Chapter

What Are They Thinking? Scientific Horsemanship and the Mind of the Horse

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Abstract

Horse behavior in an arena is examined to determine their *Umwelt*, or point of view. When in an arena singly, horses displayed home base behavior, spending their time near the entrance, and excursion behavior, trips into the arena. At home bases, horses paced against the wall, pushed against the gate, looked out, and rolled. On excursions, they displayed a "sniff, look, and loop" pattern; sniffing the ground on the outward leg, looking with ears forward down the arena at the apex, making a faster return with ears back. When free with a pair mate, the area of its excursions expanded and if a pair mate was tethered at the far end of the arena, a horse shifted its home base to that location. When ridden, horses displayed similar sniff, look, and loop behavior centered toward the entrance. Experiments on memory for the arena showed it was good but was reset each day. A model suggests that behavior is shaped by a spatial gradient, in which stress expands in proportion to distance from home, and an exploratory gradient, in which patrolling is a part of each day's outing. Science-based horsemanship can provide insight into a horse's view of its world and is relevant to safe horse handling.

Keywords: exploration of horse in arena, horse excursion, horse exploratory gradient, horse home base, horse spatial gradient

1. Introduction

The question, "what are they thinking?" in reference to horses has been addressed in many horse monographs and by many clinicians. Our intent is not to choose amongst suggested answers but to address the question by presenting a few of our own scientific studies. Science-based horsemanship can improve insight into horse behavior, contribute to the welfare of the horse, and improve safety for those interacting with a horse.

The statistics on injury related to handling or riding horses are consistent in every country in which they have been collected. The incidence of horse-related injury is due to the things that the horse does and to things that people do. The former includes things like "the horse spooked" or "the horse ran off" while the latter include things like broken or unsecured tack.

Horse-related injuries outnumber injuries obtained in other sports, including contact sports such as rugby, football, and hockey [1–3]. Injuries occur almost as frequently when a person is at home, on a farm, or at an equestrian center.

Injury is equally likely when a person is on the ground handling a horse as it is when they are riding a horse. Injury is more likely if a person is a beginner than if experienced. The average age of an injury is about 30 years of age, but injuries can happen to people of all ages, with injuries more severe in females than in males. The highest risk of injury is to young females, perhaps because so many are engaged in equestrian sports.

Although a good deal has been written on the incidence and type of injury related to handling and riding horses, less attention has been given to prevention [2]. There are ways to reduce the chance of having an accident, and in the case of an accident, to reduce severity. Inexperienced riders can take lessons from a coach who teaches safety and riders can wear helmets. Owners or buyers can ensure that a horse is well trained. But even with such precautions the statistics on horse-related injuries do not seem to change, except that head injuries are less severe if a helmet is worn.

A science-based approach to handling and training horses can improve safety with horses. Starling et al. [4] outline a 10-point approach in which understanding horse ethology is the first point. Horse ethology is the study of the natural behavior of horses. For example, ethological studies show that feral horses are herd animals. They spend up to 16 h a day feeding. They are on the move much of the day. They are flight animals and run when frightened or threatened. But a central question is, how does horse ethology translate into a relationship with humans in typical equestrian interactions?

The purpose of the present chapter is to elaborate one aspect of horse ethology that has not received much attention, the horses' *Umwelt*, its point of view. Umwelt is the biological term used to describe the world view of an animal [5]. We certainly do not know the full dimension of the horse's world view [6, 7]. The following sections present some experiments that describe behavior in an equestrian arena that provide insight into a horse's umwelt in conditions in which it is being handled or ridden. These experiments will present ideas about how humans can shape their own umwelt to that of the horse and so develop habits to improve horse handling.

2. Horse behavior in an arena

We took 18 horses, varying in age and sex, individually into a riding arena, released them, and filmed them for 30 min [8]. This is a test that has been given to other animals in laboratory studies and it reveals how they adapt their behavior to an environment that is different from their home. We found that the horses spent most of that 30 min at the end of the area near the door through which they had entered the arena. **Figure 1** shows a sketch of the movement of one horse during the 30-min test. The horse did periodically go out into the arena, each of its excursions initially got a little longer than the first one, but soon the number of excursions decreased as did the size of the excursions until finally the horse remained near the door. This representative horse did not make it past the midpoint of the arena on any excursion.

We did this experiment with our 18 horses and we have also informally watched many other horses in similar situations. The behavior of the horses was similar whether they were geldings or mares, whether they had frequently been ridden in the arena, or had only occasionally been ridden in the arena. Their behavior was similar when the arena was completely new to them, having been hauled to the arena from another farm. The behavior was similar for horses stabled inside, stabled right beside the arena, or at some distance away. Some of the horses were Thoroughbreds, some were American Quarter Horses, and some were mixed

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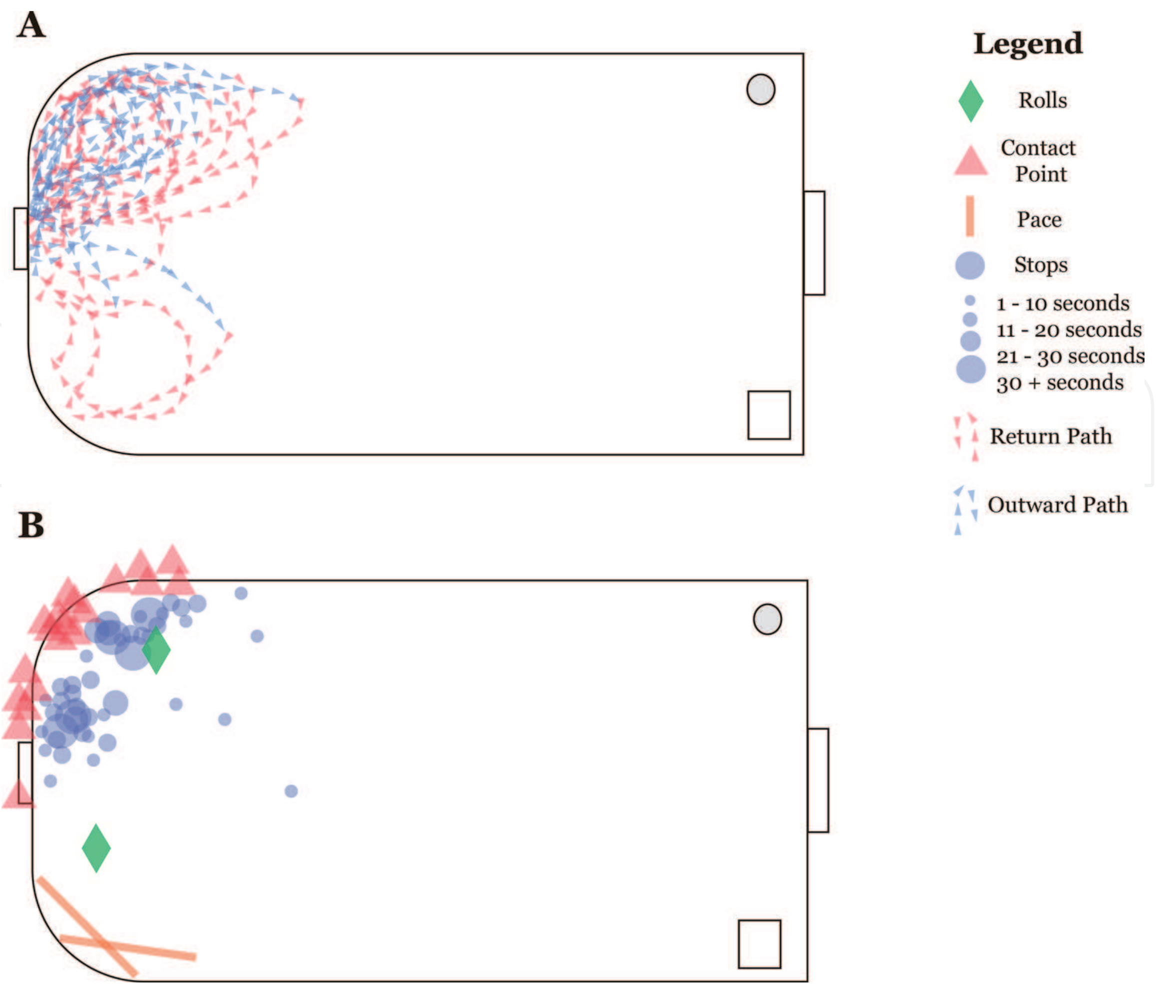

Figure 1.
The organization of the exploratory behavior of a single horse released into an arena for 30 min. (A) The horse spent most of its time near the entrance gate, its home base. Periodic excursions consist of an outward leg (blue) and a homeward leg (red) but none of the excursions went past the center of the arena. (B) Activities centered on the home base consisted of stops, pacing, pushing against the gate, and rolling.

breeds. They all behaved in much the same way. On many occasions we have observed handlers turn their horse out in the arena to exercise only to find them loitering by the gate. To encourage them to exercise, the handler might then chase them away from the gate.

The location at which an animal hangs out when placed in a novel environment is called a home base. Many different species of animal have been found to choses one or more locations—home bases—in the test area in which they spend most of their time. The behavior was first described in laboratory rats [9, 10]. Rats placed in a new environment initially remain in an area close to the entrance point and make excursions from there only to return again. If they find a more secure location, as defined by a corner or a part of the arena where a dark object is located, they move their home base to that location. Rats like areas beside walls and they like dark places. The home base for the horse in our study was the entrance point. The horses appear to otherwise avoid walls and avoid dark locations. People display home base behavior as well. Scientists have observed the behavior of small children who were taken to a novel room with their mother [11]. The children made excursions away from the mother but always returned to her. The mother's location defines the child's home base.

Behavior in a home base is characteristic. This is where a horse paces back and forth against the wall, looks out over the gate in a direction away from the arena, leans against the gate, and rolls (see **Figure 1**). Home base behavior for the horse is organized and it is different from behavior that takes a horse away from a home base.

3. Sniff, look, and loop

When horses leave a home base, their away behavior is also organized. Each trip forms a loop, in which a horse ventures away from the starting point and then returns to it. The outward trip is generally slow and sometimes features stops. The homeward trip is faster with stops less likely. If the loop takes a horse well into the arena, it may trot or even gallop back. On an outward trip a horse will often lower its head and sniff the ground. When reaching the apex of an excursion, it may stop and look toward the far end of the arena with head erect and ears pointing forward. It may then put one ear back, indicating the direction in which it will turn, drop its head, and with ears in a relatively neutral position or back, make the homeward trip. To highlight major features of this organization we call the behavior "sniff, look, and loop" and it is illustrated in **Figure 2**. Note that the horse in **Figure 2** has its tail up at the sniff and look points, suggesting waryness.

Sniff, look, and loop describe the organized ways that a horse investigates the area surrounding the home base. Sniffing the arena likely helps it to determine what other horses may have been there. A horse has one of the largest eyes of all animals and excellent vision and so it need not go to the far end of the arena to visually investigate it [12]. Its ears forward posture allows it to investigate sounds both inside and outside the arena. Its homeward trip is quicker because its investigatory

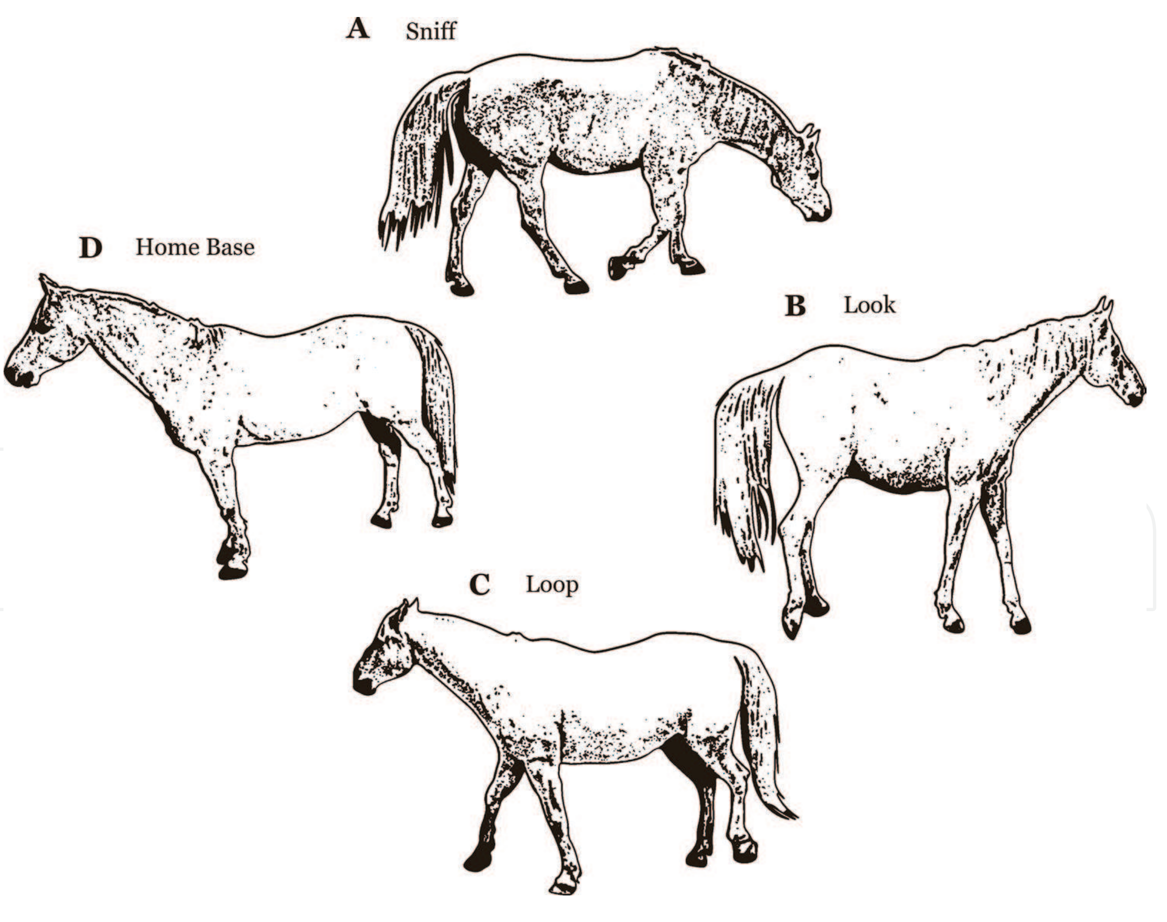

Figure 2.
Stop, look, and loop. Activities that occurred on a single excursion. (A) Sniff, the horse's head is lowered as it sniffs the ground on the outward leg of an excursion. (B) Look, a horse looks and sometimes stops and looks, with head erect and ears forward toward the far end of the arena. (C) Loop, the horse turns, often signaling the direction of turn with the retraction of the ipsilateral ear, and returns to its starting point, usually with ears back and head somewhat lowered. (D) Home base, the horse stands and looks outward. Note: tail up postures at sniff and look.

excursion is over and it can hurry back to the home base. According to the principles of optimal foraging theory, when business is done on an outward trip, it is safest not to tarry on the homeward trip [13]. Having its ears neutral or back on the homeward trip seems to suggest that a horse may be attending to what might be behind it, perhaps the unexplored arena, with which it is not comfortable. It may also be relaxing as it returns to its home base.

4. The home base as a surrogate for the herd

One explanation of home base behavior is that a horse stays near the gate because that is where it entered the arena. That location might be perceived as the shortest way back to its home paddock and its herd, which is its actual home. In short, it wants to "be at home with its buddies," as every horse person can attest. We examined this idea by giving four horses the same 30 min test as described above and observed that these horses set up their home base near the gate. We then brought a pair mate into the arena and tied it at the far end of the arena for another 30 min test. The horse that was free to move immediately moved to the far end of the arena, the area of the arena that it previously avoided, and spent the half hour near the pair mate (**Figure 3**).

This experiment suggests that what motivates the horse to remain near the gate end of the arena is that this is a place that is closest to its herd. For horses that were stalled individually in the arena, the herd explanation may still apply because they can see neighboring horses and so treat them as the herd.

The home paddock may also be attractive to a horse, however, because that is where it ordinarily finds safety and where it is fed. We tested this idea by turning out pair mates at liberty in the arena. When free the horses still displayed home base behavior and spent most of their time near the door where they also rolled. Rather than pacing, however, they spent time investigating objects near the door. Their loop excursions were much larger and frequently much faster. **Figure 4** illustrates the movements of one horse when it was in the arena alone and the movements of the same horse when it was in the arena with a pair mate. These experiments show that one reason a horse may form a home base near the door is that it wants to return to its pair mate but another reason is that it wants to return to its home territory. In its natural ecology, the two coincide.

Figure 3.
Movement in two 30-min tests. When a horse was alone, it spent its time near the gate (red paths). When a familiar horse was tethered at the far end of the arena, the free horse moved to the far end of the arena (blue paths).

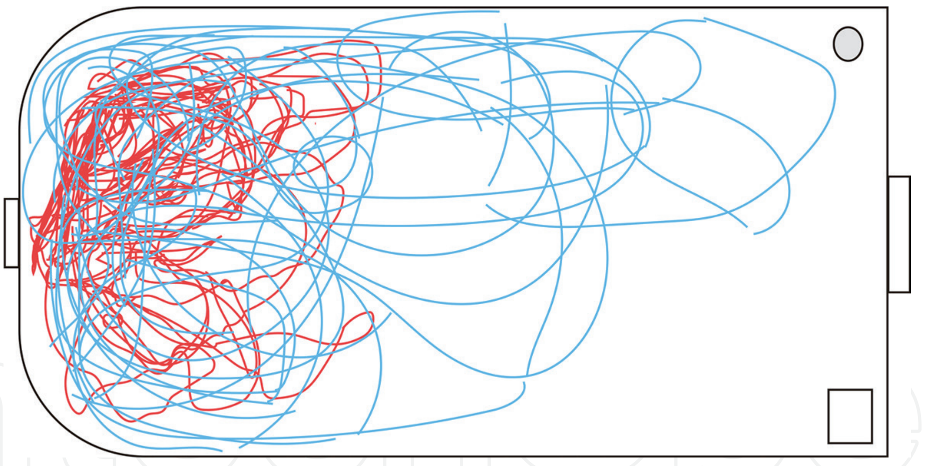

Figure 4.
The movements of a horse when in the arena alone (red paths) and when with a pair mate (blue paths). The area of movement of the horse expanded with the pair mate present but movement was centered on the "home base" door area.

5. Behavior under saddle

We asked what a horse's spontaneous behavior would be like if it were ridden but otherwise left alone. We used reining horses for the experiment because they are well schooled. All were familiar with the arena because it was their home arena and they had been frequently ridden there. We asked whether a horse would display elements of sniff, look, and loop behavior when ridden? We had riders do our 30-min test. We asked them to encourage the horse to leave the area entrance but once the horse began to do so, put down the reins and let the horse proceed as it wished. If the horse returned to the entrance, then after a pause, again ask the horse to leave. All of the horses made an excursion into the area when asked to do so and then they spontaneously stopped and looked down the arena, turned and returned to the starting point more quickly. For one of the horses the outward leg of the excursion was quite long and this was the only horse that went past the midpoint of the area. For all of the horses, successive excursions initially got a little longer and then progressively got shorter (**Figure 5**). The horses also came back more directly and more quickly than they went out. One horse first trotted back but on successive trips its speed increased until on one excursion, it galloped back. Two of the horses also sniffed the ground on the way out and all were more likely to have their ears up on the outward leg of a loop and their ears back on the homeward leg of a loop. These results suggest that the exploratory behavior of a horse under saddle reflects its behavior when it is at liberty.

We investigated whether stop, look, and loop behavior would influence a more typical riding session. We had riders enter the area singly and trot their horse around the edge of the arena, with the horse on a loose rein, so that the horse was free to choose its speed. At the same time, we timed the away and back legs of each of 10 trips. All of the horses spontaneously slowed their trotting speed as they left the gate end of the arena and they spontaneously increased their trotting speed as they left the far end of the arena on their trip back toward the gate. Consequently, the times taken to return were statistically shorter than the times to venture out. In addition, as a horse left the near end of the arena, it most often had its ears forward and looked toward the far end of the arena to which it was going. On the homeward leg of the trip, it noticeably lowered its head and frequently had its ears back (**Figure 6**). Thus, even though the horses were willingly circling the area under the guidance of a rider, they were noticeably engaging in behavior that they displayed when making

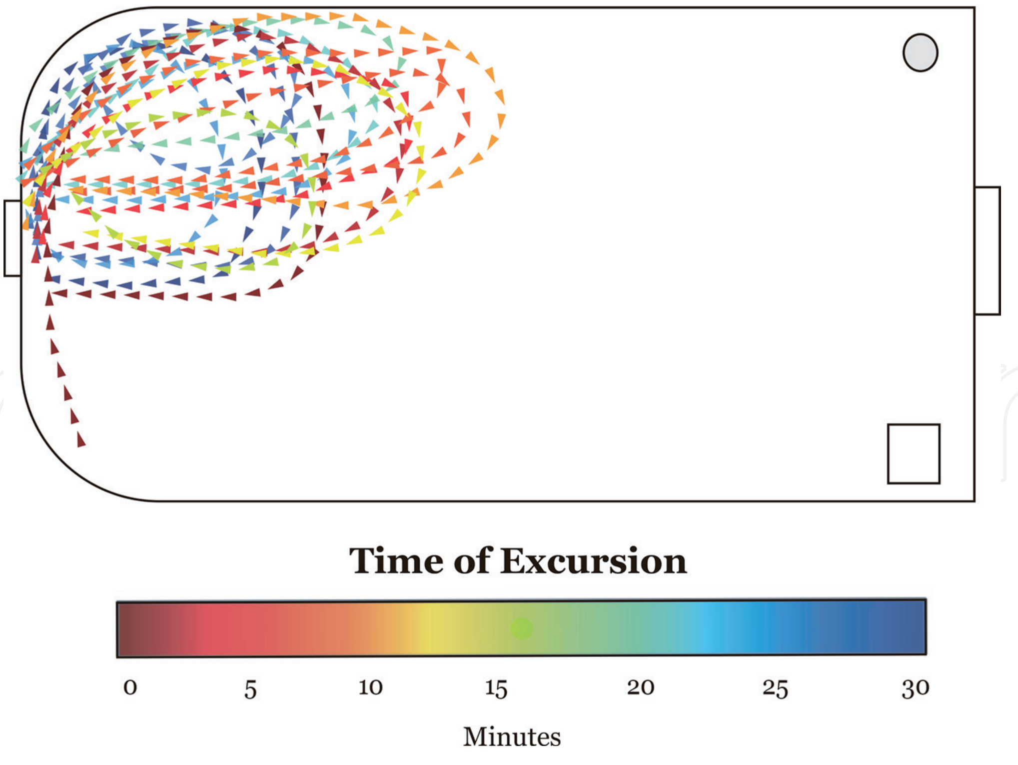

Figure 5.
Loops made by a horse under saddle. The horse was asked to walk into the arena and then released from control. Note: the horse made repeated loops near the gate area of the arena. The colored bar indicates time.

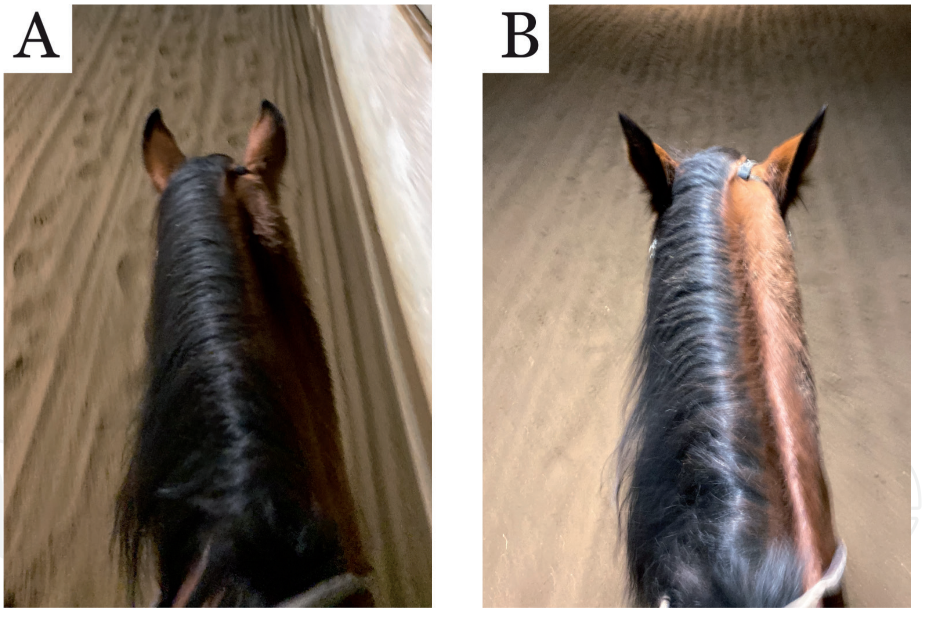

Figure 6.
Ear position on outward and inward directions when circling an arena under saddle. (A) On the outward leg of the circle the horse frequently directs its ears forward. (B) On the homeward leg of a circle the horse frequently directs its ears backward. Ear position may signal caution on the outward leg and relaxation on the homeward leg.

sniff, look, and loop trips when on their own—their going out was slow and their coming back faster and their ear position reflected their relative concern with the two ends of the arena.

The observation that ear position is a marker of the inward and outward loops of spontaneous excursions and excursions under saddle suggests that ear position could be a marker of behavior in the show pen. We used videos from the nonpro National Reining Horse Association reigning futurity held in Oklahoma

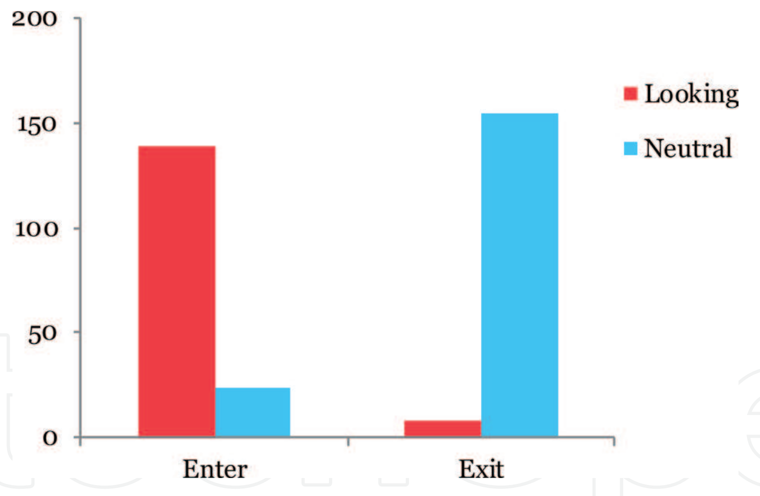

Figure 7.
Number of horses displaying either mainly ears forward or neutral position when walking into an arena or walking out of the arena as a part of reining Pattern 6. Results obtained from the non-pro National Reining Horse Association futurity in Oklahoma City in 2015.

City in 2015. The horses were performing Pattern 6, a pattern in which they walk to the center of the arena to begin the pattern and walk much the same path to the entrance gate after making their last stop. We rated ear position on the inward and outward walks. As is illustrated in **Figure 7**, inward walks were overwhelmingly associated with periods of ears forward position whereas outward walks were associated with a relatively neutral or ear back position. It is noteworthy that many riders try to minimize "look" behavior on the outward walk by collecting their horse. These results suggest that just as horses treat the outward portion of a spontaneous loop as stressful, even when well-trained they display the same behavior when performing in an arena.

6. Memory

The similarity of home-base behavior of horses that were familiar with the arena and those who were taken to the arena for the first time might suggest that horses have a poor memory of the arena. Horses that are familiar with the arena seemed to behave as if they are being introduced to it for the first time, as judged by a comparison of their behavior to the behavior of horses that were new to the arena. Many studies have noted that horses have good memory [14–19], but our question related to the memory for an arena they had previously visited. We tested arena memory with five horses that had been ridden in the arena a number of times each week for many weeks. The arena baseboard was painted white but was covered with dust and scuff marks from being hit by the tires of the tractor that was used to groom the arena. We placed a novel object on the arena wall, a three-inch wide two-foot long strip of cloth. If the horses were treating the arena as a completely new place, they should not notice the cue because it would look to them like other marks on the wall. If they had a memory for the arena, they might notice the cue. The riders were unaware of our experiment. We took any especially attentive or avoidance behavior of the horses toward the cue as a sign that they recognized that the cue was there.

All of the horses immediately noticed the cue when the riders first circled the arena past the cue, and two of the horses shied noticeably, surprising the riders who did not seem to have noticed the cue themselves. The results of this experiment suggest to us that the horse have an excellent memory for the arena—excellent in the sense that they recognize something new against a background that is familiar to them.

Accordingly, their home-base behavior and seeming avoidance of the far end of the arena on the exploratory tests cannot be explained in relation to poor memory for the arena. They were not avoiding the far end of the area because they had no memory of ever being there.

In the course of studying why horses might sniff the ground during a warm-up for riding, we observed that the horses would notice objects on the ground, go toward them and sniff them. The objects could be as small as a cigarette butt or a blade of hay, a sunbeam from a window, or the droppings left by a previous horse. We collected observations of sniffing and checking behavior as a way of assessing visual attention and memory. We found that horses would notice a small object as far as 10 feet away and a large object, such as the dropping from another horse, from as far as 30 feet away. When given the opportunity, the horses were very attentive to the ground and their inspection of the arena did not just consist of looking at objects in the distance but also consisted of inspecting the ground on which they were walking and approaching objects that they saw there.

In the course of studying this sniffing behavior we observed that a horse very seldom returned to an object once it had sniffed it. That they did not return to objects indicated that they remembered them. To further examine this form of object memory, we purposefully manipulated the delay between the first approach to sniff of an object and subsequent responses to the same object. We had a rider allow a horse to approach and sniff an object and then return along the same path to see whether the horse would again approach the object. We varied the return time by minutes, as measured by a complete circle around the arena at a walk, to a half an hour, as timed with a watch. We found that the interval did not matter, of 297 instances of return visit opportunities, only 9 were associated with a second visit to an object (results collected from four horses). We also did tests of having the horses approach the object from a different direction. Again, of 75 instances of returns, only four were associated with the second inspection of an object. The second visits were all associated with visits to droppings.

Accordingly, we made droppings a focus of examination. We allowed a horse to walk directly toward a dropping and sniff it and we timed the duration of the sniff. We then varied the time of our next visit on which we allowed the horse to walk directly toward the dropping. Of 150 such samples, on 137 occasions the horses did not sniff the dropping on the second trip but passed by. On the few occasions on which they sniffed on a return visit, the duration of sniffing was shorter than on the previous visit. There was no effect of the intertrial interval, as horses mainly ignored a target that they had recently sniffed as much as they ignored a target that they had sniffed a half hour previously.

We placed two plates containing droppings approximately 30 ft. away from each other and had a rider walk a horse toward the center of the space between the objects (**Figure 8**). Even at quite a long distance away, the horses veered toward one of the objects to sniff it. Then within a few minutes to as long as 30 min later, the test was repeated. Each horse then got a third trial, with the expectation that once they had examined both objects, they might ignore them on the third trial. The horses were given one test each day—with test at the short interval and the test at the 30-min interval alternated each day. For the tests, the objects were at different locations in the area each day. Thus, over 20 days the horse had 10 tests at the short interval and 10 tests at the long interval. The results are shown in **Figure 9**. One horse got 10/10 (they alternated on each of 10 trials) at both the short and the long interval and the other horse got 9/10 at the short interval and 9/10 at the long interval. On their third trial, both horses ignored both objects on 10/10 trials, so indicating that they remember that they had explored them. This experiment indicated that horses have an excellent short-term memory of objects that they get to sniff.

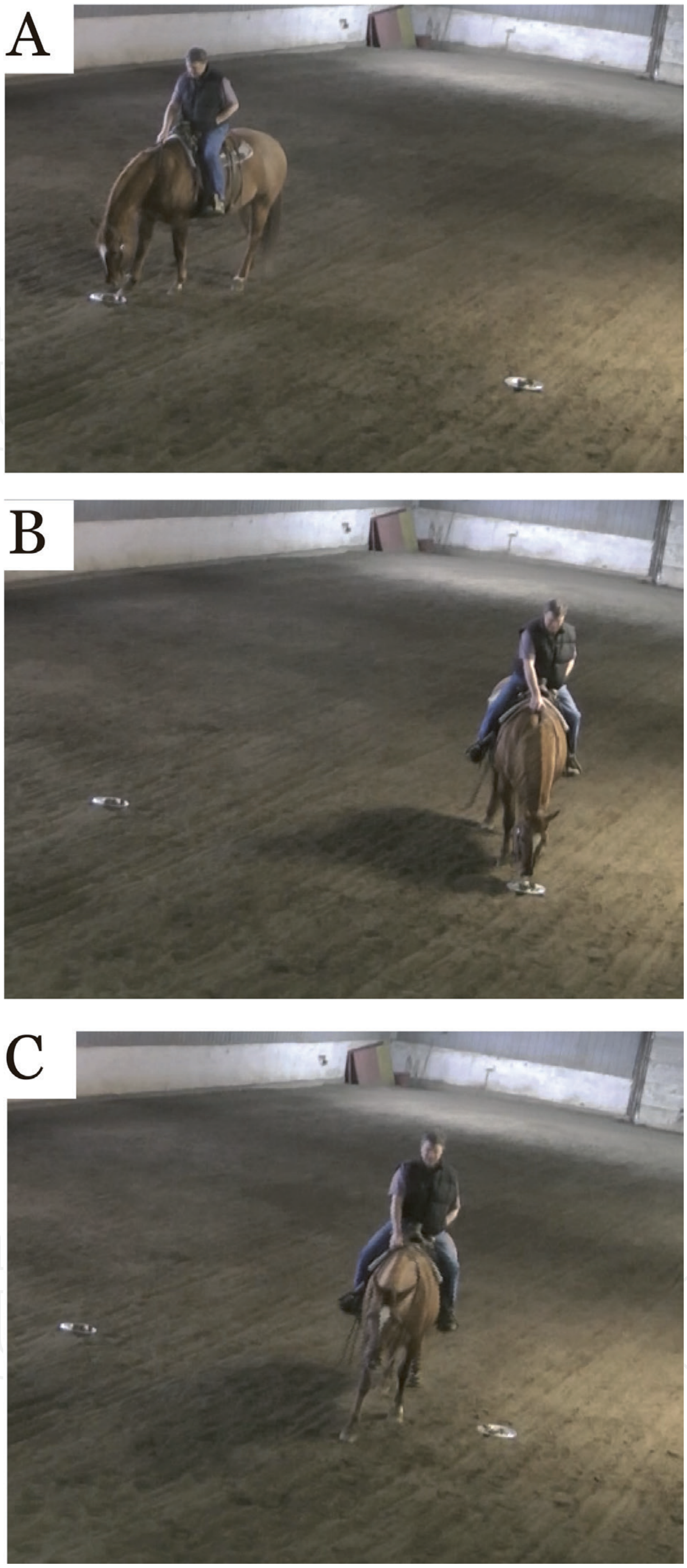

Figure 8.
Two choice memory test. (A) A horse ridden to the center point between two plates containing droppings, approaches the right plate and sniffs the target. (B) About 5 min later, the horse is given a second choice and chooses the left target. (C) About 5 min later, the horse is given a third choice and passes both targets without investigating either.

Our memory experiment shows that the horses always treated objects as novel on each day's encounter. We also tested horses in an outdoor arena, where droppings and other objects tended to be left because the arena received infrequent grooming. There, we found that the horses explored as many as six objects and remember them

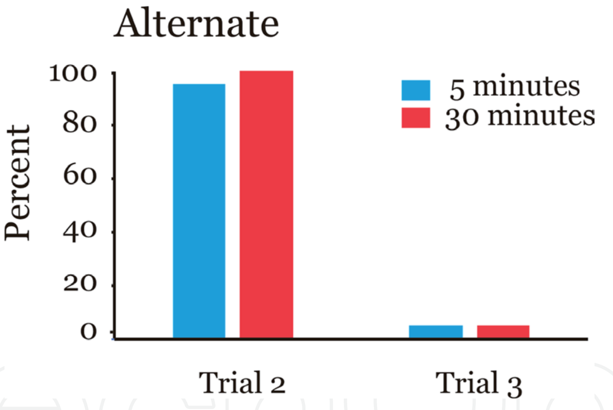

Figure 9.
Two choice test results (percent choices). On the second choice given either 5 or 30 min after the first choice there is a high probability that the horses choose the target not chosen on the first trial. On the third choice, there is a high probability that the horses choose neither target. Both results show that a horse remembers targets that it has investigated.

on a same day test. There too, when they were returned on the following day, they behaved toward the object as if they had never previously seen them. This experiment suggests that when removed from the arena for a day, a horse resets its memory and treats the objects in the arena as new.

7. Checking and shying

The experiments on memory show that horses are motivated to investigate/check small objects on the ground and they then remember those objects during the period of time that they are in the arena. It is well known that horses shy at novel objects and we reasoned that if we increased the size of the objects, their behavior should transition from investigatory to avoidance behavior. We made round cut outs of cardboard of various sizes and measured approach and avoidance behavior as we rode the horses around the arena. We found that as the size of the object increased, the probability of avoidance behavior increased. This behavior is very similar to that described by Ewart [20] for toads, which approach to eat small objects that he presented to them and who avoided larger objects that he presented, treating them as predators. We also varied the location of the objects in the arena and found that objects were avoided with more vigor at the far end of the arena. Often, an intermediate size object that was avoided at the far end of the arena was investigated at the near end of the arena. Interestingly, the horses were still likely to shy at large objects when returned to the object a short time later. Since their memory for objects in an arena is good, repeated shying appeared unlikely due to poor memory.

8. Discussion

These experiments tell us two main things about what a horse is thinking when it is taken into an arena. First, the arena is a source of stress and it is likely that it is anxiety provoking. Second, a horse views the arena as a place that is novel and that requires inspection and when not novel a place that must be patrolled and checked. In responding to these two influences, horses display a *spatial gradient* and an *exploratory gradient*. These gradients, if attended to, allow a rider to read the mind of their horse and adjust their ride and their training. We will point out some of the ways that more expert horse handlers show that they are aware of a horse's opinion of an arena to which they are taken.

8.1 The spatial gradient

Figure 10 illustrates our model of a horse's spatial view of the world in relation to its actual home, the location of its herd. The model is constructed in the shape of a loop with the base of the loop representing a horse's actual home, its paddock or stall. The blue color of the spectrum of colors in the loop indicates low stress and is associated with the actual home. The color spectrum becomes redder as distance from that home increases to signify an increase in a horse's stress in proportion to the distance from its home. The model is shaped as a loop not only to signify an actual loop but also to signify avoidance of walls or other large objects that will also provoke an increase in stress.

Research on horses in herds that have been together for some time show both that a herd is stable and within the herd social relationships are structured, with horses maintaining favorite relations [21]. Substantial information suggests that that removing an animal from its social group is stressful and remains stressful even after repeated removal [22]. The loop model when superimposed onto an arena explains why the horse chooses the gate area of the area as a home base, why it avoids the walls of the arena, why its movement pattern forms a loop and why it limits its excursion to the near end of the arena. The model also explains why its behavior remains much the same even after attempted adaptation to an arena. It will attempt to confine its activities to the blue regions that are less stressful because they are perceived as closest to its actual home.

On the basis of our model, we have experimented with the idea that when beginning a ride or when warming a horse up for a ride when the horse is alone, a rider mimics the horse's natural behavior. Accordingly, a ride begins with small loops each of which bring the horse back to the starting gate and then extend to include

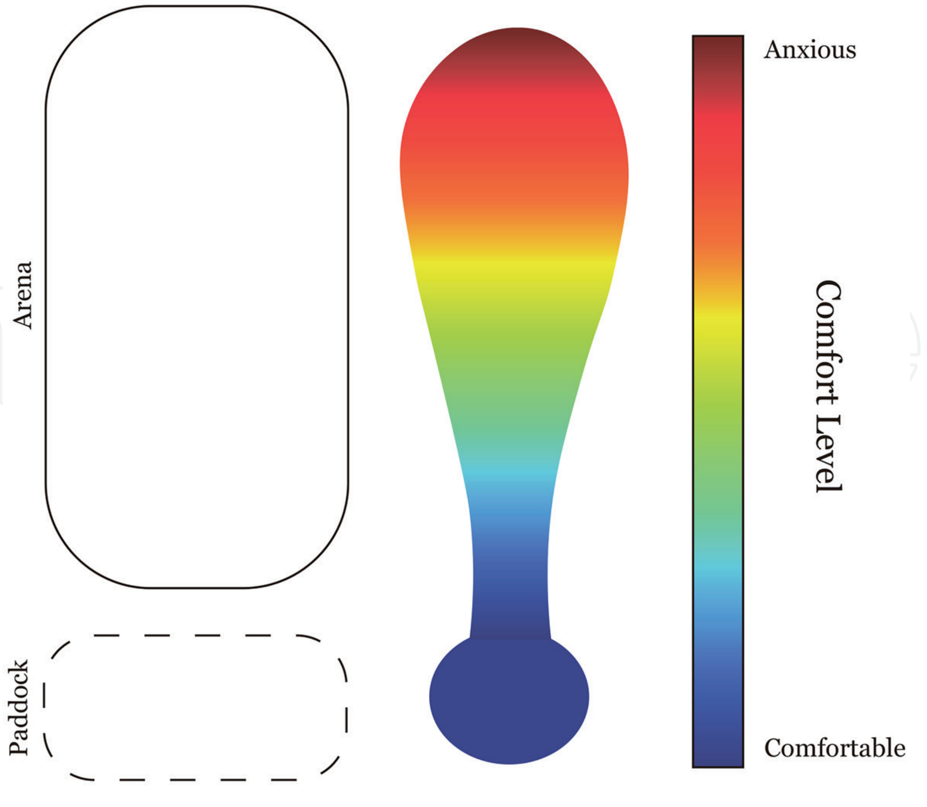

Figure 10.
A model of the spatial gradient. The colored bubble represents a loop pattern of excursion color coded to represent comfort (blue) to anxiety (red). Maximal comfort is in the home paddock and maximum anxiety is at the apex of the loop. When superimposed on the arena the anxiety gradient indicates the entrance, nearest to the paddock, features lowest anxiety and the far end of the arena indicated maximum anxiety.

more of the arena. On each outward leg of a loop, the horse's anxiety likely increases but then on the return leg to the starting point its anxiety decreases. Over a training session and over days of training, a horse learns that outward excursions will always end with homeward excursions and in this way its behavior becomes managed. A rider might not force a horse down a wall but build up to approaching walls as the ride proceeds.

We have seen aspects of our suggestion in play when young horses are first started. Some trainers first halter-break and lead-break a horse when it is in its stall and adapt a horse to a saddle while it is in its stall. We have also observed one horse trainer making the first mount and taking the first ride with horses in their stall. The stall is home and the location of a horse's lowest level of anxiety. Some trainers, when taking a horse to an arena for training might begin the training from the back of another horse. The other horse is a surrogate for its herd and serves to reduce anxiety. A trainer might begin the first ride in arena by making small circles when first asking the horse to move forward under saddle. It is likely that experience has led to training strategies that are integrated into a horse's spatial gradient. The spatial gradient also suggests that any added stress to a horse, including first separation from pair mates or pressure to perform more correctly or quickly, will shift the color gradient in our model from blue to red. It is also likely that when stressed, a horse attributes the stress to the environment and not the handler and so resistance to walls, shying at objects, and moving through the far end of an arena increase in proportion to stress [23].

We have observed handling behaviors that are inconsistent with a horse's spatial gradient. A rider might force a horse to go to the far end of an arena even though it resists. A rider might begin a ride with a horse collected and unable examine the area visually or to examine the ground by sniffing. A handler might take a horse to the center of an arena and lunge it there. Lunging will likely not substitute for arena inspection and object checking. These handling methods might maximize anxiety and result in horse/handler conflict. It is likely that rides taken outside an arena are also subject to the spatial gradient, the further a horse is taken from its paddock, the greater the stress. Many riders taking a horse out alone have experienced the anxiety gradient in a number of ways. If a horse is going to "act up" it is likely this will happen on the outward leg of a trip. A rider might also notice that a horse returns more quickly than it embarks on a ride.

8.2 The exploratory gradient

The second point raised by our experiments is that each day that a horse is taken to an arena it treats the arena as new. This is not because it does not remember being in the arena or because it does not remember objects in the arena. Rather, it is likely that it wants to ascertain that the arena is safe. Many animal species that maintain home territories patrol and check their territories regularly [24]. It is likely that they want to be certain that the representation that they have of their environment matches the environment. Therefore, to ensure that the arena is safe, a horse needs to sniff the ground and objects in the arena as well as look at them. One clinician explained a horse's display of anxiety as, "there might be a bear there." What could be more threating, however, is the presence of an unknown horse. The many new smells on the ground of the arena, the dropping of another horse left in the arena, are a sign that other horses have been there. Ecological studies of many animal species suggest that daily conspecific aggression is much more likely than is predatory aggression [25]. Previous studies of olfactory memory in horses show that a horse's memory of others is particularly good for horses that have been aggressive toward them [26–29].

9. Conclusion

With this description of our experiments we suggest that a handler can appreciate a horse's thoughts with respect to an arena into which it is taken. In the area, the further a horse goes from the entrance, the greater the stress and the more it will want to leave. Most riders will confirm that even a well-trained horse will need to be encouraged to go into an area and during a ride and will speed up when moving back in the direction of the starting point. Many horses will appear afraid of the far end of the arena and so it will be difficult to get them to go there. Once there, they will not perform as well as they do in the close end of the arena. Many horses will also avoid the wall of the arena and beginning riders may have difficulty getting their horse to stay near the wall when circling an arena. These behaviors are reflected in our model of the horse's spatial gradient. In adapting a horse to an arena, a rider might find that if given the chance, a horse will explore using vision, olfaction, and touch and it will do so each day that it comes to the arena. It has to check or patrol. Allowing a horse to explore might reduce its anxiety by making an arena more like the home paddock. In short, being aware of what a horse is thinking when it is taken out of its paddock to work will improve a horse handling experience as well as improve the chances that the handling experience is accident free. We view the present contribution to scientific based horsemanship as preliminary [30]. There are many aspects of horsemanship that can be further investigated with the arena/home base model, including sex differences, which have only been touched upon here, and genetic [31], developmental [32], and brain influences.

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