EFFECT OF COMPETITION ON SALIVARY CORTISOL CONCENTRATION OF WESTERN PERFORMANCE HORSES AND RIDERS

A Thesis

by

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ABSTRACT

Competition stress is a common factor in success of performing athletes. It is assumed that riders and horses both experience stress while competing in an event. However, few studies have measured the physiological responses to identify causes of stress in performing horses and riders. The few studies of competition stress, measured by increases in cortisol, have focused on English disciplines and racehorses. In this study, fifteen horse and rider pairs competing in western stock horse events were evaluated.

Salivary cortisol was collected in both horses and riders at rest, during practice, and over the course of four stock horse classes in a Stock Horse of Texas sanctioned event. Riders completed an additional test of a maximal exercise bout. Saliva samples were taken 20 minutes pre-test and 20 minutes post-test. Rider salivary cortisol concentration (SCC) was significantly higher than resting SCC in pleasure ($p=0.023$), cow work ($p<0.001$), reining ($p=0.017$), and maximal exercise tests ($p=0.018$). Horse SCC was higher than resting SCC in cow work only ($p=0.016$). Riders were also separated into novice (NOV) and non-pro (NP) groups to determine effect of rider level on SCC. Novice riders had a higher SCC (10.26+4.73) than non-pro riders (8.92+3.74) in the cow work. Horse SCC was not affected by rider SCC. Increased rider SCC had a negative impact on overall placing and scores in the reining class ($p=0.044$, $r^2=0.239$) and prior to the start of competition ($p=0.016$, $r^2=0.397$). Horse SCC before reining also had a negative impact on score ($p=0.034$, $r^2=0.348$). Competition stress was determined to be largely based on SCC of riders, which negatively impacted performance.

DEDICATION

I would like to dedicate this project to the teachers, coaches, and trainers that have helped me and many others manage the stress of showing horses. I would also like to dedicate this to my current and future students, in hopes that they are able to apply this knowledge to their own competitive equestrian careers.

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NOMENCLATURE

SCC	Salivary cortisol concentration
HPA	Hypothalamic-pituitary-adrenal axis
SAM	Sympathetic adrenal medullary system
ANS	Autonomic nervous system
CRH	Corticotropin releasing hormone
ACTH	Adrenocorticotropic hormone
BEG	Beginner rider group
ADV	Advanced rider group
SHTX	Stock Horse of Texas Association
AQHA	American Quarter Horse Association
SST	Swab storage tube

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1. LITERATURE REVIEW

Introduction

Sports psychology is an ever-growing field in athletics across the world. Many researchers have explored the effects of competition-related stress on the emotional and physiological state of performing athletes [1]. Equestrian sports, however, present a unique situation where two athletes of different species, i.e., human and equine, must both work together to perform. Competition-related stress in riders is considered to have an effect on performance, similarly to any performing athlete of other sports. However, competition-related stress in the equine athlete remains difficult to quantify and an area where further research is needed. In terms of welfare, competition-related stress may be considered a factor that increases risk of injury to the animals and burnout [2]. From an economic standpoint, industry professionals have shown greater interest in controlling stress factors for equine athletes in order to improve their chances of success on the track, on course, or in the arena. Due to the increasing value of the elite performance horse, avoiding stress-induced insults to performance is important to producers and competitors [3]. Finally, a marked increase of non-professional exhibitors in western performance events demonstrates a further need for research on the rider's stress level playing a factor in a horse and rider team's ability to compete successfully. Podcasts, clinics, and online resources designed to help riders reduce competition stress and improve their "mental game" at shows have increased in popularity as show numbers have increased [4].

Ultimately, stress is a factor that may influence an individual's decision-making processes, reflex response times, and dexterity [5]. Considering the inherent risks of participating in equestrian sports, stress-related physiological changes could be detrimental to both horses and riders [2]. Quantifying, with the ultimate goal of controlling these stress indicators, would be of benefit to owners and producers in the equine industry, and could ultimately be the difference between the growth of equestrian sport and its decline.

What is stress?

Stress is often a combination of physiological and psychological or perceived changes to the animal or its environment. The stress response, in summary, may result in two biological pathways: increased activity of the hypothalamic-pituitary-adrenal cortex axis (HPA) as a long-term response, and increased activity of the sympathetic adrenal medulla (SAM) as the short-term response. When the sympathetic nervous system detects a stressor or a potential threat to the body, the SAM activates the central nervous system, causing the body to send signals to respond to the stressor. This results in increased heart rate, glycogenosis, production of adrenaline, and gastrointestinal activity [6]. Typically, SAM activation is a result of an immediate threat or perceived threat that must be addressed. The activation of the HPA takes longer than SAM, and results in lasting effects of increased hormone production. When the hypothalamus detects a stressor, it sends corticotropin releasing hormone (CRH) to the pituitary gland, which then secretes adrenal-corticotropic hormone (ACTH) [7]. The release of ACTH is the signaling factor that controls cortisol production from the adrenal glands. Cortisol is a gluco-cortico-steroid responsible for increasing energy availability from the body's stores, anti-inflammatory response, increased blood pressure and oxygen utilization, and many other responses [8]. Cortisol is released into the bloodstream almost immediately after the HPA activation. After distribution throughout the body, unbound cortisol begins to leak through to the saliva. Over time, it will eventually go to the kidneys to be broken down and excreted [9]. Cortisol is one of many parameters that are widely utilized for measuring stress. However, its timely response to stressors and ease of collection and analysis makes it a viable measurement for many stress studies [10]. For this study, this subsequent increase in free cortisol that passes through to saliva will serve as an indicator of stress level.

Effects of cortisol release

Cortisol release is often considered to have a negative impact on performance in human athletes. Prolonged cortisol release can have many negative impacts on the body's overall health. However, further research has supported the potential for increased cortisol to have a positive effect on performance. The biological responses to cortisol release have been noted to activate the autonomic nervous system, increase inflammatory responses, and induce immune responses [1]. Each of these responses is absolutely vital for the appropriate mobilization of energy that is required for the activity perceived [11]. In performing athletes, stress, anxiety, and worry can lead to impaired judgment, muscle tension, increased distraction, and poor performance. However, if directed, these emotions that recruit a biological response of increased cortisol concentration in the bloodstream may be harnessed to promote concentrated physical effort and mental focus [12]. Horses with a higher serum cortisol concentration also showed a positive correlation to performance in dressage competition, suggesting that there is a benefit to the cortisol response [13]. Additionally, training and conditioning has been shown to improve mobilization of cortisol and feedback for returning to homeostasis in horses [14]. The stress response can be of benefit and detriment to athletes of any species. Ongoing research is needed to identify whether stress can be a positive or negative influence on performance.

How is stress measured?

There are many methods of evaluating stress level in horses, both behaviorally and physiologically. A commonly used method of measuring stress is blood serum cortisol. However, in the application of equine studies, blood sampling itself may also be a cause of stress and could cause variation in results [8]. Alexander and Irvine used blood serum cortisol measurements to evaluate social stress in herd management of horses [15]. Not only does this method require a trained professional to draw samples, the horses were also noted to have suppressed immune systems as a result of the stress test throughout the study. While the susceptibility to the respiratory infections noted could have been caused by the social experiment itself, blood sampling could have been a contributing factor to further increase their cortisol, therefore weakening the immune system [15]. As previously discussed, salivary cortisol is recognized as an accurate indicator of HPA activity. Kedzierski et al measured both blood serum cortisol and salivary cortisol in Arabian horses during a training session to evaluate the correlation between the two sampling methods. Results indicated a significant correlation between salivary and serum cortisol both immediately after a training session and 30 minutes after. Authors also noted that for field measurements, saliva sampling required minimal training of sample administrators and was much more efficient [16]. In another comparison study between blood serum cortisol and salivary cortisol, Peeters et al determined a positive correlation using an ACTH challenge that demonstrated salivary cortisol was an accurate and non-invasive alternative to blood serum sampling [17]. Saliva cortisol sampling has been recognized by multiple sources as less invasive and less stressful than blood serum for animals, therefore it has become more popular for equine research practices.

Cortisol can also be tested via urine and fecal sampling. However, timing of sampling is of utmost importance when considering events such as competition. A study evaluating ideal sample timing of cortisol in chimpanzees discovered that peak salivary cortisol was reached between 10 and 40 minutes after exposure to the stressor [9]. Urinary cortisol was a reliable source of free cortisol, however, similarly to fecal sampling, it was better suited for measuring long-term stress rather than specific short-term challenges [9]. In another competition stress study, Peeters et al measured salivary cortisol immediately after competition, 20 minutes after, and 40 minutes after. Results of the immunoassays showed the most significant increase in cortisol after competition to be 20 minutes post-exercise [18]. Skoluda et al measured salivary cortisol in young adult human males at multiple time points after various types of stress tests, and reported the most notable increase between 15-20 minutes post-test [10]. For this reason, in this study, saliva samples were collected 20 minutes before competition and 20 minutes post-competition. Other non-invasive methods such as pupil dilation, eye temperature, heart rate, and behavioral changes have been used for stress evaluation in horses [17]. Behavioral parameters may be difficult to record objectively due to variation in experience of the human making observations. A correlation has been reported between salivary cortisol concentration (SSC) and behavioral indicators of stress [19]. However, similarly to HR, it is difficult to separate cortisol responses in terms of physical and psychological stress. In order to avoid subjective evaluation and inconsistency of data collection, salivary cortisol assays are a consistent and reliable way to evaluate the stress response of competing equine and human athletes.

What is competition stress?

Equestrian competition is physically and mentally demanding for both the animal and human involved. The teams are asked to perform tasks that require skill, training, pattern memorization, mental focus, and physical exertion in front of an accredited judge and their peers in an unfamiliar environment. Professional competitors recognize that horses and riders experience stress during an event, yet few studies have quantified the physiological responses that occur during competition. The effects of performance related stress are well researched in human athletes [12], however limited studies explore the changes and interactions of horse and rider teams in competition. Factors that are considered competition-related stressors in human athletes include: athletic demand, psychosocial concerns related to performance, threat of failure, change in environment, interruption of meal routines, travel, increased noise and distractions, and many others [12]. Skoluda et al performed a study on young adult men using the most common stress tests to evaluate different parameters that could measure stress. Tests included a flashcard reading challenge, a hand in ice water, which was thought to illicit a minimal pain response, a social stress test presented as a mock job interview, an ergometer exercise test, and a control test. Under all parameters, with the exception of heart rate, the most stressful activity was the social stress test. Skoluda also noted that the social stress test had the greatest impact on HPA activity, in contrast to the ergometer test which impacted the autonomic nervous system [10]. This implies that the social aspect of performing in front of others, or being judged or graded on performance, may have a major impact on stress levels of competing athletes. Riders, as well as athletes in any other sport, experience psychosocial stress as well as exercise related stress [1]. It has also been shown that stress level may directly impact performance of athletes in competition, however, researchers are still identifying the positive and negative impacts on performance of a notable blood serum or salivary cortisol increase. Many authors note that an increase in cortisol at competitions may improve performance, recognizing a state of "eustress" that can be achieved by harnessing the perceived negative stressors and using this energy for focus and execution of the performance task [12], [20]. It is suggested that horses can achieve this same mental state, in which they can utilize cortisol to improve athletic performance [18].

A study evaluating the relationship between HPA activity and performance scores in shooting competitions demonstrated that individuals with higher cortisol levels had a lower average score as compared to those with cortisol levels that remained consistent with basal levels [21]. In a review of 25 anticipatory competition stress studies in human athletes, van Peridon et al observed a U-relationship curve between cortisol levels and performance [1]. This means that some increase in HPA activity can improve performance, while a greater increase in HPA activity can have a negative effect on performance in competition. In study of jumping horses and riders, increased SCC had a negative effect on rider performance, and a positive effect on horse performance [18]. This may support the idea that horses can utilize increased cortisol into a eustress state similar to human athletes, but the nature of the activity being performed must always be considered. Most equine sports require extreme physical exertion, so in most cases, increased cortisol for increased energy mobilization would have a direct benefit on scores and results. It should be noted that in Peeters' 2013 study, novice or beginner riders showed a greater increase in salivary cortisol than experienced or advanced riders [18]. Nichols' competition stress study evaluated experienced and beginner athletes and noted a decreased salivary cortisol response to competition in more experienced athletes [20]. While we can anticipate equine athletes to experience similar physiological responses, collecting controlled data on performance horses in actual competition presents challenges. It is important to identify additional factors that can contribute to increased SCC in horses outside of competition.

Causes of Stress

Horses can experience increased ACTH activity resulting in higher cortisol levels for many reasons. Numerous studies have identified a diurnal rhythm of cortisol production that peaks mid-morning, and decreases throughout the day [22]. There are many factors that can disrupt this diurnal rhythm and contribute to stress during competitions, including, but not limited to: transportation, separation from a herd, novel objects, noise, changes to feeding schedules, and additional exercise workload. Exercise alone causes an increase in SCC, as the body attempts to prioritize energy needs for movement. Because cortisol is responsive to physical workload and activity, there have been several studies that attempt to control the physical activity variable and measure differences in cortisol based on another stressor [8]. In a study of endurance training and competitions in Arabian horses, cortisol levels at competition were higher than in the training sessions, which were intended to require a similar amount of energy as competitions [23]. Because of this change between two similarly physical activities, some variable that can contribute to increased cortisol at competition must be considered.

A factor to consider that may affect horses' stress levels in competition is the impact of social stressors. Horses are naturally social animals; however, equestrian competition often requires horses to compete individually in an enclosed area or course. Additionally, performance horses may travel to competitions without their accustomed herd mates or stable mates. Arriving in a new environment with unfamiliar horses may be a cause of stress or increased plasma free cortisol levels. Alexander and Irvine noted an increased free serum cortisol value in a social stress experiment that measured free plasma cortisol in "newcomers" as they were introduced to a herd [15]. While this may be a factor in competition stress, we must consider that in most competitive situations, the competing horses will be stalled individually and will not have the stresses of hierarchy within a new environment. In a study evaluating short-term separation from an established herd, mares showed an initial increase in serum cortisol levels, and returned to normal after one day [24]. This is likely to influence performance horses that are traveling without their established companions, although further research would be needed to determine the true effects of this on stress and performance. Aurich et al determined that housing horses in group settings versus individual pens had no effect on cortisol concentration [22]. Most competitive western performance horses are conditioned to traveling and are not housed in group settings for the sake of avoiding injuries, although traveling away from home may still be a factor to consider.

Transportation is a known stressor that has been researched in various locations and conditions. Miller et al. evaluated short-term immune and endocrine responses to transport, and suggested that horses may be more susceptible to diseases immediately after hauling [25]. Many competing horses are accustomed to transportation, but experience with this type of stressor may have an impact on cortisol sampling after hauling. Fazio et al measured plasma cortisol levels of competing horses that were transported immediately prior to competing and compared them to horses that were housed at the event. Cortisol levels were significantly higher in the transported horses, both experienced and inexperienced [26]. This could encourage trainers and owners to allow horses to settle in a new environment prior to competing. Additionally, Miller noted that decreased immune response and increased stress response had resolved at 24 hours after transport [25]. The timing of transport may be a factor in many competition stress studies that did not control this potential stressor. Schmidt et al demonstrated that young horses that were repeatedly hauled, showed a lower stress response over time to transportation. This indicates that habitation of exposure to a stressor may decrease cortisol production, reducing stress and negative effects associated with the stressor [27]. There may be some negative stress-related effects of long-lasting competition that takes place over multiple days. In a 2017 study by Munk et al, salivary cortisol was tested over the course of a three-day competition of warmblood jumping horses. While the diurnal rhythm of the horses was not affected by the amount of time at the event, overall cortisol increased significantly each day of the competition, indicating that time away from home or at the event may cause increased stress [28]. This could be due to the increased length of riding time, disruption of normal feeding schedules, or increased activity within the environment such as noise, lights staying on in barns overnight, and horses or people constantly walking through stalling areas.

Some studies have shown an increase in cortisol after training and conditioning to competition. Casella et al. recorded an increased serum cortisol response to reining training sessions over time in Quarter horses [29]. In the Witkowska-Pilaszewictz study on performing Arabian horses, it was noted that competition and training experience caused an increase in cortisol levels when preparing for exercise [23]. Meaning, the longer a horse was in training, the more his body adapted to increase cortisol availability in anticipation of the exercise. This did not affect the difference between pre and post competition cortisol values, demonstrating that the trained increased cortisol may not have a negative effect on welfare at competition [23].

Similarly, a study of Hucul horses showed that in response to exercise, salivary cortisol increased with age and the number of times a horse performed [30]. However, these authors suggest that because the Hucul breed is bred and most commonly used for slow work like hippotherapy, tourism, and packing, testing them for endurance and sport performance may not be the best representation of their abilities. Both of these studies imply a positive relationship between training and SCC. In similar respects, some athletic studies have shown stress to cause an improvement in performance because of energy mobilization [3]. Peeters et al conducted a study to compare impacts of cortisol concentration on performance scores in three-event sport horses. They found a positive correlation between rider cortisol levels and performance, and a negative correlation between horse cortisol and performance [13]. This suggests that riders were able to reach a stage of “eustress” in competition settings, but contradicts Bartoleme in that horses with increased cortisol did not perform as well [3]. Also, Peeters’ findings that more experienced horses did not show significant changes in salivary cortisol at competition alludes to a habituation effect to competition stress, similar to Schmidt’s conclusion that horses can be habituated to transport stress [13], [27]. This supports the theory that exposure and experience may reduce an equine athlete’s stress level when competing. In addition, exercising horses with moderate amounts of stress may increase their ability to cope with other stressors [8]. Human athletes with more experience, competing at national-level events, have shown a lesser increase in cortisol before an event as compared to athletes competing at lower levels [20]. This is likely due to a conditioned coping response to anticipatory stress. McBride and Mills suggested that teaching equine athletes to cope with novel objects and experiences may help lower their stress levels at competitions. Horses must be both motivated to perform a task and able to manage emotional stressors in order to succeed in competition. Equine athletes have been known to sometimes thrive when exposed to a novel stimulus or event, yet they must be conditioned or desensitized to many stimulants before an event in order to be able to focus on the performance task [2]. According to Cayado et al, significant differences in cortisol levels were observed in horses of moderate, intermediate, and most experienced groups. The most experienced horses had the lowest basal and post-competition values of salivary cortisol. Dressage horses had overall higher cortisol measurements at all points of data collection as compared to show jumping horses, possibly due to the intense physical and mental workload associated with a dressage test [31]. This study also alludes to the assumption that horses can be habituated to competition in order to decrease competition stress. More research is needed to define how much stress may result in the development of coping skills without instilling fear or a negative association with competition. Many authors recognize the fact that the training program the horse is involved in may play a role in how the horse learns to handle competition stress. Trainers must focus on creating a positive learning experience from these events in order to teach the horse that competition is not a threat that requires a major physiological stress response. In addition, equine athletes also must be evaluated on an individual basis to determine how to train for both successful results and animal health.

One of the least-researched and most complex factors to consider when evaluating competition related stress is the influence of the rider. Riders are often attempting to manage their own stress level when competing, while also considering their effectiveness in communicating with their equine partner. Experience is a major factor in determining the stress level of a rider, and there is much to be researched on how this affects the stress level of the horse. It has been suggested that a nervous rider or handler may be a cause of anxiety in the horse [8]. However, Ille et al. found no significant difference of horse stress level based on rider experience. Ille et al studied cortisol levels in pairs of both inexperienced and experienced horses and riders while performing the same exercise bout. Although cortisol concentrations during and after the test were higher in less experienced horses, this was not found to be statistically different. The major results of this study demonstrated that inexperienced riders showed an increase in heart rate and cortisol concentration when competing, especially when matched with an inexperienced horse. The horses showed no statistical differentiation in cortisol response between performing with an experienced or inexperienced rider [32]. This does not support the common hypothesis that inexperienced riders cause horses more stress. Similarly, Peeters found no correlation between the increase in rider cortisol level and their equine partners

[18]. Riders and horses were evaluated before, during, and after a jump course. Riders showed a major increase in salivary cortisol, and horses showed a minor increase with competition. Again, rider competition stress was a more influential factor on the success of a horse/rider team than the horse's stress level. A study at Murray State University evaluated the stress level of Quarter horse/stock type horses in therapeutic riding and equitation lesson programs. There was no significant increase in blood serum cortisol before and after riding, and no significant impact based on rider experience level [33]. The feedback between rider and horse is a unique aspect of equestrian competition, not found in other sporting events. There is much to be discovered and measured in terms of the psychological responses and feedback resulting from this relationship. Studies investigating the factors that influence horse and rider stress during competition are limited and conflicting; indicating a need for further investigation. There is a lack of data regarding competition stress in western equestrian sports. Minimal studies have been conducted that measure fitness level and/or training responses with multiple physiological markers in Quarter or stock-type horses [34], [35], [29], but none of these have focused on cortisol responses to competition. Otherwise, Quarter horse research has been popular for other research areas. While Arabians, Thoroughbreds, Warmbloods, and Standardbreds are similarly categorized as light horses used for athletic competition, it will be beneficial to the western industry to increase data gathered on competition stress and cortisol levels to include Quarter or stock-type horses. The American Quarter Horse Association is the largest breed registry in the United States, and many non-registered horses used for western riding fall under the category of "stock-type" [36]. As competition in western performance events increases in popularity, data to promote successful performance and well-being of equine athletes will benefit the western performance industry as a whole.

As stress is a major factor in horse and rider welfare and success in competition, data from the proposed study will further the objective of identifying and ultimately controlling stressful experiences for competitive horses and riders. Many potential causes of stress that riders and owners commonly attribute as a cause of poor performance have been identified as not statistically significant. Stress, in terms of cortisol response, is much more of an issue for riders when competing as compared to their equine counterparts. Considering the findings of recent literature, this study aims to provide more data that equine professionals can utilize in order to maximize success and maintain the health of competing performance horses, specifically in western performance disciplines.

2. MATERIALS AND METHODS

Subjects

Fifteen horse and rider pairs were evaluated. Quarter horse mares and geldings with stock horse training between the ages of 3-15,weighing between 430-565 kg were used to collect salivary cortisol data. Human participants between the ages of 18-22, weighing between 45-75 kg with varying amounts of competition experience, completed salivary cortisol data collection and a VO_2max test. Salivary cortisol concentration was collected for riders and horses during a day of rest, practice, a competition day, and for riders only, the VO_2max test.

Riders and horses were all members of a competitive collegiate ranch horse team, on the same practice schedule and of similar physical fitness. Riders were separated into divisions of competition based on years of experience competing in stock horse events. Novice (NOV) riders (n=7) referred to individuals that had not won more than one championship or earned money in a western judged event. Limited non-pro and Non-pro (NP) riders (n=8) referred to individuals that had won multiple championships or earned money in a sanctioned event. For a detailed description of division eligibility, refer to the Stock Horse of Texas rulebook [37].

Practice sessions took place at Freeman Arena at Texas A&M University. Competition sessions took place at Brazos County Expo Center in Bryan, Texas, Taylor County Expo Center in Abilene, Texas, and Still Creek Arena in Bryan, Texas. Data was collected during collegiate stock horse competitions sanctioned by Stock Horse of Texas which consist of the following classes: Stock Horse Pleasure, Stock Horse Trail, Working Cow Horse and Reining. VO_2max tests took place at Heldenfels Center in the exercise physiology lab on campus at Texas A&M University, College Station.

IACUC Statement

The experimental protocol was approved by the IACUC Division of Research at Texas A&M University, AUP: IACUC 2017-0111.

Test Protocols

Practice

Each horse and rider pair were assigned a practice data collection time during a regularly scheduled team practice session. A pre-exercise salivary cortisol sample was collected from each horse and rider 20 minutes prior to the start of practice. Horse and rider would then participate in 30-40 minutes of moderate to intense exercise practicing reining, cow work, or ranch riding. Riders completed a typical practice session with warm up time, maneuver practice, pattern practice, and cool down time. Activity level for each practice was observed and recorded. Twenty minutes after the completion of the practice exercise bout, a post-exercise saliva sample was collected from both the horse and rider.

Competition

Riders were prepared to participate in saliva collection before and after competition in each of the stock horse events. Stock horse events have been developed to showcase the versatility of a working ranch horse. Standard events include:

Working Cow Horse: Riders are asked to demonstrate control of a single cow in an arena for an amount of time based on the rider's level. For this study, riders were separated into beginner and advanced groups based on their previous show experience. Beginner riders were asked to contain the cow on one end of the arena for 50 seconds. Riders with more experience in cattle- related events demonstrated a more difficult pattern, moving the cow from one end of the arena to the other within a two-minute time limit.

Reining: Riders demonstrate control and athleticism of their horse. The riders are given a pattern prior to competition which includes transitions from large fast to small slow canter circles, flying lead changes, run downs, sliding stops, and spins. Credit is earned based on willingness of the horse, speed, and accuracy. There is no time limit for this event.

Stock Horse Trail: Riders are asked to maneuver their horse through a series of obstacles that may be encountered when working on a ranch. Examples include; opening a gate on horseback, walking over a bridge, maneuvering over logs on the ground, picking up an object such as a rope or rain slicker, backing through obstacles, and demonstrating control at the walk, trot, and lope. Riders are given the pattern before the start of the event. There is no time limit.

Stock Horse Pleasure: In this class, a horse's movement and responsiveness is evaluated. Riders must show the horse at each gait both directions, and include an extended walk, extended trot, and extended lope. Signs are posted at each transition point instructing the riders which gait to demonstrate next, and riders are allowed to study the pattern beforehand. There is no time limit for this event.

All events are judged individually, with a single horse and rider pair in the arena at one time. Figure A further outlines stock horse events that each horse and rider pair performed. Each test varied in physical intensity, pattern memorization, and speed.

Event	Description	Athletic Intensity	Avg. Time to Complete	Pattern	Similar Events
Stock Horse Pleasure	Demonstrate gaits & transitions – walk, trot, lope, extended walk, trot, and lope	Low	1-2 minutes	Yes – directions given on signs inside arena	Gymkhana, ranch riding, flat work, western horsemanship, western pleasure
Stock Horse Trail	Demonstrate gaits over obstacles & navigate a course of novel objects	Low	3-4 minutes	Yes – must be memorized	Performance trail, Hunt Seat versatility, obstacle challenge
Reining	Demonstrate athletic ability of the horse in spins, sliding stops, fast and slow circles, lead changes	High	3-4 minutes	Yes – must be memorized	Dressage, gymkhana
Cow Work	Show horse's ability to control a single cow at high speed	High	1-2 minutes	No – required task to be completed	Cutting, sorting, team penning, camp drafting

Figure 1. Description of stock horse events

See appendix for sample patterns of reining, stock horse trail, and stock horse pleasure. Refer to the Stock Horse of Texas rulebook for guidelines on completing each class [37].

The competition included the four stock horse events occurring at varying times throughout a single day. Events were completed in varying orders of go depending on the rider's division of competition. Order in the draw was also a factor contributing to the order and time of day the events were completed. Prior to mounting and warming up the horse, a preliminary pre-competition saliva sample was collected from both horse and rider 20 minutes before exercise began.

Following the morning preliminary sample, saliva samples were collected 20 minutes pre-competition and 20 minutes post-competition for each of the four events. Judges' scores and results from each run were posted on the Stock Horse of Texas archived results page [38].

Rest SCC Collection

Riders were asked to take five saliva samples throughout the course of a single non-practice day. Basal cortisol samples were collected to compare resting values to practice and competition values. Time 0 was recorded as the moment the rider woke up, before brushing teeth. Samples were then taken 30 minutes after waking up, before lunch, before dinner, and before going to bed. Data collection times varied with each rider's daily routine. Basal samples were utilized to generate an equation that would predict expected salivary cortisol concentrations at rest. Using SPSS software, a generalized linear equation was produced to predict resting SCC values for all riders.

Horse saliva samples were collected throughout the course of a single non-practice day. Samples were collected every two hours from 6am to 10pm, resulting in 9 total samples per subject. Samples were utilized to generate an equation which predicted horse salivary cortisol concentration at rest. A generalized exponential equation was produced using SPSS software to predict SCC for horses at rest based on time of day.

VO_2 max test

Riders were asked to complete a VO_2 max Bruce treadmill test in order to evaluate changes in cortisol concentration after maximal physical exertion [39]. Riders were fitted with the Cosmed K4b^2 [40] mobile metabolic unit prior to the start of exercise. A saliva sample was collected 20 minutes prior to the start of exercise. Riders were then asked to begin walking on a treadmill while wearing the $K4b^2$ mask and heart rate monitor. The treadmill gradually increased with speed and incline per the Bruce treadmill test gradients [39]. Subjects were asked to run to their maximal VO_2 capacity, reaching exhaustion, and hit the stop button when they were unable to continue. Time was marked and a 20-minute post-exercise salivary cortisol sample was collected.

Collection Methods

Salivary Cortisol

Human saliva samples were collected using the SalivaBio Oral Swab (exclusively from Salimetrics, State College, PA). Horse saliva was collected using the SalivaBio Children's Swab, a synthetic swab specifically designed to improve volume collection and increase participant compliance, and validated for use with salivary cortisol [41]. Human participants were instructed to hold the swab under their tongue and allow saliva to pool for 60-90 seconds. With a gloved hand, the swab was then put directly into the swab basket of the swab storage tube (SST), closed with the cap, and put immediately on ice. For equine data collection, the children's swab was inserted into the horse's mouth, under the tongue or in the corners of the mouth where saliva would pool. The swab was held in the mouth for 60 seconds or until at least one end was saturated. The saturated end was inserted into the SST, closed, and put on ice. Each tube was labeled with a subject ID number, date, time, and sample description. All samples were taken to the laboratory at the conclusion of a collection day and stored at -20 degrees Celsius until analysis.

The Cosmed $K4b^2$ mobile metabolic unit measures breath by breath exchange of oxygen and carbon dioxide. This machine was used for the VO_2 max exercise tests. The Cosmed $K4b^2$ was calibrated per manufacturer's instruction before each data collection session. The heart rate monitor and mask were cleaned and disinfected after use according to manufacturer recommendations. Detailed instructions for setup, calibration and use may be found in the Cosmed $K4b_2$ User Manual [40].

Parameters of Interest

Measurements were taken of cortisol concentration (ug/dL) and analyzed via the Salimetrics Cortisol Assay ELISA kit in the exercise physiology lab at Texas A&M University. Multiple dilution ratios for both horse and human cortisol were tested. A dilution ratio of 1:1 (sample: assay diluent) was determined to be most accurate for both species. Cortisol samples were frozen at -20 degrees Celsius prior to analysis. When preparing samples for lab analysis, samples were allowed two hours to thaw to room temperature while reagents and equipment were prepared. Each sample was centrifuged for 15 minutes at 1500g. Samples were pipetted into the kit trays and assayed in duplicate. Detailed ELISA procedures may be found in the Salimetrics Expanded Range High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit, Item No. 1-3002 with 96-well plates [41]. After analysis procedures were completed and stop solution was administered, plates were read and data stored using MyAssay data analysis software. This equipment and immunoassay kit had been validated in other equine salivary cortisol studies [42].

After lab analysis, SCC values were converted to nmol/L for evaluation in order to align with other studies of similar protocols. After determining that inter-assay and intra-assay coefficients of variation were within acceptable ranges of <15 and <10, respectively, cortisol concentration values were transported into excel files which were then utilized to perform statistical analyses.

Statistical analyses

Statistical analysis was completed using SPSS software (IBM SPSS). Generalized linear model analysis was utilized to develop a prediction equation for basal rider and horse SCC values over time. Comparison of SCC pre and post-test and between events was accomplished using generalized linear model with resting SCC as a covariate. Regression outputs were analyzed to evaluate correlation of horse and rider SCC to placing and to score. Each set of tests were performed for both horse and rider subject samples in order to best determine which changes in SCC had the most impact on performance of the horse and rider pairs.

3. RESULTS

Cortisol at rest

Rider (n = 10) SCC was collected during a day of rest. Univariate analysis of variance indicated that there was no individual subject effect on basal cortisol values for riders ($p=0.152$). Although 15 riders' samples were collected, 5 subjects were removed from the resting value calculations due to missed sampling times. Mean salivary cortisol concentrations at rest were combined and a best-fit curve was determined through regression analysis. The relationship between rider SCC at rest and time is best fit by the exponential equation

$y = -4.19x^{10.367}$ ($r^2= 0.618$). (Figure 2)

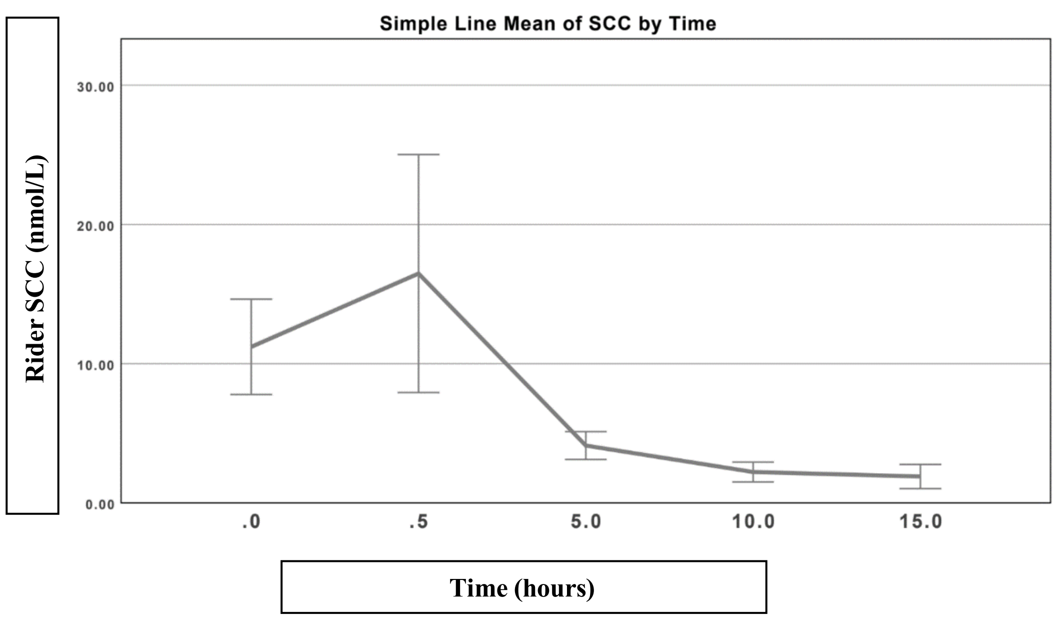


Fig. 2 Mean SCC of riders during a day of rest

Horse (n=12) SCC's were collected during a day of rest. Univariate analysis of variance indicated that there was no individual subject effect on basal cortisol values for horses ($p=.575$). Mean salivary cortisol concentrations at rest were combined and a best-fit curve was determined through regression analysis. The relationship between horse SCC at rest and time is best fit by the equation $y=2.100 + 0.011x - 3.504E\text{-}5x^2 + 2.476E\text{-}8x^3$ ($r^2=0.508$) where 960min > x > 0min. Time 0 refers to 6:00 a.m. with Time 16 referring to 10:00 p.m. (Figure 3)

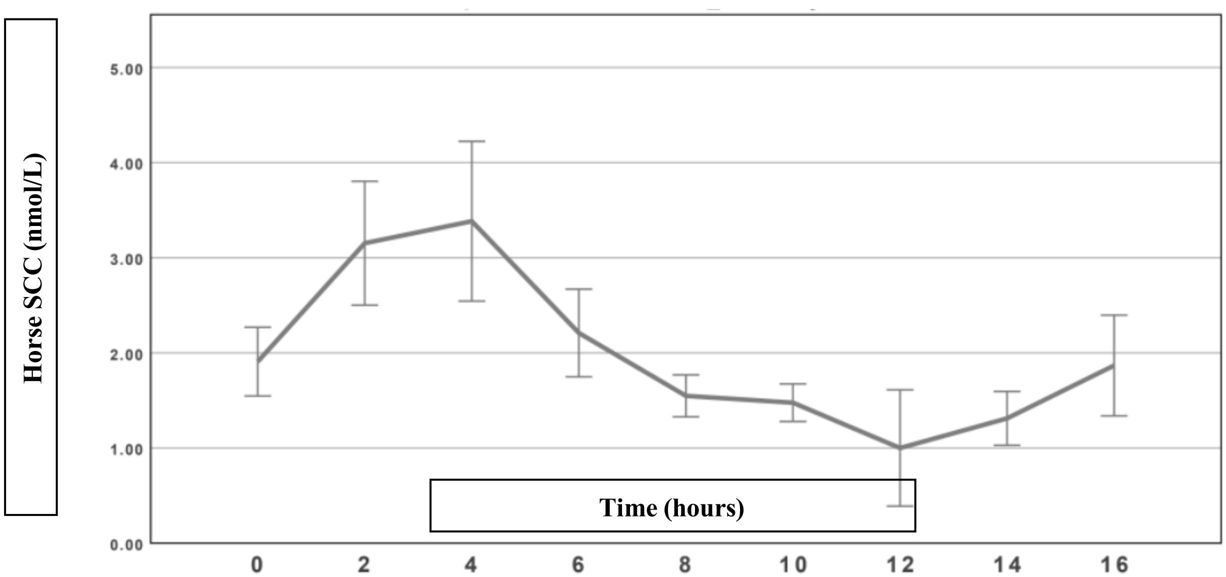


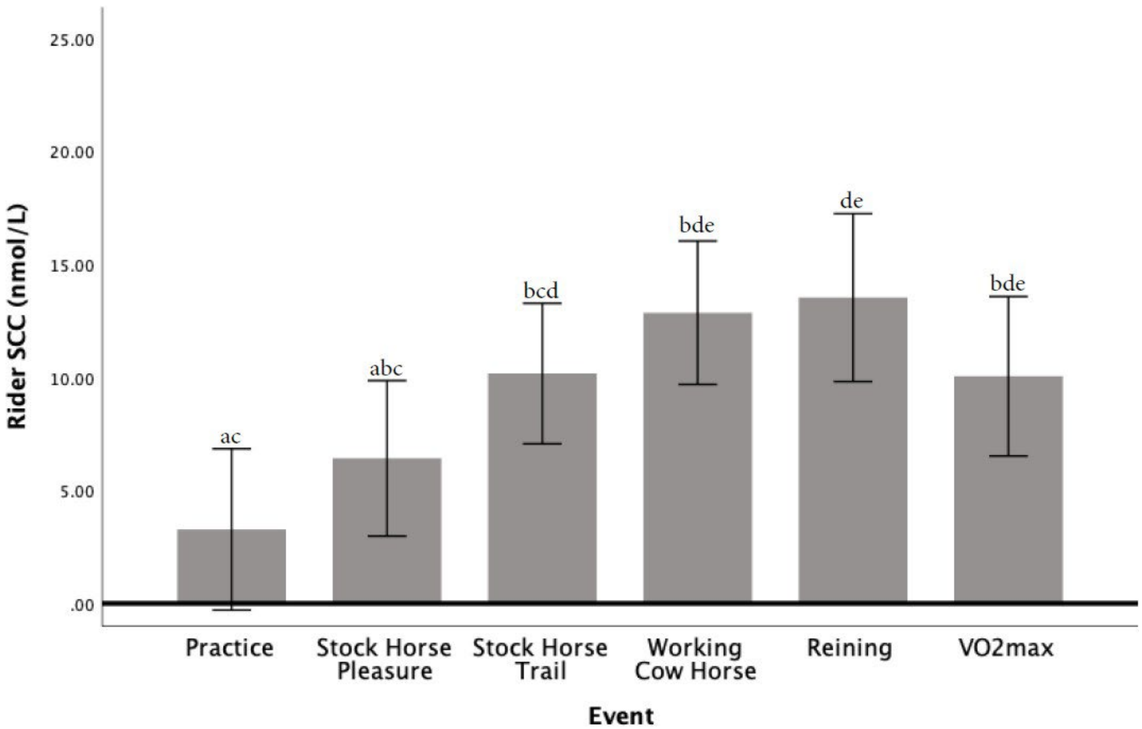
Fig. 3 Mean SCC of horses at rest

Impact of event

Six events were analyzed to determine effects of salivary cortisol concentration. Events included a practice day, four classes within a competition day, and a maximal exercise test. The practice day consisted of pre and post samples. The competition day consisted of a pre-competition sample, and a pre and post sample for each class of stock horse pleasure, stock horse trail, cow work, and reining. Fifteen horse and rider pairs completed the four competition day salivary cortisol concentration (SCC) tests. Thirteen horses total were used, with two of them being paired with a different rider for a total of fifteen competition test days. Competition day testing was completed at three different venues. However, venue did not have a significant impact on SCC when rider level was accounted for (p=0.083). Each event occurred at varying times throughout the day, based on the rider's draw. The maximal exercise test day was a VO_2max test performed on riders only, with a pre and post salivary cortisol sample obtained. A one-way ANOVA was performed on the SCC of horses and riders 20 minutes pre-test and 20 minutes post-test to determine differences between test means. Time variation was accounted for by using resting SCC as a covariate. Adjusted rider mean SCC is demonstrated in Table 1.

Table 1. Impact of practice, stock horse events and VO_2 max test on adjusted rider mean SCC (nmol/L)±SE 20 minutes pre-test and 20 minutes post-test

Test	Rider mean SCC Pre-test	Rider mean SCC Post-test	P-value
Practice	6.56±1.67	3.28±1.79	0.002
Pleasure	11.78±2.01	6.42±1.73	0.157
Trail	10.44±1.92	10.17±1.56	0.096
Cow Work	10.36±2.07	12.85±1.60	0.171
Reining	8.75±1.56	13.53±1.87	0.274
VO_2 Max	9.07±1.88	10.05±1.77	0.034



abcde Values in columns with similar subscripts are not significantly different ($p < 0.05$)

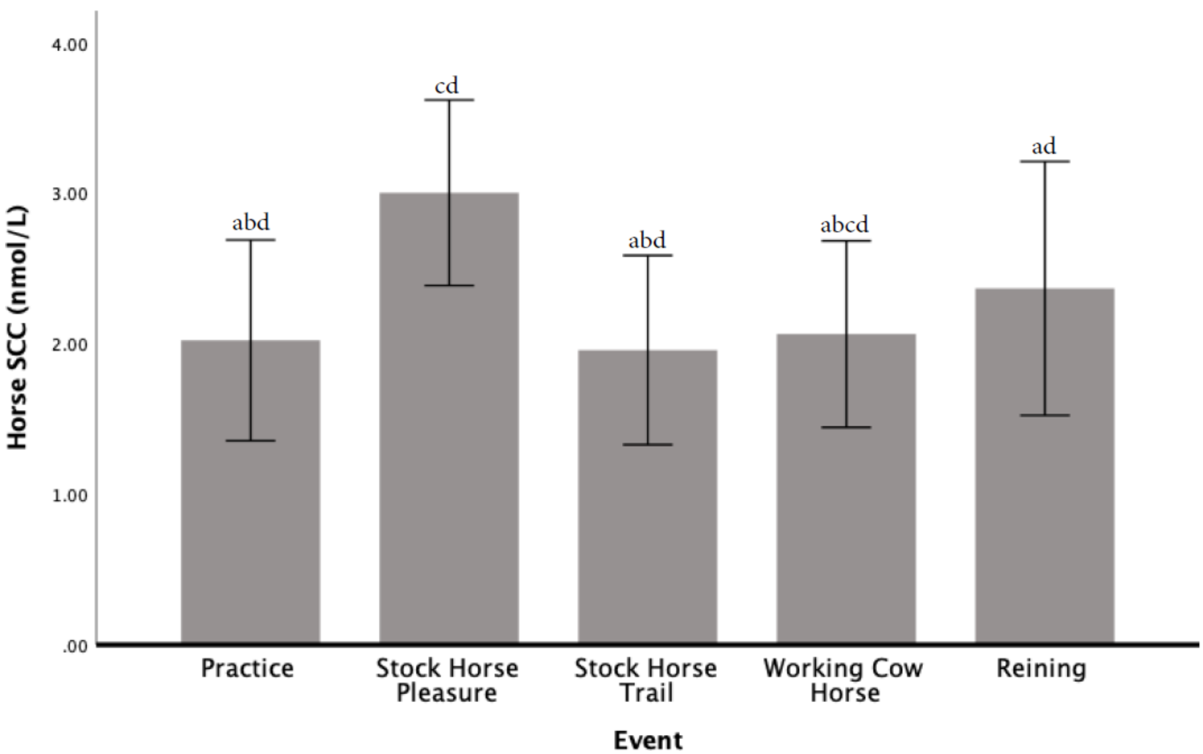
Fig 4. Impact of event on rider SCC

Salivary cortisol concentration of riders was significantly lower in practice than all tests with the exception of the pleasure class. Rider SCC post pleasure was significantly lower than reining, cow work, and VO_2max tests. Rider SCC post trail was significantly higher than practice, and significantly lower than cow work. Reining was significantly higher than practice and pleasure. Cow work was significantly higher than all events except for reining and VO_2max tests. Finally, the VO_2max values were significantly higher than practice and pleasure.

Horse mean SCC is demonstrated in Table 2.

Table 2. Impact of practice, stock horse events, and VO_2 max test on horse mean SCC (nmol/L)±SD 20 minutes pre-test and 20 minutes post-test

Test	Horse mean SCC Pre-test	Horse mean SCC Post-test	P-value
Practice	1.56±0.56	2.02±0.34	0.048
Pleasure	2.43±0.49	3.00±0.31	0.603
Trail	2.69±0.47	1.96±0.32	0.101
Cow Work	2.31±0.48	2.06±0.31	< 0.001
Reining	2.50±0.55	2.37±0.42	0.168



abcde Values in columns with similar subscripts are not significantly different ($p < 0.05$)

Fig 5. Impact of event on horse SCC

Horse SCC post practice was significantly lower than pleasure only. The post-pleasure sample was significantly higher than practice and trail. Trail was only significantly lower than pleasure; and cow work samples were not found significantly different than any other tests.

Impact of rider experience level

Riders were identified as non-pro (NP) and novice (NOV) ability level based on prior related horse show experience. A one-way ANOVA test was performed to explore the impact of rider level on both rider SCC post-test and horse SCC post-test, demonstrated in Figure 5. Rider SCC post cow work was the only value that was significantly higher for novice riders as compared to non-pro riders (Fig. 5).

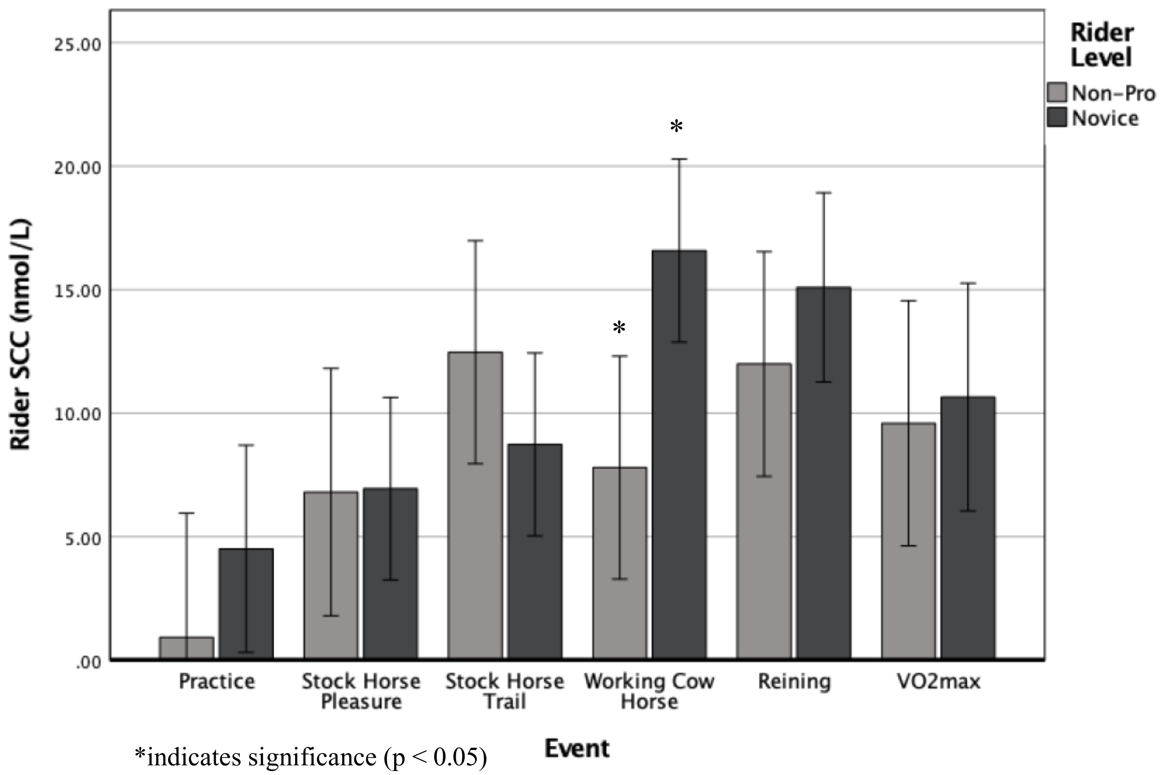


Fig 6. Impact of rider level on rider SCC

There were no significant differences in horse SCC based on rider level for any event (Fig. 7).

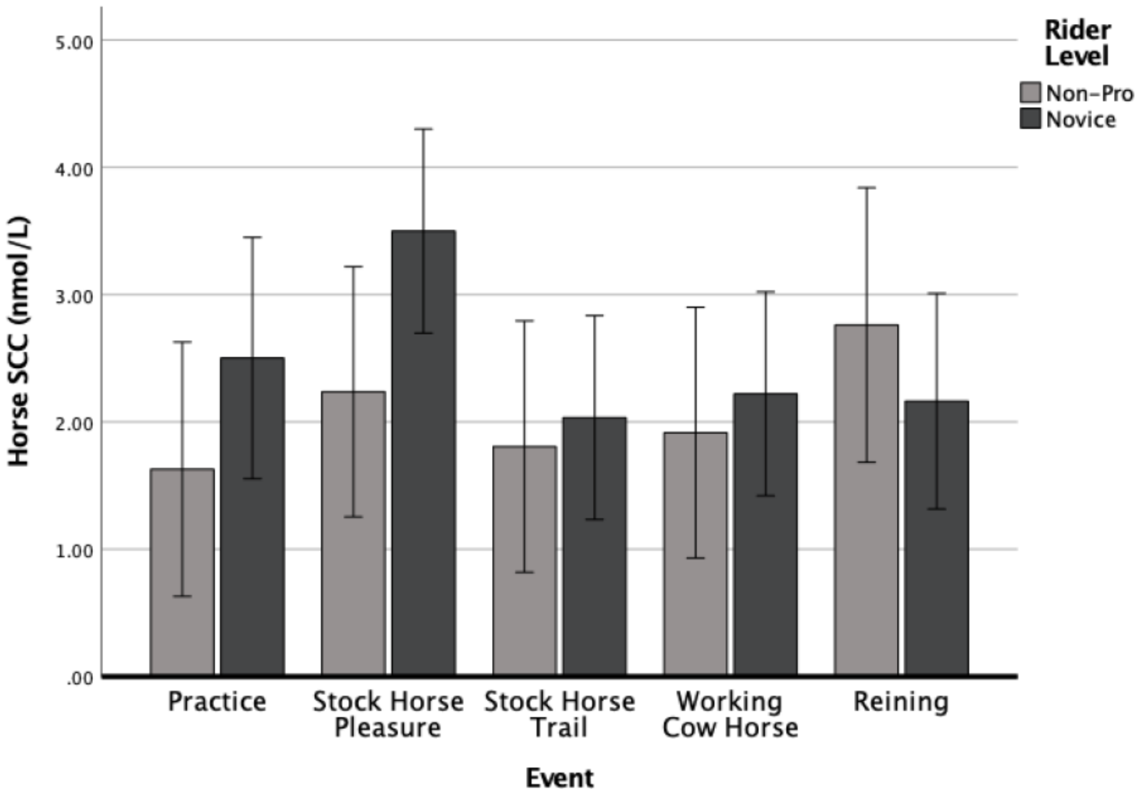


Fig 7. Impact of rider level on horse SCC

Correlation to performance - Placing

Regression analysis was performed to determine the relationship between SCC and performance. Performance at competition was evaluated by overall placing of horse and rider pairs, as well as judge's scores per each individual class. Placings were calculated based on percentages to account for number of horses in the class. For example, a horse placing 2nd in a class of 50 would be in the top 4% of the class. Therefore, the horse and rider pair with the lowest percentage had earned the highest placing in the class. Table 6 refers to regression equations for the correlation to all around placing for the competition day consisting of all four events.

Table 3. Regression equations for mean placing of all events (n = 65) $r^2 = 0.139$

Intercept	B	p-value
Constant	0.50±0.09	< 0.001
Rider SCC Pre	0.01±0.01	0.034*
Rider SCC Post	-0.01±0.01	0.063
Horse SCC Pre	0.02±0.02	0.214
Horse SCC Post	-0.04±0.03	0.105

*indicates significance

In order to further evaluate the impact of rider pre-event SCC on individual event placing, a regression analysis was performed. Table 7 refers to the SCC relationship to placing in each individual event.

Table 4. Rider SCC pre-test relationship to placing

Test	Intercept	SCC nmol/L	p-value	R^2
Pre-Comp	0.15±0.13	0.02±0.01	0.016*	0.397
Pleasure	0.57±0.10	-0.01±0.01	0.169	0.152
Trail	0.53±0.12	-0.002±0.01	0.895	0.002
Cow Work	0.30±0.13	0.02±0.02	0.176	0.147
Reining	0.22±0.15	0.02±0.01	0.134	0.177

*indicates significance

Rider SCC pre-competition had a significant negative relationship to overall placing.

Correlation to performance - Score

Scores awarded by accredited judges were recorded for each individual event. A score of 70 denotes an average performance, with 69.5 or below denoting below average and 70.5 and above denoting above average performances. Mean scores were evaluated as well.

Table 5. Regression equations for mean score of all events (n = 64) $r^2 = 0.194$

Intercept	B	p-value
Constant	76.73±6.164	< 0.001
Rider Cort Pre	-1.23±0.36	0.001*
Rider Cort Post	0.617±0.346	0.080
Horse Cort Pre	-0.75±1.29	0.560
Horse Cort Post	0.217±1.816	0.905

*indicates significance

In order to further evaluate the impact of rider pre SCC on individual event scores, a regression analysis was performed (see Table 9).

Table 6. Rider SCC pre-test relationship to score

Test	Intercept	SCC nmol/L	p-value	R^2
Pre-Comp	126.79±15.64	-3.79±0.97	0.002*	0.560
Pleasure	70.82±0.92	0.03±0.09	0.767	0.008
Trail	67.95±1.73	0.47±0.16	0.778	0.008
Cow Work	70.71±1.38	-0.24±0.17	0.174	0.148
Reining	71.52±1.61	-0.33±0.15	0.044*	0.239

*indicates significance

Rider SCC pre-competition and pre-reining had a significant impact on score. Rider SCC before pleasure, trail and cow work did not have a significant impact on score.

In order to further evaluate the impact of horse pre SCC on individual event scores, a regression analysis was performed (see Table 7).

Table 7. Horse SCC pre-test relationship to score

Test	Intercept	SCC nmol/L	p-value	R^2
Pre-Comp	70.59±0.73	-0.46±0.24	0.057	0.068
Pleasure	72.21±1.01	-0.49±0.34	0.171	0.163
Trail	69.00±2.60	-0.08±0.90	0.929	0.001
Cow Work	68.99±2.32	0.04±0.96	0.970	0.000
Reining	70.54±0.92	-0.57±0.24	0.034*	0.348

*indicates significance

Horse SCC pre-reining was the only SCC value that had a significant impact on score.

The pre-competition SCC value in riders shared a significant relationship with overall placing (r^2= 0.397, $p < 0.016$). As pre-competition SCC increased, all-around placing decreased. In addition to this effect on all-around placing, both rider and horse SCC prior to the reining class had a significant negative correlation to judge's score (rider: r^2= 0.239, $p < 0.044$; horse: r^2= 0.348, $p < 0.034$).

Coefficients of variation

The inter-assay coefficient of variation for all plates (n=21) was calculated at 14.97. The intra-assay coefficient of variation for all samples (n= 611) was determined at 4.56. Both of these values are within acceptable ranges for analyses, according to Salimetrics [41].

4. DISCUSSION

Cortisol at rest

Cortisol values collected at rest for riders were consistent with average values of college-aged adults (18-22). Because some subjects returned samples taken at extremely inconsistent times of the day, these outliers were removed and a best-fit equation was calculated with all other subjects' data. A univariate analysis of variance was performed that reported no individual subject effect (Fig. 2). This exponential equation was used to calculate expected SCC values at rest for all human subjects. The same method was used for equine subjects, although timing of sample collection was much more consistent, with a greater number of subjects used for the best-fit equation.

It has been recognized that human salivary cortisol will peak in the morning, spike within 30 minutes after waking, and then taper throughout the day [43]. In future research, a stricter timeline for collection of samples, eating meals, and controlling exercise would be beneficial in providing a representation of the resting SCC values of the group. Equine cortisol studies also show a consistent circadian rhythm between subjects [44], [22]. The equine subjects' collection times were maintained on a consistent feeding and sampling schedule, therefore providing a more consistent data set for resting SCC. Because of this structure, equine cortisol values were consistent with values collected in other studies [13], [22]. (Fig. 3)

Impact of event on riders

According to Table 1, significant differences in rider SCC were shown between practice and all other events except stock horse pleasure. A significant decrease in SCC pre to post was found in practice. This is an interesting result, as practice is generally considered exercise and would likely cause an increase in SCC post-test. However, practices were an intermittent exercise with riders taking turns to do practice drills and working different types of maneuvers. This decrease also could be due to an anticipatory response before starting practice, or, part of the daily gradual drop in cortisol as seen in a normal diurnal rhythm. There was much variation between individual riders of SCC for each competition event, except for the stock horse pleasure. This is a reasonable claim, as the stock horse pleasure pattern is generally considered less difficult than the other three events. Trail and reining were considered statistically similar for riders. This implies that the mental stimulation and attention required for the trail class is similar to the mental preparation required for the much more physical reining pattern. Reining had the highest mean SCC in riders both pre and post-test. It is not only a high-intensity activity, but may elicit the most social stress for performing in front of others for riders. The impact of various events on SCC would likely have been impacted by exercise intensity. Cow work, generally requiring the most exertion for a short period of time, also caused a notable increase in rider SCC. Skoluda et al. showed a notable difference in SCC in male human subjects after various types of stressors, including a social stress test and an ergometer test. Social stress proved to cause a much higher increase in SCC than the exercise ergometer test [10]. The social aspect of performing in competition may be a reason that riders elicit a much higher SCC during events like reining.

The pre-competition value demonstrates cortisol values that may have been elevated due to anticipation and/or "show nerves." Additionally, the significant increase in rider SCC prior to competing in an event as compared to expected resting values may also demonstrate anticipation, or competition-related stress. Because the pre-competition value was significantly higher than pre-practice, and significantly lower than the most physically strenuous event, the cow work, it can be assumed that this spike in cortisol could be due to the anticipation response, and also social stress. While some increase in SCC compared to expected resting values could have been due to physical activity of warming up, saddling, or practicing maneuvers before an event, the increase in SCC prior to each individual event was likely impacted by more than just physical exertion.

Impact of event on horses

In contrast to the rider's SCC response to competition, horses showed minimal significant effects on SCC from each event. SCC values in Table 2 demonstrate more consistency between individuals and between each test. There was a significant increase in SCC after practice, however there were no major changes reported in horse SCC before or after each competition event. One of the few notable changes alludes to elevated SCC in horses before and after performing the reining pattern. This is somewhat similar to Monk et al., which reported a higher SCC in eventing horses after the dressage event as compared to show jumping [28]. Based on reported heart rates, show jumping and working cow horse classes are likely to be more physically exerting, which could cause an increase in cortisol release.

However, the elevated SCC in dressage and reining alludes to more mental stimulation or a more stressful task in performing a dressage test or reining pattern. Kastner et al. recorded heart rate in reining horses during competition, concluding that it was a submaximal exercise activity and not exhaustive, especially if the horse had been in training for the event [29]. It should also be considered that the rider SCC was greatly increased in the pre-reining sample. This could have had an effect on the horse SCC during the reining class as well.

Impact of rider experience level

Rider experience level had a significant impact on rider SCC in cow work and no significant impact on horse SCC (Figure 6). The only significant difference between groups was in the cow work, which fits the demographic of the subjects. A majority of the beginner riders had less experience working cattle, therefore showed the highest SCC, which could be attributed to greater anxiety about the cow work class. Advanced riders with cattle experience demonstrated lower SCC, alluding to less stress or anticipation about the cow work event. It is interesting to note that while it was not reported as significant, the SCC of riders before the trail class was much higher in the advanced group. This is a reasonable observation, as many riders that had advanced experience in cow working events had done fewer pattern classes, like stock horse trail. It should be noted that there was much variation between riders' SCC. Additional research with less variability in collection times may show differing SCC values between rider experience levels. Horse SCC values are similar between individuals, regardless of rider experience level. These results are similar to those of Ille et al., which paired experienced and inexperienced riders with seasoned and less-seasoned horses on a jumping course. Inexperienced riders showed an increased heart rate and cortisol release than the experienced riders, and horses showed no change in cortisol release based on which level of rider they were carrying [32]. It should be noted that in Ille's study, horses were assigned randomly and competed twice, once with an experienced rider and once with a less experienced rider. For this study, horses were trained in practice and shown by one consistent rider for the duration of the competition season. Familiarity between horse and rider may diminish stress factors for both athletes, and also aligns with industry standards of most western competitions.

Correlation to performance

Riders that had a higher cortisol value prior to the event performed poorly compared to those that did not show a major difference between expected resting and pre-competition cortisol values. Table 4 demonstrates that pre-competition values were correlated to overall placing shown as a percentage, and no other SCC sample had a significant relationship. Table 6 demonstrates that the pre-competition value and pre-reining value had a negative impact on scores. In Table 7, there is a significant impact of horse SCC on score in the reining class only. Once again, it can be suspected that the reining pattern is a more stressful event for both horse and rider, but this is likely to be contributed to the high cortisol concentration seen in riders before this class. Either way, riders can utilize this information to understand the importance of managing stress in order to earn higher scores in competition.

Review

As with many similar equestrian studies, performing data collection on a limited number of horse and rider pairs is a limiting factor. A major strength of this study's data set was the uniformity of practice schedules and experience levels of both horses and riders. While they ranged in age, all horses were of similar breed, build, and had been competing prior to the study. All horses and riders were practicing on the same schedule, and performing the same amount of competitions each month. In addition, the subjects were able to be tested during actual competition with actual prize money, awards, and performance records on the line. Difficulties of this sample set was the varying timeline of events. In one way, the subjects competing in the four events in differing orders may have removed the influence on time of day on SCC. However, this created variability between samples. Pre-event samples may have been impacted by a subject very recently finishing one event and immediately entering another. After accounting for time using resting SCC as a covariate, adjusted means provided reasonable data. Testing the subjects in each event at the same time of day may have provided more consistent results between subjects. Even still, the real-time values collected from these subjects provided information that can be useful to riders competing in any equestrian event.

In this study, the Cosmed $K4b^2$ mobile metabolic unit was utilized during the VO_2max test in order to measure each rider's maximal exercise capacity. In order to further isolate the impacts of competition stress from physical activity, future studies could utilize the $K4b^2$ machine in a field setting of competition to determine if riders are performing at the same physical activity levels as practice or maximal exercise, determined by parameters measured by the mobile metabolic unit, such as heart rate and oxygen consumption.

Implications

Based on the findings of this study, riders and their performances can be highly affected by competition stress. Horses showed much less of a stress response to competition than riders. This data is supported by a similar study of showjumping horses, in which an increase in salivary cortisol had a negative effect performance. Peeters et al. also found a more significant effect of competition stress in riders than horses [18]. In the current study, the horses had been seasoned to competition, which may have been cause of the minimal stress response seen in the competition day values. Rider experience level however, varied greatly. Based on the backgrounds of the riders, it was clear that experience in the show pen and experience working cattle was a direct benefit on SCC and performance of riders. The correlation of anticipatory stress as seen by high pre-competition values and performance outcomes demonstrates a need for riders to learn self-regulation methods, anti-stress exercises, and stress management skills if they hope to be successful. Riders who are less stressed are most likely able to communicate well with their horse, think clearly, plan ahead in the show pen, and perform to the best of their ability. While many riders commonly blame the horses' stress level as a reason behind poor performance, this study demonstrates the likelihood that the rider's cortisol level could be a contributing factor.

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APPENDIX A

VRH and RHC Ranch Reining Pattern #7 46

Sample Stock Horse Trail Pattern 47

SHTX Pleasure Pattern #1 48

VRH Reining Scoresheet 49

VRH Ranch Trail Scoresheet 50

VRH Ranch Riding Scoresheet 51

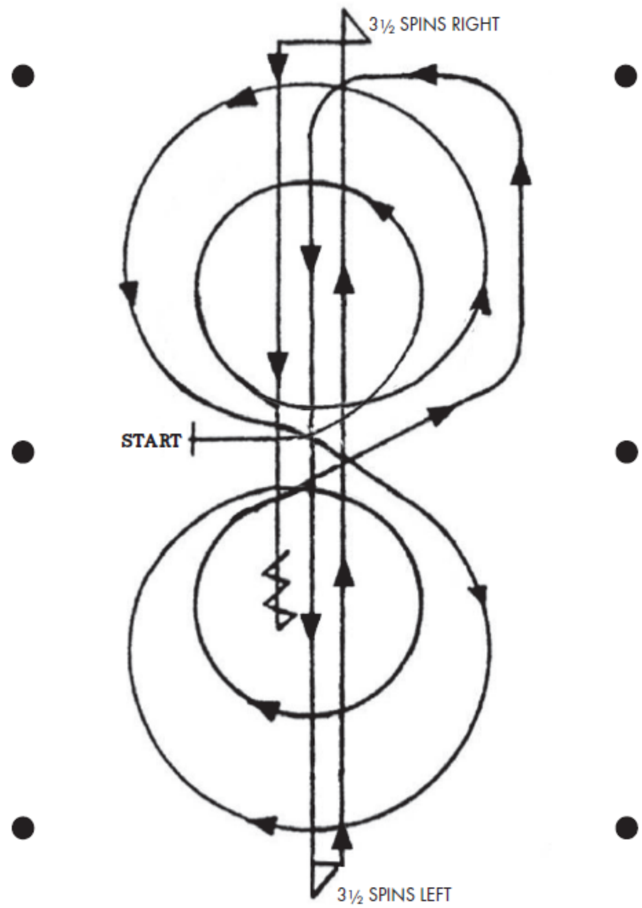
VRH Cow Work Scoresheet – LNP/NP 52

VRH Cow Work Scoresheet - NOV 53

Sample patterns

All images, patterns, and scoresheets provided courtesy of Stock Horse of Texas Association.

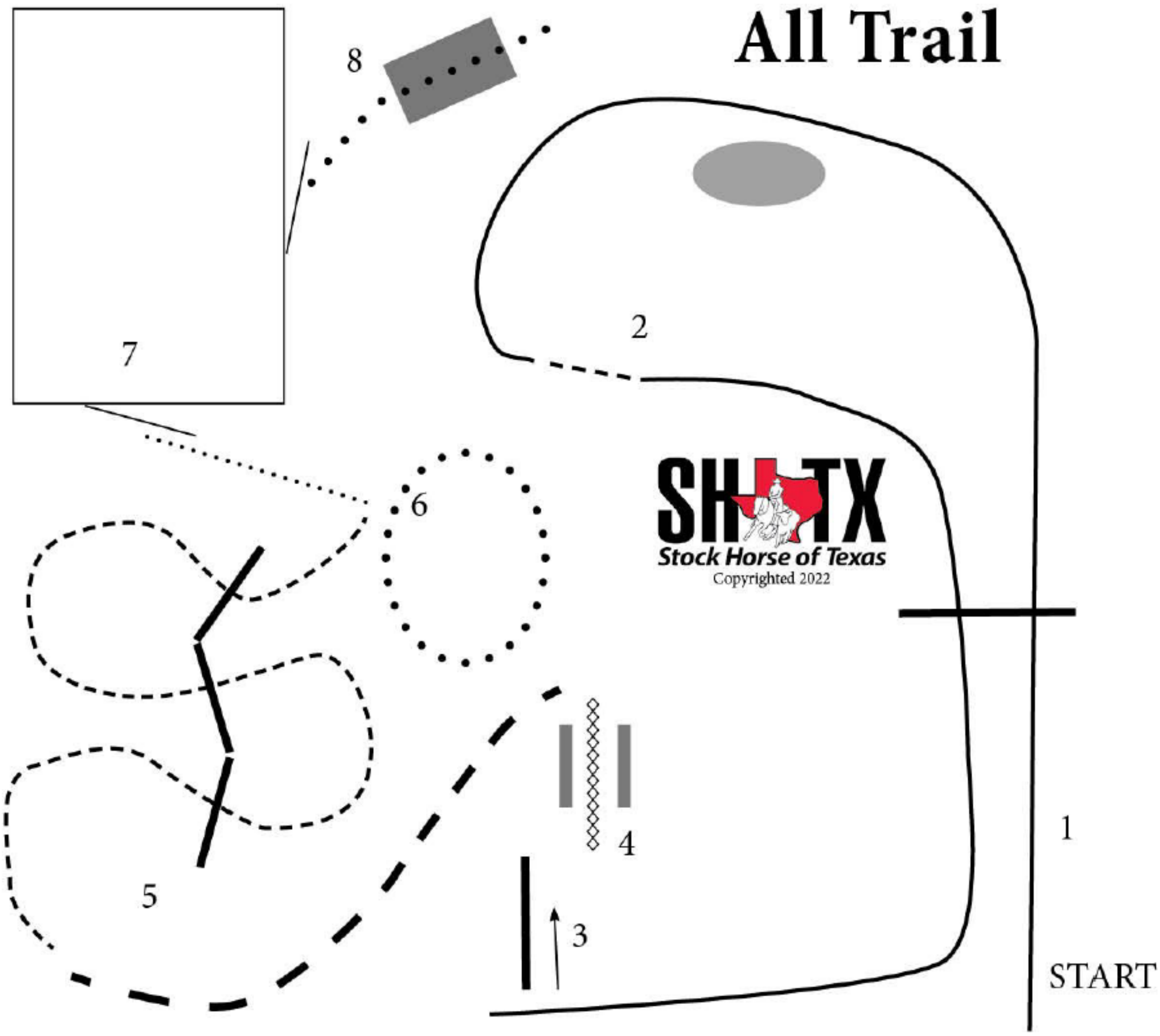
Stock Horse Reining Pattern 9



Trot to center of arena, stop.

1. Beginning on the left lead, complete 2 circles to the left. The first circle small and slow, the second circle large and fast. Change leads at the center of arena.
2. Complete 2 circles to the right. The first circle large and fast, the second circle small and slow. Change leads at the center of arena.
3. Continue around end of arena without breaking gait or changing leads, run down center of arena past end marker, and execute a square sliding stop.
4. Complete 3½ spins to the left.
5. Run down center of arena past end marker, and execute a square sliding stop.
6. Complete 3½ spins to the right.
7. Run down center of arena past center marker, and execute a square sliding stop.
8. Back up at least 10 feet. Hesitate to complete pattern.

All Trail



SHTX Patterns

Note about Stock Horse Pleasure Patterns: The pattern may be started either to the right or left direction. Markers shall be set up to designate gait changes. If the Class is held inside an arena, the course shall be set up to make approximately one pass of the arena in each direction. This may be modified due to space constraints or other conditions. If the pattern follows a different path in the arena, show management is strongly encouraged to offer a drawing of the path for exhibitors.

PATTERN I

- Extended Walk - 75 feet
- Trot - 120 feet
- Extended Trot - 240 feet
- Lope - 150 feet
- Stop and Reverse
- Ordinary Walk - 30 feet
- Lope - 150 feet
- Extended Lope - 200 feet
- Trot - 90 feet
- Stop and Back

Sample scoresheets

AQHA
AMERICAN QUARTER HORSE ASSOCIATION

NRSHA
NATIONAL RANCH AND STOCK HORSE ALLIANCE

VERSATILITY RANCH HORSE - REINING

SHOW:	
CLASS:	
DATE:	

1/2 Point Penalties:
- Starting a circle or exiting a rollback at a trot for up to two strides
- Delayed change of lead by one stride where the lead change is required by the pattern description
- Failure to remain a minimum of twenty feet from the wall or fence when approaching a stop and/or rollback
- Over-spin or under-spin up to 1/8 turn

1 Point Penalties:
- Over-bridled (per maneuver)
- Out of frame (per maneuver)
- Out of lead in the circles, figure eights, or around the end of the arena. This penalty is cumulative and will be deducted for each quarter of a circle the horse is out of lead
- Over or under spinning 1/8 to 1/4 turn
- Slipping rein

2 Point Penalties:
- Break of gait
- Freeze up in spins or rollbacks
- Failure to stop or walk before executing a lope departure on trot-in patterns
- Failure to be in a lope prior to the first marker on run-in patterns
- Failure to completely pass the specified marker before initiating a stop position
- Trotting beyond 2 strides, but less than 1/2 circle or 1/2 length of arena

5 Point Penalties:
- Spurring in front of cinch
- Blatant disobedience
- Use of either hand to instill fear/praise

10 Point Penalty: AQHA entry ONLY
- Unnatural Ranch Horse Appearance (Horse's tail is obvious and consistently carried in an unnatural manner in every maneuver)

Off-Pattern (OP): Cannot place above others who complete pattern correctly
- Breaking pattern
- Inclusion of maneuver (i.e., over or under spinning, backing more than two strides)
- Repeated blatant disobedience
- Use of two hands (except in snaffle bit or hackamore)
- More than one finger between split reins or any fingers between romal reins (except two rein)
- Trotting in excess of 1/2 circle or 1/2 length of the arena

Disqualification (DQ):
- Abuse
- Lameness
- Disrespect or misconduct
- Illegal equipment
- Fall of horse/rider
- Improper western attire
- Leaving arena before pattern is complete

W/O	#		MANEUVER SCORES Each horse/rider team is scored between 0-100 points and automatically begins the run with a score of 70 points -1 1/2 Extremely Poor, -1 Very Poor, -1/2 Poor, 0 Correct, +1/2 Good, +1 Very Good, +1 1/2 Excellent										10 POINT PENALTY	PENALTY TOTAL	SCORE	OFF PATTERN
			1	2	3	4	5	6	7	8	9	10				
		Tie-Breaker														
		Maneuver Description														
		PENALTY														
		CONTENT														
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JUDGE'S NAME (PRINTED): ____________________ JUDGE'S SIGNATURE: ____________________

AQHA
AMERICAN QUARTER HORSE ASSOCIATION

NRSHA
NATIONAL RANCH AND STOCK HORSE ALLIANCE

VERSATILITY RANCH HORSE - TRAIL

SHOW:

CLASS:

DATE:

1 Point Penalties:
- Over-bridled (per maneuver)
- Out of frame (per maneuver)
- Each hit, bite, or stepping on a log, cone, plant or any component of the obstacle
- Incorrect or break of gait at walk or trot for two strides or less
- Both front or hind feet in a single-stride space at a walk or trot
- Skipping over or failing to step into required space
- Incorrect number of strides, if specified
- One or two steps on mount/dismount on/or ground tie (except shifting to balance)
- Split log in lope over

3 Point Penalties:
- Wrong lead or out of lead
- Draped reins
- Break of gait at lope
- Break of gait at walk or trot for more than two (2) strides
- Three to four steps on mount/dismount on ground tie

5 Point Penalties:
- Spurring in front of cinch
- Blatant disobedience
- Use of either hand to instill fear/praise
- Knocking over, stepping out of, or falling off of an obstacle
- Dropping an object required to be carried
- 1st or 2nd cumulative refusal
- Letting go of gate
- 5 or more steps on mount/dismount or ground tie

10 Point Penalty: AQHA Entry ONLY
- Unnatural Ranch Horse Appearance (Horse's tail is obvious and consistently carried in an unnatural manner in every maneuver)

Off-Pattern (OP): Cannot place above others who complete pattern correctly
- Breaking pattern
- 3rd refusal
- Repeated blatant disobedience
- Failure to dally and remain dallied during the drag
- Use of two hands (except in snaffle bit or hackamore)
- More than one finger between split reins or any fingers between romal reins

Disqualification (DQ):
- Abuse
- Lameness
- Disrespect or misconduct
- Illegal equipment
- Fall of horse/rider
- Improper western attire
- Leaving arena before pattern is complete

OBSTACLE SCORES

Each horse/rider team is scored between 0-100 points and automatically begins the run with a score of 70 points
-1 1/2 Extremely Poor, -1 Very Poor, -1/2 Poor, 0 Correct, +1/2 Good, +1 Very Good, +1 1/2 Excellent

W/O	#		1	2	3	4	5	6	7	8	9	10	10 POINT PENALTY	PENALTY TOTAL	SCORE	OFF PATTERN
		Tie-Breaker														
		Obstacle Description														
		PENALTY														
		CONTENT														
		PENALTY														
		CONTENT														
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12.17

JUDGE'S NAME (PRINTED):

JUDGE'S SIGNATURE:

AQHA
AMERICAN QUARTER HORSE ASSOCIATION

NRSHA
NATIONAL RANCH AND STOCK HORSE ALLIANCE

VERSATILITY RANCH HORSE - RANCH RIDING

SHOW:	
CLASS:	
DATE:	

1 Point Penalties:
- Over-bridled (per maneuver)
- Out of frame (per maneuver)
- Too slow (per maneuver)
- Break of gait at walk
- Trot for two (2) strides or less

3 Point Penalties:
- Wrong lead or out of lead
- Draped reins
- Break of gait at lope
- Break of gait at walk or trot for more than two (2) strides
- Out of lead or cross-cantering more than two strides when changing leads
- Trotting more than three strides when making a simple lead change

5 Point Penalties:
- Spurring in front of cinch
- Blatant disobedience
- Use of either hand to instill fear/praise

10 Point Penalty: AQHA entry only
- Unnatural Ranch Horse Appearance (Horse's tail is obvious and consistently carried in an unnatural manner in every maneuver)

Off-Pattern (OP): Cannot place above others who complete pattern correctly:
- Breaking pattern
- Leaving arena before pattern is complete
- Repeated blatant disobedience
- Use of two hands (except in snaffle bit or hackamore)
- More than one finger between split reins or any fingers between romal reins

Disqualification (DQ):
- Abuse
- Lameness
- Disrespect or misconduct
- Illegal equipment
- Fall of horse/rider
- Improper western attire
- Leaving arena before pattern is complete

W/O	#		MANEUVER SCORES Each horse/rider team is scored between 0-100 points and automatically begins the run with a score of 70 points -1 1/2 Extremely Poor, -1 Very Poor, -1/2 Poor, 0 Correct, +1/2 Good, +1 Very Good, +1 1/2 Excellent												10 POINT PENALTY	PENALTY TOTAL	SCORE	OFF PATTERN
		Tie-Breaker																
		Maneuver Description																
		PENALTY																
		CONTENT																
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		CONTENT																
		PENALTY																
		CONTENT																

12.17

JUDGE'S NAME (PRINTED): ____________________

JUDGE'S SIGNATURE: ____________________

AQHA
AMERICAN QUARTER HORSE ASSOCIATION

NRSHA

VRH - LIMITED COW WORK (Amateur/Youth)

SHOW:

CLASS:

DATE:

1 Point Penalties:
A - Loss of working advantage
D - Failure to drive cow passed middle marker on second drive before time expires
P - Working out of position
S - Slipping rein
V - Over-bridled (per maneuver)
W - Out of frame (per maneuver)
E - Driving cow down the opposite fence (changing sides)

3 Point Penalties:
K - Knocking down the cow without having a working advantage
L - Losing a cow while boxing

5 Point Penalties:
B - Spurring in front of cinch
C - Blatant disobedience
E - Use of either hand to instill fear/praise

10 Point Penalty:
U - Unnatural Ranch Horse Appearance (Horse's tail is obvious and consistently carried in an unnatural manner in every maneuver

Off-Pattern (OP): Cannot place above others who complete pattern correctly
A - Turning tail
E - Repeated blatant disobedience
J - Schooling after entering the arena prior to calling for cow
K - Schooling horse between cows, if new cow is awarded
N - Failure to attempt any part of the class
H - Use of two hands (except in snaffle bit or hackamore)
M - More than one finger between split reins or any fingers between romal reins (except two rein)

Disqualification (DQ):
A - Abuse
B - Lameness
D - Disrespect or misconduct
G - Illegal equipment
F - Fall of horse/rider
N - Improper western attire
H - Leaving arena before run is complete

W/O	#		RUN CONTENT Each horse/rider team is scored between 0-100 points and automatically begins the run with a score of 70 points -1 1/2 Extremely Poor, -1 Very Poor, -1/2 Poor, 0 Correct, +1/2 Good, +1 Very Good, +1 1/2 Excellent								PENALTIES				SCORE	OP
			Boxing	Drive (Run & Rate)	Boxing	Drive (Run & Rate)	Position & Control	Degree of Difficulty	Eye Appeal	Courage	3 Points	5 Points	10 Points	Total Penalties		
Tie-Breaker																
		PENALTY														
		CONTENT														
		PENALTY														
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		PENALTY														
		CONTENT														

JUDGE'S NAME (PRINTED): JUDGE'S SIGNATURE:

For more information on how exhibitors are scored visit www.aqhuniversity.com

AQHA
AMERICAN QUARTER HORSE ASSOCIATION

NRSHA
NATIONAL RANCH AND STOCK HORSE ALLIANCE

SHOW:	
CLASS:	
DATE:	

NOVICE/YOUTH COW WORK

1 Point Penalties:
- A- Loss of working advantage
- P- Working out of position
- S- Slipping rein

3 Point Penalties:
- K- Knocking down the cow without having a working advantage
- L- Losing a cow while boxing

5 Point Penalties:
- B - Spurring in front of cinch
- C - Blatant disobedience
- D- Use of either hand to instill fear/praise

Off-Pattern (OP): Cannot place above others who complete pattern correctly
- A- Turning tail
- B- Repeated blatant disobedience
- C- Schooling after entering the arena prior to calling for cow
- K- Schooling horse between cows, if new cow is awarded
- N- Failure to attempt any part of the class
- H - Use of two hands (except in snaffle bit or hackamore)
- M - More than one finger between split reins or any fingers between romal reins (except two rein)

DQ:
- A- Abuse
- B- Lameness
- D- Disrespect or misconduct
- G- Illegal equipment
- M- Improper western attire
- H - Leaving arena before run is complete
- I- Fall horse/rider; run ends; credit will be given for work done

W/O	#		RUN CONTENT Each horse/rider team is scored between 0-100 points and automatically begins the run with a score of 70 points) -1 1/2 Extremely Poor, -1 Very Poor, -1/2 Poor, 0 Correct, +1/2 Good, +1 Very Good, +1 1/2 Excellent									PENALTY TOTAL	SCORE	OP
			BOXING MANEUVERS					PENALTIES						
			POSITION & CONTROL	DEGREE OF DIFFICULTY	EYE APPEAL	COURAGE	TIME WORKED	1 POINT	3 POINTS	5 POINTS	NOTES			
	Tie-Breakers >													

JUDGE'S SIGNATURE: ______________________________