AAIZOO

stichting voor
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in Zorg, Onderzoek en Onderwijs

Bachelor Thesis

by

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The effect of disabled children and adults on horse's heart rate variability during therapeutic horseback riding

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Program: Animal Husbandry

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Statutory Declaration

I herewith declare that I have developed and written the enclosed thesis entirely by myself and making use only of the specified literature and aids. Any thoughts or quotations which were inferred from these sources are clearly marked as such. This thesis was not submitted in the same or in a substantially similar version, not even partially, to any other authority to achieve an academic grading and was not published elsewhere.

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Abstract

Today, increasing numbers of therapeutic equine facilities are available for the public and a lot of research is done about the beneficial effects for the client, mostly regarding the positive physical results. But a lack of information can be found about the effect of Equine-Assisted Therapy on the horse. Limited research is done about how the work performed by the horses might affect the well-being of the horse.

This exploratory study was designed to investigate the influence of disabled children and adults on the horses' heart rate and heart rate variability during horseback riding in comparison to a recreational rider. Heart rate (HR) and Standard deviation of the beat-to-beat Interval (SDRR) of 12 therapy horses in two different stables were assessed.

The recreational rider caused a significantly smaller SDRR compared to the disabled riders, concluding that the activation of the sympathetic system was initiated. Reason for this could have been that the recreational rider knows how to ride a horse and possibly follows a certain pattern during riding, more is asked from the horse subconsciously. Additionally, findings suggested that the longer the horse was used in therapy, the bigger the variance of the beat-to-beat interval. Concluding the parasympathetic branch predominated, the horse was more relaxed.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND DEFINITIONS

AAI	Animal-Assisted Interventions
AAA	Animal-Assisted Activities
AAT	Animal-Assisted Therapy
EAI	Equine-Assisted Interventions
EAA	Equine-Assisted Activities
EAT	Equine-Assisted Therapy
ANS	Autonomic Nervous System
PNS	Peripheral Nervous System
CNS	Central Nervous System
PSNS	Parasympathetic Nervous System
SNS	Sympathetic Nervous System
HRV	Heart Rate Variability
HR	Heart Rate
RR or IBI	Cardiac beat-to-beat Interval or Interbeat Interval
SDRR	Standard deviation of mean value RR interval
RMSSD	Root mean square of successive RR differences
PNN50	Percentage of beat-to-beat Intervals greater than 50 ms.
SD1	Deviation of the scatterplot in the "short" direction
SD2	Deviation of the scatterplot in the "long" direction
LF	Spectral power in the Low-Frequency range between 0.04 and 0.15 Hz.
HF	Spectral power in the High-Frequency range between 0.07 and 0.60 Hz. This Frequency band usually includes the respiratory Frequency
LF/HF	Relation of Low-Frequency Power to High-Frequency Power

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1. INTRODUCTION

A horse is the projection of peoples' dreams about themselves

–

strong, powerful, beautiful - and it has the capability of

giving us escape from our mundane existence.

~Pam Brown~

Pam Brown found excellent words to worship the horse which gives us this extraordinary opportunity to experience different. The horse is prominent in all facets of life; it has played an important role in transportation, agriculture, and war throughout history. Horses have had a long relationship with humans and since the 1960´s the popularity of interventions with animals, especially horses, for therapeutic purpose has grown to worldwide attention (Fine, 2000). The Danish Lis Hartl († 2009) won in 1952 and 1956 a silver medal at the Olympic Games, although she suffered from Poliomyelitis (polio). Luckily, up to the knees most of her muscle reactivity recovered through physiotherapy and horseback riding. Her great success therefore triggered the interest of health professionals around the world. (Stable Life, 2009; Jones, 2009). Increasing numbers of therapeutic equine facilities are available for the public and a lot of research is done about the beneficial effects for the client, mostly regarding the positive physical results. Worldwide people of all ages benefit from Equine-Assisted Interventions irrespective of suffering from physical or mental disabilities or not.

Actually, these disabilities do not limit humans from interacting with horses: A lot of research shows that patients with physical needs often show improvement in flexibility, balance and muscle strength, while patients with a mental handicap improve power of concentration, learning aptitude and exposure to emotions. But a lack of information can be found about the effect of Equine-Assisted Interventions on the horse.

This research was carried out on behalf of the AAIZOO Foundation who shares and supports knowledge, research and education in the field of animal assisted Interventions in the Netherlands (AAIZOO, 2011). One of the foundations' objectives is to ensure the welfare of horses used in Equine-Assisted Interventions. Facing these facts, the following research was carried out to identify if changes in Heart rate variability can be detected by disabled individuals compared to a recreational rider.

1.1 Problem definition

Limited research is done about how the work performed by the horses might negatively affect the well-being of the horse. Animal right activists claim that horses used in Equine-Assisted Therapy (EAT) are highly stressed out and suffer from poor welfare. According to Fine (2006), it is proven that therapy animals can suffer from chronic stress through incorrect or over use of the horse during the session and in combination with too less breaks. Kaiser et al. (2006) suggests that horses used for therapeutic riding is more stressful being ridden by at-risk children (who are endangered as from exposure of familial guidance) than by physically or psychologically handicapped persons and recreational riders based on behavioural analysis. Taking this into account, the question rises if the horse is suffering from stress during therapeutic riding sessions and if the welfare of the horse is negatively influenced compared to recreational riding. Further, can the influence be measured by means of physiological events, e.g. Heart Rate and Heart Rate Variability. Taken all this into account this study explores the influence of the disabled and recreational rider on the therapy horse.

1.2 Research Objective

This pilot case study aims to investigate the influence of disabled children and adults on the horses' heart rate and heart rate variability as a measure of stress in comparison to a recreational rider during therapeutic horseback riding.

1.3 Research Question

Main questions:

- Is there a difference in the heart rate of a horse when ridden by disabled rider in comparison to recreational riders during therapy sessions?

- Is there a difference in the standard deviation of the beat-to-beat interval of a horse when ridden by disabled rider in comparison to recreational riders during therapy sessions?

Sub questions:

- Does the age of a horse influence the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

- Does the breed of a horse influence the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

- Does the months used as a therapy horse influence the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

- Does the age of the participant and months taking part as participants Therapy influence the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

- Does the age of a horse associates to the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

- Does the gender of a horse associates to the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

- Does the months used as a therapy horse associates to the horses' HR/SDRR when ridden by disabled rider or a recreational rider?

2. LITERATURE REVIEW

2.1 Animal-Assisted Interventions

In human history animals and humans are already bonded for a long period. Without a doubt it is justified that the domestication and the using of animals in agriculture positively influenced the development of the human race. Therefore, it is no surprise that after keeping animals in zoos; Dogs and cats, for instance, became rapidly loved pets. The first use of an animal for therapy is registered in 1972 in England and was the beginning of a new therapy form (Netting et al., 1987). In various forms of therapy, animals have been used to exemplify characteristics and qualities to motivate and engage humans for participating in activities. (Levinson, 1962). Research has shown that humans suffering from distress associated with loss, alienation, trauma and other imbalances shown a better curing by bonding with companion animals (Christian, 2005; Levinson,1962) as well as physiological benefits (Barker and Wolen, 2008) such as a lowered blood pressure and sensitivity. In addition, Morrison et al. (2007) stated that animal-assisted therapy enhanced cognitive, psychological, social functioning whereas blood pressure, Heart rate and levels of anxiety declined. Furthermore, companion animals for therapy have been used in prisons, institutions (Barker and Dawson, 1998) and schools (Serpell, 2004). Often regarded as the creator of animal-assisted interventions for children, Boris M. Levinson, American child psychotherapist, described in the 1960s the benefits that his dog brought to his counselling sessions with children and young adults, and provided many case studies of ways in which animals could enrich therapy (Fine, 2000).

Introduced the origin and use of Animal-Assisted Interventions, subsequently the descriptions of further AAI concentrations follows.

2.1.1 Definitions of Animal-Assisted Interventions (AAI)

According to Fine (2006) Animal-Assisted Interventions (AAI) are therapeutic processes that involve the use of trained animals in a range of activities or interactions with people that are intended to meet set goals. AAI assists maintaining mobility and improves co-ordination. People learn transferrable skills to help them in daily life and receive unconditional attention by the animal. But how do animals help humans? The value of Animal-Assisted Interventions is based in the relationship that develops between the patient and the animal; it can only be explained that the unambivalent nature of the exchange of love and friendship between animals and humans differs from the interaction with family and other human beings (Barker and Wolen, 2008). LaJoie, (2003) as cited in Kruger et al. (2006), found 20 different definitions of Animal-Assisted Therapy and 12 different expressions for the same event (e.g., pet therapy, pet-facilitated therapy, animal-facilitated counselling, four-footed therapy, pet-oriented psychotherapy, companion-animal therapy, co-therapy with animals, etc.) and therefore, confusion results within as well as outside the field, asking for standardization of terminology. One of the biggest organizations for certification of therapy animals in the U.S., has published the following commonly accepted definitions:

Animal-Assisted Activity (AAA):

Animal-Assisted Activity (AAA) is done by animals that meet specific criteria within a variety of surroundings. Volunteers and trained animal professionals as well as paraprofessionals support AAA in several ways as for instance, motivational, educational, recreational, and/or therapeutic issues to enhance quality of life or to reintegration to society. AAA is not required to reach specific treatment goals and the attending is spontaneous and therefore a therapist does not need to attend the session.

As soon as the activities have therapeutic goals, a therapist needs to attend and measure the process (Dieren in Zorg en Welzijn, 2011; Delta Society, 2011)

Animal-Assisted Therapy (AAT):

AAT is a treatment with the support of a specially trained animal directed by a therapist and trained animal professionals. The treatment focuses on reaching specific goals measured by therapeutic process for the participant.
With so much research done on AAI with benefits for the patient, a thorough evaluation is missing to what extend the therapy affects the animal welfare.
Unfortunately, little attention is paid to what the program may be doing for the animals. One reason is that animal research is often less subsidised than human research because human research contributes to our human existence and welfare, and is therefore in the latter of importance higher rated. Also human research methods are more developed than in animal research, whereat an important reason could be that humans communicate different to animals; they are able to speak, understand and be easier in control in comparison to animals. Animals communicate through body language and this is most of the times difficult to interpret and to work with this kind of population since animals cannot clearly state how they feel in regards to all kinds of research subjects and methods.

2.1.2 Critique on AAI

Serpell, Coppinger and Fine (1999 cited in Hatch , 2007, p.38) stated that there is "the high potential for inhumane or inappropriate training methods used on therapy or service animals. They also argue that many therapy and service animals are placed in positions in which they cannot avoid or escape unpleasant social intrusions that may have an adverse effect on their physical and mental well-being." Also Hatch (2007) stated that "recent sociological work affirms that animals are minded actors with distinct selves and the ability to feel and display a range of emotions . These findings raise concerns about the potential emotional and mental harm to the animals involved in AAT/AAA (i.e., stress, fear and discomfort) and whether the animals enjoy participating. Ideally, AAT/AAA programs should benefit the animals as well as the humans involved." It is therefore important to keep animals safe from inappropriate patient behaviour and accidents.

2.2 Equine-Assisted Interventions

Having covered the broad animal section, the chosen study subject, the horse assisted interventions and its specializations, are explained.

Evolving over the past 55 million years (Florida Museum of Natural History, 2009), horses have played a huge role in the development of the human race, for instance, using horses for means of transportation and agriculture. The Greek, Xenophon (355 B.C.), historically handed down the first art of horsemanship with highlighting educative aspects of horseback riding for the rider (XENOPHON e.V., 2011). The first record of the health effects of horses on humans was recorded Around the 5th century B.C when Hippocrates in ancient Greece already stated the "beneficial rhythm" of horseback riding and the increasing of the self-image in one of his writings in a chapter on 'Natural Exercise'. Also the German Johann Wolfgang von Goethe (1749-1832) recognized the horse as "human and horse become one, you are not able to state who teaches who" and indicated medicinal benefit of horseback riding (DKTHR, 2011).

2.2.1 Different forms of Equine-Assisted Interventions (EAI)

The term EAI is defined here as any therapeutic intervention that includes horses as part of the therapeutic process. Worldwide Equine-Assisted Interventions and the positive effects become more prominent, especially after 1952 when disabled Lis Hartl († 2009) won the silver medal at the Olympic Games, despite having used a wheelchair since 1943.

As the first and only International Federation the FEI administered and created a sport especially for disabled riders. Since 1996 para-equestrian Dressage is the only equestrian discipline accepted to the Paralympic Games (FEI, 2011). The dealing with horses are proven to be highly conducive, such as horseback riding has an effect on the locomotion system of humans as the rider’s body is moved similar to the human gait. Precisely, the horse's pelvis has a similar three-dimensional movement to the human's pelvis at the walk. Also Individuals with central nervous system disorders made successfully use of Equine-Assisted Interventions (All et al., 1999; Baas et al., 2009; Sterba, 2007).

Equine Assisted Activities (EAA)

Volunteers and trained equine professionals promote mental health through facilitating human-equine interaction in a variety of equine assisted activities, including therapeutic riding, driving, and vaulting. These are sport and recreational activities that have therapeutic value, but no therapeutic goals are set by a licensed therapist. Riding skills are taught along with games and activities incorporated into the lessons to enhance skills, balance, coordination, communication, strength and problem solving.

The most common form of EAA is **therapeutic riding** which covers horse-related activities for individuals and is used to stimulate disabled persons. It helps them improve their lives through better balance and coordination, overcome fears, build up trust, respect, compassion, develop communication skills, problem solving & coping techniques, improved respiration, circulation, body metabolism along with greater muscle strength, reduced muscle spasticity increased self-confidence through improved self-image, improved learning, concentration and last but not least more independence. Therapeutic horseback riding permits the rider to learn how to ride the horse with such skills as the use of aids (Marzcak et al., 2001). Further, the recreational nature of therapeutic horseback riding is a source of hope for disabled people due to leaving of clinical setting and enjoyment being able to leave the bonds of their disabilities. With the help of the horse, they can reach a sort of independence.

In regards to the terminology if therapeutic riding belongs to EAA it can be said that this form of Equine-Assisted Intervention needs a therapeutic riding instructor, but not a therapist. Therefore, in this research it correspondents to the definition of Delta Society about Animal-Assisted Activities (Delta Society, 2011).

Equine-Assisted Therapy (EAT)

Equine-Assisted Therapy (EAT) is a form of therapeutic intervention, in which specially trained horses are used as tools to support activities facilitated by a licensed therapist.

The forms of EAT are:

- **Hippotherapy and wagon-bed riding**

Hippotherapy has its origins from the Greek word "hippo" which means horse and therefore means "treatment with the horse's help". Hippotherapy is a rehabilitation strategy which is done by a Therapist who has been specially qualified to use traditional techniques such as neurodevelopmental treatment and sensory integration along with the movement of the horse to facilitate improvements in the patient. It does not teach the client how to ride the horse (American Hippotherapy Association, 2005).

Wagon-bed riding may be considered as a special kind of Hippotherapy. The wagon is a steel construction pulled by two specially educated horses. The patient is placed in supine position on the canvas, which is stretched over the backs of the horses, in the

slight hollow between the horses. It enables the severely disabled people to move and so alleviate complaints.

In Literature, misunderstanding often arises between the terms Hippotherapy and therapeutic riding because a clear global definition does not exist. Therefore, the table below is used for clarity. For the purposes of this report, the term "therapeutic riding" is used.

Table 1: Difference between Therapeutic riding and Hippotherapy (Source: Champagne, 2011)

Therapeutic riding	**Hippotherapy**
Adapted teaching for riding skills with possible progression towards independent or competitive riding goals.	A medical treatment.
Educational and recreational with possible improvement.	Specific treatment goals with outcome measures and reassessments.
Group or individual sessions.	Individual session.
Horse is led, lunged or ridden independently.	Horse is led or long-lined.
Usually with a saddle.	Sheepskin or flat pads, occasionally a saddle.
Horse is chosen for height, gait and temperament matched to the rider.	Horse is chosen for its appropriate gait and conformation.
Rider or leader influences the horse.	Horse facilitates the movement of the rider who has no control of the horse.

- **Equine Facilitated Psychotherapy**

Equine Facilitated Psychotherapy is an experiential psychotherapy that uses horses to assist people with mental disorders, behavioural problems and people who experience major life changes as divorce, loss or trauma. It does not necessarily have to ride on the horse. It may include activities such as grooming, driving, lunging and vaulting and often results in less anxiety or fear and more self confidence in the patient (Equine Facilitated Mental Health Association, 2008).

2.2.2 Preliminary research on Equine-Assisted Interventions

To underpin the positive effect of Equine Therapy, improved behaviour and reduced recidivism in inmates was the result of work programs using horses in a prison for the past 18 years (Wise, 2003). Trotter et al. (2006) stated that Equine assisted group counselling participants' social behaviour ratings improved with increases in positive behaviours and decreases in negative behaviours by high risk students.
More findings suggest that EAAs support the development of positive interactive behaviours and reduce the display of negative behaviours in children with mild learning disabilities and therefore, could be used to aid in their social education (Braat, 2008)
Håkanson et al. (2007) stated that Equine-assisted treatment reduced level of pain in patients suffering from back pain and positive effects were observed with an influence on the patients' self-image. Hameury (2009) stated that autistic children highly benefit by developing communication and social skills, and cognitive-emotional regulation from EAT.

To date, literature about equine therapy has not being successful is rare, but although most studies shown a benefit or an improvement, other studies may have not shown an animal-related effect. An important issue considered for most patients is that riding the horse is a huge issue of trust - they must be willing to trust the horse before therapy can be successful. Patients who may be unwilling or unable to form a positive relationship to the horse may not benefit the advantages of Equine-Assisted Interventions.

Having covered the topic Animal-Assisted Interventions, one critique point in the literature is that the animals may experience stress. An overview of Stress and their different types and causes will be discussed further in the following chapter.

2.3 What is Stress for an animal?

Most authorities measure welfare with the help of the Five Freedoms of Brambell :

1. Freedom from hunger and thirst; includes giving an appropriate diet.
2. Freedom from discomfort; availability of hiding options and resting place.
3. Freedom from pain, injury and disease; though prevention and/or fast treatment.
4. Freedom to express normal behaviour; and to socialize with same species.
5. Freedom from fear and distress; includes enough rest time and a good mental and physical condition.

These five statements are seen as the minimal standard needs of an animal and are the basis of working and living together with animals. Nevertheless not all of them are always executed and receive consideration and therefore, some animals may experience (chronic) stress.

2.3.1 Definition of stress

Björk, (2008) as cited in Sjaastad et al., (2003), stated that stress is in general still missing a clear definition and therefore has many characterizations and is caused by internal (e.g. depression) and/or external (e.g. leg injury) circumstances. Table two states the different types of stress.

According to the Committee on Pain and Distress in Laboratory Animals (1992) stress is defined as a reaction to a threatening factor that requests emotional, physical or mental integrity of an individual. Stress is not always undesirable as some stress probably is necessary for well-being, but good stress is not the same as bad stress (Seyle, 1974). (see table 2)

Table 2: Types of stress (Source: Committee on Pain and Distress in Laboratory Animals, 1992)

Types of stress	**Definition**
Eustress	Eustress is one of the helpful types of stress. Eustress prepares the muscles, heart, and mind for the strength needed for the start of jumping a course or a trotting race. When the body enters the fight or flight response, the eustress prepares the body to fight with or flee from an imposing danger. If the event or danger passes, the body will eventually return to its normal state.
Distress	The animal is unable to adapt completely to the stress factor and shows maladaptive behaviour, for instance, self-biting, crib-biting, repetitive stereotyped movements as weaving.
Acute Distress	Acute stress is the type of stress that comes immediately with a change of routine. It is an intense type of stress, but it passes quickly.
Chronic Distress	Chronic stress will occur if there is a constant change of routine for week after week. Chronic stress affects the organism for a long period of time.
Hyperstress	Hyperstress is the type of negative stress that comes when the organism is forced to undertake more than it can.
Hypostress	Hypostress stands in direct opposite to hyperstress. Hypostress is basically insufficient amount of stress. That is because hypostress is the type of stress experienced by an organism that is constantly underused.

2.3.2 Causes of stress

After a stress causing (i.e. physical, environmental or psychological) factor interrupts homeostasis, the body pursues to restore the condition of comfort (Seyle, 1936) which is commonly known as coping intent. Tables three describes the different forms of stress causes.

Examples of Potential Stressors

Table 3: Causes of Stress (Source: Committee on Pain and Distress in Laboratory Animals, 1992)

That Cause Physiologic Stress	**That Cause Psychologic Stress**	**That Cause Environmental Stress**
Injury	Fear	Restraint
Surgery	Anxiety	Noise
Disease	Boredom	Odours
Starvation	Loneliness	Habitat
Dehydration	Separation	Ecology
		People
		Other species
		Chemicals
		Pheromones

Knowing the types and causes of stress, more insight is given on how horses react on stress during Equine-Assisted Interventions and how in general coping and habituation to external stimuli is ensured by an individual.

2.3.3 Stress in horses used for EAI

For housing of therapy horses the same law appears as for competition or recreation horses. But there exists no specific framework/outline of training of a therapy horse, considering this as an important point. Identifying stress and their factors, thus reducing or teaching it during training, the welfare of the horse can be ensured (McLean, 2004).

Especially during therapy session, disabled children are more unpredictable of behaviour than healthy children, and therefore the horses that are not specifically trained for EAA, might react in an unpleasant way if the child is nervous or starts screaming on the horse. The "trauma" of this happening would affect both parties and is careless. Horses are one of the few prey animals used for therapy. In case of stress, this animal will flee and can harm the patient as well as oneself (Frewin et al., 2005). Not all unforeseen environmental changes initiating stress responses are negative; they also have positive effects on the horse according to Breazile (1987).

Furthermore, stress-related disorders are associated with the missing knowledge on the psychology of the horse (Miller, 2001 cited in Rietmann et al., 2004, p. 121) shortages may be found in housing, feeding, training, trailer loading, transport and handling, which result in a lower performance capacity and health of the horse (Rietmann et al., 2004).

A research carried out by Minero et al. (2006) compared reactions of 4 jumping horses and 4 therapy horses to two challenges by collecting data of Heart rate (HR), heart rate variability (HRV) and behaviour. The authors concluded that there is no difference between therapy and jumping horses to new stimuli and therefore, these findings should be considered while planning the everyday training and therapy work.

Particularly as there is no homogeneous framework, there is a strong need of formulating guidelines and standards for the training of therapy horses and certification for suitability of therapy horses as seen with guide dogs (International Guide Dog Federation, 2011).

To judge stress is hard or even impossible without physiological determinations. Behavioural observation allows too much room for multiple interpretations. It is even difficult to define if humans are stressed and how stressed they are. Even people cannot tell when their friend is stressed out. Then, surprisingly the friend disappears and commits suicide. How can we identify stress in horses if humans even cannot realise it in their own kind (Nock, 2010)?
For this reason the method of Heart rate variability (HRV) which is a proven technique in humans to evaluate training, overtraining, and fatigue, is applied in this research.
It is important to mention that HRV also has been used in farm animals to assess pain, stress, and risk of death and is therefore suitable.

Several studies proven the benefits of EAT for humans, but missing to research the horses' comfort or discomfort as therapeutic tool. Animal right activists claim that horses have a lot of stress due to the patient's disability, although Heleski et al. (2010) stated that therapeutic horseback riding based on behavioural analyses is not more demanding than traditional lessons counting for horses which are used to both types of riding. Another research conducted by Kaiser et al. (2006) stated that there was no significant difference in stress related behaviour of the horse between recreational riding and therapy session with psychometric disabled children. However, the study of Suthers-McCabe (2004) indicated that 5 of 28 therapy horses did experience significant physiological stress measured by the behaviour during therapy session and plasma cortisol pre- and post-therapy session.
According to the NARHA (2010), the need to strengthen the welfare of horses used in Equine-Assisted Therapy has increased since this kind of therapy growths in acceptance. Equine well-being is more and more essential for horse owners, students, horse associations and ministries but still knowledge on behavior and psychology of the horse is missing for engaged parties in the equine industry (Miller, 2001). Especially, lack of knowledge can be found regarding horses used for therapeutic purposes.
Limited research is done about how the work performed by the horses might negatively

affect the well-being of the horse. However, Kaiser et al. (2006) suggests that horses used for therapeutic riding is more stressful being ridden by at-risk children than by handicapped and recreational riders based on behavioural analysis. But is the horse influenced by disabled people during therapeutic horseback riding compared to a recreational rider?

Facing these findings, coping and habituation of an animal to stress factors will be discussed in the following chapter.

2.3.4 Coping with stress

After a stress stimuli experienced, the restoring of comfort goes along with changes in neuroendocrine action, psychology and behaviour of the animal. Withdrawal from a normal level of neuroendocrine action can come into consideration as an indication of stress. Neuroendocrine alterations might be so serious that weakening of the animal's condition to dysfunction or disease can occur, though the behaviour might not be different (Committee on Pain and Distress in Laboratory Animals, 1992). Further, the intensity of these changes is influenced by the animals' age, sex, experience, genetic profile and present physiologic and psychological condition.

Keeling and Jensen (2002) pointed out that facing the possible damage of stress it is important to know if the animal can predict and regulate to stress causes with the exerted active mental effort, whether or not the setting is perceived as threat and the stress is harmful or not. If the animal cannot deal with the stress, it is normally expressed by a coping behaviour. Consequently, as successful coping is not possible, performance problems and stress-related sicknesses may be found (Stauffacher, 1992 cited in Rietmann et al., 2004, p. 122). Underpinning these findings, Bachmann et al. (2003) stated that crib-biting horses, which had shown performing the stereotypy crib-biting between 10.4 and 64.7% of their stabling time, might be more stress sensitive compared to the non-crib-biting horses.

Therefore its recognition of the effects of experiencing stress is decisive to the welfare of an animal (Moberg, 1987). The adaption of the stress response is essential for learning and developing effective behaviour to reach comfort again (Committee on Pain and Distress in Laboratory Animals, 1992).

In history, stress has highlighted physiologic characteristics but variances among physiologic measures in the relation to stimuli has among scientists led to conclude that stress is a not a separate defined physiological condition (Moberg, 1987) but nevertheless remains as a general term; it helps to identify, define and sum up important sensations. Therefore as in this case study, the assessment of stress responses with only the cardiovascular parameter is still tricky as other behavioural (e.g. coping intent) and physiological components (e.g., fatigue, muscular tension) participate as well.

Habituation to external stimuli

Acoustical stimuli is a potential stressor to animals depending on the intensity, type and habituation, it is a potential source of fear for animals which can rise or lower the animals's HR (Algers et al., 1978). Wilkin (1993) has shown that the unborn child in the womb reacts with a decelerated HR on human voice or classical music whereas the HR rises by acoustical excitabilities as loud noise. A rise in HR through acoustical stimuli was found in red deer (Price et al., 1993). The repetition of external stimuli shown often a habituation effect in the HR- reaction whereas a fast stimuli repetition is often attended by a fast habituation counting for auditory and visual stimuli in rats (Haroutunian et al., 1981), the "freezing" reaction in red deer (Espmark et al.,1985) and divers non-social stimuli in tree shrews (Stöhr, 1986). Horses already habituate to the changed biomechanics on a treadmill after a couple of times, reflected by a reduced HR while excitement and anxiety of the unaccustomed horses led to an exaggerated HR-reaction (King et al., 1995).

Schmidt et al. (2010) stated that the stress response calculated with the mean RR-Interval 1551 ± 23, 1304 ± 166, and 1101 ± 123 of 8 horses decreased with repeated transport (4 times over a standardized course of 200 km); concluding horses habituate to a circumstance. Having covered all necessary background information about stress, the heart rate variability and its components will be clarified.

2.4 Heart rate variability

The autonomic nervous system (ANS), also known as the visceral nervous system, is part of the peripheral nervous system (PNS) and responsible for regulation of internal organs and glands, which occurs unconsciously. Respiratory rates, temperature, blood pressure and other physiological information from the central nervous system (CNS) affect the parasympathetic and sympathetic branch of the ANS. The parasympathetic nervous system (PSNS) is one of the two main divisions of the ANS and is active when the body is at rest. In particular, it is responsible for regeneration of the body as well as salivation, sexual arousal, digestion and defecation. The PSNS releases via the vagus nerve acetylcholine (neurotransmitter), influences the sinoatrial node (a discrete collection of nerves within the heart), and hence, influences the horse's heartbeat and interbeat intervals (Van Borel et al., 2007). A visual overview is given below (Figure 1).
The sympathetic nervous system (SNS) is responsible for stimulating activities associated with the fight-or-flight response. The SNS accounts for the changes of the heart rate by physical and mental stress through releasing of adrenalin and noradrenalin and hence, influences the HRV. In healthy animals, the length of these intervals varies from one beat to the other. Cardiac data (small differences in the interbeat interval), recorded with a sensitive monitoring device, is analysed by mathematical formulas to result in specific HRV parameters.
Under the influence of the SNS an increase in heart rate frequency and a smaller variance in the interbeat interval (IBI) can be detected. The influence of the PSNS can be observed by a decreased heart rate frequency and a higher imbalance in heart beat variance (Task Force of the European Society of Cardiology, 1996).

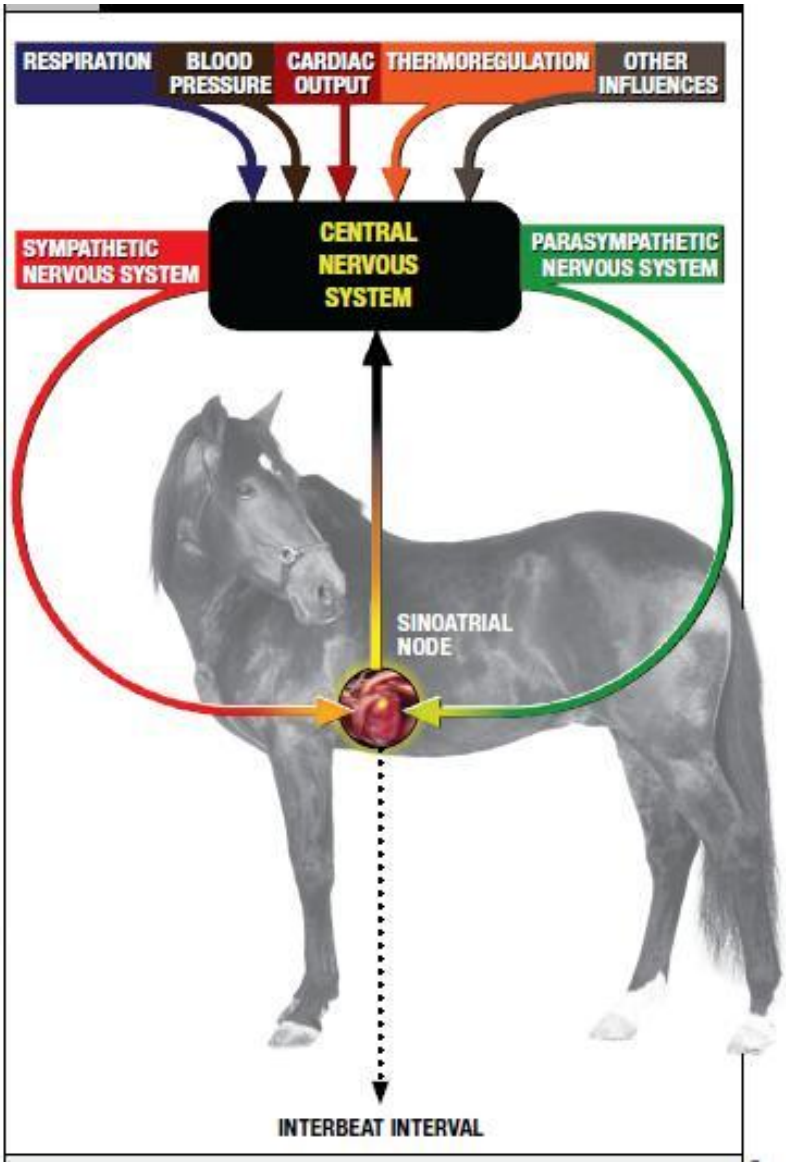

Figure 1: The emerging of the Interbeat Interval (Source: Ross, 2008)

Heart rate variability has been defined as the complex beat-to-beat variation in heart rate produced by the interaction between sympathetic and parasympathetic (vagal) neural activity at the sinus node of the heart (Van Borel et al., 2007; Thayer et al., 2006)

The heart rate variability (HRV) is a unit of measurement of the neural-vegatative activity and autonomous function of the heart. It describes whose competence, to

change stress-dependant the time distance from beat-to-beat continuously, aiming for a fast adaptation to changing requirements. Therefore, the HRV is a parameter for the adaptability of the organism to internal and external stress factors (Hottenrott, 2002).
To the different situations and the ups and downs of life, the whole organism reacts as, for instance, the common sayings "The heart leaps into the throat" or "The heart races" in stressful situations experienced by humans. These are normal adaptive processes to internal and external excitabilities which are continuously registered and through small and bigger variations in the beat-to-beat rhythm – the heart rate variability can be detected.

Decreased heart rate variability
(under the influence of the SNS, known as fight-or-flight response)

If the heart is not able to adapt flexible to stress factors anymore, the organism overstrains quickly and the human or animal experiences this as stress – an imbalance between the requirements on the one hand and on the other hand the own, available coping options. Humans develop to a considerable higher percentage serious health dysfunctions as heart disease, depression and neuropathy (Mück-Weymann, 2002). Therefore, small distances between heartbeats suggests stress on the organism.

Increased heart rate variability
(influence of the PSNS, responsible for "rest-and-digest" activities):

Increased heart rate variability seems to be an evidence of healthiness, in regards to the organisms' ability to react adequately on constant changing internal and external stresses and strains. Concluding, long distances between heartbeats suggests the body is comfortable.

The heart rate variability depends on standardization for significant results because it is a highly individual value which also fluctuates in healthy organisms. Due to the impact of the same factors which also interfere the autonomous system: sex, age, physical

condition, activity, stress, medication, fatigue, infection, weight, daytime and season of the year as well as chronic disorders (Kristal-Boneh et al., 2000; Tsuij et al, 1996; Umetani et al,1998; Delaney et al., 2000). The heart rate variability pattern is therefore a summary of many physiological factors within the body; concluding that heart rate and heart rate variability (HRV) reflect the balance of the sympathetic and parasympathetic branches of the autonomous nervous system and provides additional information on stress effects (Schmidt, 2010).
In short: the more the body is rested and relaxed, the greater the abnormality, the bigger the distance between heartbeats. Regularity or rather a small distance between the heartbeats is always an evidence of intensive stress on the cardiovascular system, for instance, through physical or mental stress and/or sickness.

2.4.1 Heart rate variability in horses

The heart rate (HR) sets/indicates the quantity of heart beats per minute. A heart rate of 50 means 50 contractions in one minute. The healthy heart of the horse beats in quiet environments around 28-40 beats/min, but increases with the speed of the horse. For Walking submaximal HR is 60-80 bpm, Trotting up to 100 beats/min and cantering up to 140 bpm. The maximum HR of a horse is around 220-230 beats/min (Marlin et al., 2002). In average the distance of one heartbeat to another is 1 second or 1000 milliseconds (ms). But this does not apply to a normal healthy working heart because it beats in irregularly. The intervals between the heartbeats represent sometimes more and less than 1000 ms – they fluctuate in mean value in split seconds.

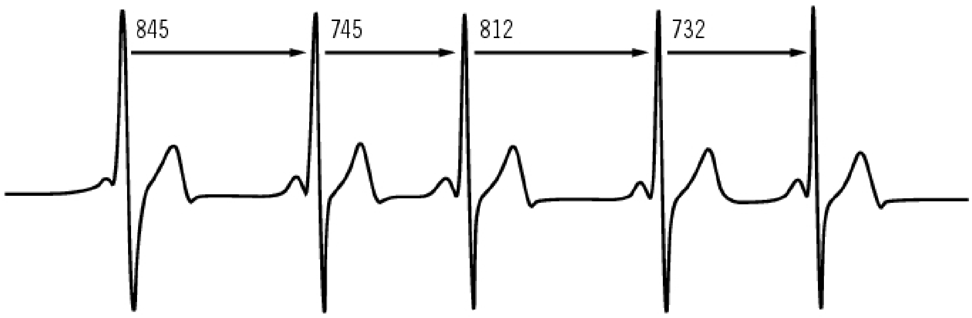

Figure 2: Example of the distance between one beat to another in ms (Source: Polar, 2007)

Through measuring this deviance of the mean value, the standard deviation or rather the variance of the phase distance between heartbeats can be calculated.

Vibe-Pedersen and Nielsen (1980) found that 22 electrocardiogram recordings of 138 horses were dedicated to heart abnormality, especially arrhythmias, i.e. respiratory sinus arrhythmia. The breathing of an organism has an influence on the heart rate because the respiratory and cardiovascular centres are close to each other in the brain. Therefore, through inspiration the sympathetic neurons are also agitated, which means fast inhalation results in a higher heart rate and thus, the vagus nerve slows down the heart rate. Both, the accelerator and vagus nerves are connected to the sinoatrial node (SA node).

The diurnal variation (influence on output levels of each day) affects the values of heart rate variability (Kuwahara et al., 1999). The HF-component differed significantly to the LF-component in which the HF-component had higher values in the mornings (5 a.m.), whereas the LF-component shown higher values in the afternoons (4 p.m.) (Uhlendorf,2009).

Parameters of the heart rate variability in horses

Time and frequency domain analysis are used for determination of heart rate variability. The principle is based on measuring of the single RR-intervals in the 24-hour electrocardiogram or short-time electrocardiogram.

Time domain analysis

The time domain analysis is a descriptive statistical diagram of sequent RR-intervals and whose differences. Therefore, Cardiac beat-to-beat (RR) interval and heart rate variability (HRV) have been suggested as parameters for stress analysis.

The following values are relevant:

- RR (=normal to normal): Cardiac beat-to-beat interval
- SDRR: standard deviation of mean value beat-to-beat interval
- RMSSD: root mean square of successive RR differences reflects a shift towards more parasympathetic dominance while reduced values indicate sympathetic dominance. It stands for the fast high frequent variability of heart rate, the RMSSD value calculates the difference of sequential RR-intervals. This reveals something about the parasympathetic action and therefore the relaxation level and recuperation of the organism. The higher the value, the more relaxed is the organism.
- PNN50: Percentage of differences between two successive IBIs greater than 50 ms.

The HRV, i.e. short term fluctuations in the RR interval, represents the balance of sympathetic and parasympathetic tone. Increases in the values of the standard deviation of RR interval (SDRR) and root mean square of successive RR differences (RMSSD) reflect a shift towards more parasympathetic dominance while reduced RR-values indicate sympathetic dominance (Schmidt et al., 2010).

SDRR, RMSSD and PNN50 show the fast impulses of the vagus corresponding to the previous intervals. These values are suitable for short- and long-time recordings (Rechlin, 1995; Task Force of the European Society of Cardiology, 1996; Polar, 2007)

Frequency domain analysis

With mathematical frequency domain analysis the spectral components of the HRV are broken down to single basic components, resulting in different basic frequencies of the total spectrum. The measurement of power within each of the frequency bands is reported in absolute values of power (ms2).

The HRV of a horse is divided in single basic components (Kuwahara et al., 1996):

- Total Power: a short-term estimate of the total power of spectral density in the range of frequencies between 0 and 0.4Hz (ms2) representing the overall activity of the ANS (autonomic nervous system) where sympathetic activity (Fight-Flight) is principal.
- VLF -very low frequency (0,000-0,04 Hz) reflecting overall activity of some slow mechanisms of sympathetic function. The VLF range is not as well defined as HF and LF and may be influenced by other factors and therefore is excluded in this research.
- LF – low frequency (0,01 -0,07 Hz) → can be considered predominantly to reflect changes in sympathetic tone (Flight-Fright response) (ms2). Mental stress increases LF activity.
- HF – high frequency (0,07 – 0,6 Hz) → reflect parasympathetic activity and corresponds to N-N variations (time between two heartbeats) caused by respiration: the respiratory sinus arrhythmia. Deep, even breathing activates the parasympathetic and raises HF. Mental stress decreases HF activity.
- HF/LF ratio –Ratio of low to high frequency power (sympathetic-vagal balance 0,5 – 2,0 Hz) is used as an index to measure the sympathovagal balance. High

numbers mean dominance of sympathetic activity while low numbers mean dominance of the parasympathetic activity

Several studies have demonstrated that the HF/LF ratio is useful as an indicator of sympathetic activity during a number of physical and psychological stresses with an increase in the LF/HF ratio being interpreted as a regulatory shift towards sympathetic dominance (von Borell et al., 2007) Under the sympathetic system high values of LF and LF/HF-Ratio can be found (Rechlin, 1995; Task Force of the European Society of Cardiology, 1996). Although Heart rate was taken into account in this research, Tiller et.al. (1996 cited in van Borell et al., 2007) stated that mental states may have an impact on sympathovagal balance in the absence of any palpable alterations in heart and/or respiration rates.

Table 4: Overview parameters HRV

Sympathetic system (fight-or-flight response)	**Parasympathetic system (Restoration)**
low values SDRR	high values SDRR
low values RMSSD	high values RMSSD
low percentage PNN50	high percentage PNN50
high values LF	low values LF
low values HF	high values HF
high percentage LF/HF ratio	low percentage LF/HF ratio

Frequency and time-domain analysis are commonly used in HRV research to indicate and evaluate the influence of stress on the individuals' autonomous system and is therefore included in this literature review. Nevertheless, the author has to admit that due to the complexity of HRV analysis, the influencing factors (e.g. training, gender, age of the horse, etc.), time management and from a physiological point of view still a lack of knowledge exists about the horses' HRV (van Breda, 2011), only Heart rate and the SDRR were used for analysis.

The method of heart rate variability used in horses

Bachmann et al. (2003) studied 11 pairs of crib-biting and non-crib-biting horses as controls to an induced Stimulus. The authors stated that "Power spectral analysis of the HRV revealed significant differences between crib-biters and controls at rest: crib-biters had a lower vagal tone (high frequency component, HF) and a higher sympathetic tone (low frequency component, LF) than controls. Therefore, crib-biting horses are more stress sensitive and physiologically and psychologically less flexible than horses without stereotypic behaviour."

The physical environment of an organism has a big influence on the heart rate. The HR of an organism adjusts to changing climatically factors, as temperature, air humidity and atmospheric pressure (Ulmer, 1977). In horses the resting HR is higher after exercising as the surrounding temperature and air humidity increased (Art et al., 1995).

Research has also shown that human-horse interactions resulted in a change in horses´ heart rate when humans were close to the horse. Lynch et al. (2007) stated that human social contact, i.e. petting caused a slowing of heart rate, while a person entering and exiting shown oscillation in horses´ heart rate. Björk (2008) stated that the heart rate of both rider and horse was recorded to identify if a correlation exists between them. The result suggested that different riders and horses probably are influencing each other and some were more influenced than others.

With the help of this research it might be possible find potential stress factors and to raise a voice for the horses they do not have.

3. METHODOLOGY

The following chapter describes the used methodology in order to achieve the aim of the research: The effect of disabled children and adults on the horse´s heart rate variability during therapeutic horseback riding. This Case Study is trying to find differences in heart rate and SDRR (standard deviation of mean value beat-to-beat Interval) between the control and the test group. This Exploratory Case Study was carried out at two stables in the south of the Netherlands.

3.1 Research Design

For investigating the topic, quantitative and qualitative measures were combined. This research was carried out as a pilot case study with repeated measures. To get an insight into the topic beforehand, background information on EAT, HRV and stress in horses was collected through desk research. Two expert interviews were held to gather ideas and personal observations and email contact was used to find suitable yards with patients willing to take part on the research. Heart rate and RR-Interval of twelve horses were measured during Equine-Assisted Therapy. Additional information about the stable, age, breed, gender and months used in EAT were collected and their relationship to Heart rate and RR- Interval investigated.

3.2 Data Collection

The data was collected in four days during a standardized test during the month of May and June 2011.

In two stables at two different days, two measurements were undertaken:

On the first day the horses were saddled and measured 3 minutes at rest to define resting heart rate prior to the first experiment. Following recording of the horse ridden by a disabled participant, and then following a recreational rider as control. The horse was hand walked by a leader while the disabled rider is sitting on the back of the horse. Meanwhile the therapist supported the disabled participant from the ground. The recording time was 10 minutes for every horse per trial and data collection began after mounting and stopped after 10 minutes after continuously recording. All measurements were taken on the left hand in constant walk around the whole outside riding arena of 40 metres by 20 metres. Collecting HRV data during mounting was excluded due to variation in time used for mounting, dependent on the disability of the participant. On day two measurements were repeated, except for the at rest recordings. Each participant was assigned to the same horses during the duration of the experiment. The recreational rider was always the same person. Recording always took place between 10.00 am and 3.00 pm to minimize the effects of the diurnal variation of heart rate variability (Kuwahara et al., 1999).

Horses:

For this research six horses in Stable A with the average age of 12.17 ± 3.76 and 6 horses in Stable B with the average age of 16.83 ± 6.40 are examined. The horses in both stables were trained and used in therapeutic riding and not for any other purposes.

The horses in stable A had an average months of experience 80 ± 49.57 in Equine-Assisted Activities. The horses in stable B were used average months 25 ± 10.33 in Equine-Assisted Activities.

In Stable A two horses were mares and four were geldings. Stable B involved three mares and three geldings. Breed, age, gender and years of experience in Equine-Assisted Activities are listed in table 5. All horses were physically sound and not given any medication or supplements. Respiratory sinus arrhythmia was not taken into account in this research due to time and people management. All horses were housed under comparable conditions in individual box stalls with a bedding of straw. Water was available ad libitum and feeding was according to individual need. All horses were easy trained at low level dressage training (basic level) to maintain stamina and gymnastic ability. Humidity, air pressure and weather temperatures ranged from 15 C to 25 C during the data collection but were excluded in this research. Worth mentioning, on the second day the weather and environmental conditions slightly changed in both stables. At Stable A weather changed from sunny to cloudy and partly rainy, also more noise and people were at the yard on the second day. Also at Stable B environmental conditions changed as a construction side was set up a week earlier and the weather conditions were windy and rainy compared cloudy on the first day. For this research feeding, housing and behaviour of the horses were excluded. Nevertheless, it was noticed that some of the horses were uncomfortable with tightening the girth.

Table 5: Details of the Horses measured during the pilot study

Stable A				
Name	**Age**	**sex**	**Months used in therapy**	**Breed**
Tessa	17	Mare	144	New Forest
Rico	14	Gelding	108	Fjord
Tinkie	13	Gelding	120	Tinker
Twister	13	Gelding	36	Fjord
Amber	10	Mare	36	Haflinger
Surprise	6	Gelding	36	Haflinger
Stable B				
Name	**Age**	**sex**	**Months used in therapy**	**Breed**
Frits	23	Gelding	24	New Forest
Jarcko	22	Gelding	30	Fjord
Kamy	19	Mare	30	KWPN
Karanta	19	Mare	6	KWPN
Isas	11	Gelding	24	Thoroughbred
Daisy	7	Mare	36	Haflinger

In stable A in the province Gelderland in the Netherlands the horses were used from Monday till Friday only for therapeutic purposes. Participants only came to ride and did not stay on the yard. Horses spent the night outside in the herd on pasture and brought back in the stable at 9.00 am and released back on pasture at 5.00 pm. On weekends the herd was completely outside on the pasture, just in human contact during feeding. In this stable all horses being ridden by the disabled participant were leaded by a person from the ground.

Stable B was located in the province North Brabant in the Netherlands. Most of the participants there lived and worked on the yard. Horses spent the night inside the stall and brought on the grassland at 10.00 am till 7.00 pm every day. In stable B all horses were ridden freely in the arena, without a leader from the ground.

Participants

This section is divided in three groups:

The first group is Stable A and consists out of children and teenagers (*n* = 6). Predominantly psychiatric disabled children (*n* = 5) and one physical handicapped children (*n* = 1) with the average age of *14.16* ± *5.26* years participated in this study.

The second group is Stable B and involves psychiatric disabled adults (*n* = 6) with the average age of *25.5* ± *4.41* years.

The Third group "recreational rider" was a leisure rider which was in all cases a 23 year old woman who was familiar with horseback riding and did not suffer from any disability. The recreational rider acted as control group in order to check for an effect in a more or less neutral situation.

During the experiment recognizable activities and external influences (e.g., noise, arriving patients) were observed and considered by analysing the HRV data. The participants were familiar with therapeutic riding and followed horseback riding once a week. Participants had an average experience in months *23.66* ± *18.94* (Stable A/children) and *26* ± *11.17* (Stable B/adults). Participants disabilities varied from dyspraxia, cerebral haemorrhage, brain tumour, paresis, short-term memory, learning difficulties, attention deficit disorder, autism to other psychiatric disorders. Participants' data and sort of handicap is listed in the Annex[1].

Materials

Heart rate variability is measured by a Polar Equine Heart Rate Monitor RS800CX G3 Science (Polar Electro Oy, Kempele, Finland). Heart rate and heart rate variability was recorded at 5 seconds intervals continually for ten minutes per trial, but only two minutes of data was used for the analysis.

[1] See Annex 1

The heart rate monitor consisted of two electrodes; one electrode was placed under the saddle pad on the right side of the withers and one electrode was fixed by a strap cranial-ventral under the girth on the left side of the horse.
The transmitter is attached by a clip between the pommel of the saddle and the withers. Electrodes and skin of the horse were moisturized with warm water to ensure a stable contact. The heart rate monitor watch was attached to the saddle during the experiment. To avoid unwanted heart rate fluctuations due to horses were not well acclimatized to the recording device, the horses had three minutes to acclimatize before the onset of data collection. In stable A the weather conditions were rainy on the second day compared to the sunny first day and more patients were around that stable on the second day of the experiment. In Stable B a construction side was set up and the weather conditions were windy on the second day.

3.3 Data Processing

The data obtained through the Heart Rate Monitor were downloaded to a computer and processed by the software POLAR Pro Trainer 5 Equine Edition after each day.
Only the parameters HR and SDRR of the Time domain analyses were used for determination of heart rate variability. HR was measured for a total of two minutes and therefore the measurement unit of bpm (beats per minute) was adapted to bp2m (beats in two minutes) in this research. The values obtained in Stable A were compared with those recorded in Stable B, with the recreational rider and at rest. The principle is based on measuring of the single RR-intervals in the short-time Electrocardiogram.
Other Information, collected through interviews with POLAR and the German federation for therapeutic riding (DKTHR) was integrated into the literature review and used as a reference point within the discussion.

Statistical analysis

For the purpose of assessing autonomic regulatory effects on HR, it makes most physiologic sense to detect the occurrence of sinus nodal events. In practice, HRV measurement is based on the sequence of RR intervals. HR and RR interval are reciprocals of each other, where HR has units of beats per minute (in this research beats per two minutes; bp2m). A useful metric of HRV, termed the SDRR, is the standard deviation of all normal RR intervals. The horses SDRR were expressed in units of milliseconds at the end of the RR- interval recording and was calculated over two minutes in walk.

The outcomes of this investigation are collected on written paper and on the computer. In order to break down the found database statistical analysis in Statistical Package for Social Sciences edition 19 (SPSS Science, Chicago, USA) and Excel is used.

The total sample number of 12 horses was used for the data processing, as all samples were valid. Horses were divided into two groups recognized as stable A (children) and stable B (adults). All data was tested for normal distribution by a Kolmogorov-Smirnov Test. Mean ± S.D. were computed for all horses. All data was processed by using an independent T-Test to determine whether there was a significant difference between Stable A, Stable B and the control group for each experiment. A probability of less than 0.05 was considered significant.

Pearson correlation tests were used to determine the degree of relationships between the SDRR and the two different conditions for each day. It was chosen as a parametric correlation test because the data set was normally distributed and represented rather linear. The parametric Independent samples t-test was used to analyse differences in SDRR parameter between gender, age, breed and months horse being used in therapy categories. The Independent samples t-test was chosen because the testing variables and

SDRR parameters were interval/ratio data and results from Day 1 and 2 recreational rider (R1; R2) and disabled rider (D1; D2) were compared independently. The Levene's test for equality of variances was taken into account to establish if the populations variances are equal.

4.RESULTS

In this section results are revealed about the Heart rate and SDRR, differences and correlations between groups.

Table 7: Heartrate (bpm) and Standard deviation of RR-Interval (ms) per Horse and condition in two minutes

	Horse	HR Rest	SDRR Rest	HR R1	SDRR R1	HR D1	SDRR D1	HR R2	SDRR R2	HR D2	SDRR D2
Stable A	Tessa	77	76.2	118	76.6	111	164.0	121	70.5	94	75.7
	Rico	67	122.6	263	62.8	86	115.0	223	60.3	92	232
	Tinkie	96	228.2	123	117.6	107	209.3	127	73.7	95	30.6
	Twister	336	37.4	323	31.7	294	51.9	100	56.8	80	61.1
	Amber	259	48.1	265	59.9	99	64.1	103	47.2	83	44.3
	Surprise	75	84.2	110	75.3	104	78.0	116	64.1	235	11.6
Stable B	Frits	79	84.6	144	62.2	125	47.9	157	40.7	152	46.8
	Jarcko	366	14.4	147	32.4	126	52.6	147	33.0	132	49.6
	Kamy	77	241.6	171	39.0	133	169.7	189	19.3	147	26.8
	Karanta	106	135.1	139	35.0	143	52.9	147	46.9	116	204.2
	Isas	75	70.6	174	38.9	154	56.8	178	32.8	153	38.9
	Daisy	227	17.3	158	79.4	147	46.9	188	44.7	171	62.4

<u>Heart rate</u>

Table 7 states horses' total heart rate in two minutes (bp2m) and SDRR (ms) per day (1 ; 2) and condition (R = recreational; D = disabled). Higher values of HR compared to the majority were marked in blue.

For stable A the HR of horse "Rico" was 263 bp2m (R1) and 223 bp2m (R2).

Remarkably higher HR of "Twister" were found for rest (336 bp2m), R1 (323 bp2m) and D1 (294 bp2m).

The resting heart rate of "Amber" was 259 bp2m and with R1 265 bp2m.

For Horse "Surprise" higher HR values was found for D2 (235 bp2m).

For stable B the horses "Jarcko" and "Daisy" showed unusually high resting heart rates of 366 bp2m and 227 bp2m.

SDRR

For stable A remarkably higher values of SDRR (marked in purple) were found in horse "Tessa" (D1 = 164.0 ms), "Rico" (D1 = 115.0 ms; D2 = 232.0 ms) and Tinkie (Rest=228.2 ms; R1 = 117.6 ms; D1 = 209.3 ms)

For stable B the horse "Kamy" higher SDRR values were found for the resting measurement (241.6 ms) and with the disabled rider Day 1 (169.7ms). The horse "Karanta" showed a remarkably higher SDRR with D2 (204.2 ms).

4.1 Mean and Standard deviation

Table 8: Mean and Standard deviation of HR and SDRR per Stable and condition

		rest	R1	D1	R2	D2
		M (SD)	***M (SD)***	***M (SD)***	***M (SD)***	***M (SD)***
Stable A	HR (bp2m)	151.67 (115.95)	200.33 (93.89)	116.83 (93.94)	131.67 (45.93)	113.17 (60.0)
(*N* = 6)	SDRR (ms)	99.47 (69.82)	70.75 (28.16)	113.68 (61.92)	62.17 (9.82)*	76.0 (79.63)
Stable B	HR (bp2m)	155.00 (118.63)	155.50 (14.60)	138.0 (11.83)	167.67 (19.72)	145.17 (18.99)
(*N* = 6)	SDRR (ms)	94.00 (74.46)	47.67 (18.68)	71.33 (48.48)	36.33 (10.33)*	71.50 (65.95)

Note: *N* = number; *M* = mean; *SD* = standard deviation; * Significant difference *p* (two-tailed) < .05

All data was normally distributed; except for the gender of the participant which was not normally distributed ($p = .031$) and was therefore excluded from this research.[2]
Mean resting heart rate between stable A and B differed by four beats in two minutes, but was not significant.
Descriptive statistics (Mean, S.D.) of heart rate and SDRR of stable A and stable B were summarised in Table 8. Values account for two minutes of recording.
The data analysis of stable A (*N* = 6) showed that the HR in rest ranged from 75 to 336 beats for two minutes (mean HR 151.67 ± 115.95). Heart rate with R1 ranged from 110 to 323 beats for two minutes (mean HR 200.33 ± 93.89). Heart rate with D1 ranged from 86 to 294 beats in two minutes (mean HR 116.83 ± 93.94).

[2] See Annex 2

For R2 the HR ranged from 100 to 223 beats for 2 minutes (mean HR 131.67 ± 45.93) and with D2 the HR ranged from 80 to 235 beats for two minutes (mean HR 113.17 ± 60.0).

The SDRR analysis of stable A (N = 6) in rest ranged from 37.4 to 228.2 ms (mean SDRR 99.47 ± 69.82). For R1 the SDRR ranged from 31.7 to 117.6 ms (mean SDRR 70.75 ± 28.16) and with D1 the SDRR ranged from 51.9 to 209.3 ms (mean SDRR 113.68 ± 61.92). SDRR for R2 ranged from 47.2 to 73.7 ms (mean SDRR 62.17 ± 9.82). For D2 the SDRR ranged from 11.6 to 232.0 ms (mean SDRR 76.0 ± 79.63).

The HR analysis of stable B (N = 6) in rest ranged from 77 to 336 heart beats in two minutes (mean HR 155.00 ± 118.63). For R1 the lowest HR was 139 and the highest 174 heart beats in two minutes (mean HR 155.50 ± 14.60). The HR of D1 ranged from 125 to 154 (mean HR 138.0 ± 11.83). For R2 the HR ranged from 147 to 189 heart beats in two minutes (mean HR 167.67 ± 19.72) and for D2 the HR ranged from 116 to 171 heart beats in two minutes (mean HR 145.17 ± 18.99).

The SDRR analysis of stable B (N = 6) in rest ranged from 17.3 to 241.6 ms (mean SDRR 94.00 ± 74.46).

For R1 the SDRR ranged from 32.4 to 79.4 ms (mean SDRR 47.67 ± 18.68) and with D1 the SDRR ranged from 46.9 to 169.7 ms (mean SDRR 71.33 ± 48.48).

The SDRR of R2 ranged from 19.3 to 46.9 ms (mean SDRR 36.33 ± 10.33) and with D2 the SDRR ranged from 26.8 to 204.2 ms (mean SDRR 71.50 ± 65.95). (See table 7 and 8).

4.2 Heart rate during experiment

4.2.1 Differences in HR between disabled riders and recreational rider

All differences in this study were tested by an independent t-test.

Levene's test for the heart rate with R1 was significant and therefore, the assumption of homogeneity has been violated (p = .000).
For R1 a significant difference was not found between the mean heart rate of stable A (M = 200.33, SD = 93.89) and of stable B (M = 155.50, SD = 14.60), t(5.24) = 1.16, p = .298.

Levene's test for HR with D1 was not significant (p = .11) and the assumption of homogeneity has been met.
For D1 a significant difference was not found between the mean heart rate of stable A (M = 116.83, SD = 93.94) and of stable B (M = 138.00, SD = 11.83), t(10) = -0.55, p = .596

Levene's test for heart rate R2 and D2 were not significant (p = .34; p = .15) and therefore, the assumption of homogeneity has been met.
For R2 a significant difference was not found between horses' mean HR of stable A (M = 131.67, SD = 45.93) and of stable B (M = 167.67, SD = 19.72), t(10) = -1.76, p = .108.
A significant difference was not found between heart rate for D1 stable A (M = 113.17, SD = 60.0) and stable B (M = 145.17, SD = 18.99), t(10) = -1.25, p = .241. [3]

[3] See Annex 3

4.2.2 Comparing HR with other parameters

Levene's test for HR and age of the horse as well as gender of the horse was not significant ($p > .05$) and therefore, the assumption of homogeneity has been met.
A significant difference was not found between HR and the age[4] of the horse as well as gender[5] of the horse ($p > .05$).
Mean HR of the two stables and age of the participant[6] as well as months taking part as participant in Therapy[7] did not differ significantly in all conditions ($p > .05$).
A significant difference was not found between horses' mean heart rate and the time the horse being used for equine therapy[8], but D1 was close to significance ($p = .062$).

[4] See Annex 4
[5] See Annex 5
[6] See Annex 6
[7] See Annex 7
[8] See Annex 8

4.3 Standard deviation of beat-to-beat interval during experiment

4.3.1 Differences SDRR between disabled riders and recreational rider

Levene's test for SDRR and all tests was not significant ($p > .05$) and therefore, the assumption of homogeneity has been met.

For R1 a significant difference was not found between the mean SDRR of stable A (*M* = 70.75, *SD* =28.16) and stable B (*M* = 47.67 , *SD* =18.67), *t*(10) = 1.67, *p* = .125.

For D1 a significant difference was not found between the SDRR of stable A (*M* = 113.67, *SD* = 61.91) and of stable B (*M* = 71.13, *SD* = 48.48), *t*(10) = 1.32, *p* = .217.

For R2 a significant difference was not found between the SDRR of stable A (*M* = 62.18 , *SD* =9.83) and of stable B (*M* = 36.33 , *SD* =10.33), *t*(9.98) = 4.44, *p* = .001.

For D2 a significant difference was not found between the SDRR of stable A (*M* = 76.00, *SD* = 79.63) and of stable B (*M* = 71.5, *SD* = 65.95), *t*(10) = .107, *p* = .917.[9]

4.3.2 Comparing SDRR with other parameters

SDRR and the age[10] and gender[11] of the horse did not differ significantly ($p > .05$).

A significant difference was not found between SDRR and the Participant ' age ($p > .05$).[12]

For the months taking part as participant at equine therapy and SDRR a significant difference was not found ($p > .05$).[13]

For the time being used as therapy horse and SDRR a significant difference was found for R1 (*p* = .030), D1 (*p* = .006), R2 (*p* = .012), but was not found for D2 (*p* = .281).[14]

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[9] See Annex 9
[10] See Annex 10
[11] See Annex 11
[12] See Annex 12
[13] See Annex 13
[14] See Annex 14

4.4 CORRELATIONS

Horses' age and SDRR between the disabled riders and the recreational rider were not significantly correlated ($p > .05$).[15]
The gender of the horse and SDRR of all four conditions were not significantly correlated ($p > .05$).[16]

4.3.2 Correlations between age of the participant and SDRR

The Pearson correlation showed a moderate negative relationship between the SDRR of D1 and the age of the participant, $r = -.489$, but was not significantly correlated ($p = .107$). No significant relationship was found between the SDRR D2 and the age of the participant, $r = -.238$, $p = .457$).[17] The result was visualized with help of a scatter-dot-diagram (see figure 3).

[15] See Annex 15
[16] See Annex 16
[17] See Annex 17

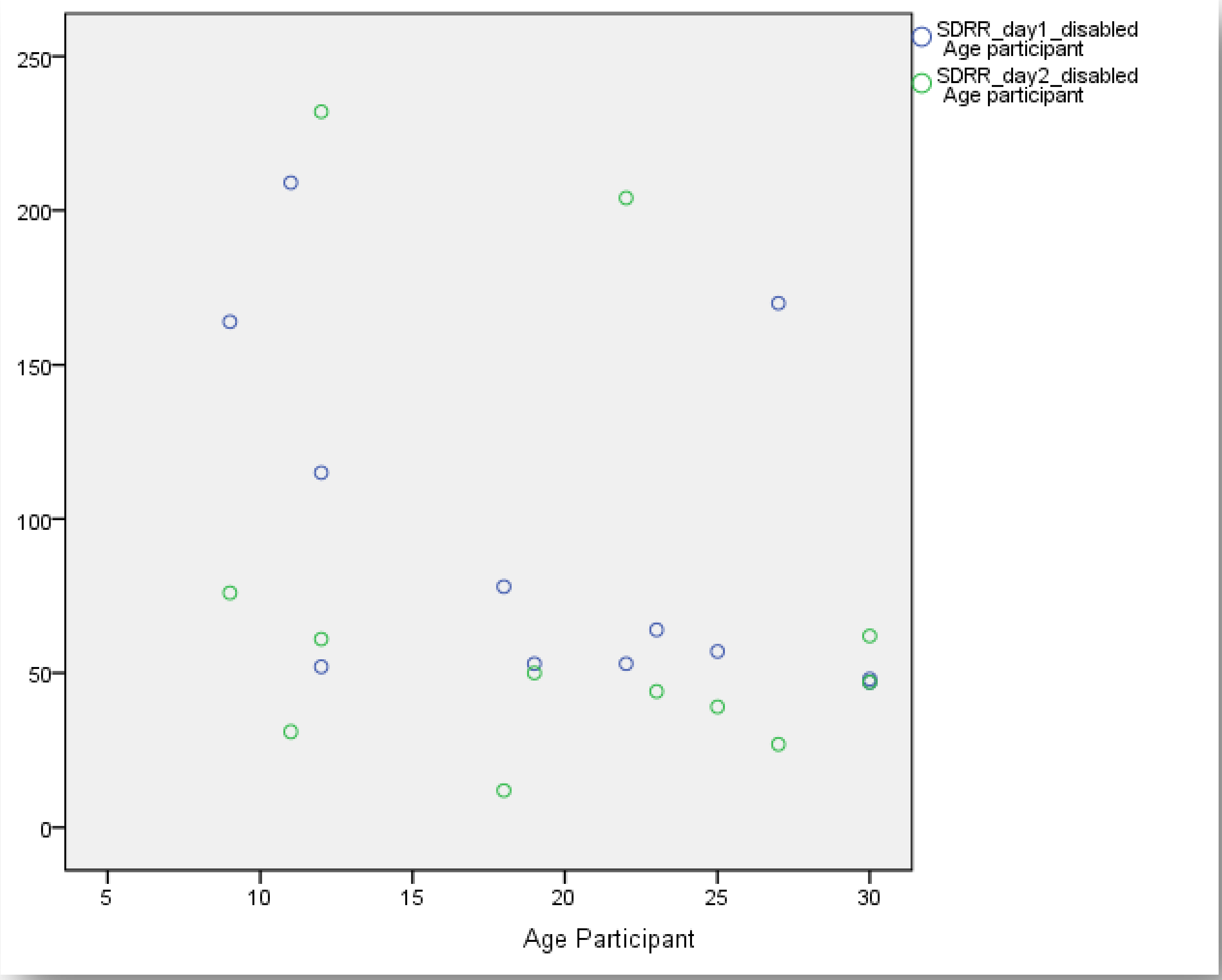

Figure 3: Scatterplot Age of the disabled participant and SDRR D1 and D2

As shown in the scatterplot Tessa, Rico, Tinkie and Kamy for D1 were situated out of the group. Different results as the majority were found for the horses Rico and Karanta for D2.

4.3.3 Correlations between months horses used in therapy and SDRR

For R1 the SDRR and the time the horse being used in therapy yield a fairly high positive correlation coefficient (*r* = .657) and was significantly correlated (*p* = .020).

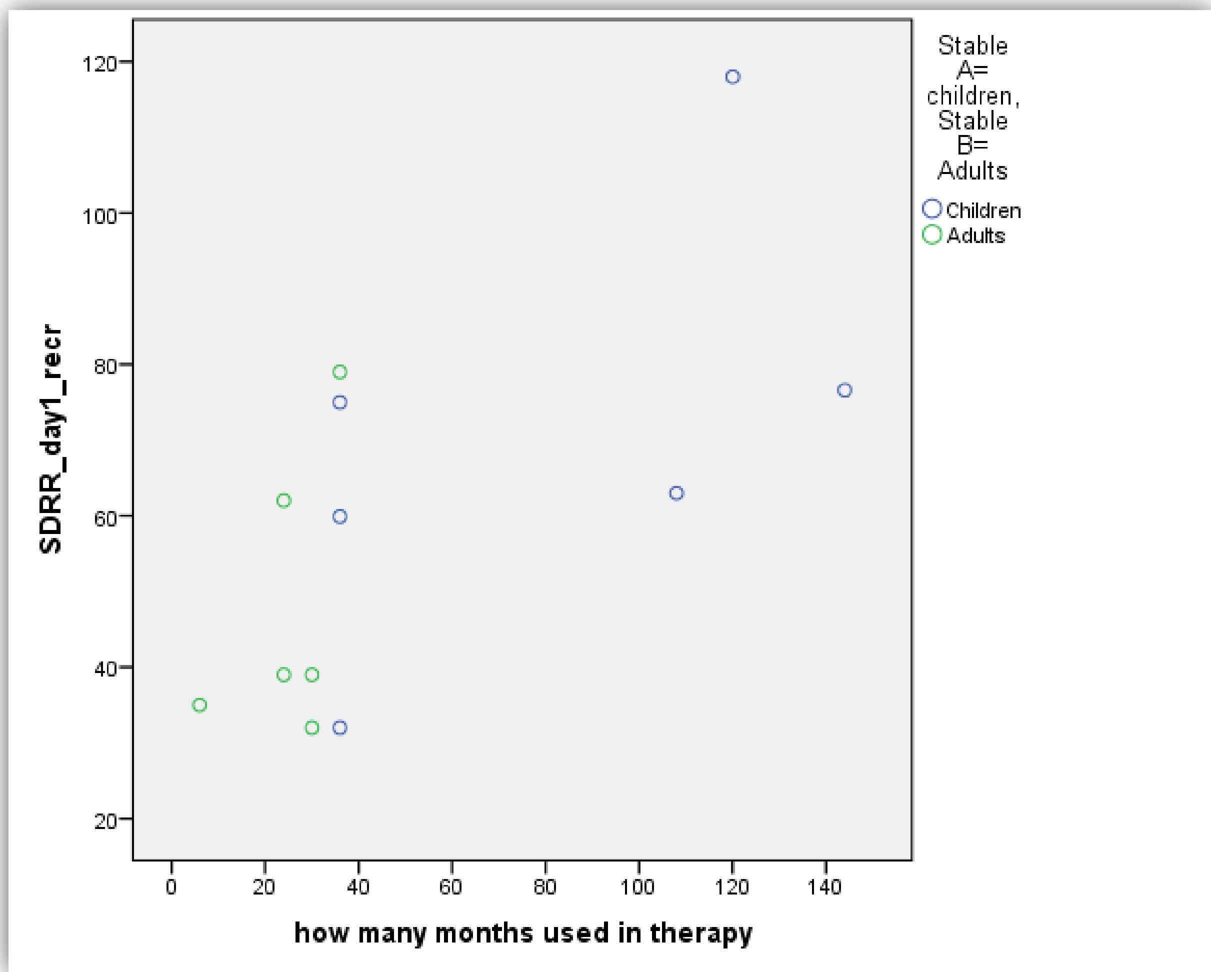

Figure 4: Scatterplot time horse is being used in therapy and SDRR for R1

As shown in the scatterplot three horses (Tessa, Rico, Tinkie, Kamy, Karanta) were situated out of the group.

Furthermore, for R2 the SDRR and the time the horse being used in therapy yield a fairly high positive correlation coefficient (*r* = .719) and was significantly correlated (*p* = .008).

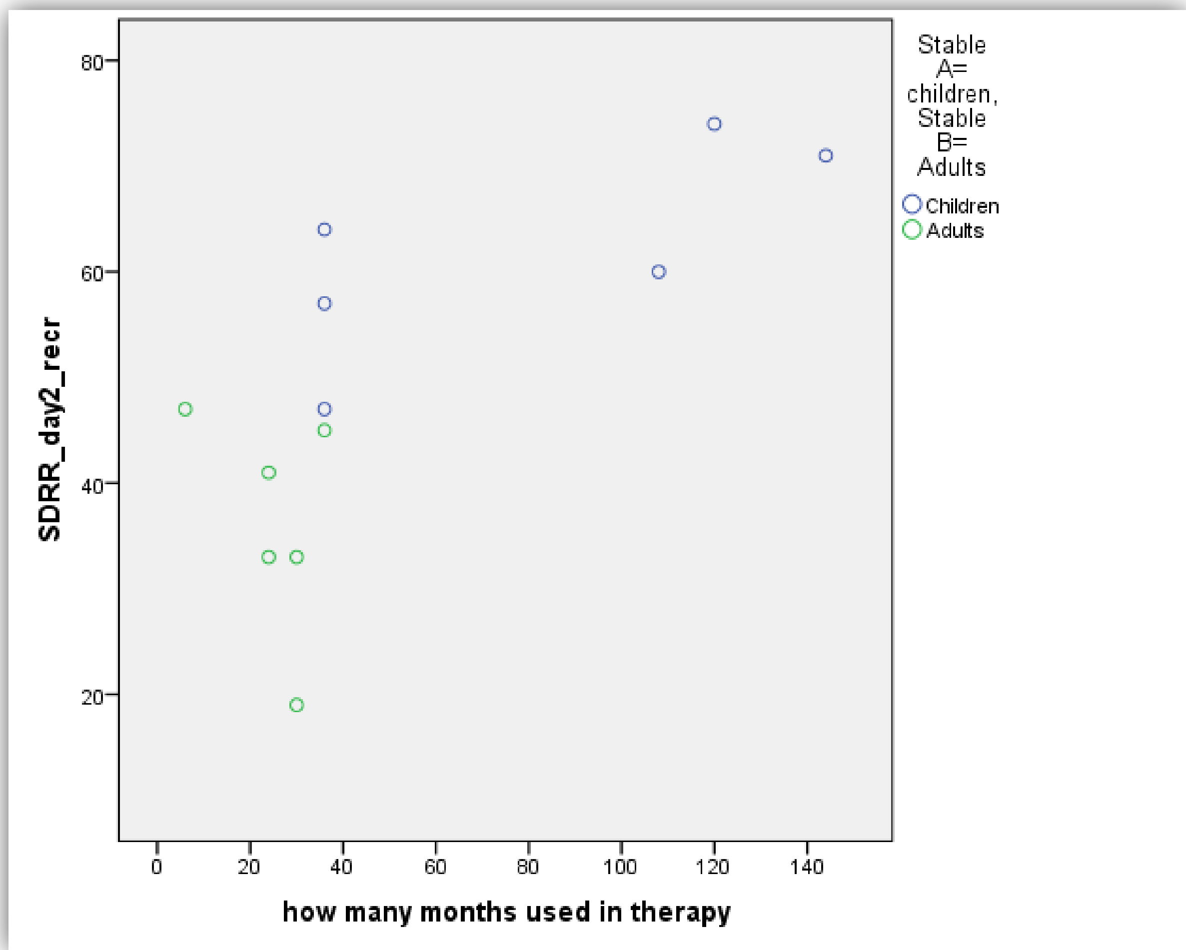

Figure 5: Scatterplot time horse is being used in therapy and SDRR for R2

As shown in the scatterplot three horses (Tessa, Rico, Tinkie, Karanta) were situated out of the group and showed higher SDRR values for R2.

The outcome of the Pearson correlation showed that there is a high positive relationship between SDRR for D1 and the months the horse being used in therapy, r =.747. The correlation was significantly correlated (p = .005).[18] The result was visualized with help of a scatter-dot-diagram (see figure 6).

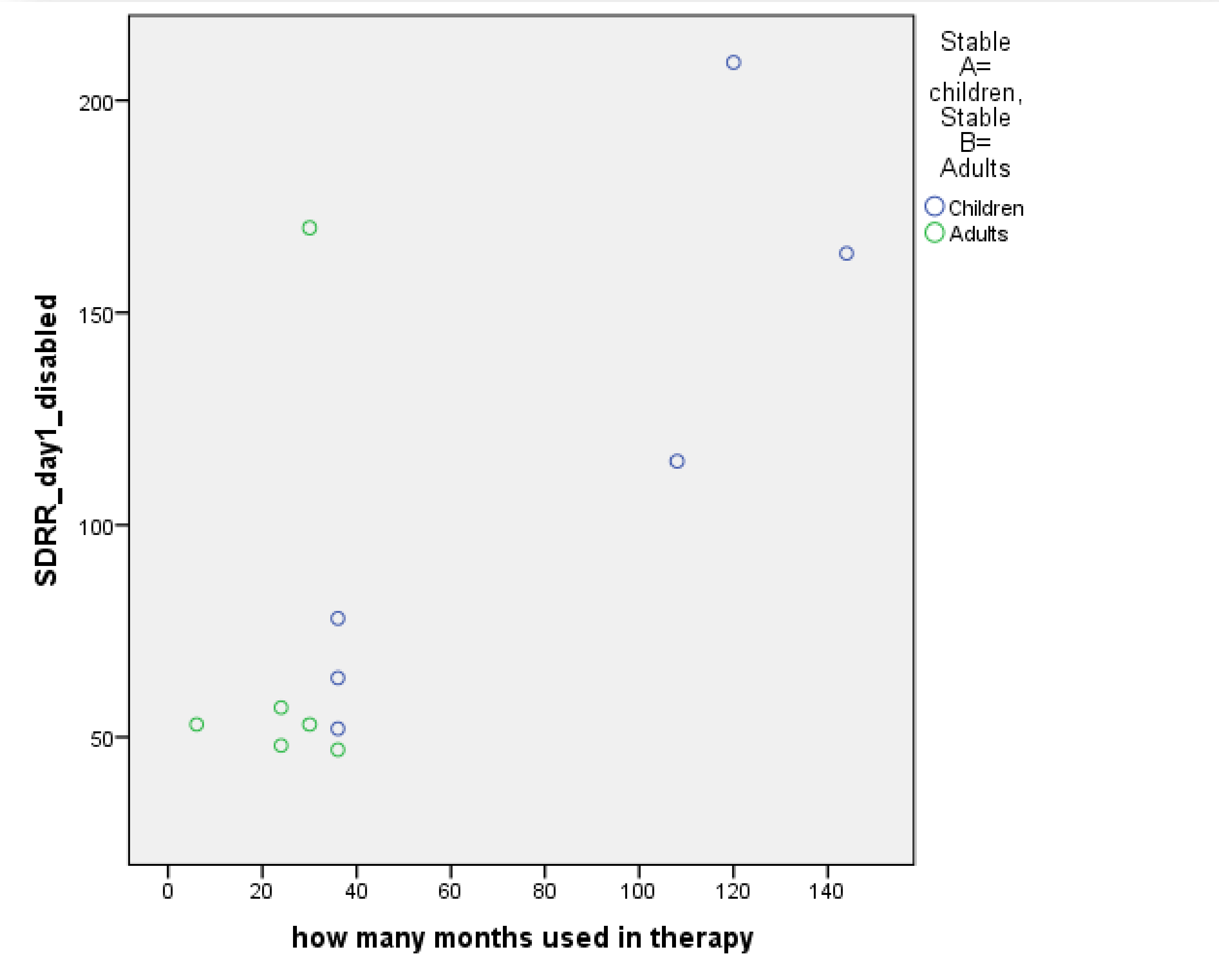

Figure 6: Scatterplot time horse is being used in therapy and SDRR for D1

[18] See Annex 18

The scatterplot shows a linear regression but as shown in the scatterplot 2 horses (Kamy, Tinkie) were situated out of the group and showed highest SDRR values for D1.

No significant relationship was found for SDRR D2 and the time the horse being used in therapy (r = .155, p = .631).

Accounting for all scatterplots the horses Tinkie (13 years, 120 months EAT), Tessa (17 years, 144 months EAT), Rico (14 years, 108 months EAT), Karanta (19 years, 6 months EAT) and Kamy (19 years, 30 months EAT) were situated out of the group.

5. DISCUSSION

The aim of this study was to investigate the influence of disabled and recreational riders on the horses' heart rate and heart rate variability during therapeutic riding. The found results are stated below.

Remarkably higher values of HR and SDRR in single horses

First, the following horses are worth mentioning because they have remarkably higher HR values or higher SDRR values than the majority of the tested horses. Reminding at this point that a higher HR (low SDRR) indicates the influence of the SNS, known as fight-or-flight response and therefore the horse may experience stress. Because the respiratory sinus arrhythmia was not taken into account in this study the high HR was maybe triggered by fast inhalation (Vibe-Pedersen and Nielsen, 1980). Further, a high SDRR value (increased heart rate variability and low HR) seems to be an evidence of healthiness and relaxation suggesting the horse was in a comfort state.

Stable A

In stable A the Heart rate monitor registered significantly higher HR values (236 and 223 beats in two minutes) with the horse **"Rico"** suggesting a stress response during the experiments with the recreational rider for both days compared to the disabled rider. Reason for this might be that since a recreational rider knows what to do on the horse and the possibility of following a certain pattern during riding, more is asked from the horse subconsciously. This outcome confirms the findings of the high SDRR with the resting measurement (122.6 ms) and with the disabled child (D1 = 115.0 ms; D2 = 232.0 ms) and "Rico" was therefore more relaxed which might indicate that the horse habituated and may know that the disabled is not requesting as much as the recreational rider. This corresponds with findings of King et al. (1995) and Schmidt et al. (2010) who stated that coping to a new stimuli occurs after repetition of tasks concerning that "Rico" was already used for Equine-Assisted Therapy for a long time.

"Twister" showed a significantly high resting heart rate (336 beats in two minutes) which might be due to mental excitement, as all horses were saddled and measured directly prior to the first experiment (Heipertz-Hengst, 2002). Another possible reason could be that the horse was uncomfortable to the measuring device, although every horse was given two minutes to adjust. On the first day also fairly high heart rates for the recreational rider (R1 = 323 bp2m) and disabled rider (D1 = 294 bp2m) were measured which suggest the horse was not familiar with the circumstances, was excited or had problems adapting to the research conditions. This type of acute stress comes immediately with a change of routine (Committee on Pain and Distress in Laboratory Animals, 1992). On the second day it seems "Twister" habituated to the research situation which was shown by lower heart rates. Bearing in mind that coping occurs after repetition of the event also other possible influences, as for instance, sex, breed, age, fatigue, infection, weight as well as season of the year (Kristal-Boneh et al., 2000; Tsuij et al, 1996; Umetani et al., 1998; Delaney et al., 2000) may be taken into account.

The Horse **"Amber"** also showed a high resting heart rate (259 bp2m) which might be as well due to mental excitement or the horse was uncomfortable with the measuring device. The significantly higher HR (265 bp2m) when confronted with the recreational rider at day 1 may indicate that the horse might not be accustomed to the research circumstances compared to the second day.

The Horse **"Surprise"** had a significantly higher heart rate (235 bp2m) when confronted with the disabled rider at day 2 which might suggest that environmental conditions or the disabled rider somehow influenced the horse that day. Also other physiological and mental events may have influenced the heart rate as already discussed.

For the first day **"Tinkie"** showed significantly higher SDRR (Rest = 228.2 ms; R1 = 117.6 ms; D1 = 209.3 ms) in all three conditions which suggests that "Tinkie" did not suffer from acute stress since he was saddled and the horse adapted adequately to the research circumstances. For the second day the horse showed significantly lower SDRR (R2 = 737 ms; D2 = 30.6 ms) suggesting he was highly influenced by the environmental conditions such as noise, people and weather.

On day one, the horse **"Tessa"** was the most relaxed with the disabled rider (SDRR =164.0 ms), suggesting that the recreational rider challenged her more. The significantly lower SDRR with the disabled rider on the second day may be traced back to windy and noisy conditions.

Stable B

In stable B the horses **"Jarcko"** and **"Daisy"** (366 bp2m and 227 bp2m) showed both unusually high resting heart rates. This suggest that both horses experienced mental excitement since they were saddled and ready to leave the stall, and/or were not accustomed to the measuring device.

The Horse "Kamy" showed significantly higher SDRR for the resting measurement (241.6 ms) as well as with the disabled rider at Day 1 (169.7ms), suggesting the horse was more relaxed when she was ridden by the recreational rider.

The horse "Karanta" showed a high SDRR for the rest measurement (135.1 ms) suggesting the horse was not mentally excited before the onset of data collection. But the horse showed significantly lower SDRR in three of four conditions (R1 = 350 ms; D1 = 52 ms; R2 = 46.9 ms) suggesting that the horse experienced a type of stress. Surprisingly, "Karanta" showed a remarkably higher SDRR (204.2 ms) with the disabled rider Day 2 which may was a result of habituation to the environmental conditions and/or the rider influenced the horse less than in other conditions.

5.2 Evaluation of HR

No significant difference was found in heart rate between the disabled riders and the recreational rider for both days. Only Horses heart rate with the recreational rider at day 1 was not normally distributed for both stables. The possible reason for no homogeneity of the variance might be that three horses of Stable A showed higher heart rates than the rest of the tested horses.

Evaluation HR with other parameters

Confirming findings of Rietmann et al. (2004) no differences between HR and age of the horse as well as gender of the horse were found which suggests that age and gender have no influence on HRV short time recordings.
No differences between HR and age of the participant and the months taking part as participant in therapy were found. This suggests that the HR is not influenced by participants factors in short time recordings.

A difference was not found between horses' mean heart rate and the time the horse being used for equine therapy, which was close to significance (p = .062 for the disabled rider on the first day. This suggests that the longer a horse is used in therapy, the more the HR lowers compared to horses which are being used in therapy only for a short period of time. The HR change was minor and not significant. Another possible reason could have been the better weather conditions on the first day (sunny) compared to the second day (windy and rainy). These findings also correspond to the study of King et al. (1995) and Schmidt et al. (2010) who stated that coping occurs after repetition of the circumstance. Also findings of Ulmer (1977) who stated that the HR of an organism adjusts to changing climatically factors, as temperature, air humidity and atmospheric pressure can be considered in this case.

5.3 Evaluation of SDRR

In both stables the recreational rider caused a significantly lower SDRR on the second day. The reason for this might be that on the second day of the experiment more surrounding activities happened (more people and noise on the yard) compared to the first day in both stables. In stable A the weather conditions were cloudy and partly rainy compared to the sunny first day and more people were present. In Stable B a construction side was set up recently and the weather conditions were windy and rainy. This might correspondence to the findings of Ulmer (1977) who stated that the HR of an organism adjusts to changing climatically factors, as temperature, air humidity and atmospheric pressure. Also the status of health that day, emotional and physical fitness of horse and participant on the experiment days may have been influenced. These findings correspond to a study of Björk (2008) who investigated the heart rate of both rider and horse to identify any existent correlations. The results suggest that different riders and horses probably are influencing each other and some were more influenced than others. Taking this into account, it is possible that if the recreational rider has not been well familiarized, the horse wasn't either. An important outcome to mention is the fact that the recreational rider clearly caused a lower SDRR for both days in all studied horses. Therefore, this indicates a shift to the sympathetic nervous system in all horses compared to the disabled riding.

Evaluation SDRR with other parameters

There was a significant difference in horses' SDRR between the time being used as therapy horse when being ridden by the recreational rider at both days and by the disabled rider on day one. Since a recreational rider knows how to ride a horse and possibly follows a certain pattern during riding, more is asked from the horse subconsciously. This could be the reason for the low standard deviation of interbeat-

interval with the recreational rider. On the first day for the disabled riding a bigger SDRR was found. This suggests that the disabled rider does not demand a lot from the horse and the horse is therefore more relaxed. On the second day the weather conditions were cloudy and it was more surrounding noise which suggests that the horses experienced more stress compared to the first sunny day with the disabled rider.

5.4 Relationships

A negative relationship was found on the first day between SDRR disabled rider and the age of the participant This suggests that the older the participants, the lower the SDRR. Reason for this might be that with increasing age of the human, his or her weight increases. This results in a lessened degree of flexibility and suppleness in comparison to a child. Furthermore, older aged participants may experience a higher range of anxiety and insecurity since they might have been involved in negative events earlier. All these factors could have a bigger impact on the horse.

Relationship between months used in therapy horse and SDRR

A positive relationship was found for SDRR Day 1 with the disabled rider and the months the horse was being used in therapy. As expected this suggests that the longer the horse is used in therapy, the more the horse is accustomed and the higher the SDRR and therefore, the horse is more relaxed. This outcome underpins the findings of Schmidt et al. (2010) who stated that mean SDRR decreased if task (transport) repeated, concluding horses habituate to a circumstance. Also King et al. (1995) stated that Horses already habituate to the changed biomechanics on a treadmill after a couple of times.

As the horses Tessa, Rico, Tinkie, Kamy and Karanta showed different results than the majority it suggests that these horses might be more relaxed due to the horses' age on the one hand and by the time the horse is already being used in therapy on the other hand. Therefore, the older the horse, the more relaxed through life experience. This does necessarily mean, the younger the horse, the more time is needed to reach the relaxation/adaptation. Also the underlying personality traits of the animals differ widely and should be taken into account.

Supplementary, the author suggests that horses which are not specifically trained for Equine-Assisted Therapy might react in an unpleasant way if the child is performing an unpredictable behaviour on the horse. Because horses are prey animals, the horse will flee and can harm the patient as well as itself (Frewin et al., 2005). A study conducted by Minero et al. (2006) stated that jumping horses and therapy horses react in the same way to new events or unforeseen situations and consequently this should be considered while planning the everyday training and work.

The results of this study do not support the findings of Kaiser et al. (2006) that stated 14 horses being ridden by disabled persons is no more demanding than being ridden by recreational riders. On the contrary, the study of Suthers-McCabe (2004) stated that 5 of 28 therapy horses did experience significant physiological stress when being ridden by disabled riders. Most importantly, in the end these results point out that the recreational rider caused more physiologic stress to the horses used in this study compared to disabled individuals, proving that the horses are ridden by disabled riders are more relaxed.

5.5 Limitations of the Data Collection

Study limitations need to be considered when evaluating the meaning of the findings.

The HRV data may have been affected by the responses of the horses to momentary environmental events that occurred during the observation periods. However, the purpose of the study was to obtain data of a normal day in the life of a therapy horse.

Further, horses with unclear or small arrhythmia cannot be detected without a vet and therefore were not eliminated from this study. Sinus arrhythmia was not considered

since the observations were not videotaped and the author was by herself when collecting the data. Additionally, the difficulty of time management and availability of disabled participants account for the small sample size. Therefore, the outcomes of this study cannot be considered representative, because the group of studied horses is too small for applying the outcomes to the whole population. Additionally, the animal and equine-assisted intervention literature is provided with contradictory findings as studies differ widely by type of activity, participants and study settings (Barker and Wolen, 2008).

6. Conclusion

The outcome of this case study enables the author to draw the following conclusions:

Concluding that the recreational rider caused a smaller variance in the standard deviation of the beat-to-beat interval in all horses, the activation of the sympathetic system is initiated. The horses therefore experienced a type of stress. Bearing in mind that the disabled rider sometimes cannot perform sufficient riding aids and a correct riding posture, the horse seems to adapt to this circumstance easily and is more relaxed whereas this purely accounts for walk.
Therefore, all horses participated in this study were significantly more relaxed with the disabled riders in both stables. Horses may be able to differentiate between people and their particular states. Further, some horses clearly showed mental excitement directly prior to the first experiment and this should be considered for collection of resting heart rate in future research. Also some horses were not able to adapt to the research conditions on the first day and were influenced by other environmental factors on the second day. Also riders may influence horses differently, some may have more influence on the horse than others. In general, the longer the horse is used in therapy, the more relaxed the horse is during therapy session. The same accounts for horses that are older but just lately started to be used as therapy horse. The life experience of an older horse can contribute to the ability of coping, even if the horse is fresh in the field of equine-assisted therapy.

7. Recommendations

Having identified influencing factors and highlighted the more relaxing effect of a disabled rider on the horse, it is now possible to analyse steps that can be taken in order to ensure the welfare of therapy horses.

Ultimately, the method of using HRV as measurement tool is highly recommended because heart rate and heart rate variability (HRV) reflect the balance of the sympathetic (known as fight-or-flight response) and parasympathetic (rest and digest) branches of the autonomous nervous system and provides additional information on stress effects (Schmidt, 2010).

For future studies, influencing factors as weather, environmental conditions and health status of the horse should be included in the research. The influence of the age of the disabled patient and the time the patient already takes part at EAT should be investigated in regards to the HR of the horse for long time recordings. Also conducting the same study in different gaits could be of interest since this study only focussed on walk.

Organisations offering Equine-Assisted Therapy should observe and identify horses that experience any form of stress which may lead to health and behavioural problems (e.g. the horse being girthy or bites) because this is the horse's only way of trying to communicate unhappiness, discomfort or pain.

Development of tools to assess and quantify meaningful welfare changes is needed to exactly assess the positive and negative influences of Equine-Assisted Therapy on the horse. Particularly as there is no homogeneous framework, there is a strong need of formulating guidelines and standards for the training and certification for suitability of therapy horses as realized with guide dogs (International Guide Dog Federation, 2011). Further, long term studies with a bigger population that especially address the benefits and disadvantages occurring through Equine-Assisted Therapy are crucial to assure the horses' welfare and the quality of the interventions. There might be need for the development of a community based interdisciplinary team which ideally should consist out of an equine scientist and veterinarian together with human professionals (psychologists, physical therapist, nurses, rehabilitation specialists, etc.). The veterinary and equine practitioner is a key figure in Equine-Assisted Interventions to ensure the preservation of horse welfare and safety of clients. More research is advised to enhance knowledge and development in the field of stress in therapy horses with a larger sample and over a longer period of time.

8. Samenvatting

Steeds meer therapeutische paarden voorzieningen zijn beschikbaar voor het publiek. Veel onderzoek is gedaan over de positieve effecten van Equine-Assisted Therapy, meestal met betrekking tot de fysieke voordelen voor de mens. Maar er is nog steeds een groot gebrek aan informatie over het welzijn van het therapie paard. In dit onderzoek wordt nagegaan in hoeverre gehandicapte mensen invloed hebben op de hartfrequentie-variabiliteit (Heart RateVariability = HRV) van paarden.
Dit is onderzocht worden tijdens paardrijden met gehandicapte in vergelijking met een recreatieve ruiters. De hartslag (HR) en de standaarddeviatie van de beat-to-beat Interval (SDRR) worden vergelijken van 12 therapie paarden. Deze paarden waren op twee verschillend bedrijven gestald. De gekozen methode hartslagvariatie (HRV) is een bewezen techniek, die al is gebruikt worden in de sector van de landbouwdieren ter beoordeling van pijn en stress. Hartfrequentie-variabiliteit is gedefinieerd als de complexe beat-to-beat variatie in hartslag geproduceerd door de interactie tussen sympathische en parasympatische neurale activiteit op de sinusknoop van het hart. De HRV is een parameter voor het aanpassingsvermogen van het organisme op interne en externe stressfactoren.
De resultaten maken duidelijk dat hoe langer het paard in therapie wordt gebruikt, hoe groter de variantie van de beat-to-beat-interval (SDRR). Vervolgens daardoor wordt de parasympatische tak voor "rust en vertering" activeert. Verder is vastgesteld worden dat de recreatieve ruiter een significant kleinere SDRR veroorzaakt bij het paard dan de gehandicapte ruiter. Een verklaring hiervoor kan zijn dat de recreatieve ruiter van het paard onbewust meer vraagt dan de gehandicapte ruiter.
Op dit moment zijn er nog geen richtlijnen geformuleerd op het gebied van therapie paarden, waardoor het welzijn van het paard onvoldoende beschermt is. Hiervoor moeten richtlijnen opgesteld worden die het opleiden en certificeren van geschrikte therapie paarden adequate waarborgen. Vervolgonderzoek is aan te bevelen te doen met

een grotere steekproef om de voor- en nadelen met betrekking tot welzijn van het paard in Equine-Assisted Therapy beter in kaart te brengen. Voor te toekomst van Equine-Assisted Therapy zal een team uit dierenartsen en paardenwetenschappers noodzakelijk zijn om een goede ontwikkeling van de sector te ondersteunen.

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10. Annex

ANNEX 1 - PARTICIPANTS DETAILS

Stable A				
Children	**Age**	**gender**	**how long following EAA**	**Disability**
1	9	female	18 months	artificial hip
2	12	female	42 months	Dyspraxia, short-term memory, learning difficulties
3	11	female	42 months	attention deficit disorder
4	12	male	36 months	cerebral haemorrhage, hemi-paresis left
5	23	male	2 months	braintumor, paresis left
6	18	female	2 months	cerebral haemorrhage, partial paresis
Stable B				
Adults	**Age**	**gender**	**how long following EAA**	**Disability**
7	30	male	36 months	Psychatric disorder / Multiple complex developmental disorder
8	19	male	24 months	Autistic
9	27	male	30 months	Psychatric disorder
10	22	male	6 months	Psychatric disorder / attention deficit disorder
11	25	male	24 months	Psychatric disorder
12	30	male	32 months	Psychatric disorder / Multiple complex developmental disorder

OUTCOME FROM SPSS

ANNEX 2 - NORMAL DISTRIBUTION

Data	Mean	Standard deviation	p
SDRR in rest	96,73	74,46	0.55
SDRR Day 1 recreational rider	59.21	25,8	0.72
SDRR Day 1 disabled rider	92,5	57,44	0.33
SDRR Day 2 recreational rider	49,25	16,57	0.98
SDRR Day 2 disabled rider	73,75	69,75	0.17
Gender horse	1.42	0.52	0.07
Age horse	14.5	5.57	0.99
Breed horse	3.42	1.51	0.92
Months in therapy horse	52.5	44.62	0.05
Participant Child or Adult	19.83	0.52	0.15
Age participant	19.83	7.52	0.83
Gender participant	1.33	0.49	0.03
Months in therapy participant	24.5	14.65	0.94

OUTCOME FROM SPSS – DIFFERENCES HEARTRATE

ANNEX 3 - DIFFERENCE HR BETWEEN STABLE A AND STABLE B

Group Statistics

	Stable A= children, Stable B= Adults	N	Mean	Std. Deviation	Std. Error Mean
heartbeats in rest (2 min)	Stable A	6	151.67	115.948	47.335
	Stable B	6	155.00	118.631	48.431
Day1_recr_heartbeats	Stable A	6	200.33	93.889	38.330
	Stable B	6	155.50	14.598	5.960
Day1_disabled_heartbeats	Stable A	6	116.83	93.935	38.349
	Stable B	6	138.00	11.832	4.830
Day2_recr_heartbeats	Stable A	6	131.67	45.929	18.750
	Stable B	6	167.67	19.715	8.048
Day2_disabled_heartbeats	Stable A	6	113.17	59.998	24.494
	Stable B	6	145.17	18.989	7.752

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
heartbeats in rest (2 min)	Equal variances assumed	.009	.926	-.049	10	.962	-3.333	67.721	-154.226	147.559
	Equal variances not assumed			-.049	9.995	.962	-3.333	67.721	-154.237	147.570
Day1_recr_heartbeats	Equal variances assumed	58.755	.000	1.156	10	.275	44.833	38.790	-41.597	131.264
	Equal variances not assumed			1.156	5.242	.298	44.833	38.790	-53.514	143.181
Day1_disabled_heartbeats	Equal variances assumed	3.099	.109	-.548	10	.596	-21.167	38.652	-107.288	64.955
	Equal variances not assumed			-.548	5.159	.607	-21.167	38.652	-119.612	77.279
Day2_recr_heartbeats	Equal variances assumed	1.006	.340	-1.764	10	.108	-36.000	20.405	-81.465	9.465
	Equal variances not assumed			-1.764	6.782	.122	-36.000	20.405	-84.566	12.566
Day2_disabled_heartbeats	Equal variances assumed	2.418	.151	-1.246	10	.241	-32.000	25.692	-89.244	25.244
	Equal variances not assumed			-1.246	5.992	.259	-32.000	25.692	-94.886	30.886

ANNEX 4 - DIFFERENCE BETWEEN AGE HORSE AND HR

Group Statistics

	age of the horse	N	Mean	Std. Deviation	Std. Error Mean
heartbeats in rest (2 min)	>= 13	8	150.50	124.608	44.056
	< 13	4	159.00	97.871	48.935
Day1_recr_heartbeats	>= 13	8	178.50	74.220	26.241
	< 13	4	176.75	64.814	32.407
Day1_disabled_heartbeats	>= 13	8	128.13	79.023	27.939
	< 13	4	126.00	28.507	14.254
Day2_recr_heartbeats	>= 13	8	151.38	39.228	13.869
	< 13	4	146.25	42.960	21.480
Day2_disabled_heartbeats	>= 13	8	113.50	27.412	9.692
	< 13	4	160.50	62.511	31.256

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
heartbeats in rest (2 min)	Equal variances assumed	0.244	0.63	-0.12	10	0.908	-8.5	71.788	-168.453	151.453
	Equal variances not assumed			-0.13	7.67	0.901	-8.5	65.845	-161.471	144.471
Day1_recr_heartbeats	Equal variances assumed	0.268	0.62	0.04	10	0.969	1.75	43.802	-95.847	99.347
	Equal variances not assumed			0.042	6.94	0.968	1.75	41.699	-97.013	100.513
Day1_disabled_heartbeats	Equal variances assumed	0.483	0.5	0.051	10	0.96	2.125	41.601	-90.568	94.818
	Equal variances not assumed			0.068	9.6	0.947	2.125	31.365	-68.156	72.406
Day2_recr_heartbeats	Equal variances assumed	0.399	0.54	0.207	10	0.84	5.125	24.73	-49.977	60.227
	Equal variances not assumed			0.2	5.61	0.848	5.125	25.569	-58.523	68.773
Day2_disabled_heartbeats	Equal variances assumed	1.819	0.21	-1.86	10	0.092	-47	25.236	-103.23	9.23
	Equal variances not assumed			-1.44	3.59	0.232	-47	32.724	-142.093	48.093

ANNEX 5 - DIFFERENCE BETWEEN GENDER HORSE AND HR

Group Statistics

	gender of the horse	N	Mean	Std. Deviation	Std. Error Mean
Day1_recr_heartbeats	gelding	7	183.43	79.400	30.010
	mare	5	170.20	56.645	25.333
Day1_disabled_heartbeats	gelding	7	142.29	70.235	26.546
	mare	5	106.60	56.682	25.349
Day2_recr_heartbeats	gelding	7	149.71	41.544	15.702
	mare	5	149.60	38.805	17.354
Day2_disabled_heartbeats	gelding	7	134.14	53.371	20.172
	mare	5	122.20	36.629	16.381
heartbeats in rest (2 min)	gelding	7	156.29	133.586	50.491
	mare	5	149.20	87.179	38.988

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Day1_recr_heartbeats	Equal variances assumed	1.089	.321	.317	10	.757	13.229	41.677	-79.632	106.090
	Equal variances not assumed			.337	9.989	.743	13.229	39.273	-74.289	100.747
Day1_disabled_heartbeats	Equal variances assumed	.046	.835	.935	10	.372	35.686	38.149	-49.317	120.688
	Equal variances not assumed			.972	9.759	.354	35.686	36.705	-46.372	117.744
Day2_recr_heartbeats	Equal variances assumed	.000	.999	.005	10	.996	.114	23.697	-52.686	52.915
	Equal variances not assumed			.005	9.144	.996	.114	23.403	-52.701	52.929
Day2_disabled_heartbeats	Equal variances assumed	.388	.547	.430	10	.676	11.943	27.748	-49.885	73.770
	Equal variances not assumed			.460	10.000	.656	11.943	25.986	-45.957	69.843
heartbeats in rest	Equal variances assumed	1.689	.223	.103	10	.920	7.086	68.654	-145.884	160.056
	Equal variances not assumed			.111	9.971	.914	7.086	63.792	-135.107	149.278

ANNEX 6 - DIFFERENCE BETWEEN AGE PARTICIPANT AND HR

Group Statistics

	Age participant	N	Mean	Std. Deviation	Std. Error Mean
Day1_recr_heartbeats	>= 20	6	175.2	46.18	18.85
	< 20	6	180.7	89.91	36.71
Day1_disabled_heartbeats	>= 20	6	133.5	19.78	8.074
	< 20	6	121.3	93.56	38.19
Day2_recr_heartbeats	>= 20	6	160.3	32.79	13.39
	< 20	6	139	43.9	17.92
Day2_disabled_heartbeats	>= 20	6	137	31.92	13.03
	< 20	6	121.3	58.38	23.84

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Day1_recr_heartbeats	Equal variances assumed	5.029	0.049	-0.133	10	0.897	-5.5	41.263	-97.441	86.441
	Equal variances not assumed			-0.133	7.467	0.897	-5.5	41.263	-101.85	90.85
Day1_disabled_heartbeats	Equal variances assumed	2.541	0.142	0.312	10	0.762	12.167	39.038	-74.815	99.149
	Equal variances not assumed			0.312	5.446	0.767	12.167	39.038	-85.762	110.095
Day2_recr_heartbeats	Equal variances assumed	0.189	0.673	0.954	10	0.363	21.333	22.371	-28.512	71.178
	Equal variances not assumed			0.954	9.254	0.365	21.333	22.371	-29.062	71.728
Day2_disabled_heartbeats	Equal variances assumed	1.004	0.34	0.577	10	0.577	15.667	27.165	-44.86	76.193
	Equal variances not assumed			0.577	7.744	0.58	15.667	27.165	-47.337	78.671

ANNEX 7 – DIFFERENCE BETWEEN MONTHS TAKLING PART IN THERAPY PARTICIPANT AND HR

Group Statistics

	Months taking part in EAA participant	N	Mean	Std. Deviation	Std. Error Mean
Day1_disabled_heartbeats	>= 22	8	146.5	63.36	22.4
	< 22	4	89.25	55.75	27.88
Day2_disabled_heartbeats	>= 22	8	127.8	34.05	12.04
	< 22	4	132	70.02	35.01

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Day1_disabled_heartbeats	Equal variances assumed	0	0.993	1.528	10	0.157	57.25	37.461	-26.219	140.719
	Equal variances not assumed			1.601	6.893	0.154	57.25	35.76	-27.576	142.076
Day2_disabled_heartbeats	Equal variances assumed	2.459	0.148	-0.145	10	0.887	-4.25	29.257	-69.438	60.938
	Equal variances not assumed			-0.115	3.729	0.915	-4.25	37.024	-110.059	101.559

ANNEX 8 - DIFFERENCE BETWEEN TIME HORSE BEING USED FOR EQUINE THERAPY AND HR

Group Statistics

	how many months used in therapy	N	Mean	Std. Deviation	Std. Error Mean
Day1_recr_heartbeats	>= 52	3	168.00	82.310	47.522
	< 52	9	181.22	68.216	22.739
Day1_disabled_heartbeats	>= 52	3	68.00	50.468	29.138
	< 52	9	147.22	58.038	19.346
Day2_recr_heartbeats	>= 52	3	157.00	57.236	33.045
	< 52	9	147.22	34.662	11.554
Day2_disabled_heartbeats	>= 52	3	93.67	1.528	.882
	< 52	9	141.00	47.207	15.736

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Day1_recr_heartbeats	Equal variances assumed	.243	.632	-.278	10	.786	-13.222	47.506	-119.071	92.627
	Equal variances not assumed			-.251	2.982	.818	-13.222	52.682	-181.467	155.023
Day1_disabled_heartbeats	Equal variances assumed	.020	.891	-2.099	10	.062	-79.222	37.737	-163.305	4.861
	Equal variances not assumed			-2.265	3.960	.087	-79.222	34.975	-176.721	18.276
Day2_recr_heartbeats	Equal variances assumed	1.722	.219	.365	10	.723	9.778	26.803	-49.942	69.498
	Equal variances not assumed			.279	2.510	.801	9.778	35.007	-115.022	134.578
Day2_disabled_heartbeats	Equal variances assumed	3.278	.100	-1.681	10	.124	-47.333	28.152	-110.061	15.394
	Equal variances not assumed			-3.003	8.050	.017	-47.333	15.760	-83.638	-11.029

OUTCOME FROM SPSS – DIFFERENCES SDRR

Annex 9 - DIFFERENCES IN THE SDRR BETWEEN STABLE A AND B

Group Statistics

	Stable A= children, Stable B= Adults	N	Mean	Std. Deviation	Std. Error Mean
SDRR_day1_recr	Stable A	6	70.75	28.157	11.495
	Stable B	6	47.67	18.673	7.623
SDRR_day1_disabled	Stable A	6	113.67	61.912	25.275
	Stable B	6	71.33	48.475	19.79
SDRR_day2_recr	Stable A	6	62.17	9.827	4.012
	Stable B	6	36.33	10.328	4.216
SDRR_day2_disabled	Stable A	6	76	79.632	32.509
	Stable B	6	71.5	65.948	26.923

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SDRR_day1_recr	Equal variances assumed	0.214	0.653	1.674	10	.125	23.083	13.793	-7.65	53.816
	Equal variances not assumed			1.674	8.685	.130	23.083	13.793	-8.292	54.459
SDRR_day1_disabled	Equal variances assumed	0.777	0.399	1.319	10	.217	42.333	32.101	-29.193	113.859
	Equal variances not assumed			1.319	9.456	.218	42.333	32.101	-29.755	114.421
SDRR_day2_recr	Equal variances assumed	0.025	0.876	4.439	10	.001	25.833	5.82	12.866	38.801
	Equal variances not assumed			4.439	9.975	.001	25.833	5.82	12.861	38.805
SDRR_day2_disabled	Equal variances assumed	0.072	0.794	0.107	10	.917	4.5	42.21	-89.551	98.551
	Equal variances not assumed			0.107	9.664	.917	4.5	42.21	-89.995	98.995

ANNEX 10 - DIFFERENCE SDRR AND THE AGE OF THE HORSE

Group Statistics

	age of the horse	N	Mean	Std. Deviation	Std. Error Mean
SDRR_day1_recr	>= 13	8	57.20	29.818	10.542
	< 13	4	63.23	18.124	9.062
SDRR_day1_disabled	>= 13	8	108.00	65.483	23.152
	< 13	4	61.50	13.026	6.513
SDRR_day2_recr	>= 13	8	50.25	18.919	6.689
	< 13	4	47.25	12.764	6.382
SDRR_day2_disabled	>= 13	8	91.00	80.257	28.375
	< 13	4	39.25	20.678	10.339

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SDRR_day1_recr	Equal variances assumed	0.912	0.362	-0.366	10	0.722	-6.025	16.442	-42.661	30.611
	Equal variances not assumed			-0.433	9.308	0.675	-6.025	13.902	-37.315	25.265
SDRR_day1_disabled	Equal variances assumed	12.734	0.005	1.374	10	0.199	46.5	33.833	-28.885	121.885
	Equal variances not assumed			1.933	8.034	0.089	46.5	24.05	-8.919	101.919
SDRR_day2_recr	Equal variances assumed	1.477	0.252	0.283	10	0.783	3	10.596	-20.61	26.61
	Equal variances not assumed			0.324	8.708	0.753	3	9.245	-18.021	24.021
SDRR_day2_disabled	Equal variances assumed	4.942	0.05	1.241	10	0.243	51.75	41.7	-41.164	144.664
	Equal variances not assumed			1.714	8.627	0.122	51.75	30.2	-17.02	120.52

ANNEX 11 - DIFFERENCES IN THE SDRR BETWEEN GENDER OF THE HORSE

Group Statistics

	gender of the horse	N	Mean	Std. Deviation	Std. Error Mean
Day1_disabled_heartbeats	gelding	7	142.29	70.235	26.546
	mare	5	106.60	56.682	25.349
Day2_disabled_heartbeats	gelding	7	134.14	53.371	20.172
	mare	5	122.20	36.629	16.381

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Day1_disabled_heartbeats	Equal v. assumed	.046	.835	.935	10	.372	35.686	38.149	-49.317	120.688
	Equal v. not assumed			.972	9.759	.354	35.686	36.705	-46.372	117.744
Day2_disabled_heartbeats	Equal variances assumed	.388	.547	.430	10	.676	11.943	27.748	-49.885	73.770
	Equal variances not assumed			.460	10.000	.656	11.943	25.986	-45.957	69.843

ANNEX 12 - DIFFERENCE SDRR AND AGE OF PARTICIPANT

Group Statistics

	Age participant	N	Mean	Std. Deviation	Std. Error Mean
SDRR_day1_disabled	>= 20	6	73.17	47.847	19.534
	< 20	6	111.83	63.810	26.050
SDRR_day2_disabled	>= 20	6	70.50	66.383	27.101
	< 20	6	77.00	79.186	32.327

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SDRR_day1_disabled	Equal variances assumed	1.028	0.335	-1.188	10	0.262	-38.667	32.561	-111.216	33.883
	Equal variances not assumed			-1.188	9.272	0.265	-38.667	32.561	-111.996	34.662
SDRR_day2_disabled	Equal variances assumed	0.06	0.811	-0.154	10	0.881	-6.5	42.184	-100.493	87.493
	Equal variances not assumed			-0.154	9.704	0.881	-6.5	42.184	-100.882	87.882

ANNEX 13 - DIFFERENCE SDRR AND MONTHS TAKING PART AS PARTICIPANT IN THERAPY

Group Statistics

	Months taking part in EAA participant	N	Mean	Std. Deviation	Std. Error Mean
SDRR_day1_disabled	>= 22	8	93.88	63.898	22.591
	< 22	4	89.75	50.546	25.273
SDRR_day2_disabled	>= 22	8	68.63	67.224	23.767
	< 22	4	84.00	84.159	42.079

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference: Lower	95% Confidence Interval of the Difference: Upper
SDRR_day1_disabled	Equal variances assumed	0.831	0.383	0.112	10	0.913	4.125	36.867	-78.021	86.271
	Equal variances not assumed			0.122	7.624	0.906	4.125	33.898	-74.722	82.972
SDRR_day2_disabled	Equal variances assumed	0.389	0.547	-0.345	10	0.737	-15.375	44.532	-114.598	83.848
	Equal variances not assumed			-0.318	5.001	0.763	-15.375	48.328	-139.595	108.845

ANNEX 14 - DIFFERENCE SDRR AND THE MONTHS THE HORSE IS BEIN USED IN THERAPY

Group Statistics

	how many months used in therapy	N	Mean	Std. Deviation	Std. Error Mean
SDRR_day1_recr	>= 52	3	85.87	28.647	16.539
	< 52	9	50.32	18.782	6.261
SDRR_day1_disabled	>= 52	3	162.67	47.014	27.144
	< 52	9	69.11	39.014	13.005
SDRR_day2_recr	>= 52	3	68.33	7.371	4.256
	< 52	9	42.89	13.476	4.492
SDRR_day2_disabled	>= 52	3	113.00	105.485	60.902
	< 52	9	60.67	56.009	18.670

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
SDRR_day1_recr	Equal variances assumed	0.861	0.375	2.524	10	0.03	35.544	14.084	4.162	66.927
	Equal variances not assumed			2.01	2.601	0.152	35.544	17.685	-25.952	97.041
SDRR_day1_disabled	Equal variances assumed	0.149	0.707	3.445	10	0.006	93.556	27.16	33.039	154.072
	Equal variances not assumed			3.108	2.984	0.053	93.556	30.098	-2.517	189.628
SDRR_day2_recr	Equal variances assumed	0.859	0.376	3.054	10	0.012	25.444	8.331	6.882	44.007
	Equal variances not assumed			4.112	6.822	0.005	25.444	6.188	10.735	40.154
SDRR_day2_disabled	Equal variances assumed	2.611	0.137	1.141	10	0.281	52.333	45.874	-49.881	154.547
	Equal variances not assumed			0.822	2.388	0.485	52.333	63.699	-183.172	287.839

OUTCOME FROM SPSS – CORRELATIONS

ANNEX 15 - CORRELATION AGE HORSE AND SDRR

Correlations

		SDRR_day1_recr	SDRR_day1_disabled	SDRR_day2_recr	SDRR_day2_disabled
age of the horse	Pearson Correlation	-.381	.076	-.359	.199
	Sig. (2-tailed)	.222	.815	.251	.536
	N	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

ANNEX 16 - CORRELATION GENDER HORSE AND SDRR

Correlations

		gender of the horse	SDRR_day1_recr	SDRR_day1_disabled	SDRR_day2_recr	SDRR_day2_disabled	Rest_SDRR
gender of the horse	Pearson Correlation	1	-.045	.109	-.184	.112	.083
	Sig. (2-tailed)		.890	.736	.567	.729	.798
	N	12	12	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

ANNEX 17 - CORRELATION AGE PARTICIPANT AND SDRR

Correlations

		SDRR_day1_disabled	SDRR_day2_disabled
Age participant	Pearson Correlation	-.489	-.238
	Sig. (2-tailed)	.107	.457
	N	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

ANNEX 18 - CORRELATION MONTHS HORSES USED IN THERAPY AND SDRR

Correlations

		SDRR_day1_recr	SDRR_day2_recr	SDRR_day1_disabled	SDRR_day2_disabled
how many months used in therapy	Pearson Correlation	.657*	.719**	.747**	.155
	Sig. (2-tailed)	.020	.008	.005	.631
	N	12	12	12	12

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).