The impact of physiological symptoms of arousal in the rider on a dressage performance

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1 Abstract

Communication with horses whilst mounted depends on a harmonious horse –rider interaction. Anecdotal evidence suggests that a horse is able to pick up the emotional state of the rider and any changes made in the given aids. So far, little scientific research has been done examining the physiological signals from the rider on the behaviour of the horse and in which way this might influence performance. The aim of the current preliminary study was to investigate interactions between psychophysiological parameters of the rider and behaviour of the horse during a dressage test. Seventeen Dutch horse-rider combinations (mean age 25.67 ± 8.43) were recruited for the study. All riders were required to ride a standard dressage test at their current level. Throughout the dressage tests heart rate (HR), muscular tension (MT) of the trapezius muscle, skin conductance (SC) and skin temperature (ST) of the riders were recorded using a NeXus 4 biofeedback monitor. Furthermore, all tests were taped on camera (Sony) to allow for subsequent analysis of equine behaviour during the tests. An equine ethogram was designed measuring resistance of the horse and obedience to riders' aids on a 4-point scale (1 = "no adverse reaction" to 4 = "extreme adverse reaction"). Equine behaviour was subsequently scored from video on 23 pre-determined points of a dressage test. A total behavioural score for each horse was calculated by adding up all obedience scores. Pearson's Product Moment Correlations were conducted to investigate relationships between average rider psychophysiological parameters for the duration of the tests and total equine ethogram scores. Furthermore, every time a horse-rider combination scored a 5 or lower on the dressage test, psychophysiological data 5 seconds prior to and 5 seconds following the event were compared to mean data from both tests using a one-way repeated measures ANOVAs with post-hoc paired samples t-tests including Bonferroni corrections. Most important findings showed that during dressage tests SC levels tended to be lower prior to the horse misbehaving than afterwards ($t(9) = -2.40$, $P = 0.04$; 3.69 ± 2.33 vs. 3.92 ± 2.59) and compared to average

levels (t (9) = -4.71, P = 0.001; 3.69 ± 2.33 vs. 4.29 ± 2.42). Furthermore final dressage scores and equine ethogram scores where positively correlated (r = .61, P < 0.01). Findings may suggest that lower SC levels just before a horse shows adverse behaviour are indicative of decreases in cognitive processes such as directional attention and alertness to the current horse behaviour. Rider aids, which should direct the horse, may subsequently not be applied insistently enough and may result in the horse acting out of its own accord and contrary to riders' intention. Results also indicate that in a competitive dressage setting, more spirited horses that, at times, may be prone to misbehave, are likely to receive higher scores than horses that are extremely obedient. In conclusion, the current study supports the notion that riders must remain alert and focused at all times whilst riding. Seeing that a horse has a will of its own, any decrease in attention on what the horse should do, may tend to result in unwanted behaviour on the part of the horse. Equally, in order to perform well in the discipline of dressage, rider should choose more active and in this way more expressive horses.

2 Nederlandse samenvatting

Deze studie is uitgevoerd om wetenschappelijke bewijzen te vinden over de fysieke symptomen van een ruiter tijdens vermoedelijke stressvolle situaties zoals een dressuurproef. Omdat je prestaties tijden een dressuur wedstrijd afhankelijk zijn van de goede communicatie tussen ruiter en paard, en hoe het gedrag van je paard reageert op jou wedstrijdspanning. Er zijn tot nu toe nog geen soortgelijke onderzoeken gedaan, en dat maakt het belang van dit preliminair onderzoek op het gebied van sport psychologie in de paardensport erg groot. Er is een totaal van 17 deelnemers opgemeten met een biofeedback apparaat (NeXus 4 monitor). Ook zijn alle proeven gefilmd met een digitale camera van Sony om later het gedrag van het paard tijdens de proef te beoordelen aan de hand van een ethogram. Ieder paard kreeg uiteindelijk een totaal score voor zijn gedrag.

Tegen de hypothese in, die stelde dat de ruiter meer last heeft van stress voordat het paard enige storingen in de proef vertoont, bewees de meting van huidgeleiding een significante verschil (t (9) = -2.40, P = 0.04; 3.69 ± 2.33 vs. 3.92 ± 2.59) dat de waardes lager waren voordat het paard een storing vertoont dan erna. De waardes voor de storing waren ook lager ter vergelijking aan de gemiddelde (t (9) = -4.71, P = 0.001; 3.69 ± 2.33 vs. 4.29 ± 2.42). Dit betekend dus niet dat de ruiter meer aanspant voor wangedrag van het paard, maar dat de ruiter een kort moment van ontspanning heeft. Dit geeft aan dat het voor de ruiter ten alle tijden belangrijk is of gefocust te blijven tijdens je proef, en dat ieder moment van afleiding ervoor kan zorgen dat het paar de kans grijpt om tegen je hulpen in te gaan of voor een storing in je oefening kan zorgen.

Een andere significante correlatie is gevonden bij de vergelijking van ethogram scores en de dressuuruitslagen. Wat betekend dat een hogere ethogram score zal leiden tot een hogere dressuur score. Specifieker gezegd, een paard dat de neiging heeft om meer kleine foutjes te maken tijdens de proef, maar de uitgevoerde oefeningen vol expressie en actie laat zien een hogere dressuur uitslag zal krijgen dan een paard dat gehoorzaam zijn proef loopt. Voor de ruiter betekend dit dat ze een actiever paard moeten kiezen boven een paard met een flegmatiek karakter.

De uitslagen van dit onderzoek kunnen worden gebruikt in sport psychologie lessen maar ook door individuele ruiters en trainers in alle facetten van de paardensport.

3 Introduction

The use of horses by humans goes back a long way in history. Until the beginning of the 20th century, horses were used preliminary for hunting or transport. Recently however, horses are increasingly used for sports and the popularity of the equine sport is increasing rapidly. (Mcgreevy and Mclean, 2007)

Equine sports can be divided into different categories or disciplines: Show jumping, dressage, eventing, driving, endurance and vaulting. The discipline of dressage is often thought to be basis for all other disciplines. Horse and rider should move in perfect harmony together, with the horse obedient to the lightest of aids from the rider. In the sport of dressage an optimal horse rider interaction is therefore very important. A good interaction between horse and rider is important for the transition of the aids but also to prevent interruptions during a dressage test. As equine sport performances depend on animals and the cooperation with the human, the bonding between horse and rider is of great importance. The combination must look harmonious and relaxed. The horse must be willing to work for the rider, in order to react properly to the aids. The rider must fulfil the role of a leader but must also earn respect from the horse.

Horses are different from other domestic animals due to the fact that it are prey species. They show flight behaviour from dangerous and painful situations. Horses learn to avoid potentially threatening situations from the day they are born, and whenever their attempts to avoid those situations they will often express problem behaviours. (Waran *et al*, 2007)

Since a horse-rider combination is judged on their harmonious appearance of their performance, dressage horses are selected or trained to be very sensitive on the riders aids. Whilst riding the contact between horse and rider is very close. However the biggest challenge for the rider is the communication since this is non-verbal the rider must develop a proper body language. (Brandt, 2004)

The performance of a dressage test can cause a serious anxious feeling for the rider. Which is then also implemented by the horse. In this study it is examined what happened in the body of the rider when they are undergoing a presumable stressful situation. The different parameters used during this research and in which stress can be indicated are presented below.

Skin conductance level is measured with electro dermal sensors, which measure the activity of the eccrine sweat glands. Skin conductance reflects on an arousal process, when athletes are confronted with an emotionally significant stimuli the skin conductance level will increase.

Heart rate is used as an indicator of exercise intensity. Also the definition of training loads are often based on heart rate data. (Lucia, A. *et al*, 2000) Stress can cause an elevation of heart rate and blood pressure.

Skin temperature will decrease in a stressful situation and is a good indicator for emotional arousal.

Mental stress induces muscular tension, psychological stress plays a role in muscoskeletal disorders by increasing muscular tension situated in low workload situations and in the absence of physical load. (Lundberg *et al*, 1994)

The aim of this research is to investigate the effect of physiological symptoms of the rider during the potentially stressful situation of a dressage test on the behaviour of the horse. There has been some research on dressage riders to indicate stress levels and anxiety. However, it still cannot be proven that the tension in a rider is of influence on the horse or the horse-rider performance. And questions like; Does tension in a rider have an influence on the dressage performance or does the horses behaviour influence a dressage performance, still cannot be answered.

For this study the following hypothesis is formulated. The riders physiological stress symptoms will show an increase in anxiety prior to the horse misbehaviours. The in-and decrease of anxiety can be specified by the following statement.

- Prior to the horse misbehaviour the physiological symptoms of the rider will change whereby heart rate and skin conductance will increase, finger temperature will decrease and muscle tension will increase.

4 Literature Review

Every human being interprets feelings differently. And especially competitive anxiety is difficult to state, since it changes over time and during different competing conditions. In addition, individuals may respond differently to potential stressful situations and have different optimal arousal levels. (Caruso *et al*, 1990) The psychological and physiological interest of researchers on this subject is the effect of anxiety on behaviour and sport performance. (Acevedo and Ekkekakis, 2001) However, equine sports have the unique factor where the behaviour of the horse and the horse-rider interaction become of influence. Knowing this, the further explanation of anxiety in sports, the influence of anxiety on equine performance and the physiological factors of competitive anxiety can be found in this review.

4.1 Definition of anxiety

Since anxiety in an athlete can form a threat for the level of performance it is necessary to analyse the definition of anxiety and what influence anxiety might have on the athlete and their performances.

Humans performing sport with the goal of optimizing their performance, use cognitive appraisal for their effort in determining their level of exertion. (Caruso *et al*, 1990) Whilst competing the athlete feels the need to perform at their best possible way, this may be a personal standard or perform at the best of their capacities. Competitive sport activities can, in this way, cause anxiety and fear. This can be expressed in different ways such as; Fair of failure, fear of societal consequences and worry about not living up to expectations. And this anxiety has a negative influence on the sport outcomes Smith and Smoll (1990) .

Furthermore, Smith (1996) stated that multidimensional state anxiety is a response to a central cognitive appraisal process of the athlete. The intensity and the duration of precompetitive state anxiety coming from this central appraisal process are influenced by the competitive sport situation, individual differences in sport- specific cognitive and somatic trait anxiety but also the personal coping skills of the athlete.

To go deeper into the coping skills of an athlete the study of Gaudreau and Blondin (2004) investigates the use of different coping strategies. It states that before, during and after sport competitions athletes are confronted with series of physical, technical and tactical psychological demands. Coping contains any focussed attempt to manage situational demands. To cope effectively with the demands athletes depend on the achievement of performance goals and their psychological well being. With coping is meant any focussed attempt to manage situational demands.

Another study of Gaudreau and Blondin (2002) assesses 10 coping strategies which are categorized in three groups; (1) task-oriented coping (mental imagery, thought control, relaxation, logical analysis, seeking support, and effort expenditure), (2) distraction-oriented coping (distancing and mental distraction), and (3) disengagement-oriented coping (disengagement/resignation and venting of unpleasant emotions). Athletes often combine task-oriented coping as well as both disengagement-oriented coping in order to manage the constantly changing demands of different situations. When an athlete for examples makes a mistake, he might go from task-oriented coping strategies to disengagement strategies to cope with the emotional discomfort. So, each individual uses different combinations of coping strategies, those different coping profiles were associated differently to self-referenced goal achievement, affective stated and experience of control.

4.1.1 Cognitive and somatic anxiety

To define anxiety the defined types, named cognitive an somatic anxiety, the difference between those two are explained below.

The mental part of anxiety can be described as cognitive anxiety the fear of bodily harm of fear of failure. Whereas, somatic anxiety is the physical part of anxiety such as increasing heart and respiratory rates, muscular tension and other physiological reactions. (Endler et al, 1991)

A research performed by Wolframm and Micklewright (2010) investigates the effect of intensity an direction of arousal and self-confidence on dressage and show jumping performance. It has been found that the intensity of pre-competitive cognitive and somatic anxiety influences equestrian performance. However, the greater the intensity of cognitive and somatic anxiety, the less facilitative these symptoms were experienced by the riders.
In dressage, a greater level of cognitive anxiety had a negative effect on the dressage performance and on the horse-rider interaction. While in show jumping no relationships were found. Research supported the fact that cognitive anxiety may improve performance if the tasks are not attentionally demanding. Where dressage is high attentionally demanding and the action undertaken in a dressage test require a good memory capacity of the rider. This greater demands in sport cause the negative relationship between cognitive anxiety and performance, including horse-rider interaction. This may lead to inabilities to ride a movement, react to the horses behaviour in an appropriate way or execute the right aids, and in this way affect the performance. Furthermore, communication between the horse and rider might be obstructed.

In addition, another big influence on performance is self confidence. The same study of as mentions above of Wolframm and Micklewright (2010) states that a positive interpretation of self confidence les to more facilitative interpretations of both cognitive as somatic anxiety. This can be supported by Hanton *et al*, (2004) which examines the relationship between self confidence and the intensity of competitive arousal. It was found that a lack of self confidence will lead to a loss of perception of control, problems with focussing and concentration and a negative effect on the interpretation of arousal. Where in athletes who show more self-confidence experiencing an higher levels of arousal, this leads to an increase in motivation and effort. Those athletes will experience the higher levels of anxiety as facilitative.

In equestrian sports the unique factor of a living creature is playing an important role. As the horse appears to be able to sense the emotional state of the rider. Another study of Wolframm and Micklewright (2009) reveals that elite riders experience lower levels of somatic arousal and higher levels of self-confidence compared to non-elite riders. Between elite and non elite riders there appears to be a considerable difference in pre-competitive stated of somatic arousal en self-confidence. Taken into consideration the equine learning theories and the need for fine motor control in the ability to give the proper aids, a low somatic anxiety will be facilitative for performance. It can be concluded that elite riders interpret cognitive anxiety as more facilitative due to the fact they experience a higher level of self-confidence prior to the competition.

4.2 Competitive anxiety

The relationship between competitive anxiety and sport performance is one of the most researched items in sport psychology.

Every athlete, from recreational to elite levels, experience some type of anxiety before competing. Nevertheless, these athletes may view the same anxiety responses in different ways. As one athlete might find an increase in heart rate a negative nervousness, another describes this as a positive feeling. (Jerome and Williams, 2009) A study of Wolframm and Micklewright (2010) states that the way athletes interpret the feeling of pre-competitive arousal is linked to their performance. In equestrian sports the rider need to interpret the temperament of their horse which is a unique factor and of great influence to the riders level of arousal and performance.

To express the influence of competitive anxiety, the self confidence of an athlete is an important variable. The experience of increased pre-competitive anxiety caused by a low self confidence results in a loss of perceptions of control, leading to problems with focus and concentration. Under conditions of high self confidence the athlete is experiencing an increase of motivation and effort and gives the athlete the ability to maintain a confident outlook towards the performance. Which ensure the athlete of being in charge of their pre-competitive symptoms. (Hanton *et al*, 2004)

In addition, Roberts (1986) sais that the meaning of achievement is the critical determinant of performance related cognitive anxiety, affect and sporting behaviour. Roberts argued that athletes who cope with high task orientation and low ego orientation are less likely to experience an increase of state anxiety prior to competition. These athletes are able to focus more on challenge seeking when achievement is under control. This allows the strive to positive achievement and higher self confidence even in difficult circumstances, because their self confidence is not affected by perceptions of social comparative failure. Unlike, athletes which sense a strong ego orientation and low task orientation who interpret achievement rather different. Success and failure is socially judged. When athletes start to doubt that their ability compared favourably with others, unwanted pre competitive anxiety may occur, and a depressed feeling may lead to inadequate performance.

4.3 Physiological aspect of anxiety

To learn more about the physiological aspect of anxiety the starting point is the explanation of the physiological symptoms of stress in a human body. Stress is of psychological source. Nevertheless, it has an effect on a number of physiological processes in the human body (Taelman *et al*, 2008) The physiological stress response begins with the stimulation of sensory receptors from the peripheral nervous system. Through the sensory neural pathways the information sent to the limbic system and the cortical levels of the brain. This is the place where the analytical interpretations of the stimuli starts and an internal stress response occurs. The stimulation of the cortical levels from the limbic system leads to an activation of the physiological factors: the neural and the neuro-endocrine systems. (Acevedo and Ekkekakis, 2001)

For the equestrian sports the physiological aspects of somatic arousal can include an increase of muscular tension, respiratory rate and heart rate. These symptoms are examples of factors which may influence the transmission of the riders communication towards the horse. (Wolframm and Micklewright, 2009) For this study we chose heart rate, skin conductance, finger temperature and muscle tension as indicators of arousal.

4.3.1 Biofeedback

The use of biofeedback became more and more popular over the last years. And is used to give feedback on the involuntary physiological symptoms of humans. (Raymond *et al*, 2005)

In sport, biofeedback can be used to evaluate the psychological state of the athlete by measuring the changes in physiological symptoms.

A preliminary investigation of Raymond *et al* (2005), aimed to improve dance performances through alpha-theta neurofeedback and heart rate variability biofeedback. Twenty-four ballroom dancers were randomly allocated to three groups where one group received neurofeedback, one group received HRV biofeedback and the last group had no interventions. The study provided the evidence that neurofeedback and biofeedback has a positive influence on dance performance, compared to the no control group. The participants in the neurofeedback group showed an increase of timing and the biofeedback group showed an increase in technique.

Another study of Bar-Eli *et al* (2002) performed to investigate the relevance of mental training and biofeedback in relation to performance enhancement was designed among 11-14 year old swimmers. An adapted version of the Wingate five-step approach was used as mental preparation technique. A successful technique to experience and learn more of arousal self-regulation is biofeedback. In this research is concluded that the use of regular training combined with mental training and the use of biofeedback will lead to better performance then with regular training only.

A more detailed explanation of the different physiological symptoms used for this research will be presented below.

4.3.2 Heart rate

The measurement of heart rate is used as an indicator of exercise intensity. Also the definition of training loads are often based on heart rate data. (Lucia, A. *et al*, 2000)

Nowadays a lot of people suffer from stress and one way to measure stress is by measuring heart rate. Even though anxiety is a psychological symptom from origin it can definitely have an effect on physiological processes in the human body. By stimulating of the autonomic nervous system the heart is directed by the brain, this is divided in two parts: Sympathetic and parasympathetic branches. The sympathetic activity of the brain leads to an increase in heart rate during sports exercise and the parasympathetic activity reduces heart rate. (Taelman *et al*, 2008)

McNaughton (1989) stated that mental activity and stress induces many different autonomic responses. Those responses such as; an elevation of heart rate but also blood pressure, respiration rate and electrodermal activity are influenced by the functioning of the emotional system.

A research performed by Taelman et al (2008) showed a significant increase in 24 out of 28 cases from rest compared to a situation with the load of a mental task added.

4.3.3 Skin conductance

Skin conductance level is measured with electro dermal sensors, which measure the activity of the eccrine sweat glands. Those sweat glands are located on the palmer surface of the hand and the plantar surface of the foot. Skin conductance level is used in psychology to indicate arousal (Treymane and Barry, 2001) Also Fowles *et al* (1997) state that skin conductance level reflects an arousal process. To use skin conductance as an index of arousal there is a difference in Russian and Western theorizing. In Russian theories transmarginal inhabitation reduces the central excitement process, but also reduces peripheral responsiveness. Where in Western theorizing arousal keeps increasing even if the efficiency of performance is decreasing.

Adolph *et al* (2010) stated that skin conductance is a marker of sympathetic autonomic activity, associated with arousal and orienting towards a meaningful stimulus. When athletes are confronted with a neutral object the skin conductance response will remain lower, than when the athletes are confronted with a emotionally more significant stimuli.

4.3.4 Finger temperature

Finger temperature feedback is a therapy procedure being used to treat migraine headaches but also to reduce anxiety. Boudewijns (1976) investigated the effect of stress vs. relaxation on the finger temperature response. This is a research regarding finger temperature as a psychophysiological indicator of arousal.

There was concluded that finger temperature decrease during an assumed stressful situation. While the finger temperature increases in assumed relaxed condition.

However there was no significant correlation found between the finger temperature and other psychophysiological measures. Nevertheless, the finger temperature did relate to self-report of arousal.

Measuring finger temperature as a biofeedback therapy has potential. It is a reliable indicator of emotional arousal and it is easy for patients to understand that a warm and inactive body indicates relaxation.

One of the most significant overall finding in the research of Boudewijns is that the finger temperature response is quite slow to detect changes is stimulus conditions compared to skin conductance. Which means that, with the use of finger temperature as a parameter to determine arousal, finger temperature will be less vulnerable to environmental changes than other psychophysiological indicators.

4.3.5 Muscle tension

It is generally assumed that mental stress induces muscular tension. Psychological stress plays a role in muscoskeletal disorders by increasing muscular tension situated in low workload situations and in the absence of physical load. (Lundberg *et al*, 1994)

A research of Oishi and Maeshima (2004) stated that the sympathetic nerve activity to the skeletal muscle is directly related to the level of stress. Which means that an increased level of stress results in more sympathetic nerve activity.

While athletes participate in a sport event may central neural networks are activated. Those central neural networks are involved in motor execution and planning, emotion, behaviour and sensory, perceptual and cognitive systems. The physical goals that are set to achieve with the musculoskeletal system are reached with use of the emotion-behaviour system. Overall, the ability to control the central nervous system becomes more important when athletes are using fine movements. This ability to control the motor system improves motor or physical performance situated in high mental stress. (Oishi and Maeshima, 2004)

Larson *et al* (1995) stated that fatiguing static contractions of large muscle groups such as those of the neck-shoulders are companied by increase of heart rate, arterial blood pressure and sympathetic nerve activity. The research demonstrated an increased shoulder-muscle tension by induced mental stress. Overall, the results of this research shows that the blood flow in the neck-shoulder muscles normally increase when exposed to mental stress as did the muscle tension. This is of clinical significance in work situation involving repeated static load to the neck-shoulder muscles and exposure to mental stress.

4.4 Nature of the horse

In order to fully understand de relationship between the rider and the horse it is necessary to first analyse the use of the horse, his learning processes and natural behaviour.

Human use of horses goes back for many years. This all started by using horses for hunting, relatively recently we started using horses as beasts of burden also horses are used as means of transport, war and agriculture. More recently horses are used for sport and leisure. (Mcgreevy and Mclean, 2007)

Accoring to Waran et al (2007) horses are different from other domestic animals due to the fact that it are prey species. They show flight behaviour from dangerous and painful situations. Horses learn to avoid potentially threatening situations from the day they are born, and whenever their attempts to avoid those situations they will often express problem behaviours.

4.4.1 Equine learning theories

"What works for horses is immediate comfort or immediate relief from discomfort." (Mcgreevy, 2007)

By learning, animals can use information to adapt their responses to environmental changes. Training however, changes responses by increasing desirable reactions and suppressing undesirable ones. Overall, there are two categories of learning; non associative and associative learning. Non associative learning involves a single stimulus which can be habituation and sensitisation. Associative learning involves a relationship between at least two established stimuli. (Mcgreevy, 2007)

A wide range of training methods are developed since the start of equine domestication. Equine ethology and ethological training are increasingly used in the equestrian sector even as a brand for training systems. However, these term lack of clarity. Effective and humane training always account of animals'ethology, so there seems to be little need to develop a separate training class. Two things must be taken into consideration namely, the natural behaviour of the horse and the learning capacity. Which means that the trainers interaction should be based on 3 elements: Flight, herd instinct and hierarchy. Training methods which include learning theory take into account the types of stimuli the horses are most likely to respond to and the types of reinforcement that are most rewarding. (Mcgreevy and Mclean, 2007)

To improve equine performance the training of the horse is of great importance. A study from Aerts *et al* (2008) was designed to look at the possibilities of using model based algorithms to control the heart rate of horses by controlling the running speed. This advanced control method can help trainers and riders to train their horses more optimal by adjusting the horses workload during training and defining the needs of the horse and trainer.

4.5 Equine Sport

The dressage sport as it is performed nowadays has a purpose to develop a horse towards its natural athletic ability and willingness to perform, thereby maximizing his potential as a riding horse. At the peak of a dressage horse's gymnastic development, it can rapidly respond to riders aids by performing the requested movement while remaining relaxed and appearing effortless. With the execution of certain exercises the horse is trained towards the specific performance goal of the rider. Dressage is often named as the gymnastic basis of equestrian sports. The goal of dressage is to make the horse a 'happy athlete' through a harmonious and systematic education. The horse should be fully impressible for the rider's aids and response accurate and without hesitation.

Dressage competition starts with introductory levels. Horses and riders becoming more advanced through a graduate series of Nationally defined levels, each test is increasing difficulty at each level.

Dressage tests are a range of dressage movements used while competing. Horse-rider combinations are competing against each other, however a dressage test is performed by one combination and scores are individually judged. (KNHS, 2008)

4.6 Horse-rider interaction

Communication with horses whilst mounted involves a combination of seat, leg, weight and rein aids. Followed by consequent requirement of fine motor control and accuracy. (Oxendine, 1970)

According to Mcgreevy (2007) the natural behaviour of the horse plays a sever role in the relationship and communication between human and horse. The way in which the horse responds to humans is comparable to how they would respond to any predator. They will want to avoid physical or psychological pressure by moving away bodily or postural. When the human is not successful in modifying this behaviour to create a highly responsive equine performer, it can be assumed that there is possibility for the animal to turn into a 'problem horse'.

The first thing to be noticed when we look at the communication between horse and rider is the close contact between the body of the horse and rider whilst riding. Furthermore, the obvious larger size of horses' body compared to the human is noticeable. Which means that there is always an element of danger involved in the interaction between horses and human. In order to realize a good relationship a fine developed body language is necessary. Language is a starting point for proper communication and it can be a challenge to communicate with horses since it is non-verbal communication. A horse is highly developed at reading the body language of its rider. Therefore, it is of great importance for the human to understand the body language of the horse, in order to respond in such way that the horse understands the meaning. (Brandt, 2004)

The horse as it is used today, is asked to learn a wide number of different tasks. Many of those requirements aren't of the horses natural instinct. To perform a dressage test the horse must ignore and undermine many of his natural instinct. Also he needs to learn to react to many different stimuli. Overall, equine training methods are based on the assumption that horses learn by trial and error. This is also called; stimulus-response-reinforcement chains. Horses react to both positive and negative reinforcement. It is proven that horses when handled at a early age are less emotionally and have increased learning abilities. (Mccal, 1990)

A study of von Borstel *et al* (2010) investigates fear reactions among trained and untrained horses from dressage and jumping breeding lines. The hypotheses among riders that dressage horses are more easily scared than show jumping horses was confirmed. However, there is stated that jumping horses are reacting less to frightening stimulation not that dressage horses are reaction more to frightening stimulus. Since a horse-rider combination is judged on their harmonious appearance of their performance, dressage horses are selected or trained to be very sensitive on the riders aids. In this way, the rider van communicate with the horse as invisible as possible.

Nowadays, the European dressage rider believes that dressage horses tend to be more nervous than jumping horses and the study of von Bortstel *et al* (2010) confirms this statement. Anxiousness of horses can be used for different types of work and it is found that dressage horses are animals with high emotionality, where show-jumping horses show a low emotionality. (Lundin, 2005)

4.7 Anxiety in the rider

Any type of anxious feelings may have an influence on the performance of the rider. In case of equestrian sports the horses is an important factor in the level of performance. Since anxiety in a rider appears to have an influence on the horse it is of great value to analyse this component.

The emotional composition of the rider seems to be critical in equestrian sports. (Wolframm *et al*, 2010) This research investigated the differences in pre-competitive mood disturbances of advanced and novice riders before a dressage competition. The most important findings were that advanced riders show lower levels of confusion than novice riders. High confusion levels in riders might lead to a poor focus on relevant sport tasks but also de inability to process information. This can decrease equine performance by the fact that riders become unable to process body language of the horse and therefore are unable to give the proper aids. Equestrian sports depend on horse rider interaction, and therefore any confidence building interventions will also benefit the interaction with the horse. When riders become less doubtful and uncertain they are much quicker in reacting to their horse but also more consistent about the given aids.

For most of the athletes, the coach or trainer is of great influence of the competitive experience. A sport coach should be aware of the behaviours they are showing towards the athlete during a competition. The behaviour have an effect on the total and cognitive forms of anxiety. Especially when coached tend to show negative personal report behaviours its assumed that this would increase the level of anxiety. (Baker *et al*, 2002)

The preliminary aim of this study is to investigate the interactions between psychophysiological parameters of the rider. The secondary aim of is to investigate the relationship between physiological symptoms of the rider and the behaviour of the ridden horse.

5 Method

5.1 Participants

The research was carried out in 2 different regions of the Netherlands. The first research day took place in Delfgauw, situated near The Hague. The second day was executed in Driel, near Arnhem. A total of 17 participants (mean age: 25.67 ± 8.43) were measured. All test riders ride regularly and were measured whilst riding their own horse. Riders performed a dressage test at their own level.

The group consisted of both competitive (competing at the Dutch B to Z level) and non-competitive riders (n = 17, competitive = 8 and non-competitive = 9) All participants performed horseback-riding regularly. The horses ridden during the test were familiar to the riders, it was either their own or their lease horse. (n = 17, own horse = 15, lease horse = 2).

5.2 Procedure

The permission of both stables was gained prior to the data collection. The first step taken before data collection was the organisation of two clinics on two locations. At each day 10 participants were able to ride a dressage test. Together with the sign up lists the participants were informed about the procedure and they al signed up voluntary. After this starting orders could be determined. Furthermore, participants were advised that all gathered information would be handled confidentially. All participants filled in the CSAI-2R questionnaire shortly prior to warming up their horse and performing the dressage test.

All participant performed a dressage test at their own level. In this way the that the test are too easy or too difficult for the horse or rider was eliminated. Each test is segmented into a number of sequential blocks which may contain one or more movements. Each block is generally scored between one and ten on a scale such as the following:

- 10 Excellent
- 9 Very good
- 8 Good
- 7 Fairly good
- 6 Satisfactory
- 5 Sufficient
- 4 Insufficient
- 3 Fairly Bad
- 2 Bad
- 1 Very bad
- 0 Not performed

(KNHS,2009)

On each trial day riders were free to warm up their horse as they pleased in another arena. Prior to entering the arena, participants were fitted with a NeXus 4 biofeedback monitor. This recorded the heart rate (HR), muscular tension (MT) of the trapezius muscle, skin conductance (SC) and skin temperature (ST) throughout the entire dressage test.

Each dressage test was recorded on film for the analysis of equine behaviour throughout the test. The riders were filmed from the moment they entered the arena till the end of their test (the end being halt at A).

During the entire test, the horse-rider combination was followed at a distance of maximal 10 meters by a person carrying a laptop in order to collect data. On the laptop, markers in the biofeedback program were placed in order to indicate fixed points of the exercise:

- Marker 1: Start of dressage test, rider passes A.

- Marker 2: At the end of the dressage test, were the rider executes an extended walk to A, and stop at the letter A.

These markers were used in the data processing in order to equalize the biofeedback data and film material.

5.3 Materials

A NeXus-4 of Mind Media B.V. was used for data collection. The NeXus-4 is a 4 channel physiological monitoring and biofeedback platform that utilizes Bluetooth 1.1 class 2 wireless communication and flash memory techniques. It offers data collection with up to 1024 samples per second. For the current study, 32 samples per second were collected. Channels operating at a sample frequency of 1024 Hz were used to measure heart rate (EKG) and muscle tension (EMG). Channels operating at a sample frequency of 128 Hz were used to measure skin conductance and skin temperature.

The film of the entire dressage test was made with a digital camera from Sony.

5.4 Scoring performance

After data collection, the performance of rider and horse was scored with the conducted video material, using an ethogram. This ethogram consisted of 4 categories; resistance to riders aids, flight behaviour, rider behaviour. These categories were measured at a 4-point scale:

- Resistance to riders aids, ranging from 1(Willing to work, react immediately to riders aids, tail swings loosely, ears relaxed) to 4 (Extreme resistance to riders aids through; running, stopping, bucking or rearing.)
- Rider behaviour, ranging from 1 (Rider sits quietly, quietly insisting that the horse obeys) to 4 (Rider uses hands, legs, seat and whip together, appears hectic and forceful)

- Head shaking, ranging from 1 (Horse shows steady head carriage, contact with range is consistent and steady) to 4 (No consistent rein contact throughout the entire test with no steady head carriage.
- Tail sweeping, ranging from 1 (Continious swishing of the tail, which causes tension in the back)

All 23 predetermined points of the dressage test are judged by these 4 points.A total behavioural score for each horse was calculated by adding up all obedience scores.

5.5 Questionnaires

Participants (N = 17) were asked to complete the CSAI_2R questionnaire . The participants were informed that the conclusions of the questionnaires would be handled confidentially. The participants were asked to complete the questionnaire shortly prior to the warming up of their horse. The questionnaire was developed by Cox *et al* (2003). This is a 17 itemed questionnaire which takes anxiety measurement inventories. Such as: subscales of somatic anxiety (arousal), cognitive anxiety (arousal) and self-confidence. Each CSAI-2R item is rated on a 5-point scale and scoring was carried out manually according to the instructions. . In addition, riders indicated the direction of the CSAI-2R items on a ‘direction scale’ developed by Jones and Swain (1992). Riders rated each item from on a scale from -3=‘very unhelpful’ to +3=‘very helpful’, which depended on how helpful riders felt each item to be for their performance. For example, a score of 3 (moderately so) on ‘I am feeling confident’ might be experienced as ‘somewhat helpful’ to their performance and thereby scored as a 2 on the direction scale. Final scoring was carried out manually in accordance with the instructions by Cox *et al* (2003).

5.6 Data processing and analysis

The collected data was processed with the help of SPSS (Statistical Package for Social Students). Pearson's Product Moment Correlations were conducted to investigate relationships between average rider psychophysiological parameters for the duration of the tests and total equine ethogram scores. Furthermore, every time a horse-rider combination scored a 5 or lower on the dressage test, psychophysiological data 5 seconds prior to and 5 seconds following the event were compared to mean data using a one-way repeated measures ANOVAs with post-hoc paired samples t-tests including Bonferroni corrections. The significance value of $P = 0.05$ was used to state the level of significance. Finally, the relationship between the CSAI-2R questionnaire and the average psychophysiological values was investigated using Pearson product-moment correlation coefficient.

6 Results

6.1 Heart rate

A one-way repeated measures ANOVA was conducted to compare scores on the average heart rate (*M* = 158.48, *SD*= 13.11) and values prior to (*M* = 159.44, *SD* = 11.32) and after (*M* = 158.25, *SD* = 10.77) misbehaviour of the horse. There was a no significant difference found for heart rate [Wilks'Lambda =.983, *F* (2, 8) = 0.68 , *P* = .935, multivariate partial eta squared = .17.]

6.2 Skin conductance

A one-way repeated measures ANOVA was conducted to compare scores on the average skin conductance and values prior to and after misbehaviour of the horse. There was a significance for skin conductance [Wilks'Lambda =.28, *F* (2, 8)= 10.22 , *P* = .006, multivariate partial eta squared = .72.]

A post-hoc paired-samples t-test was conducted to investigate specific differences between skin conductance values of the rider. There was a statistically significant lower skin conductance prior to the horse misbehaving (*M* = 3.6886, *SD* = 2.33901) than afterwards [*M* = 3.9152, *SD* = 2.59605, *t* (9) = -2.403, *p* = .04; 3.69 ± 2.33 vs. 3.92 ± 2.59]. The values of skin conductance before an event were also lower(*M* = 3.6886, *SD* = 2.33901) compared to the average (*M* = 4.2624, *SD* = 2.42851, t (9) = -4.71, P = .001; 3.69 ± 2.33 vs. 4.29 ± 2.42). This was similar to the comparison of skin conductance after an event (M = 3.9152, SD = 2.59605) and the average skin conductance (*M* = 4.2624, *SD* = 2.42851, t (9)= -2.873, P = .018; 3.9152 ± 2.59605 vs. 4.2624 ± 2.42851).

Figure 1: Visualisation of the differences in values of skin conductance prior to and after a horse misbehaviour and the average values.

6.3 Finger temperature

A one-way repeated measures ANOVA was conducted to compare scores on the average finger temperature (*M* = 23.086, *SD* = 4.539) and values prior to (*M* = 25.36, *SD* = 4.679) and after (*M* = 25.78, *SD* = 4.36) misbehaviour of the horse. There was no significant difference found for finger temperature [Wilks'Lambda = .82, F (2, 8) = .860 , *P* = .459.]

6.4 Muscle tension

A one-way repeated measures ANOVA was conducted to compare scores on the average muscle tension (*M* =-1.1709, *SD* = 3.19335) and values prior to (M = -7.8547, SD = 6.58913) and after (*M* = 18.18, *SD* = 24.45017) misbehaviour of the horse. There was no significant difference found for muscle tension [Wilks'Lambda = .913, F (2, 8) = .380 , *P* = .696.]

Furthermore, the relationship between the muscle tension of the rider and the finger temperature was investigated using a Pearson's Product Movement Correlation coefficient. There was nearing significance positive correlation between the two variables [*r* = -.352, *N* = 17, *P* = 0.097], with high muscle tension values associated with higher levels of finger temperature.

6.5 Ethogram related to dressage score

The relationship between the ethogram score of the horses and the dressage score of the test was investigated using a Pearson's Product Movement Correlation coefficient. There was a strong positive correlation between the two variables [*r* = .61, *N* = 17, *P* = 0.01], where high ethogram scores associated with higher dressage scores.

6.6 CSAI-2R questionnaire

The relationship between the average heart rate of the rider and intensity of the somatic anxiety was investigated using a Pearson's Product Movement Correlation coefficient. There was a strong negative correlation between the two variables [*r* = -.626, *N* = 17, *P* = .001], with high heart rate values associated with lower level of interpretation for the intensity of somatic anxiety.

Another relationship was investigated regarding heart rate, this time in relation to the direction of somatic anxiety. This using Pearson's Product Movement Correlation coefficient. There was a strong positive correlation between the two variables [*r* = -.513, *N* = 17, *P* = .012], with heart rate values associated with higher level of appreciation for the direction of somatic anxiety.

Furthermore, the relationship between heart rate and the intensity of self-confidence was investigated. This resulted in a nearing significance positive correlation between the two variables [*r* = -.404, *N* = 17, *P* = 0.056], with heart rate values associated with higher levels of interpretation for the intensity of self-confidence.

In addition, other investigations among the CSAI-2R questionnaire where made, however no further correlations where found.

7 Discussion

The aim of the current study was to investigate interactions between psychophysiological parameters of the rider. More specifically this study aims to determine differences in those psychophysiological symptoms of the rider during moments of tension prior to and following and anxiety inducing event, including average values. The secondary aim was to investigate a relationship between physiological symptoms and the behaviour of the ridden horse. In addition, pre-competitive mood states were taken into consideration.

7.1 Heart rate

It was hypothesized that anxiety in the rider causes an increase in heart rate. However, results showed no significance. This might be caused by the fact that the value of heart rate is influenced by different factors. By measuring heart rate the intensity of exercise can be indicated (Lucia, A. *et al*, 2000). Even though anxiety is a psychological symptom it can definitely have an effect on the physiological processes in the human body, such as heart rate. This is supported by Taelman *et al* (2008) and McNaughton (1989) which stated that an elevation of heart rate is influenced by the emotional state of the athlete. Where emotional state means stress or anxiety. This would mean that heart rate can be an indicator of stress.

For the current research this would mean that when the heart rate of the rider increased the level of anxiety is increasing and this could have resulted in misbehaviour of the horse during a dressage test. However, in contradiction to previous studies, this study is done while exercising not during rest. Which means that more external factors must be included. Such as; the competitive setting or the usage of the biofeedback technology.

As mentioned this research is conducted in a competitive setting. Which means that precompetitive anxiety may have influenced the heart rate of the riders as well. All kind of competitive sport activities can cause anxiety and fear. This can be expressed in different ways such as; Fair of failure, fear of societal consequences and worry about not living up to expectations. And this anxiety has a negative influence on the sport outcomes Smith and

Smoll (1990). This is supported by Wolframm and Micklewright (2010) which states that the way athletes interpret the feeling of precompetitive anxiety is linked to their performance.

The way the riders interpret the feelings of precompetitive anxiety might differ individually. As one athlete might find an increase in heart rate a negative nervousness, another describes this as a positive feeling. (Jerome and Williams, 2009)
Where in equestrian sport another unique factor of the interaction between horse and rider is of influence on the performance. In the same research as mentioned above of Wolframm and Micklewright (2010) is said that the rider also need to interpret the temperament of the horse. This is unique in comparison to other sports as the horse appears to be able to sense the anxiety of the rider. A horse is highly developed in reading body language of the rider. (Brandt, 2004) And where riders train their horses to be sensitive to the given aids to perform a dressage test which is harmonious, the greater emotional demand of competitive sports may obstruct the communication between horse and rider. (Wolframm and Micklewright, 2010)

Despite all the previous research with regards to a possible increase in heart rate when the horse showed any kind of misbehaviour this research wasn’t able to find any significant differences in heart rate. Since there were many factors involved which may influence the riders heart rate this may have limited the possibility to find any significant differences between heart rate and anxiety during the performance of a dressage test.

7.2 Skin conductance

To indicate arousal the measurement of skin conductance is often used in psychology. (Treymane and Barry, 2001; Fowles *et al*,1997) Adolph *et al* (2010) stated that when athletes are confronted with a neutral object the skin conductance response will remain lower, than when the athletes are confronted with a emotionally more significant stimuli. This is in contradiction to the findings of the current study. Which show significant differences for skin conductance prior to and after misbehaviour of the horse. There was found a significantly lower skin conductance prior to the horse misbehaving than afterwards. Also the values of skin conductance prior to an event were lower compared to the average skin conductance. Furthermore, there was a significant difference for skin conductance after an event compared to the average skin conductance. This indicates that the rider shows a moment of relaxation before misbehaviour of the horse and right after the misbehaviour of a horse. Nevertheless, skin conductance levels are still higher then before the event. This is caused by the fact that the rider is not able to release all the tension right after the horse showed misbehaviour.

The findings of the current study can be declared by the fact that dressage is high attentionally demanding. This greater demands in sport cause the negative relationship between cognitive anxiety and performance, including horse-rider interaction. This may lead to inabilities to ride a movement, react to the horses behaviour in an appropriate way or execute the right aids, and in this way affect the performance. Furthermore, communication between the horse and rider might be obstructed. (Wolframm and Micklewright, 2010) During a dressage test the rider must be very concentrated. Since the horse is trained to react on the most subtle aids. Were tension in the rider might lead to the inability to give subtle aids. Since, fine motor control can be blocked or influenced by an increase of stress. Where the rider asks from the horse to be fully impressible for the rider’s aids and response accurate and without hesitation. (KNHS, 2008) Where the horse is able to sense every slight change in the riders body language, he is most certainly able to sense anxiety. Therefore, it is important for the rider to get in control of their precompetitive anxiety.

Despite of previous research which stated that a higher emotional stimuli increases skin conductance can't be supported by the current study. Where the lower skin conductance prior to and after the horse misbehaviour show some kind of relaxation. From this point of view we can support the fact that the horses misbehaviour is in some way caused by the rider. During the dressage test the rider in focussed on the test and the horse. When the horse-rider combination is in an exercise and the rider looses focus or attention , by the proven moment of relaxation, the horse might sense a change of aid or any kind of other miscommunications may occur. Since the communication with horses whilst mounted involves a combination of seat, leg, weight and rein aids. Followed by consequent requirement of fine motor control and accuracy (Oxendine, 1970). Any minute changes of the rider's aids will be picked up on by the horse (Wolframm *et al*, 2009). In this case, the slight relaxation of the rider before the misbehaviour of the horse can indicate the cause of the so called `misbehaviour´.

It has been said that for the rider it is becomes of great importance to get in control of their pre-competitive anxious feelings. And as the findings of the current study show that the rider expresses a slight moment of relaxation prior to the horse misbehaviour. It can be said that the rider must stay focussed and concentrated at all times to prevent the horse from acting out on its own. At the moment where the horse does show any kind of misbehaviour the rider must have the ability to react in a proper way, without disturbing the performance even more. In order to react on the horse's misbehaviour the rider must be able to cope with the situation where, in this case the horse misbehaviour, some thing went wrong and this will be of influence on the performance. According to Gaudreau and Blondin (2004) coping contains any focussed attempt to manage situational demands. To cope effectively with the demands athletes depend on the achievement of performance goals and their psychological well being.

With coping is meant any focussed attempt to manage situational demands.: categorized in three groups; (1) task-oriented coping (mental imagery, thought control, relaxation, logical analysis, seeking support, and effort expenditure), (2) distraction-oriented coping (distancing and mental distraction), and (3) disengagement-oriented coping (disengagement/resignation and venting of unpleasant emotions). Some of these coping strategies of combination of them can be helpful for the rider to deal with unpleasant situations whilst performing. For example; when the rider is not able to leave the mistake behind or catch up with the test, the tension in the dressage course will maintain, and this will be picked up by the horse. All this will then have a negative effect on performance.

As we take into consideration the results of the current study and previous research, it can be said that it is important for the rider to find a balance between efficient anxiety and proper internal and external focus. Where a moment of too much relaxation gives the horse an opportunity to act out on its own accord in contradiction to the riders aids, which may lead to a decrease in performance. Where a high level of non facilitative anxiety may make the rider less able to give adequate aids and give the proper responses to the horses behaviour. By knowing all this the importance of the riders attention and focus can be indicated.

7.3 Finger temperature

The current study did not find any significant differences in finger temperature when the values were compared with values prior to and after the horse shows misbehaviour. This can be caused by the fact that finger temperature response is quite slow to detect changes in stimulus conditions (Boudewijns, 1976). Which means that the use of finger temperature as a parameter to determine arousal, will be less vulnerable to environmental changes than other psychophysiological indicators.

However, the investigation of Boudewijns (1976) stated that the usage of finger temperature as biofeedback has potential as is it easy to understand that a warm inactive body indicated relaxation.

As mentioned in previous studies the finger temperature should have decreased prior to the horses misbehaviour. Since a decrease in finger temperature is an indicator of stress. However, the fact that we measured finger temperature during exercise instead of rest may have limited the research to find any significant difference.

7.4 Muscle tension

It was hypothesized that an increase of anxiety in the rider would lead to an increase in muscle tension and in this way a decrease in performance. However, the current study shows no significant differenced between muscle tension prior to and after the horse misbehaviour.

During the dressage test the rider's muscle tension was measured on the trapezius muscle, located on the upper shoulder of the rider nearing the neck. A research of Larson *et al* (1995) stated that fatiguing static contractions of large muscle groups such as those of the neck-shoulders are companied by increase of heart rate, arterial blood pressure and sympathetic nerve activity. The research demonstrated an increased shoulder-muscle tension by induced mental stress. Overall, the results of this research shows that the blood flow in the neck-shoulder muscles normally increase when exposed to mental stress as did the muscle tension. This information would support our hypothesis. However, the reason that no significant differences were found might be due to the fact that the muscular tension in the trapezius muscle is related to the arms and in this way the rein contact of the rider. It may be assumed that the constant force of rein contact also causes a constant form of muscle tension in the trapezius muscle. Also, the static upright seat of the rider might be of influence on the muscle tension in the measured muscle. Both the seat as the constant rein contact might be a cause of the fact that we didn't find any significant differences. However, it is stated by different studies that the sympathetic nerve activity to the skeletal muscle is directly related to the level of stress. Which means that an increased level of stress results in more sympathetic nerve activity (Oishi and Maeshima, 2004; Lundberg *et al,* 1994). Moreover this means that psychological stress can play a role in the increase of muscle tension.

7.5 Muscle tension related to finger temperature

Since the current research is a preliminary investigation different possible factors of influence on the misbehaviour of the horse are examined. An interesting fact is that there was found a nearing significant correlation in muscle tension related to finger temperature which indicated that a higher muscles tension value is associated with higher levels of finger temperature. Whereas, higher muscle tension indicated a higher level of anxiety (Oishi and Maeshima, 2004; Lundberg *et al,* 1994) and a higher finger temperature indicated relaxation (Boudewijns, 1976). A possible way to explain this is the increase of blood circulation. Higher muscular activity means a higher blood flow. And a higher blood flow increases the temperature of the human body. It is investigated that while athletes participate in a sport event many central neural networks are activated. Those central neural networks are involved in motor execution and planning, emotion, behaviour and sensory, perceptual and cognitive systems (Oishi and Maeshima, 2004). This is supported by McNaughton (1989) which stated that mental activity and stress induces many different autonomic responses. Those responses such as; an elevation of heart rate but also blood pressure, respiration rate and electrodermal activity are influenced by the functioning of the emotional system.

The fact that the relationship between muscular tension and finger temperature were nearing significance might be caused by the activation of many different central neural networks are activated. And the increase of one psychophysiological symptoms will then be automatically followed by another symptom. Moreover, the fact that this preliminary investigation was inspected to have limits, this outcome of the research had to be discussed.

7.6 Ethogram related to dressage score

Results of the current study show that there was a strong positive correlation between high ethogram scores associated with higher dressage scores.

The goal of the participant whilst performing a dressage test are to perform a dressage test in the best possible way. An athlete which is participating in competitions is willing to win. However, the goal of dressage is to develop a horse towards its natural athletic ability and willingness to perform, thereby maximizing his potential as a riding horse. Since dressage is often named to be the gymnastic basis of equestrian sports. During training the horse is gaining skills of which it can rapidly respond to the riders aids by performing the requested movement while remaining relaxed and appearing effortless. With this execution of certain exercises the horse is trained towards the goal of the rider. (KNHS, 2008)

Higher ethogram scores mean that the horse will show more disturbance during the dressage course. To explain the fact that this may lead to higher dressage scores it is necessary to look through the eyes of a dressage judge. A judge criticize every component of a preset floor pattern during a dressage test. More misbehaviours of the horse would then lead to a lower score in dressage. Moreover, when a horse shows a little more attitude during a dressage test this may lead to more expression during the course. With the risk that more exercises go wrong, but the exercises which are normally going well might become outstanding when the horse shows a little more character.

During this study participants were asked to perform a dressage test on their own current level. Performers are confronted with series of physical, technical and tactical psychological demands not only before, but also during and after competitive sport activities (Gaudreau and Blondin, 2004). Competitive sports have the ability to, in this way, cause anxiety and fear (Smith and Smoll,1990). Competitive anxiety changes over time and during different competing conditions (Caruso *et al*, 1990). Since the rider is able to learn more about their level of precompetitive anxiety or becoming more able to deal with their feelings and the way the horse reacts to this physiological changes. Dressage horses are trained to be very sensitive to riders aids. In this way, the rider van communicate with the horse as invisible as possible (von Borstel *et al*,2010). The communication between horse and rider is of great importance since the combination is judged on the harmonious appearance of their performance. As the horse is highly developed in reading the body language of the rider, it is important for the rider to understand the body language of the horse. This to prevent miscommunications in such way that the horse understands the meaning of the riders aids (Brandt, 2004).

This might have something to do with the way athletes interpret the equine temperament. A study of Wolframm and Micklewright (2010) stated that the perception of equine temperament traits such as \`excitable´, ´temperamental´ and ´spirited´ seemed to release an increase of arousal intensity and its interpretation. For dressage riders this means that the perception of active horses may lead to an increase of somatic anxiety. Next to an increase in arousal, a more active horse may also lead to greater physical effort to maintain in control of the horse. This would mean that a more active and expressive horse also causes more anxiety during a dressage course. It then becomes of importance for the rider to find a balance between facilitative arousal during a dressage test and still maintain an active and expressive horse. It is the riders task to use anxiousness of the horse for different types of work.

7.7 CSAI-2R questionnaire

As all participants of the current study filled in a CSAI-2R questionnaire to measure anxiety. Not only somatic and cognitive anxiety were measured but also self confidence. The questionnaire also gives the opportunity to measure the interpretation of anxiety.

The current study shows that there was found a strong negative correlation between heart rate values and the interpretation of the intensity of somatic anxiety. Which means that rider interpret the direction of somatic anxiety as debilitative when they are experiencing an increase in heart rate.

Furthermore, there was a positive correlation of heart rate values associated with a higher level of appreciation for the direction of somatic anxiety. This can be supported by Micklewright and Wolframm (2010) which stated that the intensity of pre-competitive cognitive and somatic anxiety influences equestrian performance. However, the greater the intensity of cognitive and somatic anxiety, the less facilitative these symptoms were experienced by riders.

As a high level of anxiety and debilitative feelings proved to be of negative influence on performance (Micklewright and Wolframm (2010). It can be suggested that it is necessary for the rider to train pre-competitive arousal in such way that the anxiety is under control, this in order to improve equine performance. When the rider is able to find a balance of facilitative arousal during a dressage course, the performer will become more able to ride a movement, react to the horses' behaviour in an appropriate way and execute the right aids. At last, a better balanced rider may prevent obstructions between horse rider communications.

This preliminary research still had some limitations, which makes it more difficult to find statistically significant values. At first this is an exploratory study, for that reason the nearing significant correlations were also taken into consideration. Furthermore, the limited number of riders might have influenced the outcomes as well. A larger sample group might have an different influence on the results. Next to this, the software used had never been used for this purpose before, creating a challenge to record all the physiological symptoms effectively. Finally, finding significant results regarding solely symptoms like heart rate and muscle tension and the behaviour of the horse, as it was influenced by the fact that data was collected during exercise.

It is recommended to use the results of the current study during sport psychology lessons. Nevertheless, it might also be used individually by riders and trainers from different facets of equine sports. It is necessary for the rider to find a balance between being focussed and alert next to an excessive level of arousal. This balance will help the rider to optimize the horse-rider interaction and subsequently will increase performance. In order to create and maintain this balance, training of cognitive processes can be useful. Similarly to other skills, it will take regular training sessions in order to reach cognitive processes that are helpful with regards to performance.

During training more attention should go to the thoughts and feelings of the rider. Also, the physiological signs of arousal should be taken into account. Parts of the training session can be focussed on the prevention of loosing focus or the increase of the level of arousal. For the trainer it is important to make the rider aware what an increase of arousal might do with the horse-rider interaction. Since, it is often not noticed by themselves. Whilst working on the rider’s individual difficulties and improve of horse-rider interaction will occur, and subsequently the performance will increase.

8 Conclusion

The statistical differences found might have a great impact on riding performances of individual riders. The hypothesis that the riders becomes more tense prior to and afterwards the horse misbehaviour can be rejected. Since the significant correlation of skin conductance showed a slight moment of relaxation in the rider prior to and after the horse misbehaviour. Which indicated that as soon as the rider looses attention, the horse takes the opportunity to act our on its own. For the rider this means that it is important to find a proper balance between facilitative arousal and pre competitive anxiety. Where to much anxiety can influence the riders ability to correctly submit the aids towards the horse. Facilitative arousal, on the other hand, makes the rider more able to stay alert and focussed on the performed ride.

A second interesting finding is the statistical significant correlation between ethogram scores and dressage scores. More specifically, a horse which shows more action and expression during the test will receive higher dressage scores. In practice, this is probably caused by the fact that overall more small mistakes are made. However, the movements which are correctly executed are graded with high marks.

Summarized, results indicate the importance for a rider to maintain alert and focused at all times whilst riding a horse. However, existing literature found an excessive level of arousal to be debilitative for performance as well. In order to optimize the horse-rider interaction and subsequently equine performance, a balance between alertness and focus and an excessive level of arousal should be found.

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10 Annex

10.1 Table 1 Correlations between CSAI-2R and average psychophysiological values (Pearson correlation, $p < 0.05$)

10.2 Table 2 Correlations between ethogram scores and dressage scores (Pearson correlation, $p < 0.005$)

10.3 Table 3 Differences in skin conductance between prior to and after a horse misbehaviour and average values (one-way ANOVA,$p < 0.05$)

10.4 Table 4 Differences in skin conductance between prior to and after a horse misbehaviour and average values(t-test, $p < 0.05$)

10.5 CSAI-2R

10.6 Ethogram of dressage test

10.1 Table 1 Correlations between CSAI-2R and average psychophysiological values (Pearson correlation, $p < 0.05$)

10.2 Table 2 Correlations between ethogram scores and dressage scores (Pearson correlation, $p < 0.005$)

Correlations

	HRaverage	MTaverage	SCaverage	Tempaverage	Dressagescore	Percethogram		
HRaverage	Pearson Correlation	1	,169	-,077	-,014	,238	,341	
	Sig. (2-tailed)		,516	,768	,957		,359	,181
	N	17	17	17	17		17	17
MTaverage	Pearson Correlation	,169	1	,006	,456	-,275	-,185	
	Sig. (2-tailed)	,516		,983	,066		,286	,476
	N	17	17	17	17		17	17
SCaverage	Pearson Correlation	-,077	,006	1	,093	,013	,088	
	Sig. (2	,768	,983		,723	,960	,736	

Correlations

		HRaverage	MTaverage	SCaverage	Tempaverage	Dressagescore	Percethogram	
HRaverage	Pearson Correlation	1	,169	-,077	-,014	,238	,341	
	Sig. (2-tailed)		,516	,768	,957		,359	,181
	N	17	17	17	17		17	17
MTaverage	Pearson Correlation	,169	1	,006	,456	-,275	-,185	
	Sig. (2-tailed)	,516		,983	,066		,286	,476
	N	17	17	17	17		17	17
SCaverage	Pearson Correlation	-,077	,006	1	,093	,013	,088	

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• N• 17• 17• 17• 17• 17 N		17	17	17	17	17	17
Tempaverage	Pearson Correlation	-,014	,456	,093	1	,002	,007
	Sig. (2-tailed)	,957	,066	,723		,994	,980
	N	17	17	17	17	17	17
	Pearson Correlation	,238	-,275	,013	,002	1	,605*

	Sig. (2-tailed)	,359	,286	,960	,994		,010

Correlations

	HRaverage	MTaverage	SCaverage	Temperage	Dressagescore	Percethogram		
HRaverage	Pearson Correlation	1	,169	-,077	-,014	,238	,341	
	Sig. (2-tailed)		,516	,768	,957		,359	,181
	N	17	17	17	17		17	17
MTaverage	Pearson Correlation	,169	1	,006	,456	-,275	-,185	
	Sig. (2-tailed)	,516		,983	,066		,286	,476
	N	17	17	17	17		17	17
SCaverage	Pearson Correlation	-,077	,006	1	,093	,013	,088	

• N• 17• 17• 17• 17• 17• 17• • Percethogram• Pearson Correlation• ,341• -
,185• ,088• ,007• ,605*• 1• • • Sig. (2-
tailed)• ,181• ,476• ,736• ,980• ,010• • • • N• 17• 17• 17• 17• 17• 17• • *. Correlation
is significant at the 0.05 level (2-tailed).• •
N

10.3 Table 3 Differences in skin conductance between prior to and after a horse misbehaviour and average values (one-way ANOVA,$p < 0.05$)

Multivariate Tests[b]

Effect• Value• F• Hypothesis df• Error df• Sig.• Partial Eta Squared• • factor1• Pillai's
Trace• ,719• 10,218[a]• 2,000• 8,000• ,006• ,719• • • Wilks'
Lambda• ,281• 10,218[a]• 2,000• 8,000• ,006• ,719• • • Hotelling's
Trace• 2,554• 10,218[a]• 2,000• 8,000• ,006• ,719• • • Roy's Largest
Root• 2,554• 10,218[a]• 2,000• 8,000• ,006• ,719• • a. Exact statistic• • b. Design: Intercept

Value

Multivariate Tests[b]

Effect• Value• F• Hypothesis df• Error df• Sig.• Partial Eta Squared• • factor1• Pillai's Trace• ,719• 10,218[a]• 2,000• 8,000• ,006• ,719• • • Wilks' Lambda• ,281• 10,218[a]• 2,000• 8,000• ,006• ,719• • • Hotelling's Trace• 2,554• 10,218[a]• 2,000• 8,000• ,006• ,719• • • Roy's Largest Root• 2,554• 10,218[a]• 2,000• 8,000• ,006• ,719• • a. Exact statistic• • b. Design: Intercept

Value

b. Design: Intercept

Within Subjects Design: factor1

10.4 Table 4 Differences in skin conductance between prior to and after a horse misbehaviour and average values(t-test, $p < 0.05$)

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean

Pair 1

•

10.5 CSAI-2R Questionnaire

10.6 Ethogram of dressage test

Resistance to riders aids (verzet)

1 Willing to work, reacts immediately to riders aids, tail swings loosely, ears relaxed
2 Short delay to riders aids, some minor resistance such as ears flicking, tail swish
3 Delay to riders aids, show of resistance through tension of neckline, big periods of tail swishing
4 Extreme resistance to riders aids through; running, stopping, bucking or rearing.

Rider behaviour

1 Rider sits quietly, quietly insisting that the horse obeys.
2 Rider increases force of aids (short kicks with legs, obvious half halt)
3 Rider uses the whip to reinforce aids, obvious use of seat.
4 Rider uses hands, legs, seat and whip together, appears hectic and forceful.

Head shaking

1 Horse shows steady head carriage, contact with the reins is consistent and steady.
2 Horse shows mostly consistent head carriage with intermittent loss of contact due to head shaking The head shaking displayed is noticeable but does not severely disturb the overall picture.
3 Head shaking of the horse is disturbing to the overall picture and results in regular loss of rein contact.
4 No consistent rein throughout the entire test with no steady head carriage

Tail sweeping

1 The tail of the horse swings loosely.
2 The tail of the horse shows slight movement throughout the test.
3 The tail of the horse shows great movement. A lot of tail swishing throughout the entire test. The horse shows tension in the back for some periods in the test.
4 Continuous swishing of the tail, which causes tension in the back.

- 23 point in a dressage course are judged by these 4 points. At the end of the course the figures are added up and the horse gets a total score. The highest receivable score is 368.
- Of each part of the test where the horse scores a 4. The data of the rider is checked: 5 seconds before the start of the exercise and 5 seconds after the end of an exercise.