door open the trial before (the same door was never open twice in a row) and try the other three doors. Monkeys tended to perseverate by opening the same door several times. Dogs, cats, and horses had a tendency to avoid one particular door regardless of the reward contingency attached to it. These different search patterns were used as an indication of relative learning capacity and showed that dogs, cats, and horses showed the least productive problem-solving approach.

Gardner conducted one of the few series of experiments during the 1930s and 1940s. She used the same apparatus for her four published experiments and changed the cue (stimulus quality) for each study in the series. A special box stall was designed with the door centered on one side and three identical feed boxes on the wall opposite the door. For the

first experiment (1933), a quart of grain was put in one feed box and all the spring lids were closed. The horses were brought to the door and allowed to enter and search for the grain. After an initial six trial orientation period where the horse learned to eat from and operate the boxes, the experiment was begun. It was found that in only four trials, the horses (36 Percherons, 11 Belgians, 20 grades, and 1 Thoroughbred) had reduced their average time from 160 to 5 seconds. Only 30% of the horses showed any forgetting from trial one to trial two. Limited follow-ups at 2 months, 6 months, and 1 year showed virtually no forgetting. Overall, mares were slightly slower to open the box than geldings. Gardner offered no explanation for this sex difference.

The second experiment (1937) elaborated on the first procedure. Once more the orientation trials assured that the subjects (62 horses similar in breed to the first study) could open the hinged lids. In this variation, the bin containing the grain was covered with a black cloth and the lid was removed. The horses had to learn to select the black cloth covered box and nudge the cover aside to get the grain. Although this discrimination problem was learned within four trials, it was not retained as well as simple lid opening. It also demonstrated a learning curve where rapid learning occurred during the first six trials and then leveled off. After 17 trials the error rate increased. After two or three days off, the error rate once more decreased. There were no sex differences between mares and geldings in this

experiment but it was noted that the more emotional horses were slower learners.

An interesting sidelight of this second experiment was the observation that the horses did not seem to be using their sense of smell in locating the grain. At one point sawdust was put in the tubs instead of grain, and the horses ate a few bites before they realized what it was. A blind horse had to be within one foot of the grain in order to orient towards it. When noxious smells like formaldehyde and burning punk were put in the bin, the horse was undeterred in opening the lid. Since very little has been done on the sense of smell in the horse, this sidelight and Houpt and Wolski (1979) offer some evidence of its insufficiencies.

The third experiment was conducted on 44 horses of the same basic mix of Percherons, Belgians, and grade horses. In this experiment Gardner (1937) hung a black cloth signal either above or below the closed lid of the bin containing the grain. It was found that the error rate for the high signal was nearly twice the error rate for the low signal. The low signal in turn, had twice the error rate of the "cloth on lid" signal. These results demonstrated a cue proximity gradient from the closest cue (on the lid), to the next closest cue (below the lid), to the furthest cue (above the bin). This gradient becomes clearer when the habitual head carriage of the horse was considered. The low head carriage made the high signal more difficult to see. A two and one half year follow-up retest showed an amazing amount

of retention with the error rate actually below the original experiment's figures.

In the fourth experiment in the series, Gardner (1942) used metal pails as the cue. Since most of the horses should of had experience with pails as a food recepticle, it was considered a strong signal in conjunction with the closed feed bins. However, virtually no learning occurred after 34 trials. In an attempt to decrease the error rate, 28 new horses were given lid opening trials where the grain was in the pail inside the feed box. Subsequently, the empty pails were hung in front of the full grain box and the error rate dropped. The pail was now associated with the grain reward.

Another variation to enhance learning was the addition of punishment. A perforated metal strip was placed around the edge of the lids. Fifteen horses from the first half of the experiment where very little learning had been demonstrated, reduced their error rate from .96 to .31. Additional findings showed that the high or low positioning of the pail showed the same effect on error rate as the signal cloth in the previous experiment. The low signal produced a lower error rate than the high signal.

Overall, the findings from Gardner's experiments were clear and consistent. The younger horses (0 to 4 years old) were the better learners and older horses (over 14) were slower learners. Mares had a slight tendency to be slower learners than geldings. Emotionality had a variable effect, sometimes enhancing and sometimes inhibiting learning. The

key finding was the remarkable retention ability of these horses. Despite difficulties in learning the task, once learned it was virtually never forgotten. One of the difficulties that Gardner experienced was that once the horse learned to open the feed box lids, they no longer saw or paid attention to the more refined discrimination cues. In a very practical way they had already learned all they needed to know: If you keep opening lids you will eventually find food. Hurry is a human trait. Thus, this series of experiments were conducted in such a way that extra discrimination learning had very little reward. Learning to open lids and dogged persistence were the only things necessary to survival. A research design where the horse only got one chance or went hungry would have been a better test of his discriminative ability.

Warren (1962) conducted an experiment to test the relative ability of a racoon and a horse at reversal learning. Both animals had to choose between a black box and a white box to receive a food reward. Criterion was 11 out of 12 correct choices in each set, then the rewarded box was reversed and another set run until criterion was reached. Warren found that the racoon made fewer errors than the horse. Both animals made progressively fewer errors thus showing a "learning to learn" phenomena.

Dixon (1970) conducted a fascinating single-case learning experiment on a pony gelding. She used a design developed by Rensh (1957) where the pony was presented with different

visual stimuli presented on two cards. To receive a carrot reward, he had to push the appropriate ball. He was taught 20 pairs in 87 daily sessions with 100 trials given a day. On the last six days, 100 trials on all pairs were made. It took over one thousand trials to learn the first pair. From the sixth pair on, it took approximately 50 trials to reach criterion level, thus clearly demonstrating the phenomena of "learning to learn." The correct choice rate for the final six days of the experiment was 92.5%. One month later the rate was 81%. Three months later it was 78% and six months later it was 77.5%. The pony's retention ability was excellent.

Kratzer (1977) conducted a maze learning reversal experiment where 37 Quarter horse yearling geldings served as subjects. The horses were confined at night in the barn and then released one at a time in the morning. In order to get outside to join the other horses and reach water, they had to make a left or right hand exit decision. After establishing directional preferences during the first four trials where all exits were open, trials five to nine used the right hand exit at the correct response. Trials 10 to 13 used the left exit. The results from the baseline work showed that 49.2% of the horses chose right hand exits and 50.8% chose left hand exits. There was no evidence of a side preference or handedness. During the first set of learning trials, errors decreased, time latency decreased, and looking to the right increased. During the reversal

trials, the error rate increased and then gradually decreased but right hand (incorrect) choices were still made first. In order to reduce errors, trials 13 to 15 added a burst from a CO_2 fire extinguisher as punishment for an incorrect right hand choice. The result was a decreased error rate, fewer initial right choices, but an increased latency of escape. For nearly half of the horses it took more than one trial to learn to avoid the right hand choice indicating that one trial learning was not occurring. One of the basic problems with this research was that too few trials were available to the horse. Instant learning was just not possible in this situation so any natural learning curves were not allowed to develop.

The center of most current research on equine behavior is Texas A & M University. Under the direction of Gary Potter, a group of animal science graduate students and veterinary students have produced a series of studies and theories on equine behavior. The most prolific member of this group is Jeanna C. Fiske who had produced articles for the general public (1978; Grant, 1977, 1978a, 1978b) as well as for scientific journals (1979). In addition, she has published a book (1979) on "equine psychology applied to training" which provides an excellent summary of the horse's sensory systems, basic learning principles, and an extensive review of equine behavior and training literature.

In an 1979 article, Fiske and Potter used 26 Quarter horse and Quarter-Thoroughbred yearlings in an experiment

on reversal learning. Each morning for 20 days, the young horse was brought to a start position directly opposite two straight stalls which served as a Y maze. The horse's morning ration of grain was located in one side of the maze. Each trial was composed of releasing the horse at the start position and allowing him to choose a stall. If an incorrect choice was made, the yearling was brought back to the start position. If a correct choice was made, he was allowed to eat for 30 seconds. After the first day, alternating reversals were made for 20 days. Criteria required 11 out of 12 correct responses with a maximum of 30 trials per day. After each daily session, a six point emotionality score was assigned to each horse. In addition, the instructor who had previously trained these horses rated them on a six point scale of how difficult they were to train.

The results showed a "learning to learn" pattern where fewer errors occurred over time. Definite sex differences existed where geldings made significantly fewer errors than colts, and colts made significantly fewer errors than fillies. Colts and geldings showed a significant correlation between ease of training, emotionality, and error rate where the calmer horses were easier to train and made fewer errors. Fillies showed a similar correlation between emotionality and error rate but showed no correlations with the instructor's ratings of trainability. This finding combined with their overall high error rate led the researchers to

conclude that the fillies' estrus cycle was causing most of the excess variance in their scores.

This research partially supported Fiske's theory (1978) that a horse's trainability could be determined by assessing the animal along the dimensions of dominance and emotionality. A horse low in emotionality (or nervousness) and average in dominance would be easier to train. Since a mare's estrus cycle directly effects both their emotionality and dominance, their trainability is more variable.

In general, we still know very little about equine behavior and although there are signs of increased interest, it is unlikely that there will be a sudden explosion in controlled experiments. Thus far, the fragmented research done in this country has shown none of the finesse of the Russian investigators (Popov, 1956; Bobylev, 1960) and with the exception of Potter et al. (unpublished, 1979) very little theorizing has been done. We know that horses are capable of learning and have a remarkable retention capacity but we know little else about their cognitive functioning. The next section shifts the focus from general learning research to the information available about one specific behavioral aberration, cribbing.

Cribbing and Wind-Sucking

"Chewing on the wood of the stall leads some horses to develop the unpleasant and unhealthy habit of hooking the upper front teeth over a convenient post or ledge, such as

the edge of a manger, and then arching the neck and pulling back to distend the muscles around the throttle, and sucking air into the stomach . . . (it) can be partially controlled but very rarely cured" (Sumner, 1977). This description and observation by Sumner neatly summarizes cribbing, one of the few common aberrant behaviors common among horses. There is no data on the frequency of cribbing among horses, but we know it has existed since far back in history and in all parts of the world (Sevelius, et al., 1976). Most of what is known about cribbing comes from two sources; the lay public which has had to contend with the problem and veterinarians who have tried to answer the owner's pleas for help.

Cribbing is considered a health problem for several reasons. The actual motion of hooking the teeth and sucking air wears out the front teeth at an abnormally fast rate and results in an inability to properly chew their food. Without the complete grinding of their food, the horse's digestive system is unable to breakdown the whole kernals of grain and hay so its nutritional value is lost. The horse tends to lose weight and condition even though it is being fed enough food. This unchewed food and the additional air in the stomach from the wind-sucking also contribute to an increased risk of colic (Berry, 1978; Baird, 1977; Denning, 1977; Sumner, 1977) which can often be fatal in horses.

The lay journals and books have suggested the possible causes of cribbing. The most frequent cause cited is boredom and long confinement without proper exercise (Berry, 1978;

Baird, 1977; Clay, 1977; Geddes, 1978; Leonard, 1978; Summerhays, 1977; Fiske, 1979; Sevelius, et al., 1976). Other possible causes include teething generalization (Berry, 1978), poor tooth care (McKibbin, et al., 1977), vitamin deficiency (Baird, 1977), and poor form or quality of feed (Leonard, 1978). A secondary cause frequently mentioned is imitation, where other horses within a barn will "catch" the behavior from the original cribber (Leonard, 1978; Summerhays, 1977; Fiske, 1978; Sevelius, et al., 1976). It must be emphasized that none of these potential causes have ever been empirically tested. All these observations are based on observation only. We do not know why boredom should "cause" the behavior to appear or why horses in certain situations imitate another cribbing horse creating a virtual epidemic while in other cases the horses live side by side for years and imitation never occurs. Many horses are bored but very few become cribbers.

Some of the recommended "cures" for cribbing include painting the stall or cribbing spots with noxious mixtures (Berry, 1978; Clay, 1977), removing projections (Berry, 1978; Summerhays, 1977; Sumner, 1977), putting the horse outside (Leonard, 1978), and use of a cribbing strap (Berry, 1978; Clay, 1977; McKibbin, et al., 1977; Summerhays, 1977; Sumner, 1977). All of these "cures" have had at least temporary success at reducing cribbing.

Veterinarians have been looking at surgery as a cure for chronic cribbers. Professor Gerhard Forssell (Sevelius,

et al., 1977) developed an operation during the 1920s which involved removing part of the muscles in the horse's throat. A follow-up of 130 horses operated on in Helsengbord, Sweden showed a 90% success rate with the best prognosis for three year olds and the worse prognosis for older, long-term cribbers.

McKibbin et al. (1977) mentioned another type of operation where holes the size of quarters are made in the horse's cheeks. These holes prevent air from being sucked into the stomach. No information on the success rate of this procedure is available.

The difficulty with surgical cures lie in their cost and deforming side-effects. The cost puts surgery beyond the reach of most horse owners and the scars make surgery impossible for halter horses and show animals judged for appearance.

One other area of veterinary research is looking for the cause of cribbing in heredity. In Sweden, where the horse population is smaller, self-contained, and breeding is under closer control, Sevelius et al. (1977) have noted that the get of one cribbing stallion demonstrate a high incidence of cribbing. Although this line of research has not been systematically investigated, lay observers such as Williams (in Geddes, 1978) have also noted the possibility of an inherited factor. This area deserves further empirical testing.

The literature on cribbing presents a remarkable consensus of opinion on the causes and the lack of a long-term cure for cribbing, but it is a consensus without empirical support. We now turn to the empirical work on perseverative behavior in laboratory animals to see if this area can help our understanding of cribbing.

Perseveration Research

It is somewhat difficult to describe cribbing in standard learning terminology because its causes and rewards are unknown. We are in the unusual position of having a "spontaneous" behavior and trying to discover how it was created, what keeps it going, and how to extinguish it.

The fact that cribbing is "spontaneous" and unamiable to alteration suggests that the act of cribbing has primary reinforcing properties. The act of sucking air into the stomach may result in a "full" or "satiated" feeling for the horse. The air may be a food substitute which gives no nourishment but alleviates the physical symptoms of hunger. This would give cribbing powerful reinforcing properties. This would also explain why few horses crib only occasionally or crib at one point in their life and then quit. The horse, which has an amazingly good retention capacity, need only crib a few times to discover it can create a "full" feeling any time it wants. This self-reinforcement may fill in the gaps left by modern horse management procedures where the horse is fed only twice daily. The horse evolved as a

grazing animal which ate small amounts throughout the day and night. Undoubtably, even though adequately fed, our domestic horses may often "feel" hungry.

If a "full" feeling is the reinforcement connected with cribbing, then any attempt to use punishment to extinguish the behavior is likely to fail. Even using an optimum punishment procedure (Azrin & Holtz, 1966) where the onset of each cribbing action is immediately punished using a strong punisher, it will probably not be effective. Any spontaneous recovery (which is likely when this procedure is used) will reinstate the reinforcing properties of the act of cribbing. Any other punishment schedule which does not totally eliminate every wind-sucking attempt, will only produce the condition where both punishment and reward occur as a result of the behavior. This situation has been found to be very resistant to extinction (Church, 1963).

It has been recommended in most of the punishment literature (Walters & Grusec, 1977) that when a response is being extinguished, alternative behaviors should be provided. This is another obstacle in managing the cribber. There is no easy alternative behavior for the horse to do. Continuous feeding is only a partial solution because the horse is capable of eating and cribbing virtually simultaneously. There is no easy incompatible alternative behavior which would interfere with the cribbing response and make it impossible. Thus, most punishment procedures lead to the unfortunate situation where the horse is punished for cribbing

and is left with the alternative of sleeping or staring at his surroundings. Boredom is increased and in all probability the motivation of hunger becomes more salient.

The nature of cribbing places it outside the most common laboratory-produced behaviors and places it closer to the phenomenon of autism in humans. Autism is characterized by extreme perseverative behaviors and self-stimulation (Lovaas & Newsom, 1976). The rocking, hand flapping, and twirling of autistic children may be behaviorally similar to equine weaving and the regular rocking motion of cribbing. Sevelius et al. (1976) cited cribbing as an example of aerophagia or air swallowing, common in severely disturbed humans. To avoid misinterpretation, it is not being suggested that cribbers are autistic or psychotic animals. On the contrary, they are usually normal in every other way. They get along socially with other horses, they are capable of normal learning, and they usually do not exhibit any other abnormal behavior. What is being proposed is that within the horse's simple mental capacity, some physical or chemical factors could be functioning with only minimal behavioral consequences.

The research on brain lesions in rats offers some interesting parallels with equine cribbing. Osborne and Black (1978) summarized the research done on hippocampal and fornix lesions. It was found that lesioned rats had somewhat lower acquisition rates, slower extinction times, and a more limited behavioral repertoire. Since the normal

horse has a somewhat slow acquisition rate, a remarkable retention ability (and probable resistance to extinction), and few behaviors in its natural repertoire, an animal with a type of lesion or chemical imbalance would not stand out as being too different from his fellows. He could live a relatively normal life especially in a herd where few independent actions are necessary.

Cribbing and perhaps weaving appear to have all the ear marks of a physical condition. The most conservative view would postulate an inherited predisposition triggered by environmental stimuli such as prolonged confinement and lack of grazing opportunities. Once started, the reinforcement properties of the behavior combined with possible chemical changes (Gray, 1969), result in a behavior unamiable to change. Physiological research is needed to test these postulates and unfortunately this author lacks the requisite skills.

Summary and Hypotheses

The purpose of this research is two-fold. The first phase (Part I) of this study will utilize a questionnaire administered to 4-H horse owners in Michigan to determine the frequency of equine behavior disorders in the state horse population and some of the possible correlates of this undesirable behavior. We will examine horses' living conditions in Michigan, their diets, early history, and work schedules. This information will provide a data base for

future equine investigations and to assist in determining promising avenues of research. Some of the major questions to be answered in Part I include:

1. Are there sex differences in the number of undesirable habits equines possess? There is no literature to support a prediction.

2. Does age have an effect on the number of vices a horse possesses? It is popular belief that horses develop more bad habits over time (Summerhays, 1977).

3. Are there differences between the breeds in the number of vices or bad habits? Once more, this is exploratory work with no literature base.

4. Does amount of physical confinement correlate with undesirable behavior? The cribbing literature suggests a positive relationship.

The second phase (Part II) of this study will examine cribbing behavior in a single case design. (Although it would have been preferable to use several animals, limited financial and human resources and a lack of donated cribbers made this impossible.) An alteration of the horse's feeding schedule into a more natural demand diet will be examined in a A-B-A-B design. Cribbing rate and general behavior will be recorded. In the second half of this phase, cribbing contingent electric shock will be examined in the same design with a one week follow-up. The hypotheses in Part II include:

5. Continuous haying should reduce but not eliminate cribbing by offering an alternative behavior and hunger satiation (Walters & Grusec, 1977).

6. Contingent electric shock punishment should suppress cribbing behavior. When the shock is no longer applied, spontaneous recovery should occur (Azrin & Holtz, 1966).

7. Follow-up measurements will show no long-term effects of the shock punishment on cribbing rate.

CHAPTER II

METHOD

This chapter presents the methodology and design that were used to test the hypotheses. The study was conducted in two distinct phases. The first, a survey phase, determined the incidence and concomitants of equine behavior disorders. A large number of horse owners completed a questionnaire concerned with their horse's demographic characteristics, living conditions, diet, work schedule, early history, and undesirable habits.

The second phase was a single case, behavior modification experiment focused on altering chronic cribbing through the use of two dissimilar manipulations: a demand diet which was a "naturalistic" approach and electric shock punishment of cribbing. The diet and shock treatments were examined using an ABAB and ACAC design with a one week follow-up assessment.

Survey

Recruitment of Subjects

A variety of recruiting techniques were used to secure a large and varied pool of questionnaire respondents. The

support and cooperation of the Michigan 4-H Horse Program and the Midwest Dressage Association (MDA) provided access to several large gatherings of active horse owners thus greatly facilitating data collection. Through the aid of these organizations, four groups of horse owners were administered the questionnaire.

The first and largest gathering was the Dressage Seminar conducted February 10, 1979 at Michigan State University. The 4-H Horse Program and MDA co-sponsored and promoted the seminar among their members and the general public. For a nominal admission fee, the seminar provided demonstrations and lectures on the purpose and usefulness of dressage training principles for both Western and English riding styles.

The audience of nearly one thousand was primarily composed of 4-H club members and their leaders. In addition, a smaller proportion of the audience were dressage and hunter/jumper enthusiasts from the general public. Thus, the sample characteristics were skewed towards young (10 to 18 year old), female horse owners. The young, white female is a mainstay of the Michigan and, more generally, the American horse industry. In addition, the adult amateur horse owner was represented by the 4-H leaders and professional horsemen were represented by the seminar speakers and local professionals in attendance.

In an attempt to evaluate rural horse owners in Michigan, questionnaires were distributed at a 4-H Horse Camp located

in the central, northern part of the state. This sample was composed solely of 4-H club members and their leaders participating in a four day horse management camp. The total attendance was around 200 people. The location of the camp drew a larger proportion of nonurban horse owners who are more likely to board their horses at home and have total responsibility for their care. This representation was important to provide a range of equine life styles from the confined city horse to the backyard suburban horse to the farm horse.

In a further attempt to tap outlying regions, 4-H leaders at both the Dressage Seminar and horse camp were encouraged to take questionnaires back to their clubs and return the completed surveys in the provided envelopes. This third group of respondents included many of the more distant 4-H clubs and some of the club members less active in the horse program.

The fourth and final group of respondents comprised a different population of horse-owners. The Midwest Dressage Association is an affiliated member of the American Horse Show Association. Amateurs and professionals with an interest in showing or promoting dressage make up its membership. The age range of members varies from juniors to active horsemen in their seventies, and although dominated by females, there are a larger proportion of male participants. A copy of the questionnaire was reduced and included in the summer, 1979 MDA Newsletter which was mailed to approximately

200 active members. Interested respondents returned the questionnaires at their own expense. The reproduction and return of these questionnaires was unsolicited, and the author was not aware it had occurred until the forms started arriving in the mail.

The total useable sample was composed of 725 large gathering respondents, 90 mail-in 4-H respondents, and 28 MDA Newsletter returns for a grand total of 843 questionnaires. There was a 100% return rate at both large gatherings. The return rate for the outlying individual 4-H clubs is difficult to calculate because the 4-H leaders often duplicated the questionnaires at their own expense. Thus, the return rate was at least 75% (with no follow-ups).

Materials

Each subject completed a questionnaire encompassing six content areas. A sample of this questionnaire is included in Appendix A. The first section asked for the following demographic information about the respondent's horse: breed, age, height, weight, sex, length owned, and the number of prior owners. In addition, the owner's name and address and the horse's name were obtained to prevent possible questionnaire duplication.

The second section dealt with the animal's housing and living situation. The first question asked how many other horses were stabled with the subject's horse. This would be an indication of the horse's isolation or companionship

level. Additional questions determined whether the horse had a box or straight stall and whether this stall had a window. The size of the pasture or turn-out area and whether it had grazing material was also assessed. These variables combined with the proportion of time spent confined to a stall as opposed to loose outdoors served as an index of the life style of the horse. A horse with no stablemates, confined to a windowless straight stall, with outside time limited to brief intervals in a small dirt paddock is far removed from his evolutionary pattern of a free-ranging herd animal.

The third section dealt with the amount of contact between horse and owner. Owners were asked how many times a week they rode the horse outdoors, rode indoors, lounged, groomed, and spot checked the horse. These rates would indicate how much handling and work the horse normally received.

The fourth section requested information about the horse's feeding schedule. Owners were asked how often and at what times the horse was fed and whether this schedule was consistent or flexible. The form of the roughage, type of grain, and access to a mineral block assessed the content and gave an indication of the adequacy of the diet. The owners were also asked how often they fed their horses treats by hand.

The fifth section asked for a description of the horse's temperament and vices. The owner was given an 11-point scale from "hot blooded (high strung)" to "cold blooded

(calm)" and asked to place a check mark along the continuum at the point which best described his horse's temperament. This served as the measure of general emotionality. The respondents were then asked to indicate on a 12-item checklist, any behavior they had seen the horse do five or more times. This list included standard vices such as weaving and cribbing and a variety of behaviors dangerous to handlers (bucking, biting, shying) and property (stall kicking, wood chewing). This list was followed by a series of questions asking if the owner had tried to break these habits, what they had done, and if it had worked.

The last questions were an attempt to find any occurrences in the horse's early life which would contribute to future behavior disorders. The age at weaning and health of the dam were assessed as well as the amount of indoor confinement the foal and dam had. Additional questions on the amount of human handling the foal had, any early health problems, and any recurring or current health problems ended the questionnaire.

Two cover letters were prepared. Copies of these cover letters appear in Appendix B. One cover letter was prepared for the 4-H leaders who would be taking blank questionnaires back to their clubs and returning them by mail. It briefly described the purpose of the research as an investigation of the horse's daily routine and personality. The leader was asked to read three brief paragraphs to the club members before they filled out the questionnaire. These points

guaranteed anonymity and voluntary participation, assured that there were no right or wrong answers, and indicated that the results would appear in the 4-H newsletter. An endorsement by a local veterinarian and the 4-H Horse Specialist appears at the bottom of the page along with the experimenters' names and addresses.

The second cover letter was stapled to the front of all the questionnaires distributed at the large gatherings. The basic information contained in this cover letter was identical to the first cover letter, only the format was altered.

Procedure

Questionnaires were handed out at the entrance to the Dressage Seminar. The questionnaires were self-administered and returned as the participants left the hall. Large cardboard boxes labeled "Questionnaire Deposit Box" were placed at the exits. Each box had a large slit cut in the top for the deposit of questionnaires.

The procedure was nearly identical for the horse camp. Questionnaires were distributed in the cafeteria during the lunch hour and returned to the deposit boxes located in the central hallway.

4-H leaders at both the above large meetings were asked if they would like to take the questionnaires back to their 4-H clubs. If they expressed interest, they were given blank questionnaires, an explanatory cover letter, and a stamped return envelope.

The MDA newsletter spontaneously reprinted the questionnaire. Respondents were responsible for the return postage.

Behavior Modification Study

Variables and Experimental Design

The second portion of this research utilized a single-case experimental design. Two major independent variables were examined: continuous haying (B) and cribbing-contingent electric shock (C). One day (15 hour) units were used for each treatment session. The first series was an ABAB design. Three days later, the second series was begun using an ACAC design with a one week limited follow-up. The dependent variable was the number of cribs per unit of time. Major co-variants included time spent eating hay, time spent grazing in the absence of food, and body orientation within the stall.

Subject

The subject was a 14 year old registered quarter horse gelding named Boston. He was owned by Willow Pond Stables and served as one of their school horses for their busy group lesson business. He was used in approximately seven to ten hunt seat/jumping lessons per week. All the school horses had Sunday off and were turned outside if weather permitted. Boston was fed one and a half pounds of sweet feed and two flakes of hay morning and night. Stalls were usually picked out once a day in the afternoons.

Attempts to trace the horse's background prior to his purchase by Willow Pond at the age of nine were futile. He had been a chronic cribber since his arrival at the stable. His general health was good and he was sound although his legs showed evidence of multiple healed injuries. His general temperment was dull and lazy. His manners around other horses while under saddle were nonthreatening and his behavior in the herd was that of a horse with medium status (neither aggressive nor passive). However, he had a reputation of biting and kicking his human handlers.

Materials

A World War II surplus event recorder was used to record the subject's behavior. This piece of equipment had 20 pens which produced a continuous line on a roll of ruled paper. Fourteen keys and one backup key were used in this research. Individual events or elapsed time could be recorded by depressing the appropriate key. The recorder was set to run at three inches per minute.

A Sensitronix Trainer (Relco Industries) electric shock collar sold commercially and used primarily for training hunting dogs was adapted for this study. The collar was remote controlled by a radio receiver and had a range of five miles. There was a two second delay between depression of the shock button and the animal's receipt of the shock. This delay was reduced to near zero by experimenter practice and knowledge of anticipatory cribbing behaviors. The lowest shock setting of 30 milliamps (10 K resister), the

"toy poddle" setting was used for this study. This setting was selected to reduce the chance of the animal injuring himself, property, or the handler during his shock reaction.

The shock collar was strapped around the horse's neck approximately four inches from the throatlatch. In this position, the collar was too low to act in the same fashion as an ordinary cribbing collar. However, this position made the collar impervious to accidential damage or removal attempts. This position was also unimpeding and relatively unobtrusive since the horse was accustomed to wearing a diamond cribbing collar (which pilot data indicated was completely ineffective in preventing cribbing).

Procedure

The subject was housed in a newly constructed barn which had 22 stalls arranged on either side of a 12 foot wide cement central aisle. Each 10' by 9'8" stall was equipped with an automatic waterer, grain bucket, sliding door, and metal bars across the upper half of the face of each stall. (For a diagram of the stall see Appendix C.) The subject's stall was located second on the right from the entrance. The first stall to the left of the entrance had been converted into a tack room. The event recorder was set up in front of this room and on a diagonal approximately 15 feet from the subject's stall. This angle allowed a complete view of the subject without being in his constant field of vision.

Pilot work had indicated that the following 12 activities described the horse's routine stall behaviors: urination/defecation, having a human touch or speak to him (independent of other activities), stall cleaning, tacking/grooming, chewing or mouthing objects, cribbing, eating hay, eating grain, drinking water, grazing in the absence of food, and laying down. Absence of these behaviors indicated a motionless, often drowsy state. In addition to these specific behaviors, the horse's movement within the stall was continuously recorded. Location was determined by dividing the stall into quadrants and recording the location of the horse's head relative to this grid (see Appendix C for the grid diagram). For urination/defecation, human attention, playing, and cribbing, the individual event was recorded. For the remaining behaviors, the duration of each event was recorded.

Pilot data on the 24 hour activity of the subject indicated that a 15 hour interval from 7:00 a.m. to 10:00 p.m. adequately represented the horse's normal activities. This unit was therefore used for each treatment application. Each series was begun on a Monday and finished on Thursday.

The first treatment variable to be used was continuous haying. It was selected as the first manipulation because of its basically nonreactive nature. A standard ABAB design was used to examine the effects of continuous feeding on cribbing rate. Day 1 was a baseline measure of normal stall behavior. Day 2 (B) instituted continuous feeding so the

subject was never without hay. Day 3 (A) returned to normal feeding practices. Day 4 (B) resumed continuous haying. Each day's activities were charted on the event recorder.

The following Monday the next treatment series was begun. Once more an ACAC design was utilized. This time the treatment was cribbing-contingent electric shock punishment. Day 1 (A) was a baseline of a normal day. The subject wore a dummy shock collar for this baseline. On Day 2 (C) shock was immediately delivered at the end of each cribbing response. There was no delay between behavior and punishment. Day 3 (A) was a return to baseline recordings with the dummy shock collar. Day 4 (C) was a repeat of Day 2 where each cribbing behavior was immediately punished by a brief shock.

Due to the mechanical limitations of the shock collar, the following procedures were standardized for administering the punishment. When the subject grasped the edge of the cribbing surface with his teeth, the shock button was depressed for three seconds. The two second delay of the equipment put the onset of the shock contingent with the horse's completion of the air-sucking motion. This procedure put the shock slightly overlapping the end of the punished behavior. The author is aware that this punishment timing does not produce optimum results. Punishment administered at the very start of the target behavior is a more efficient modifier. The two second delay on the collar prevented use of this more efficient sequencing.

One week later (the following Thursday), a five hour (12:00 p.m. to 6:00 p.m.) follow-up observation was conducted. Previous observations had indicated afternoons as the period of peak cribbing activity, so this time was deemed most suitable for a follow-up procedure. Baseline data was once more recorded for the horse under "normal" or no treatment conditions.

CHAPTER III

RESULTS

The questionnaire data collected during the first phase of this experiment was used to examine the first four hypotheses. Hypotheses 1, 2, and 3 were examined using an analysis of variance. The major dependent variable was the total number of vices each horse possessed. The independent variables were gender, age, and breed. Hypotheses 4 examined the relationship between physical confinement and vices utilizing a correlational analysis.

The second phase of the experiment was composed of a single case experimental design focusing on the specific vice of cribbing. A subset of the questionnaire data was reanalyzed to locate any significant differences between cribbers and a like number of randomly selected "normal" horses. This subset was analyzed using T-tests and Chi Square measures. The three hypotheses for the single case design portion of this study involved an examination of the effectiveness of cribbing contingent electric shock punishment and continuous haying on cribbing rate. A one week follow-up evaluation was also made. Summary graphics present the findings.

The present chapter first examines the subject population in terms of demographics and then looks at the tests of the questionnaire hypotheses by looking at the analyses of variance and correlational analysis. The last part of the chapter will examine the hypotheses for the single case design via summary tables and look at the daily pattern of the subject animal.

Questionnaire Data

Sample Description

Table 1 presents the questionnaire respondent's horse population broken down by the major independent variables: breed, gender, and age. The questionnaire was designed to assess behavioral disorders among horses worked under saddle. To meet this criterion, young animals not working under saddle and stallions were excluded from the analyses. Although stallions can be used as saddle horses, they are often used exclusively for breeding purposes. This double use combined with their small representation prompted their exclusion from the sample.

Examination of Table 1 reveals that quarter horses far out number the other breeds. Grade (mixed parentage), arabs, half arabs, and appaloosas are also well represented. Other breeds such as morgans and thoroughbreds have a smaller representation indicative of their numbers in the population of 4-H horses.

Table 1.--The Total Sample Broken Down by Breed, Gender, Age.

Group	n[b]	Age[a]					
		1-3	3.1-6	6.1-9	9.1-12	12.1-15	15+
Quarter Horse							
Mares	108(49.8)	7.4	35.2	28.7	13.0	9.3	6.5
Geldings	109(50.2	10.1	27.5	29.4	17.4	9.2	6.4
Arab							
Mares	37(47.4)	13.5	35.1	27.0	13.5	8.1	2.7
Geldings	41(52.6)	12.2	41.5	34.1	7.3	4.9	--
Half Arab							
Mares	38(46.9)	--	34.2	26.3	15.8	21.1	2.6
Geldings	43(53.1)	11.6	30.2	30.2	25.6	2.3	--
Appaloosa							
Mares	35(46.1)	11.4	31.4	25.7	11.4	8.6	11.4
Geldings	41(53.9)	14.6	29.3	22.0	22.0	12.2	--
Thoroughbred							
Mares	18(38.3)	5.6	16.7	38.9	22.2	11.1	5.6
Geldings	29(61.7)	--	34.5	24.1	24.1	13.8	3.4
Morgan							
Mares	6(25.0)	33.3	33.3	16.7	16.7	--	--
Geldings	18(75.0)	5.6	33.3	22.2	22.2	--	16.7
Pinto							
Mares	17(51.5)	17.6	23.5	35.3	11.8	11.8	--
Geldings	16(48.5)	18.8	--	18.8	25.0	25.0	12.5
Pony							
Mares	17(63.0)	5.9	11.6	29.4	17.6	35.3	--
Geldings	10(37.0)	10.0	10.0	20.0	10.0	10.0	40.0
Other Pure Breeds							
Mares	14(53.8)	--	21.4	14.3	28.6	21.4	14.3
Geldings	12(46.2)	--	8.3	16.7	50.0	25.0	--
Grade							
Mares	58(43.3)	5.2	24.1	29.3	27.6	5.2	8.6
Geldings	76(56.7)	5.3	27.6	21.1	13.2	22.4	10.5

[a] Reported in percent.

[b] Numbers in () represent % gender within each breed.

Overall there are slightly fewer mares (N=348) than geldings (N=395). The distribution of gender within each breed is fairly uniform. The same thing is true of age. With the exception of the pony breed which characteristically has a longer useful life span, all the other breeds have a mean age of from six to nine years old.

The large number of quarter horses and pure and cross-bred arabs is indicative of the preferences of the youthful owners. Quarter horses (and grade horses) possess many qualities which increase their value as 4-H mounts such as an even temperament, easy upkeep, the ability to go equally well English and Western, and their relative inexpensiveness. The prettiness of the arab and their popularity in children's literature undoubtably contributes to their popularity among 4-Hers. The rest of the breeds represented are relatively less common in the horse population (pintos, ponies), more expensive (thoroughbreds), or more specialized (other pure breeds) resulting in their lesser representation.

The size and relative uniformity of this sample provides a good representation of the Michigan 4-H horse population. The blend of the different breeds in this sample assures representation of all areas of performance, behavior, and personality. Gender and age are uniformly spread across all breeds thus producing three orthogonal independent variables; breed, gender, and age.

Hypotheses 1, 2, 3

Hypotheses 1, 2, and 3 asked if gender, age, or breed had an effect on the overall number of vices a horse possessed. This dependent variable was submitted to a 2 (Gender of Horse) X 6 (Age of Horse) X 10 (Breed of Horse) analysis of variance, which is summarized in Table 2. As Table 2 indicates, one main effect and one interaction were significant.

Table 2.--Summary of the 10 (Breed of Horse) X 2 (Gender of Horse) X 6 (Age of Horse) ANOVA with Number of Vices as the Dependent Variable.

Source	df	SS	MS	F
Breed (A)	9	19.870	2.208	.907
Gender (B)	1	1.216	1.216	.500
Age (C)	5	28.260	5.652	2.323*
A X B	9	53.881	5.987	2.461**
A X C	43	84.014	1.954	.803
B X C	5	20.617	4.123	1.695
A X B X C	32	64.301	2.009	.826
Error	607	1476.715	2.433	

*p<.05
**p<.01

Hypotheses 1 and 3 made no predictions about gender and breed differences on the number of vices possessed but served as exploratory hypotheses. No significant main effects were found, indicating that number of vices is not systematically related to gender or breed. Mares are no

more likely to have a large number of vices than are geldings, and the breed of a horse does not predict the number of vices it will possess.

Hypotheses 2 predicted that number of vices would increase with age. The analysis of variance indicated a main effect for age ($F=2.323$, $p<.05$). Examination of the mean number of vices for each age category (Table 3) reveals a curvilinear relationship. Horses at their peak working years showed the highest number of vices. Very young (under three) and older horses (over 12) showed fewer vices. This curvilinear relationship only partially supports Hypotheses 2.

Table 3.--Mean Number of Vices: The Main Effect for Age.

Age[a]	n	Mean	SD
1-3	122	1.4836	1.2076
3.1-6	221	2.1131	1.6155
6.1-9	210	2.1286	1.6652
9.1-12	136	2.0956	1.7078
12.1-15	88	1.6591	1.3804
15.1+	50	1.7000	1.3132

[a]The sample is restricted to mares and gelding working under saddle. Age is reported in years.

The Breed X Gender interaction was also shown to be significant in the analysis of variance ($F=2.461$, $p<.01$). Table 4 presents the means relevant to this interaction. Examination of these means reveals no evidence of a simple trend. Quarter horse, half arab, appaloosa, pony and grade geldings show a higher vice mean than their female counterparts. Arab, thoroughbred, morgan, and other pure breed mares show a higher vice level than geldings of the same breed. Further research is needed to clarify this complex interaction.

Table 4.--Mean Number of Vices: The Breed X Gender Interaction.

Breed	n	Geldings	Mares
Quarter Horse	215	1.90	1.83
Arab	77	2.05	2.14
Half Arab	78	2.43	1.97
Appaloosa	73	2.00	1.48
Thoroughbred	46	2.00	2.39
Morgan	24	1.78	2.67
Pinto	33	2.06	2.06
Pony	27	3.00	1.88
Other Pure Breeds	26	.92	2.21
Grade	132	2.05	1.97

Hypothesis 4

Hypothesis 4 predicted a positive correlation between confinement rate and the number of vices a horse possesses. Table 5 presents each of the individual vices which made up the vice scale, total vices, and the owner's rating of the horse's temperament (scaled from hot blooded (1) to cold blooded (11)) correlated with confinement and handling rate. Confinement represents the percent of time during an average day that the horse remains in his stall. Handling rate is a summary variable encompassing the number of times per week the horse is groomed, lunged, or ridden.

Analysis revealed that handling rate and confinement are significantly correlated ($r=.18$, $p<.01$) indicating that horses which are handled more often are more likely to be confined to the stable a larger proportion of the time. This result is probably determined by two related factors. The first is a human logistics issue. In order to handle the horse on a regular basis, the horse must be easy to catch. The easiest way to save time and effort in catching the horse is to confine him to his stall. The second related factor is exercise. Pasturing and handling both provide the horse with exercise. Owners often use them in tandem to balance the horse's activity level.

Confinement was also related to three individual vices; kicking the stall ($r=.17$, $p<.01$), biting people ($r=.07$, $p<.05$) and kicking other horses ($r=-.11$, $p<.01$). All three of these relationships are dependent on opportunity. Kicking

Table 5.--Correlations Between Confinement, Handling, and Vices.

Variable	Confinement	Handling Rate
Kick Stall[a]	.17**	.04
Bite People	.07*	.00
Weave	.03	.06*
Rear/Buck	.03	.04
Crib	-.02	.01
Chew Wood	.03	-.01
Kick Horses	-.11**	.03
Run Away	-.04	.01
Resist Saddle/Bridle	-.01	-.04
Play With Bit	.01	.01
Shy	.01	.02
Stumble	-.01	-.08*
Total Vices[b]	.02	.02
Temperament[c]	.01	.00
Confinement[d]	--	.18**
Handling Rate[e]	.18**	--

[a]All the vices were scored as absent (0) or present (1). N=829.

[b]Total vices has a range of 0 to 11. N=827.

[c]Temperament Scale: 1 = hot blooded, 11 = cold blooded. N=817.

[d]Confinement scored as percent of time confined in stall. N=827.

[e]Handling rate is the sum of weekly work contacts with the horse. N=827.

*p<.05

**p<.01

the stall and biting people can only happen if the horse is confined and in proximity to people. Kicking other horses is possible only when the horse is pastured and has the opportunity. Handling rate was related to stumbling ($r=-.08$ $p<.05$) and weaving ($r=.06$, $p<.05$).

Overall, the correlations were few, small, and commonsensical. The summary variable of total number of vices was uncorrelated with confinement ($r=.02$, n.s.), thus Hypothesis 4 was not supported. Number of vices is not systematically related to the amount of time a horse is stalled.

Factor Analysis of Vices

The 12 vices were submitted to further analysis via a principal component factor analysis with varimax rotation (Kim, 1975). Due to the small number of individual components, a three factor solution was specified. The results are shown in Table 6.

The factor analysis produced three clear factors which represent different dimensions of equine personality orientation. The first factor could be labelled "aggression" and is composed of the active, forward vices utilizing the horse's natural weapons, i.e., his teeth and hooves. Kicking the stall, biting humans, rearing/bucking, and kicking other horses falls in this factor.

The second factor is composed of three vices which represent the passive components of equine self-defense.

Table 6.--Varimax Factor Matrix for Vices.

Vice	Factors		
	Aggression	Flight	Mouth
Kick Stall	.25052*	-.01487	.10823
Bite People	.41455*	.00553	.09162
Rear/Buck	.42735*	.27284	.06212
Kick Horses	.29418*	.09679	.05010
Run Away	.05810	.48505*	.00745
Resist Saddle/Bridle	.08340	.18491*	.12683
Shy	-.00937	.25576*	.12642
Chew Wood	.13723	.02695	.18760*
Play with Bit	.06889	.04883	.44182*
Stumble	.05383	.03609	.23514*
Crib	.07354	.10643	-.04234
Weave	.11721	.08353	.03848

*Factor loading.

This "flight" factor includes the vices of running away with the rider, resisting the saddle or bridle, and shying. All of these vices represent the horse's avoidance response.

The third factor is not as clearly defined. It is composed of wood chewing, playing with the bit, and stumbling. Since two of the components of this factor represent oral vices, it has been labelled the "mouth" factor. These vices

do not conceptually vary along the dimension of aggression/flight, and seems to represent a group of horses whose orientation seems to revolve around oral activity, i.e., eating.

It is interesting to note that only two vices failed to load on any factor. Cribbing and weaving seem to be distinct behaviors which do not have the same properties as the other vices. The other ten vices seem to represent variations and manifestations of different personalities among normal horses. Cribbers and weavers seem to fall outside the plane of "normal" behavior and represent a dimension of distinctly aberrant behavior.

Questionnaire Data on Cribbing

A subset of the questionnaire data was randomly drawn to provide a comparison group for the 29 cribbers identified in the vice assessment portion of the questionnaire. The only restriction on the sample of "normal" horses was that they must be six years of age or older. This restriction was made after initial analyses revealed no cribbers under six years old. Appropriate T-tests and Chi Square analyses on virtually every questionnaire item and summary variable revealed no significant differences between the cribbers and noncribbers. The living conditions, feed schedule, work schedule, and demographics of this subsample showed no areas of dissimilarity which could be related to the behavior of cribbing.

Single Case Design

Hypothesis 5

Hypothesis 5 predicted that the continuous haying of the cribbing subject would reduce the number of cribbing behaviors. One day (15 hour) units were used for each treatment session. The continuous haying session was an ABAB design where A represented a normal feeding schedule and B represented a continuous haying session. Table 7 presents the results.

Six major behaviors are recorded in the table. The mean number of cribs per hour and the mean number of mouthing or wood chewing attempts per hour are presented first. The actual percent of time the horse spent eating hay and grazing in the absence of food are next presented. The percent of time the horse spent out of his stall is also recorded. Stall position refers to the location of the horse's head relative to the four quadrants of the stall (see Appendix C).

Examination of the table shows clear support for the short term reduction of cribbing by continuous haying. The horse decreased his cribbing rate over one hundred cribs per hour, an average decrease of 83%. Concurrently, the horse increased the time spent eating and grazing from an average of 37.8% on normal days to an average of 79.8% on haying days, a rate much closer to his evolutionary "normal" rate. The horse also shifted his position preference from left front (his preferred cribbing area) to the right front (his preferred feeding area).

Table 7.--Continuous Haying Treatment: Hourly Means for the Major Variables.

Variable	Treatment Condition			
	Normal(A)	Hayed(B)	Normal(A)	Hayed(B)
Crib	134.24	29.13	153.11	19.02
Play/Chew	1.04	.87	2.15	.30
Eat Hay[a]	16.00	77.00	18.60	82.60
Graze[a]	15.00	--	26.00	--
Out of Stall[a]	16.67	--	8.33	11.67
Stall Position:[b]				
Left Rear	2.90	3.10	3.00	1.40
Right Rear	6.80	5.80	2.60	6.00
Left Front	65.00	25.30	69.60	24.70
Right Front	25.30	65.80	24.80	67.90

[a]Figures represent the percent of time spent on each activity over the 15 hour observation period.

[b]Percent of time spent in each location while in stall.

Hypothesis 6

Hypothesis 6 predicted that cribbing contingent electric shock punishment would suppress cribbing behavior. When the shock was no longer applied, cribbing would recover. Table 8 presents the results of the electric shock punishment treatment.

The punishment paradigm dropped the cribbing rate to near zero from an average of 105.85 on normal (A) days. Concurrently, on shock days (C), the horse spent less time in the left front of his stall (his habitual cribbing location). The time dropped from an average of 57% of the time to 22.7% of the time indicating an avoidance response. Eating and grazing behavior were uneffected. These results support Hypothesis 6. Electric shock suppressed cribbing behavior. However, when the shock was no longer contingent, cribbing recovered to previous levels. A low level of "testing" cribbing behaviors occurred throughout the shock administration.

Hypothesis 7

Hypothesis 7 predicted no long-term change in cribbing behavior during the one week follow-up measurement session. It was predicted that the horse's cribbing behavior would be back to baseline levels. Table 9 presents the results for this hypothesis.

Three groups were compared. The baseline group data was gathered before any treatments had been applied. The

Table 8.--Electric Shock Treatment: Hourly Means for the Major Variables.

Variable	Treatment Condition			
	Normal(A)	Shock(C)	Normal(A)	Shock(C)
Crib	84.70	.55	127.00	.29
Play	6.39	1.03	3.23	.15
Eat Hay[a]	19.90	23.00	25.60	20.00
Graze[a]	11.30	12.20	11.20	25.90
Out of Stall[a]	5.00	--	5.00	8.33
Stall Position:[b]				
Left Rear	.70	9.40	2.50	3.80
Right Rear	6.00	16.30	3.40	23.20
Left Front	50.00	16.40	63.90	29.00
Right Front	43.20	57.80	30.30	41.10

[a]Figures represent the percent of time spent on each activity over the 15 hour observation period.

[b]Percent of time spent in each location while in stall.

Table 9.--Comparison of One-Week Follow-up, Treatment Normal, and Baseline Measures for the Major Variables.

Variable	Observation Day[a]		
	Baseline[b]	Treatment Normals[c]	Follow-up
Crib[d]	206.50	194.00	9.60
Play/Chew[d]	1.17	5.00	1.20
Graze[e]	2.30	13.00	10.00
Out of Stall[e]	--	20.00	--
Stall Position:[f]			
Left Rear	1.70	2.80	10.30
Right Rear	2.70	4.50	15.30
Left Front	65.70	65.40	37.00
Right Front	30.00	27.30	37.30

[a]All observations made from 1:00 p.m. to 6:00 p.m.

[b]Measurements taken before any treatments begun.

[c]Average of all the (A) treatment normal days.

[d]Hourly means.

[e]Percent of time spent on activity.

[f]Percent of time spent in each location while in stall.

(A) or normal days during the treatment sessions were averaged to provide the second comparison group, the treatment normals. The third group is the actual follow-up assessment. Comparison of these figures shows a dramatic decline in cribbing rate on the follow-up day. The rate of 9.6 cribs per hour is bested only by the shock punishment days in terms of low cribbing rate. The follow-up day also shows a shift in positioning towards the rear of the stall (preferred sleeping location) and away from the left front (preferred cribbing location). These results do not support my prediction for Hypothesis 7. It is likely that external conditions not under the control of the experimenter produced a very sleepy horse on the follow-up assessment day.[1]

Cribbing Pattern

The horse used for these observations had a remarkably consistent pattern in his eating, sleeping, and cribbing behaviors. Whenever food was available, it consumed virtually all his attention until it was completely gone. A brief bout of cribbing would then ensue, followed by a short nap. After

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[1]It is the author's opinion, based on several informal observation periods, that the horse resumed his cribbing behavior soon after the shock contingency was ended. On the prearranged follow-up day, the subject spent most of the five hour session dozing. Questioning of the barn staff revealed that on the night preceeding the follow-up evaluation, work crews were constructing jumps for a horse show in an area adjacent to the barn. The striking follow-up results were probably an artifact of a sleepless night.

the nap, an intense period of cribbing would begin interspersed with brief grazing periods. This would continue until the next meal arrived during the daylight hours or until sleep occurred at night. The horse was fed twice daily so this cycle was repeated with the morning and evening meal. Prolonged sleep only occurred for four or five hours from two or three in the morning until seven or eight when the cycle would begin again with the arrival of the morning meal. If the horse was removed from his stall during any part of the day, he would resume his behavior immediately upon reentering his stall as if no interruption had occurred.

The cribbing motion itself was very rhythmical and almost hypnotic. He would grasp, crib, and release approximately every three or four seconds for 10 or 15 cribs in a row. He would then pause for a few seconds and begin the rocking motion all over again. During the midafternoon and late evening, this pattern would go on for hours interspersed only with brief grazing periods. By human standards, the horse had a remarkably boring, repetitive life accentuated by his perseverative cribbing.

CHAPTER IV

DISCUSSION

Seven major hypotheses were tested in the present experiment. As noted in the previous chapter, analysis of the questionnaire data revealed partial support for only one of the four hypotheses relevant to that phase of the study. The single case design or second phase, produced support for two of the three hypotheses proposed. This final chapter explores some of the methodological factors that may have contributed to these results. The discussion also focuses on the theoretical and practical impact of the present findings on the management of equine behavior disorders. In addition, new lines of profitable research are outlined.

Hypotheses 1 and 3

Hypotheses 1 and 3 focused on the relationship between breed, gender, and the number of vices the horse possessed. The hypotheses were nondirectional because of an absence of any prior research or theory in the area. Folklore has as many theories as there are proponents, making it an unreliable guide. Unfortunately, even common folklore would not have predicted a significant Breed X Gender interaction.

Neither the horse's breed nor its gender alone had a systematic effect on the number of vices the horse possessed. It was the combination of these two variables which predicted number of vices.

Closer inspection of the data revealed that five breeds showed geldings to have more vices (quarter horses, half arabs, appaloosas, ponies, and grade horses), four breeds showed mares to average more vices (arabs, thoroughbreds, morgans, and other pure breeds), while pintos showed no difference in the average between the sexes. In general, the group where mares had more vices contained the more finely bred horses. However, it is not obvious why the degree of breeding should interact with gender.

A naturally occurring population was tapped in this study to provide a representative, nonselected sample of the state's horse population. To further examine the Breed X Gender interaction, future research should utilize a more restricted sampling technique resulting in a factorial design balanced by breed, sex, age, and possible use (breeding, pleasure, or performance animal). Analysis of this design could clarify the interaction found between breed and gender.

Hypothesis 2

Hypothesis 2 predicted that age would be positively related to the number of vices a horse possesses. It was only partially supported by a curvilinear relationship where horses between the ages of three and 12 exhibited higher

vice scores. This finding is probably attributable to two methodological causes.

The first methodological cause is the vice scale used in this study. It was composed of a checklist of 12 misbehaviors. Approximately six of the vices are related to riding the horse, three specifically and three indirectly. Running away with the rider, resisting the saddle, bridle or halter, and playing with the bit are all specific to riding. Rearing and bucking, shying, and stumbling may be minor problems when the horse is being handled from the ground but they are major problems when the horse is being ridden. Very young horses and many older horses may not be ridden as often as the middle-aged animals, thus effectively limiting the range of vices they can exhibit.

The second methodological problem concerns the way the data was collected. Horse owners were asked to complete a checklist indicating what behaviors their horse displayed. This sort of secondhand self-report is subject to many inaccuracies. Aside from the halo effect of either "loving" your "perfect" horse or "hating" the "miserable" animal, it is also subject to handling and knowledge factors. If the owner does not handle the horse often, such as some children reliant on their parent's help, a few people who board their horses, and many people who pasture their horses year round, they may simply not know how the horse behaves in the stable. The related problem is lack of knowledge, where if a proper label for the behavior is lacking, the vice does not exist.

Many people may have a weaver or cribber and not recognize the behavior as a vice.

These two methodological factors may have contributed to the curvilinear nature of the age main effect. The younger and older animals may not be handled as much as their working counterparts so their vices go unnoted. It is also more likely that the horse will be exposed to outsiders (friends, judges, trainers) when it is being handled and shown during its prime years, thus not allowing vices to be overlooked through lack of knowledge.

The solution for these methodological problems is two-fold. The only completely reliable way to avoid the errors in self-reports is to use outside observers to record each horse's behavior. Unfortunately, this is out of the economic reach of most researchers. An alternative is to (1) produce a checklist which has pictorial and text descriptions of the vices plus behavioral criteria to help owners identify the behaviors, and (2) use theoretically equivalent separate scales of vices for working and nonworking horses. These changes should help eliminate some of the weaknesses of the present procedure.

Hypothesis 4

Hypothesis 4 predicted a positive correlation between confinement and the number of vices a horse possesses. It is the consensus of folklore and the scientific community that confinement and its consequent boredom contribute to

vice formation. This hypothesis was not supported. Vice rate was found to be unrelated to rate of confinement.

One possible explanation would be the observation that confinement and boredom are not necessarily the same thing, even though they are used interchangeably in the literature. In order to partially answer this issue, handling rate as well as, confinement was used in the analysis. It is possible that confined horses are not suffering from boredom because they are handled more often to compensate for their lack of physical space. The relationship between confinement and handling was significant ($r=.18$, $p<.01$), but not particularly strong considering the size of the sample ($N=827$). It probably represents an arrangement made for human convenience rather than the horse's comfort. People who ride frequently tend to confine their horses to avoid the task of catching a reluctant animal in large and often muddy fields. Nevertheless, handling rate was retained in the analysis to provide a secondary measure of possible boredom.

Most of the significant correlations between confinement and individual vices were logical deductions. Confinement and stall kicking were correlated. Confined horses had both the motivation and opportunity to display this particularly costly and destructive vice. Confinement was also shown to be positively correlated with biting people. Once more, I am unsure whether this relationship is due to increased motivation, opportunity, or both. On the reverse side, confinement was negatively related to kicking other horses.

This is a case where lack of opportunity must be a major factor.

Handling rate was negatively correlated with stumbling. Since part of any training program is to teach the horse balance, this finding is encouraging. The only other significant correlation was with weaving. This positive relationship is interesting because weaving has been noted in the lay literature as being prevalent among performance horses. The correlation was too low to overanalyze, but this result is in line with previous theories on weaving, which predicts that too much handling results in "nervous" weavers.

In general, the correlations were very low and no significant results were reported for the summary variable, number of vices. This data offers strong evidence against the hypothesis of the relationship of boredom and vice development. A basic rethinking of the operationalization of boredom is in order. Future research should consider a composite variable including both confinement, handling, and possibly equine companionship.

Factor Analysis of Vices

Some of the most interesting and promising findings issuing from this research were revealed in the factor analysis of the 12 vices in the questionnaire checklist. These three factors may represent three dimensions of equine personality. The first two factors, aggression and flight,

have been postulated as the two primary orientations towards other horses and humans that a horse may display. Although every horse can assume either orientation depending on the situational factors, it has been postulated that the horse assumes a characteristic orientation and will prefer one mode over the other (Fiske, 1979). This factor analysis offers support for this theory and offers the possibility of assessing an animal's personality through his manifestation of particular vices. If an animal could be behaviorally assessed through his vices, then appropriate training procedures geared to the personality of the horse could be initiated without the waste of trial and error, rider/horse combinations would be easier to select, and the individual animal would "appear" more predictable to new handlers thus lowering the risk of handler or equine injury.

However, the picture is not as clear as the above discussion indicates. A third factor composed of wood chewing, playing with the bit, and stumbling came out of the factor analysis. This factor was given the name "mouth" because it seems to represent an oral orientation. In order to check this postulate, further research needs to assess whether this factor (and the others) reappear in new samples, and, if so, if it is related to the eating habits of the animal. If it does reappear, the main equine orientations may be fight, flight, or food!

Two of the vices did not load on any of the factors. Cribbing and weaving seem to be fundamentally distinct from

the other vices, thus adding further support to a genetic or physically based causation (see the next section). If these two vices were part of the range of normal behavior and personality, they would probably have loaded on a factor. However, their uniformly low coefficients indicate their independence from the other ten vices. Thus, cribbers and weavers can manifest the orientations of any of the three personality groups.

Questionnaire Data: Cribbing

The total lack of difference between the living conditions and treatment of cribbers and normal horses offers evidence against a management based causation for cribbing. If anything, the cribbers were better cared for than their noncribbing counterparts. They were given roomy accommodations, adequate food on a regular schedule, exercise, and horse companionship. It seemed to be a case of overcompensation where the current owner follows all the standard advice on cribbing to help alleviate the problem.

In order to make a clear distinction between management and genetic causation, more complete data is needed. A series of complete case histories of cribbers is necessary to determine the conditions surrounding onset of the vice. Genetic histories of the horses need to be made to see if it follows a line of descent. There is evidence in Sweden (Sevelius, et al., 1976) that cribbing is genetic. Under the ideal situation of a small country, good bookkeeping

procedures, and a limited horse population, it has been found that many cribbers were descendents of one particular stallion. Such an investigation needs to be made in this country. Unfortunately, the size of our horse population, the lack of complete records for many breeds, and the unwillingness of many owners and breeders to admit to the presence of the vice for fear of financial loss, makes the prospect of such a study in the United States very small indeed.

Hypothesis 5

Hypothesis 5 predicted that feeding hay on demand would decrease the rate of cribbing by providing an alternative behavior. This hypothesis was supported by a substantial decrease in the amount of cribbing on haying days in the ABAB design. We still do not know what the long term effects of haying on cribbing would be. It awaits further research.

Hypothesis 6

Hypothesis 6 predicted that cribbing contingent electric shock punishment would suppress cribbing behavior. When the contingency was eliminated, cribbing would undergo spontaneous recovery due to its self-reinforcing properties. The results supported the hypothesis. After three to five cribbing behaviors were immediately punished, most attempts at cribbing ceased. Approximately every three to four hours during each 15 hour treatment session, the horse would make another cribbing attempt. During the two shock treatment

days in the ACAC design, these "testing" attempts persisted. When the shock was no longer present, the horse quickly recovered to previous cribbing rates.

The next obvious step is to combine the shock punishment and continuous haying into a unitary design. Continuous 24 hour surveillance and punishment would be needed until the exploratory cribbing attempts have met a strict extinction criterion. Remedial measures such as; painting cribbing surfaces with carbalinium, adequate exercise, maintenance of the demand diet, and turn out time may be necessary to prevent the behavior from recurring. This procedure needed to be done in the current study, but was beyond the financial and physical resources of a single researcher, and required a level of commitment on the part of the horse owner that was beyond their interest in the project.

This research, like so many in equine behavior, awaits the facility, support staff, and financial backing it requires. The technology is already at hand.

APPENDICES

APPENDIX A

GENERAL QUESTIONNAIRE

APPENDIX A

GENERAL QUESTIONNAIRE

(Fill out one questionnaire for each horse you own)

Name: _____

Address: _____

City/State: _____ Zip Code: _____

Name of Horse (optional): _____

Breed: _____ Age: _____

Height: _____ Weight: _____

How long have you owned the horse? ____ years

How many owers has the horse had? ____

How many other horses are stabled with your horse? ____

Sex: ____ Gelding

____ Stallion

____ Mare

____ Colt

____ Filly

During the average day, how many hours does your horse spend in the following areas?

_____ standing in stall/barn

Is it a straight or box stall? _____

Does it have a window? ____yes ____no

_____ loose in pasture/field

Does the field contain grass or grazing material? ___ yes ___ no

What is the approximate size of the field? _____

Total 24 Hours

How many times a week is the horse

_____ ridden (outside)

_____ ridden (inside)

_____ groomed

_____ lounged

_____ spot checked (visits that do not include the above activities)

Feeding:

How often is the horse fed? _____

At what time(s) each day is the horse fed? _____

Is the schedule? ____flexible

____regular and consistent

In what form does your horse receive roughage? ____hay

____pellet

____grazing

Does your horse receive grain? ____no ____yes If yes, what kind of grain? _____

Does the horse have access to a salt or mineral block? ____yes ____no

Do you feed your horse treats by hand? ____never

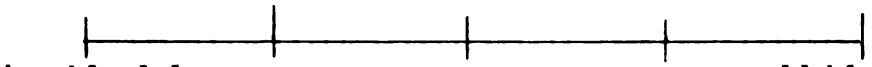
____rarely

____occasionally

____once during every visit

____more than once during a visit

How would you describe your horse along a scale from hot blooded (high strung) to cold blooded (calm)? Place a check along the line at the point which describes your horse.



Check any of the following behaviors you have seen or know your horse has done five (5) or more times:

____ kicking the stall
____ biting/snapping at people
____ weaving in stall
____ rearing/bucking
____ cribbing/wind-sucking
____ wood chewing
____ kick/bite other horses
____ run away with rider
____ resist saddle/bridle/halter
____ playing with the bit
____ shying (regularly)
____ stumbling/clumsiness

Have you tried to break the horse of any of these habits?

What did you do?	Did it work?
_____	_____
_____	_____
_____	_____
_____	_____

Leave the following 5 questions blank if you do not know the horse's early history.

1. At what age was the foal weaned? _____

2. Was the dam ____a poor milker

____reject the foal

____in poor health, specify _____

____a normal mare

3. Where was the foal kept? ____barn/stable

____field/pasture

____field during day, barn at night

4. How much time was spent handling (in physical contact with) the foal?

____ foal never handled

____ rarely handled

____ irregularly handled

____ handled during every visit

____ great deal of time spent handling foal during each visit

5. Did the foal have any health problems? ____no ____yes, specify

_____

Does the horse have any current or recurring health problems?

____ no ____ yes, specify _____

APPENDIX B

COVER LETTERS

APPENDIX B

COVER LETTERS

Dear 4-H Leader:

The enclosed questionnaires are part of a continuing study investigating learning and habit formation in horses. With the help of clubs such as yours, we hope to gather information on many horses and learn more about a horse's daily routine and "personality."

It is very important for each participant to know the following three things before she/he completes the questionnaire. Please read the following to all club members:

1. This study is being conducted by Michigan State University graduate students who have a dual interest in horses and behavior theory. Since this is part of a continuing study, we have asked you to put your name and address on the questionnaire. In the future, we may contact you for further information on your horse; however, any participation is completely voluntary. We guarantee that your name is only for our files and will not be given to any other persons, governmental agencies, or any manufacturer's mailing lists. The names will be kept confidential and for research purposes.

2. There are no right or wrong answers on this questionnaire. Just as each horse is unique, so is each owner.

3. The results of this questionnaire will be presented in a future issue of Michigan 4-H Hoofbeats. If you have any questions or want any further information, please contact us at the address given at the end of this letter.

After the club members have completed the questionnaires, they can be returned in the provided self-addressed, stamped envelope. Please return only completed questionnaires. Blank questionnaires can be discarded. We are very grateful for your help and cooperation in furthering our knowledge of equine behavior.

Very Sincerely,
Andrea Doughty and Carla Clos
Department of Psychology 11-3763
135 Snyder Hall
Michigan State University
East Lansing, Michigan 48824

We endorse the concept of this type of research. Research into equine health problems in general is still in its early stages compared to other species, but investigation into psychological or behavioral conditions is in its infancy. The starting point in this type project is identifying horses who have behavioral habits. I hope you will cooperate in this study as it could have beneficial effects not only for your horses but for many others.

Ken Gallagher, D.V.M. M.S.
Equine Extension Veterinarian

Richard J. Dunn
Extension Specialist in Animal Husbandry

Dear Participant:

This questionnaire is part of a continuing study investigating learning and habit formation in horses. On the following pages are a series of questions which will give us an idea of the horse's daily routine and "personality." There are no right or wrong answers. Just as each horse is unique, so is each owner.

This study is being conducted by Michigan State University graduate students who have a dual interest in horses and behavior theory. Since this is part of a continuing study, we have asked you to put your name and address on the questionnaire. In the future, we may contact you for further information on your horse, however, any participation is completely voluntary. We guarantee that your name is only for our files and will not be given to any other persons, governmental agencies, or any manufacturer's mailing lists. The names will be kept confidential and for research purposes only.

The results of this questionnaire will be presented in a future issue of Michigan 4-H Hoofbeats. If you have any questions or want any further information, please contact us at the following address. There is also room at the end of the questionnaire for any additional comments you would like to add. Thank you for your help and cooperation in furthering our knowledge of equine behavior.

Sincerely,

Andrea Doughty and Carla Clos
Department of Psychology
135 Snyder Hall
Michigan State University
East Lansing, Michigan 48824

We endorse the concept of this type of research. Research into equine health problems in general is still in its early stages compared to other species, but investigation into psychological or behavioral conditions is in its infancy. The starting point in this type project is identifying horses who have behavioral habits. I hope you will cooperate in this study as it could have beneficial effects not only for your horse but for many others.

Ken Gallagher, D.V.M. M.S.
Equine Extension Veterinarian

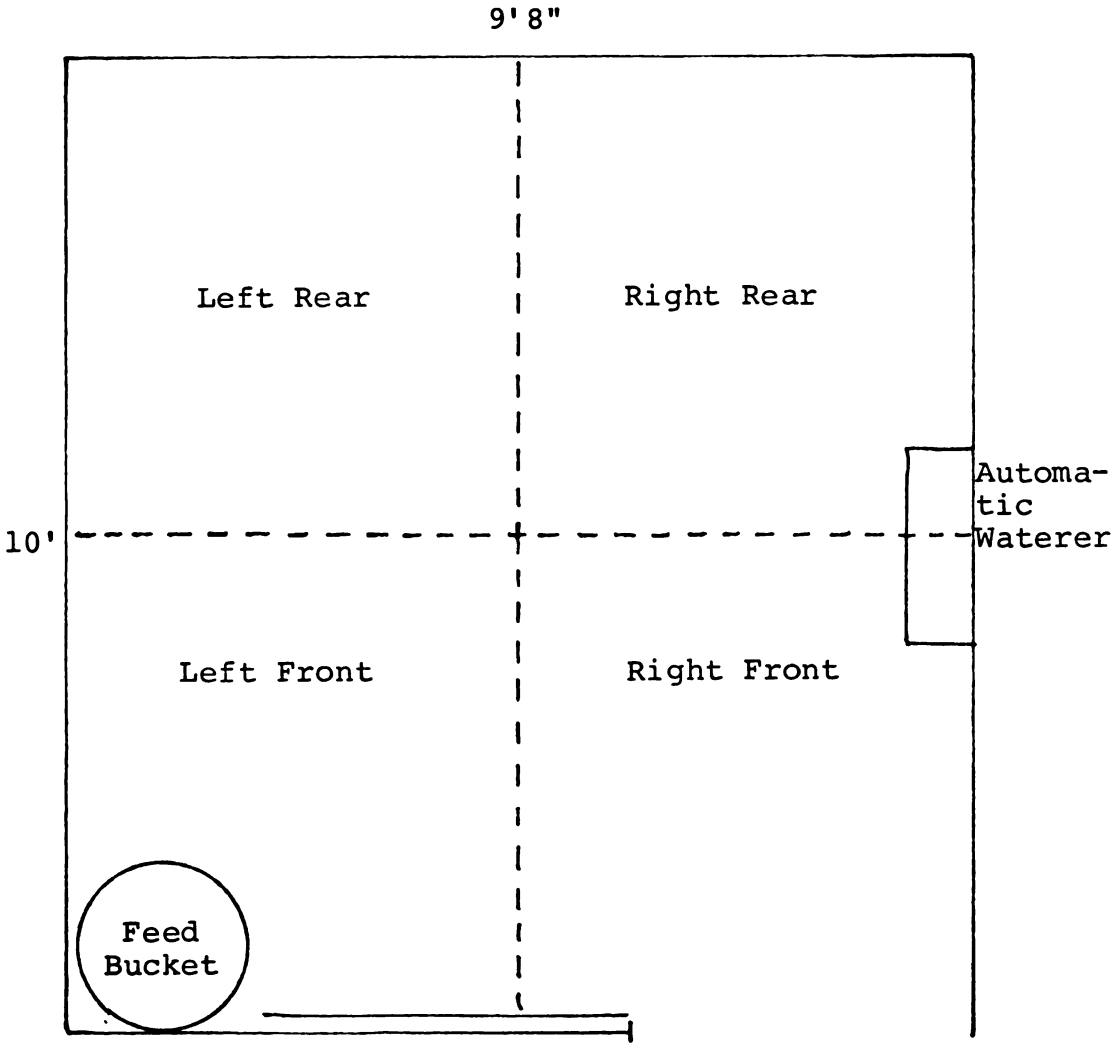
Richard J. Dunn
Extension Specialist in Animal Husbandry

APPENDIX C

STALL DIAGRAM

APPENDIX C

DIAGRAM OF STALL



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