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"Behavioral and Physiological Effects of Horse-assisted Therapy for Mother-Child Pairs with Insecure Attachment"

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Zusammenfassung

In dieser Studie wurde das Ziel verfolgt, Effekte pferdegestützter Frühförderung für Mutter-Kind Paare mit attestiert unsicherem Bindungsmuster zu untersuchen. Den theoretischen Hintergrund für die Untersuchung bilden die der Mensch-Tier-Beziehung zu Grunde liegenden Mechanismen: der Kontakt zwischen Mensch und Tier kann zur vermehrten Ausschüttung des Bindungshormons Oxytozin führen, welches mildernd auf die humane Stressreaktivität wirken kann. Dieser physiologische Mechanismus kann innerhalb eines therapeutischen Settings einen Anstoß zur Ausbildung eines sicheren Bindungsmusters auf Seiten des Klienten geben.

Um Effekte der Intervention auf die Anwesenheit des Pferdes zurückführen zu können, wurde ein vergleichender Forschungsansatz gewählt. Demnach wurden 20 Mutter-Kind Dyaden mit unsicherem Bindungsstil zwei verschiedenen Interventions-Settings zugewiesen, einerseits einer pferdegestützten Frühförderung andererseits einer Frühförderung in spieltherapeutischem Setting. Die Dyaden erhielten acht wöchentlich stattfindende Fördereinheiten. Dabei wurden Fürsorgeverhalten der Mütter, Stressreaktionen von Müttern und Kindern (HPA-Achse mittels Speichel-Cortisol Bestimmung und SAM-Achse mittels Aufzeichnungen von Herzraten und Herzratenvariabilität) sowie der Austausch zwischen Müttern und Therapeuten festgehalten. Verhaltensdaten wurden mittels Videoaufzeichnungen und Kodieren markanter Verhaltensparameter gesammelt. Anschließend wurden die Daten statistisch mit SPSS ausgewertet.

Die Ergebnisse zeigen, dass innerhalb des pferdegestützten Settings mehr Körperkontakt sowie sprachlicher Austausch zwischen Müttern und Kindern stattgefunden haben. Mütter der pferdegestützten Interventionsgruppe zeigten eine höhere Aktivierung des sympathischen Nervensystems (indiziert via erhöhten Herzraten). Mütter im spieltherapeutischen Setting zeigten hingegen eine höhere parasympathische Aktivierung (indiziert durch höhere Herzratenvariabilität). Eine Verminderung der HPA-Achsen Aktivität im Lauf der Sitzungen konnte nur für zwei Einheiten im pferdegestützten Setting ausgemacht werden. Aber dieses Muster war nicht kontinuierlich. Bezüglich der Hinwendung der Klienten zum Therapeuten ließ sich feststellen, dass Mütter im spieltherapeutischen Setting mehr mit den Therapeuten sprachen.

Hinsichtlich dieser Ergebnisse scheint im Fall der Intervention für unsicher gebundene Mutter-Kind Paare eine Kombination aus spieltherapeutischer als auch pferdegestützter Intervention von Vorteil zu sein.

Schlagwörter: pferdegestützte Therapie, pferdegestützte Frühförderung, Mechanismen der Mensch-Tier-Beziehung, Bindungsverhalten, Fürsorgeverhalten, Stressreduktion

Abstract

The aim of this study was to investigate effects of equine-assisted early intervention for mother-child dyads with an attested insecure attachment style. The theoretical basis is the so called "underlying mechanisms" of human-animal interactions. Contact between humans and animals can facilitate an increased secretion of the hormone oxytocin which can induce an alleviation of human's stress-response and furthermore can pave the way towards enhanced attachment security of clients within an therapeutic setting.

To trace effects back on the presence of the horse during the intervention a comparative procedure was conducted. Thus, 20 mother-child dyads with insecure attachment were randomly assigned to either a horse-assisted or a play-intervention setting. Effects of eight weekly intervention sessions on mothers' caregiving behavior, mothers' and children's stress response (HPA-axis via salivary cortisol and SAM-axis via heart rate and heart rate variability monitoring) as well as on the relation between clients and therapists were analyzed. Behavioral data were collected via video recordings which were coded for further analysis.

The horse-assisted setting promoted significantly enhanced body contact as well as an enhanced vocal exchange between mothers and infants. Participants in the horse-assisted intervention showed a significantly higher sympathetic activation (indicated by higher heart rates), participants of the play-intervention showed a significantly higher parasympathetic activation (indicated by higher heart rate variability values). A decrease of HPA-axis activity during the sessions was just found in two sessions of the horse-assisted intervention, but this pattern was not continuous. Comparing talking intensity between mothers and therapists, mothers obtaining play-intervention spent more time talking to the therapists.

Hence, when conceptualizing intervention-programs for mother-child dyads with insecure attachment a combination of sessions in a play-intervention and a horse-assisted setting should be considered.

Key words: equine-assisted therapy, equine-assisted early intervention, horse-assisted therapy, horse-assisted early intervention, underlying mechanisms of human-animal interactions, attachment behavior, caregiving behavior, stress-alleviation

1 Introduction – a selective View on Human-Animal Interactions

Animals in interventional programs (eg. visiting programs in homes for elderly, dogs present in classrooms) and therapy became increasingly popular over the last four decades (Beetz et al. 2012b, 7; Berget et al. 2011, 51; Yorke et al. 2012, 6; Zilcha-Mano et al. 2011, 541). Positive effects of human-animal interactions, animal-assisted interventions and therapeutic programs on physiological, psychological and behavioral levels were reported in many different studies and reviews. Beetz et al. (2012a), Greiffenhagen and Buck-Werner (2007) as well as Julius et al. (2013) review a variety of studies that show positive effects on physical, mental as well as on cardiovascular health, an improvement of social behavior, a reduction of aggression, improved learning and empathic skills. Also anxiolytic and depression minimizing effects of human-animal interactions were found. The presence of animals increases trustworthiness, trust in others and improves pain management. Research findings also show a decrease in heart rate, blood pressure, skin temperature and stress when animals are present.

Despite this variety of studies about effects of human-animal interaction in different contexts, studies about underlying mechanisms of these phenomena are still sparse, necessitating further comprehensive research (Beetz et al. 2011, 363; Beetz et al. 2012a, 1; Yorke et al. 2012, 5f; Zilcha-Mano et al. 2011, 541f). Following Yorke et al. (2012, 5f), this is especially true for horse-assisted therapy. Thus, in the frame of this study the aims lies at investigating effects of horse-assisted early intervention (a form of horse-assisted therapy) on behavior, physiology and furthermore at connecting these findings with proposed underlying mechanism of human-animal interactions.

1.1 Terminology – to get a clear view on the matter

Different fields of Animal Assisted Intervention (AAI) can be distinguished. Every field referring to its own terminology, own way of assigning the animals and specific animal species that are used. To get a clear view on the AAI in focus within the present study, a description of these differentiations will be given in the following.

The term “human-animal-interactions” serves as umbrella term for non-professional (eg. pet ownership) as well as professional interactions between humans and animals. Fields where animals are professionally assigned are so-called AAI, subsuming “Animal-assisted

education/pedagogy" (AAE), "Animal-assisted activities" (AAA) and "Animal-assisted therapy" (AAT). AAI's can be conducted with virtually any animal such as dog, cat, guinea-pig, hamster, rabbit, pet bird, pet fish, reptile, horse and farm animal (Greiffenhagen & Buck-Werner 2007, 211-230; Prothmann 2008, 94).

The international Society for Animal-Assisted Therapy (ISAAT) gives clear definitions of each of these fields according to standards derived from the Delta Society (American Organization of Human-Animal Relationships). These definitions give information about particular goals of certain interventions as well as who is allowed to conduct these interventions.

Therefore animal-assisted therapy has to be delineated from "animal-assisted education/pedagogy" (AAE) which is "conducted by a regular school teacher with knowledge of the animals involved, but when conducted by a remedial (special education) teacher, a social pedagogue, or teacher working in a correctional school" (ISAAT: http://www.aat-isaat.org/index.php?option=com_content&view=article&id=17&Itemid=18). As well as from "animal-assisted activities" (AAA) which "are most often conducted on a volunteer basis by people and animals (usually dogs), who have received at least introductory training and preparation for visitation in social institutions for motivational, educational and/or recreational reasons" (ISAAT: http://www.aat-isaat.org/index.php?option=com_content&view=article&id=18&Itemid=19).

During development of animal-assisted therapeutic approaches different terms such as "pet-facilitated therapy", "pet therapy" and "animal-assisted therapy" occurred. Since the beginning of the 90ies the term "animal-assisted therapy" (AAT) became standard (Prothmann 2008, 89).

According to ISAAT, animal-assisted therapy "is a goal-oriented intervention to promote the functioning and/or welfare of an individual patient or client" (ISAAT: http://www.aat-isaat.org/index.php?option=com_content&view=article&id=16&Itemid=17). "AAT is designed to promote improvement in human physical, social, emotional, and/or cognitive functioning [cognitive functioning refers to thinking and intellectual skills]. AAT is provided in a variety of settings and may be group or individual in nature" (Delta Society: http://www.petpartners.org/page.aspx?pid=320). AAT "is conducted by, or at least conducted under the supervision of, medical or therapeutic professionals. The use of the title 'therapist' – be it in psychology/ psychiatry for psychotherapy, family or partner counseling, occupational (ergo-) therapy, speech therapy etc. – is usually regulated by

national laws, often including required membership in professional organizations" (ISAAT: http://www.aat-isaat.org/index.php?option=com_content&view=article&id=16&Itemid=17). Another very critical aspect that distinguishes therapy from other interventions is, that the therapeutic process is documented and thus open for reflection and goal-assessment (Delta Society: http://www.petpartners.org/page.aspx?pid=320).

One specific field of AAT is "equine-assisted therapy" (EAT). Within this therapeutic approach therapists work with horses and people with emotional, social, physical or cognitive disabilities or diverse needs (Horse & Human Research Foundation: http://www.horsesandhumans.org/About_EAAT.html). EAT can be differentiated into three sub-fields: Hippotherapy, Therapeutic Riding/Vaulting and Equine Facilitated Psychotherapy (Gäng 2004, 24; Horse & Human Research Foundation: http://www.horsesandhumans.org/About_EAAT.html;
ÖKTR: http://www.öktr.at/pub/home/index.php).

- **Hippotherapy** means physical therapy on horseback especially in regard to medical indications and has to follow medical prescription (ÖKTR: http://www.oktr.at/hippotherapie). Hippotherapy is conducted by physiotherapists (Gäng 2004, 18).
- **Therapeutic Riding/Vaulting** is a resources-oriented intervention for children, adolescents and adults with eg. special-education needs, mental handicaps, impaired speech, emotional or social difficulties and psychiatric or behavioral disorders. According to requirements, resources and abilities of the client psychological, rehabilitative and socio-integrative actions are implemented with assistance of a horse (ÖKTR: http://www.oktr.at/heilpaedagogisches-voltigieren-reiten). Therapeutic Riding/Vaulting is conducted by (remedial) teachers, social pedagogues, kindergarten teachers or youth and childcare workers (Gäng 2004, 18).
- **Equine Facilitated Psychotherapy**, in contrast to therapeutic Riding/Vaulting, offers a psychotherapeutic intervention for children, adolescence and adults conducted by psychotherapists, psychologists, occupational therapists or psychiatrists (Gäng 2004, 18). Equine facilitated psychotherapy is indicated in case of trauma (Gäng 2004, 20), post-traumatic stress disorder, psychiatric disorders (eg. Schizophrenia, borderline syndrome), addictions, psychosomatic disorders, eating

disorders, anxiety disorders or depression. (FAPP & DKThR 2008; Sonderhefte des DKThR 2005).

A special case of Equine facilitated Psychotherapy is horse-assisted early intervention. The goal of early interventions is to support families and their young children in case of disability or if their healthy development is at risk. During early intervention medical, psychological as well as pedagogical aspects are taken into account. (HELP.gv: https://www.help.gv.at/Portal.Node/hlpd/public/content/122/Seite.1220210.html; Post Graduate Center University of Vienna: http://www.postgraduatecenter.at/lehrgaenge/bildung-soziales/interdisziplinaere-mobile-fruehfoerderung-und-familienbegleitung/).

In the study at hand the focus is on equine-assisted early intervention for mothers and their infants. As mentioned before, the study aims at investigating effects of such an intervention as well as their connection with underlying mechanisms of human-animal interactions. Thus, in the following sub-chapter the proposed underlying mechanisms are explained.

1.2 Underlying mechanisms of human-animal interactions

As major underlying mechanism of human-animal interactions in general, as of animal-assisted therapy in particular, the behavioral attachment system in connection with stress regulation is proposed (Beetz et al. 2011, 350; Beetz et al. 2012a, 11; Julius et al. 2013, 142-147; Yorke et al. 2012, 7; Zilcha-Mano et al. 2011, 541f). Thus, Bowlby's attachment theory and its connection with human stress regulation are taken into view within the following chapters.

1.2.1 Attachment theory

Bowlby (1969) defined the attachment behavioral system to have the function to promote reproductive success and survival. He described attachment behavior as "any form of behavior (e.g. crying, calling, seeking eye contact, reaching out for or following) that results in a person attaining or maintaining proximity to some other clearly identified individual who is conceived of as better able to cope with the world" (Bowlby 1988, 26f). In the very first relationships of every human being this individual is the mother or other primary caregiver. Attachment behavior is most obvious in situations of distress or anxiety

and is displayed to obtain attention and devotion of the other individual, mother or caregiver to ensure caregiving behavior such as proximity, body contact, vocal contact, protection and comforting (Bowlby 1969; Bowlby 1988, 26f; Beetz et al. 2011, 351; George & Solomon 2008, 835). Especially vocal and physical contact is seen as signs for secure attachment behavior as well as social support (Beetz et al. 2011, 357). Thus attachment behavior is the basis for attachment as an enduring relationship or tie bond (Ainsworth et al. 1978, 17).

Fine-tuned mutual and complementary coordination between the attachment behavior of the infant and the caregiving behavior of the primary caregivers constitutes a basic mechanism to buffer and reduce stress in inconvenient or unpleasant situations and thereby, to comfort and calm both sides (Bowlby 1958 & 1982 cit. in Diamond 2001, 277; Beetz et al. 2011, 351). The caregiving behavior is interpreted in terms of a behavioral system with the goal to protect ones offspring and to provide proximity, comfort and care (Bowlby 1969; George & Solomon 2008, 835). The caregiving system is activated either when parents perceive a certain situation as dangerous respectively stressful for the child or reciprocal to the child's display of attachment behavior. Caregiving behavior may include maintaining proximity, following, retrieval, carrying, looking, calling and smiling (George & Solomon 2008, 835)[1].

This very first relationship experiences of an infant with its primary caregivers are internalized as "conscious and unconscious mental representations of self and relationship partners [in other words as] internal working models of self and others" (Zilcha-Mano et al. 2011, 542). These relationship representations help to "anticipate, interpret, and guide interactions with partners" (Bretherton & Munholland 2008, 102) as they allow to imagine interactions with others based on previous experiences (Bretherton & Munholland 2008, 103). Further on in a child's development these internal working models are transferred to all other close relationships (Beetz et al. 2011, 352; Beetz et al. 2012b, 2; Bretherton & Munholland 2008, 102; Mikulincer & Shaver, 2007 cit.in Zilcha-Mano et al. 2011, 542). Thus, internal working models constitute the background for selecting and interpreting information as well as evaluating and generating alternative plans of action (Bowlby 1980; Bretherton & Munholland 2008, 111). Therefore a child's first relationship experiences are of great impact on coping with interpersonal relations in general.

[1] Bowlby's descriptions of attachment behavior were primarily on an operative and behavioral level. Neuronal basis of the attachment system were not known then. Today behavior can be linked to brain mechanisms (in the case of attachment the oxytocinergic system). Further details will be given in chapter 1.2.2

According to the success of this fine-tuned interplay between child and caregiver, as judged versus the potential optimum of a highly sensitive and reliable mother-child relationship, children develop different styles of attachment during their first year of life (Bowlby 1969). Attachment styles are "trait-like expectations concerning the responsiveness of attachment figures" (Diamond 2001, 278). According to their attachment style, individuals are equipped with different strategies and capacities for arousal and affect regulation (Kobak & Sceery, 1988; Mikulincer & Florian 1998). During an experimental separation between infant and primary caregiver (the so called "Strange Situation Test" developed by Ainsworth and colleagues) the behavior of the children can be categorized according to four different attachment styles:

If primary caregivers respond reliably and sensitively, are available and susceptive to the attachment behavior of their infant, it will develop trust that in case of need a supportive and protective figure will be emotionally available. Furthermore the child develops the ability to utilize its caregivers as secure base in stressful situations. In this case a *secure attachment* pattern can form and children can unobstructed start to explore its environment using the caregiver as secure base to which it can return in case of distress (Ainsworth et al. 1978, 311ff; Beetz et al. 2011, 351; Bretherton & Munholland 2008, 104).

If primary caregivers respond unsupportively and rejectively to the child's attachment behavior, the child starts to avoid relating to them in stressful[2] situations. Later on, these children will be inhibited to seek social support from other relationship partners in stressful situations. This behavior marks the *insecure-avoidant attachment* (Ainsworth et al. 1978, 314ff). The third attachment category is an *insecure-ambivalent* attachment style. This attachment style is formed if parents behave unpredictably towards their infants. Thus, children start to display ambivalent behavior towards their caregivers. They either seek constant closeness to them or show them aggression and anger. But maintaining closeness cannot calm them down (Ainsworth et al. 1978, 314ff). Later on, Main and Solomon (1990) described a fourth form of attachment style: the *disorganized attachment*. If caregivers constantly fail to provide security in stressful situations children, if they frighten, maltreat or neglect the child, it will not be able to build an adaptive strategy in attachment style. Thus, a breakdown of attachment strategies occurs (George & Solomon 2008, 848; Main & Solomon, 1990), except for the last resort of controlling behavior. These children learn that parental behavior only is – within limit – predictable, if

[2] The term "stress" was introduced into biology by Selye (1950 cit.in DeVries 2002, 405) as a concept for disrupted homeostasis.

controlled by the child. This vestigial adaptive strategy later tends to be used also towards further social partners.

Regarding social abilities and even health condition the type of attachment style does have a traceable impact over life. Children with insecure or disorganized attachment have more difficulties to establish secure relationships, have difficulties to reach the kind of balanced emotionality which is the prime predictor for a healthy and happy life (Coan 2011) and to seek effective social support from others in stressful situations (Beetz et al. 2012b, 2; Larose et al. 1999, 236; Maunder & Hunter 2001, 562f). Thus, a linkage between attachment style, stress coping and further more health can be claimed.

1.2.2 The Attachment System and its Connections to Physiology and Health

The most effective way to reduce stress is generally a close and trusting relationship (Beetz et al. 2011, 352). Thus positive social interaction has stress-protective effects (Heinrichs et al. 2009, 550). Thereby the neuropeptide Oxytocin plays an important role.

Oxytocin is synthesized in magnocellular neurons of the paraventricular nucleus (PVN) and the supraoptic nucleus (SON) – two sites of the hypothalamus (Kleine & Rossmanith 2007, 47ff; Landgraf & Neumann 2004, 150; Ross & Young 2009, 534; Striepens et al. 2011, 426). During labor, mother-infant interactions such as breastfeeding, during non-noxious somatosensory stimulation resp. physical contact, sex, warmth as well as during positive social contact and positive emotions oxytocin is released into the blood stream as well as into the central nervous system (Diamond 2001, 286; Handlin et al. 2009, 207; Heinrichs et al. 2009, 553; Julius et al. 2013, 60; Stock & Uvnäs-Moberg 1988, 29; Turner et al. 1999, 97; Unväs-Moberg 1997a, 38; Unväs-Moberg 1997b, 146; Unväs-Moberg et al. 2008, 199). These releasing processes are mediated by two different neuronal circuits.

The peripheral release is mediated by neurons from the PVN and SON. These neurons project into the posterior pituitary from where the neuropeptide is released into the venous bloodstream. Oxytocin further affects endocrine glands. Examples for the peripheral virtue of oxytocin are parturition and milk ejection (Kleine & Rossmanith 2007, 47ff; Landgraf & Neumann 2004, 150; Ross & Young 2009, 534; Striepens et al. 2011, 426). Additionally Oxytocin is released centrally via parvocellular neurons of the PVN and collaterals of magnocellular neurons which project to different brain regions such as hypothalamus, cortex, limbic system (amygdala, raphe nuclei), the column of the spinal cord and the

spinal cord itself (Ross & Young 2009, 544; Striepens et al. 2011, 426). In these brain regions the regulation of social behavior, stress, fear, memory, learning and pain is mediated (Julius et al. 2013, 60). Oxytocin is also released from dendrites and acts as autocrine and paracrine signal at their site of release as well as at more distanced sites within the central nervous system. Centrally released oxytocin functions as neuromodulator due to binding to oxytocin-receptors and induces long-lasting alterations in behavior (Ludwig & Leng 2006, 126) such as onset of maternal behavior, bonding between mother and offspring, alloparental behavior, pair bonding and social recognition (Carter et al. 1995, 303; Fahrbach et al. 1985, 526; Kendrick et al. 1997, 385; Keverne & Kendrick 1992, 83; Leengoed et al. 1987, 275; Pedersen et al. 1982, 648; Ross & Young 2009, 539). Julius et al. (2013, 63fff) review further oxytocinergic effects. Thus, oxytocin decreases anxiety and increases calmness and trust in others. Oxytocin also facilitates a heightened pain threshold and an increase in healing-processes. Furthermore centrally released oxytocin has an anti-stress effect (Beetz et al 2012a, 11; Legros et al. 1988, 2004; Neumann et al. 2000, 235).
Preliminary the physiological level of the response to stress will be described and how oxytocin can alter these physiological mechanisms. Thereafter the connection between oxytocin, attachment and the stress-system will be outlined.

Throughout mammalian species typical physiological reaction patterns to stress are sheared (Julius et al. 2013, 60). Cannon (1929) described these patterns as fight or flight response. Arousal, anger and fear as well as increased cardiovascular functioning (heightened activation of the sympathetic nervous system) and decreased gastrointestinal activity (alleviated parasympathetic functioning) are components of the stress reaction (Cannon 1929; Diamond 2001, 279; Selye 1976 cit.in Julius et al. 2013, 61). In response to stress two neuroendocrine systems are activated: 1) the sympathetic-adrenal-medullary axis (SAM) 2) the hypothalamic-pituitary-adrenal axis (HPA). These two functional-circuits initiate different stress-related physiological processes and long-term consequences for mental and physical health (Diamond 2001, 283).

- **The sympathetic-adrenal-medullary axis (SAM)**

This axis is responsible for the rapid alarm response (Selye 1951 cit.in Julius et al. 2013, 29) which is mediated by a quick release of the catecholamines epinephrine and norepinephrine from the adrenals. These accelerate the sympathetic activity and lead to a

change in heart rate and blood pressure (reviewed in Baum & Grunberg cit.in Diamond 2001, 283; Penzlin 2009, 498).

- **The hypothalamic-pituitary-adrenal axis (HPA)**

This axis is responsible for the slower but longer-lasting alarm response. In the presence of stress the corticotropin-releasing factor (CRF) is released from the hypothalamus and enters the anterior pituitary. There CRF facilitates the release of adrenocorticotropic hormone (ACTH). ACTH is peripherally released and affects the adrenal cortex where in response the glucocorticoid cortisol is synthesized and released (Julius et al. 2013, 29; Penzlin 2009, 481&500). Clucocorticoids play an important role in metabolic processes due to regulating energy use. They induce cluconeogenesis and thus provision of energy (McEwen & Wingfield 2003, Sapolsky 1992 & van Holst 1998 cit.in Julius et al. 2013, 29; Penzlin 2009, 500)

Both stress axis respond very sensitively to social contexts (Julius et al. 2013, 29). On the one hand social stress leads to an activation of the SAM and HPA axis (DeVries 2002, 405; Wascher, Arnold & Kotrschal 2008, 100; Wascher, Scheiber & Kotrschal 2008, 1653). On the other hand social support provides a dampening effect on stress-response. Thereby Oxytocin plays an important role as it mediates a stress alleviating effect. Thereby oxytocin inhibits the HPA activity on different levels (Beetz et al. 2011, 363; DeVries et al. 2003, 399; Julius et al. 2013, 146). "It decreases CRF release in the PVN, it decreases ACTH secretion in the anterior pituitary, [sic!] and it decreases cortisol secretion from the adrenal cortex via direct action in the adrenal cortex" (Julius et al. 2013, 75). As a consequence of the influence of oxytocin social support can dampen anxiety, aggression and physiological as well as energetic cost of social life. Furthermore socio-positive interactions are enforced and social bonds strengthened (Julius et al. 2013, 28).

Julius et al. (2013, 81) and Diamond (2001, 284) point out, that oxytocin release requires a "certain quality of relationship" (Julius et al. 2013, 81.), best an attachment-relation (Julius et al., 81). Findings of a study on squirrel monkeys conducted by Mendoza et al. (1991 cit.in Diamond 2001, 284) show, that the presence of attachment figures has a stress-reducing effect due to alleviated cortisol secretion. Depending on an individual's attachment style, the reaction to stress is molded. Thus, adolescents and adults with secure

attachment are better able to respond to stress on emotional and behavioral levels (Cooper et al. 1998, 1380; Diamond 2001, 283; Mickelson et al. 1997, 1092). The reason for this phenomenon is, that secure attached individuals show a higher basal level of oxytocin than sub-optimal attached ones (Julius et al. 2013, 142), this effective stress-response may be facilitated by a "good tone or function in their oxytocin system" (Julius et al. 2013, 126). In contrast, individuals with insecure and disorganized attachment patterns exhibit a deregulated oxytocinergic system (Julius et al. 2013, 142), an exaggerated reactivity of the HPA-axis to stress (Diamond 2001, 284; Julius et al. 2013, 112) as well as heightened sympathetic activity in situations of distress. Furthermore they cannot gain a calming effect from the presence of their caregivers but are rather stressed in their company (Julius et al. 2013, 111f&116f). In this regard a causal relationship between attachment-style and oxytocinergic stress regulation can be proposed (Julius et al. 2013, 142; Maunder et al. 2006, 289).

As children and adults with a sub-optimal attachment style might not as much rely on the soothing effect of social partners compared to children and adults with secure attachment style they may face a greater impact of stress or chronic stress responses (Beetz et al. 2012b, 1; reviewed in Diamond 2001, 288). Heightened or chronic stress exposure then impacts on human health as elevated cortisol levels lead to an inhibition of vegetative processes and immune system (Rensing et al. cit. in Schöberl & Wedel 2012, 166). Furthermore even slight increases in the cortisol level are associated with a decline in executive functioning (Beetz et al. 2012b, 2).
About 40% of children in general population show disorganized or insecure attachment patterns but most children with special educational needs (Beetz et al. 2012b, 1). According to former remarks these children are highly at risk to develop insufficient and maladaptive social bonds as well as chronic stress, with implications for success in school, society and health.

A possibility to alleviate these long-lasting effects of attachment insecurity an animal-assisted intervention-approach is considerable as:

1) human-animal interactions can facilitate an alteration of attachment-structure
2) Julius et al. (2013) propose that the interplay between the oxytocin- and stress-system can be regarded as an underlying mechanism of human-animal interactions resp. animal-assisted therapy. Thus, many studies show that after human-animal

interactions an increase of oxytocin and furthermore an alleviation of stress-response can be found (Allen et al. 1991; Allen et al. 2002; Barker et al. 2005; Beetz et al. 2011, 2012b).

In the subsequent chapter these aspects will be further explicated.

1.3 Attachment as therapeutic target

Attachment representations may be stable, but are open for alterations. Thus, Bowlby (1988) claimed that interactions with others throughout life can alter a person's inner working models and thus attachment patterns (Zilcha-Mano et al. 2012, 542). Hence, there is space for therapeutic and corrective interventions. Specifically the therapist can embody a security enhancing figure of attachment so that the attachment security of the client is induced (Bowlby 1988 cit.in Zilcha-Mano et al. 2012, 546). A "secure attachment-like relationship toward a therapist" (Julius et al. 2013, 149) might function as a secure model which is then transposed upon other relations beyond therapy (Julius et al. 2013, 149). As a consequence stress coping mechanisms, reliability towards others and social integration might be improved. Furthermore changed interpersonal relations can alleviate the negative impact of stress on health.

Especially animal-assisted therapy holds specific benefits which may help to promote a stable relation between clients and therapists. In literature three setting specific aspects of animal-assisted therapy that promote a relation between client and therapist can be detected:

1) Is an animal present during therapy there are many opportunities for close physical contact between client and animal. This is especially true for equine-assisted intervention, above all when riding on horseback. This physical contact may activate the oxytocin system which then induces positive physiological and psychological and effects, such as reduced fear and stress, increased trust and sociability (Beetz 2010, 13; Julius et al. 2013, 147). This can mark one basis for developing a stable relation between client and therapist.
2) The presence of the animal alters the client's perception of the therapist. The relation between therapist and pet may show the client that the therapist is a caring, attentive and sympathetic person. This might facilitate rapport and sympathy towards the therapist (Zilcha-Mano et al. 2011, 551).

3) The change in maladaptive working models which accompany impaired attachment patterns is a main goal of therapeutic intervention (Mikulincer & Shaver 2007 cit.in Zilcha-Mano et al. 2011, 547). A companion animal might "facilitate the formation of an attachment bond that can be relatively free of maladaptive projections and therefore can help clients to revise their maladaptive working models" (Zilcha-Mano et al. 2011, 547). This secure bond to the therapy-pet might promote a secure attachment relation to the therapist himself.

Furthermore animal-assisted intervention and therapy can not only support a stable attachment relation between clients and therapists but also directly support the attachment security in children and adults with insecure or disorganized attachment. This is because companion animals can serve as attachment figures alternative to the primary attachment representation. Already Levinson (1969 cit. in Zilcha-Mano et al. 2011, 54) claimed that pets are natural objects of attachment. But also in recent publications animals are seen as attachment partners (Opgen-Rhein 2011, 11). Following Zilcha-Mano et al. (2011, 542) Kurdek (2008, 249) and Yorke et al. (2012, 6) pets share key characteristics and functions with human attachment figures. Human bonds towards pets also meet the four criteria for an attachment bond stated by Ainsworth (1991, 38) which are: proximity seeking, separation distress, secure base[3] and safe haven[4]. As studies show animals owners rely on their animals for social support in stressful situations (Kurdek 2009, 444f; Rost & Hartmann 1994, McNicholas & Collis 2006 cit. in Beetz 2012b, 2). Animal owners also report emotional closeness to their companion animals, enjoy and seek their physical closeness (Barker & Barker 1988, 46; Kurdek 2008, 247; Kurdek 2009, 439).

Children with an attachment impairment who would not rely on humans in for instance stressful situations open up more easily and spontaneous towards animals and relate to them (Beetz et al. 2012b, 2). The study by Beetz et al. (2012b) shows that animals can be a more efficient emotional support for children with insecure or disorganized attachment in a stressful situation than a friendly adult or toy dog. A specific feature of the human-animal bond is that even humans who avoid relating to humans usually relate to animals as attachment avoidance towards humans is not transferred to animals (Beetz et al. 2011, 353; Zilcha-Mano et al. 2011, 544).

[3] Within attachment theory "secure base" refers to a safe and holding relationship from where an infant can either explore the world (Ainsworth et al. 1978, 255f).

[4] Within attachment theory "safe haven" refers to a relationship partner to whom one turns in case of distress (Julius et al. 2013, 117).

These aspects can be seen as supportive in the therapeutic work, especially with patients with insecure attachment. Animal-assisted therapy might be one possibility to enhance attachment security in these patients and thus minimize the social and health consequences of insecure attachment patterns. This research-project was conceptualized to especially study effects of animal-assisted therapy on levels of attachment, caregiving, stress coping and in respect of its influences regarding the relation between therapist and client.

In this study the focus is on equine-assisted early intervention, one division of animal-assisted therapy, and its effects on mother-child-pairs with attested attachment insecurity. Thereby attention is especially drawn to effects that are connected with the previously proposed underlying mechanisms of human-animal interaction such as attachment (caregiving), stress- and oxytocinergic responses.

To find out, if effects of the therapeutic intervention can especially be attributed to the assistance of horses within the therapy a comparative research procedure was conducted. Thus, study participants were divided into two groups. The intervention group obtained equine-assisted early intervention while a control group obtained early intervention in a play-setting.

1.4 Questions of Research and Hypotheses

Based on the theoretical background of the underlying mechanisms of animal assisted therapy the following questions and hypotheses arise:

Influences of equine-assisted early intervention on the caregiving behavior

Does equine assisted therapy facilitate caregiving behavior (George & Solomon 2002) in mothers as compared to the play therapy situation?

- Does equine-assisted therapy facilitate touch between mother and child over the course of all therapy sessions?
- What is the average-duration of constant body-contact and non-body contact between mother and child during the therapeutic sessions?
- Is there a setting dependent difference concerning body contact and touching frequency between mother and child?
- Is there a correlation between the frequencies with which the mother touches her child and the horse?

- Is there a correlation between verbal contact of the mother towards her child and towards the horse (which would be a hint of a relatively unspecific, arousal-related mechanism behind)?
- Does equine-assisted therapy facilitate vocal exchange between mother and child over the course of all therapy sessions?
- Does equine-facilitated therapy facilitate positive reinforcement between mother and child?

General Hypotheses

Null-Hypothesis A: There is no difference in caregiving behavior before and after the iteration of the therapy sessions.

Null-Hypothesis B: There is no setting-specific difference in caregiving behavior between mothers of EAT and of the play group.

Working Hypothesis A: After the iteration of the therapy sessions mothers will show a more differentiated caregiving behavior towards their infants.

Working Hypothesis B: Mothers of the equine-assisted therapy group will show a more sophisticated caregiving behavior towards their infants than mothers of the play group.

Predictions

If the horse facilitates secure attachment through enabling physical contact and through the mediational effect on the relationship between therapist and the mother-child dyad one can expect that due to this effect the relationship bond between mother and infant is strengthened. If so attachment behaviors like vocal exchange, physical contact and positive reinforcement should increase over the period of the therapy.

Influences of EAT on stress levels – HPA-axis and SAM-axis

Is equine-assisted therapy associated with a lower stress level in clients than in play therapy?

- Is there a setting-dependent difference in stress levels measured via salivary cortisol in mothers and children (HPA-axis)?
- Is there a setting-dependent difference in stress levels measured via heart rates in mothers and children (SAM-axix)?

Specific Hypotheses

Null-Hypothesis C: There is no setting-specific difference in stress levels in mother and infants.

Working Hypothesis C: Mother-child dyads in the EAT group will show a lower stress level than mother-child dyads in play group.

Predictions

1) The onset of the therapy might induce a stress reaction within the clients. If the presence of the horse helps facilitate a trustful relation to the therapist, cortisol levels of mothers within the horse-intervention group should decrease more rapidly than of mothers within the play therapy group.
2) If due to the presence of the horse oxytocin release is stimulated its calming effects on the stress system should be visible in a reduction of the stress hormone cortisol. If this is a specific effect of equine assisted therapy cortisol levels within the horse-intervention group should be lower than within the group obtaining play therapy.

Influence of EAT on therapist-client relations

Does equine-assisted intervention provide a setting that facilitates a more intensive relation between mothers and therapists?

- Is there a setting dependent difference in vocal exchange between mothers and therapists?
- Is there a setting dependent difference in vocal exchange between children and therapists?

Specific Hypotheses

Null-Hypothesis E: There is no setting specific difference in vocal exchange between mothers and therapists.

Null-Hypothesis F: There is no setting specific difference in vocal exchange between mothers and children.

Working Hypothesis E: Vocal exchange between mother and therapist will be higher in the horse-intervention group.

Working Hypothesis F: Vocal exchange between mother and therapist will be hither in the horse-intervention group.

Predictions

As mentioned before, animal-assisted therapy holds benefits which may help to promote a stable relation between clients and therapists as oxytocin release after animal contact facilitates trust (Beetz 2010, 13; Julius et al. 2013, 147) as well as contact to animals alter the client's perception of the therapist which might lead to an enhanced rapport (Zilcha-Mano et al. 2011, 551). Thus, it can be assumed that vocal exchange between mothers and therapists is higher within the horse-intervention group.

2 Study design and Methods

As Kaminsky et al. (2002, 323) claimed, comparative research on animal-assisted therapy and play therapy is sparse. Thus, a comparative research design was chosen to answer the questions of research presented before. In the following subchapters details about subjects, procedure and methods will be given.

2.1 Subjects

Twenty Mother-Child dyads with attested attachment impairment took part in this study. Mothers were aged between 19 and 46 years (median: 27.5).Children (12 girls, 8 boys) were aged between 1 to 2 years (median 15.5 months) and came from high-risk families. This means that premature birth, domestic violence, neglect or abandonment etc. characterizes their family background. The mother-child pairs were assigned from the Child and Adolescent Psychiatry Augsburg, Germany. After assignment 10 mother-child dyads randomly obtained horse-assisted early intervention (7 girls, 3 boys) whereas 10 pairs obtained play-intervention (5 girls, 5 boys). The following table shows the distribution of attachment patterns within the tow intervention groups.

Table 1 Distribution of attachment patterns within the two intervention groups

Attachment pattern	**Horse-intervention Group**	**Play-intervention group**
Secure	1	5
Insecure-avoidant	4	1
Insecure-ambivalent	0	0
Disorganized	5	4

2.2 Therapists

Both settings were covered by two female therapists. One therapist had a psychotherapeutic educational background the other one was trained as an occupational therapist. Each therapist was randomly assigned to 10 mother-child dyads, 5 pairs in horse assisted and 5 pairs in play-intervention.

2.3 Materials and Procedure

2.3.1 Horse-assisted Intervention

- **Facilities**

The equine-assisted intervention took place at the grounds of the psychiatry. There a small barn offering space for up to four horses was installed. In front of the stables a fenced area was used to groom and saddle the horses. In short walking distance a small outdoor riding arena (20x20 meters) and a roofed riding pavilion were situated (diameter of 10m). Within about 50 meters walking distance to the stables an oval and fenced riding coral (30x50 meters) was located (chart 1).

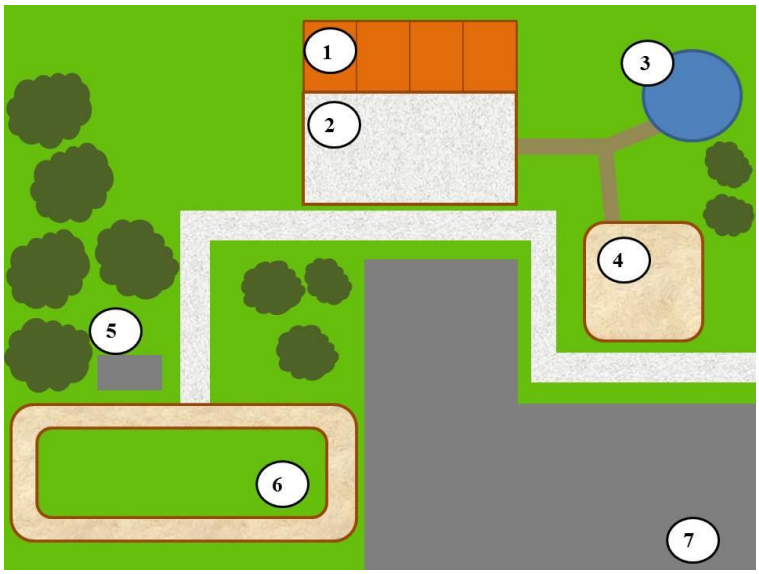


Chart 1 Facilities of horse-assisted intervention: 1) stables 2) grooming area 3) riding pavilion (Ø=10m) 4) small, fenced riding arena (Ø=20m) 5) mounting aid 6) fenced riding coral (15x40m) 7) psychiatry building

- **Horses and Equipment**

All assigned horses belonged to one of the therapists and were brought to the clinic stables only for working in therapy sessions. On days off therapy they spent their time in an open stable where they were kept together in a herd. For the study mainly three horses were assigned. First a small, dark-brown pony gelding. Then a robust, white cart-horse mix gelding and a slim, black arabian-mix gelding. All horses were very calm and especially trained for their assignment in therapy.

Before mothers and children arrived the therapists groomed and equipped the horses with a well-fitted halter, a leading rope, a thick saddle pad normally used in western riding and a vaulting girth.

- **Procedure**

The mother-child pairs from the intervention group participated in eight weekly sessions of equine-assisted early intervention. The sessions were structured in three main phases. First was the welcoming period. Mother and child were given the chance to approach the horse, pat or talk to it. Thereafter the therapist, the horse and the mother with her child went to a fenced outdoor riding area where the main intervention took place. The horse was guided by a trained horse-leader. The therapist accompanied mother and child on foot. The first session was conducted with a pony and took place on the smaller riding arena. In this session just children were riding, mothers accompanied them on foot. From the second session onward a bigger horse was used and the sessions took place at the big riding coral. From this session onwards mothers could choose to either ride or walk next to horse and child. In case of rainy and wet weather, the sessions were accomplished in a circular riding pavilion.

In the intervention phase child, mother or both sat on horseback. Throughout the therapy-sessions mother child and therapist implemented different mutual tasks. The main focus was on positive interaction between mother and child. After the intervention phase the horse was returned to the stable where mother and child were allowed to feed the horse with bread or carrots and to see off the horse.

During the session two students were present. One student was equipped with a digital video camera the other with a salvia-collection set. During videotaping the student followed mother and child resp. the horse in a short distance. Only for salvia sampling the second student approached mother and child. If children approached the students, they tried to stay as noninvolved as possible.

2.3.2 Play Therapy

- **Facilities**

The play-intervention took place in little rooms (about 20m²) located in a half-cellar floor in one of the psychiatry-buildings. The rooms were especially adapted for this kind of therapy. The furniture was colored in friendly and natural shades. The walls were painted in light yellow and a green, fluffy carpet covered the floor. The room was equipped with different toys (dolls, cars, toy blocks, instruments etc.), small chairs and tables (chart 2).

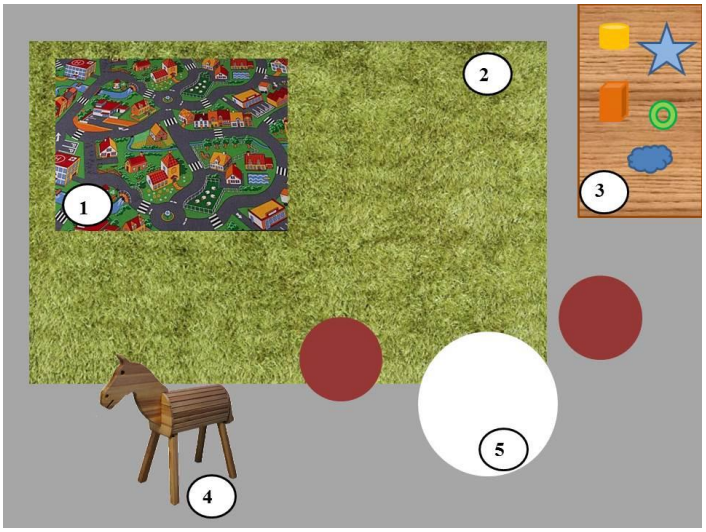


Chart 2 Playroom: 1) play carpet 2) soft carpet 3) table with toys 4) wooden horse 5) table and chairs

- **Procedure**

The mother-child pairs from the control group obtained eight weekly sessions of play-intervention. After arrival mother and child were able to freely choose a certain activity. The therapist was also involved in playing but followed the interests of mother and child. As in the intervention group the focus was on a positive interaction between mother and child. During the session a student equipped with a digital video camera and a salvia-collection set was present in the room for data collection. During videotaping the student remained in a corner of the room. Only for salvia sampling the student approached mother and child. If children approached the student, the student tried to stay as noninvolved as possible.

2.4 Measures and Analysis

2.4.1 Psychological Measures

- **Assessment and Analysis of Attachment**

One week before the onset of therapy and one week after the last session the attachment of the child to the mother was assessed via the standardized Strange Situation procedure (Ainsworth et al. 1978). This procedure consists of eight episodes where child and mother are separated and reunited, in and without the presence of a female stranger. According to the child's behavior during separation and especially during reunion the attachment-style of the child can be assessed.

- **Assessment and Analysis of Caregiving Behavior**

One week before the onset of therapy and one week after the last session the caregiving behavior of the mother towards the child was assessed via the CARE-Index. This index assesses the interaction between mother and infant. During a short video-taped play-interaction between mother and child unresponsiveness, sensitivity, covert and overt hostility of the mother as well as passivity, cooperativeness, compulsive compliance and difficultness of the child are measured. The measures between mother and child correlate in the listed order. The results of the CARE-Index assess the effectiveness of intervention.

2.4.2 Behavioral Measure

The therapeutic sessions were videotaped and coded afterwards regarding for 64 different behavioral variables using the SOLOMON Coder. Variables for mother, child, therapist and horse were determined concerning motion, vocal exchange between the participants, touch and proximity between mother and child. Furthermore mood, positive as well as negative reinforcement between mother and child were recorded. For further details about variables and their definition see appendix I.

2.4.3 Physiological Measures

To obtain information about the impacts of the therapy on both stress-axes the hypothalamic-pituitary-adrenal (HPA) axis and the symapthetic-adrenal-medullary (SAM) axis two measurements were applied:

1) **Measurement of Cortisol and Analysis**

Salivary cortisol (an equivalent for free plasma cortisol) as an indicator of stress at the HPA-level (Gallagher et al. 2006; Vining & McGinley 1987; Woodside et al. 1991) was collected via salivettes (Sarstedt, Etten-Leur, the Netherlands) at three time points during the sessions (Beginning, after 20 minutes and at the end of therapy). It was taken care of, that mother-child dyads obtained there therapy-sessions at the same time of the day each week as cortisol secretion follows a circadian rhythm. A peak occurs in the morning followed by a gradual decline during the day (Mommersteeg et al. 2006, 243). Ensuring the same time-points of the repeated measurements similar basal cortisol levels can be expected. Thus, a distortion of cortisol levels due to the circadian changes can be

prevented. The samples were frozen at -20 degrees Celsius. For analysis enzyme immunoassays (EIA) were used.

To gain insight into changes of cortisol levels over the course of the therapy sessions differences between salivette 2 and salivette 1 as well as between salivette 3 and salivette 1 were calculated. Thus positive differences indicate a rise in cortisol levels and a negative score a decline.

Another standard method in studies that refer to repeated salvia measurements is the calculation of the *area under the curve* (AUC) (Beetz et al. 2011, 357). AUC-values "comprise information that is contained in repeated measurements over time" (Pruessner et al. 2003, 917). Thus, information about changes over time as well as "the overall intensity at which the recorded events occurred" (Pruessner et al. 2003, 917) can be gained. The formulas for calculating AUC-values are derived from the trapezoid formula (Pruessner et al. 2003, 916).

Pruessner et al. (2003) differentiate two different AUC-values, referring to two different formulas. First the AUC with respect to the ground (AUCg), shown in figure 1. The AUCg-value represents the whole area under the curve, thus taking into account the difference between the points of the single measurements from zero.

The AUCg is calculated with the following formula:

$$AUCg = \frac{(m2 + m1).t1}{2} + \frac{(m3 + m2).t2}{2}$$

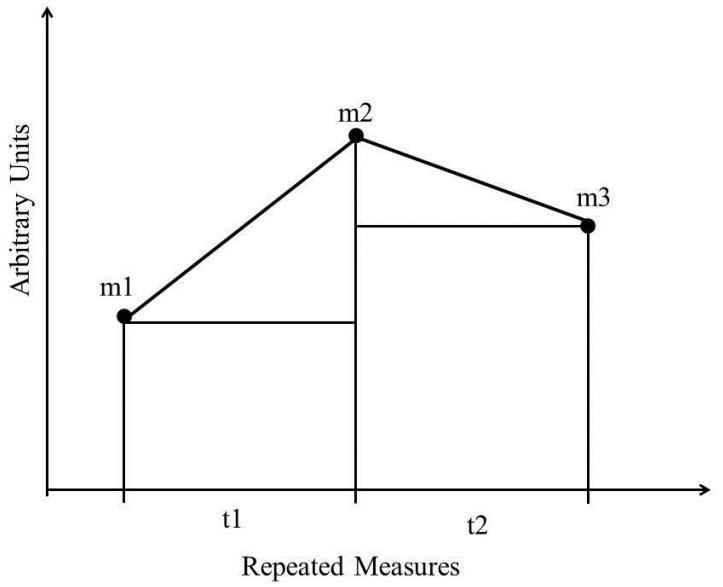


Figure 1 Area under the curve with respect to the ground; m1 –m3= single measurements, t1 – t3 = time between measurements (20 minutes).

Second the AUC with resprect to the increase (AUCi), shown in figure 2. The AUCi-value ignores the distance of the measure points from zero. Instead "the curve is calculated with reference to the first value" (Pruessner et al. 2003, 919). Thereby changes over time are emphasized (Pruessner et al. 2003, 919).

For calculation of AUCi-values the following formula is used:

$$AUCi = AUCg - (m1 \,.\, tges)$$

Pruessner et al. (2003, 321) emphasize, that also negative results can be expected as the formula refers to the first measure. Thus, a negative result indicates a decrease whereas a positive result indicates an increase over time.

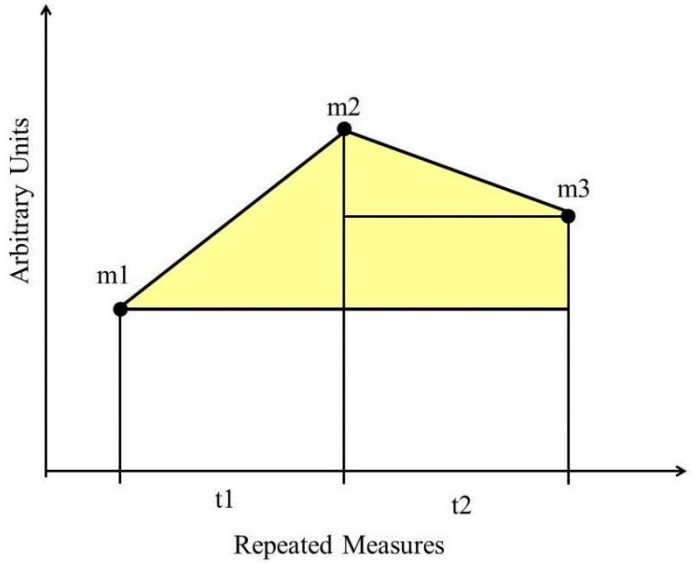


Figure 2 Area under the curve with respect to increase; m1 –m3= single measurements, t1 – t3 = time between measurements (20 minutes).

2) Assessment of Heart Rates and Analysis

To measure the impact of the sessions on the SAM-axis heart data were collected. During the sessions, mother, child and horse carried a polar chest belt and a polar watch for the assessment of heart rates. Heart rates provide insight into the stress reaction and management during the therapeutic sessions as heart rates sum up a subject's reaction to internal as well as external stressors (Kučera 2006, 3; Mulder 1992, 205; Wascher, Arnold & Kotrschal 2008, 100). Before the chest belts were put on, the electrodes were carefully moistened with a sponge thus providing better skin contact and pulse transmission.

The obtained heart rate data were manually error-corrected. Therefore missing data, especially for toddlers, were calculated from the available data if less than 10% of data were missing.

Besides the mean heart rate (HR), heart rate variability (HRV) was taken into view. HRV is a measure for the range of the beet to beet variation of the heart.

In a resting situation the human heart beats about 50-80 times per minute. In a cardiogram these beats are shown as R-peaks. The heart rate indicates the beats per minute. But a healthy heart at rest beats not strictly at a regular base but certain temporal irregularities between the beats (in the cardiogram between the R-peaks) occur (Curic et al. 2007, 4f; Kučera 2006, 3). These irregularities result from the interplay of the sinoatreal node, the sympathetic and parasympathetic system (N. *vagus*). Under stressful situations the sympathetic system is activated thus, the HR increases and the variation of heart beat decreases. During calm and quiet situations the parasympathetic activity is prevalent. Thus, the HR decreases while the variation of heart beat increases (Kučera 2006, 3). Different indices for the HRV can be calculated (as was done in this study):

RRI: is the interval between two R-peaks in the cardiogram. The higher the mean heart rate, the lower is the interval between two R-peaks (Curic et al. 2007, 7).

pNN50: percentage of successive RRI's that differ in more than 50 percent. This measure gives information about the parasympathetic activity. The higher the scores the higher is the parasympathetic activity and thus relaxation (Curic et al. 2007, 7; Hottenrott et al. 2006, 545).

RMSSD: is a measure for rapid, high- frequent fluctuations of heart rate. Differences in successive RRI's are calculated. The RMSSD scores also indicate parasympathetic activity. The higher the scores the higher is the parasympathetic activity and thus relaxation (Curic et al. 2007, 7; Hottenrott et al. 2006, 545).

HR and HRV were calculated for the entire therapy sessions and the phases between salivettes 1 and 2 and between salivettes 2 and 3. While a higher heart rate (HR) indicates activation, a higher HRV (all indices) indicates more relaxation.

2.4.4 Data analysis

After data extraction statistical analysis were applied via PASW SPSS 18.00. As most biological data do not follow a normal distribution non-parametric tests were applied:

- To analyze changes in certain variables over the course of the eight therapeutic sessions Friedman Tests were applied.
- To compare variables of two sessions Wilcoxon Matched Pairs Tests were used.
- Mann-Whitney-U Tests were used to trace differences between the horse-intervention group and the control group.
- To compare means of variables of more than two groups Kruskal-Wallis Tests were applied.
- To find out if patterns in certain variables were associated with each other Spearman's correlations were calculated.

Applying many statistical correlations the probability of committing a type I error, thus, rejecting the Null-Hypothesis though it would be correct, rises. Rice (1989) first proposed to apply a so called Bonferroni Correction to prevent such errors in statistical analysis. This correction was first developed in 1979 by Holm, who proposed to adjust probability values according to the number of simultaneous tests. Therefore the alpha-level should be divided through the number of simultaneous tests applied (Holm 1979). Although some authors claim that such a corrective calculation is necessary (Holm 1979; Rice 1989; García 2004) others argue that such corrections would reduce the statistical power of the statistical tests, especially in cases of small sample sizes or when calculating with more variables, like often in behavioral research (Moran 2003, 404; Nakagawa 2004, 1044). Moran (2003, 405) also states that lowering the level of significance could result in losing important results – especially when doing research in a novel field. According to Cabin and Mitchell (2000) meta-analysis show that the decision about applying corrective methods is highly subjective. Thus they claim that decisions for and against corrective methods should be "as explicit as possible" (Cabin & Mitchell 2000, 248). Therefore, following Moron (2003) and Nakagawa (2004), it will be abstained from applying Bonferroni Correction in this study, as the sample size is relatively small (n=20) in comparison to the many variables assessed.

Moran (2003) emphasizes that there are certain criteria that should be met to ensure profound statistical analysis if no Bonferroni Corrections are applied:

1) Describing results not just p-values but also effect sizes should be represented
2) If repeated patterns of results can be detected the probability that results are spurious decreases
3) Interpretation of correlations/results should be led by hypotheses and the rules of reason
4) Results should be reproducible

These criteria will be applied in the description of results, since it seemed more suitable to abstain from Bonferroni correction in this study.

Effect sizes "provide an objective and standardized measure of the magnitude of the observed effect" (Field 2005, 32) and allows to compare results across studies (Field 2005, 32) For Mann-Whitney-U Tests and Wilcoxon Matched Pairs Tests were calculated as recommended by Field (2005, 541&532) with following formula (Rosenthal 1991, 19):

$$r = \frac{Z}{\sqrt{N}}$$

Effect sizes for Spearman Correlations were calculated with following formula

Field (2005, 32) shoes standard values, suggested by Cohen (1988 & 1992) that mark different effect-sizes:

r=0,10 (small effect) – 1% of total variance is explained by the effect
r=0,30 (medium effect) – 9% of total variance is explained by the effect
r=0,50 (large effect) – 25% of total variance is explained by the effect

For Spearman Correlations R^2 was calculated for gaining insight to which extent the variance in one variable is explained by the other (Field 2005, 128).

3 Results

In the subsequent chapter the results of the statistical analysis will be shown. Subchapters reflect topics that were issue in the previously described hypotheses.

3.1 Setting dependent influences of horse-assisted intervention and play-intervention on mothers' caregiving behavior

To answer, if there are any setting-dependent influences on mothers' caregiving, the following variables were involved in statistical analysis as they fit George & Solomon's (2002) description of caregiving behavior:

Body contact resp. proximity between mother and child	• Mother and child having constant body contact (duration) • Mother touches/strokes child (frequency)
Vocal exchange between mother and child	• Mother speaks with child (duration) • Mother reinforces child positively (frequency) • Mother rebukes child negatively (frequency)

3.1.1 Body contact and touching between mother and child

In advance, it was examined if any differences in caregiving behavior occurred depending on which therapist was holding the sessions. Mann-Whitney-U Tests revealed just one significant difference. In session 5 mothers touched their children more often if the occupational therapist was leading the session (n=20, Z=-1.780, p=0.039, r=-0.40).

Before setting specific tests regarding body contact and touching were applied it was tested if the sex of the child or the affiliation to a certain attachment category influences body contact or touching frequency between mothers and children.
Summarizing the data for all eight sessions it can be detected that mothers touched their children more often if it is a girl (Mann-Whitney U Test: n=20, Z=-1.968, p=0.025, r=-0.44) – figure 3. Analyzed separately for single sessions, it was found that this pattern especially occurred in sessions 4, 6, and 7 (Man-Whitney-U Tests: session 4: n=20, Z=-1.891, p=0.030, r=-0.42; session 6: n=20, Z=-1.856, p=0.033, r=-0.42; session 7: n=20,

Z=-2.169, p=0.015, r=-0.49). In therapy sessions 2 and 3 a tendency in this direction was found (Mann-Whitney-U Tests: session 2: n=20, Z=-1.509, p=0.069, r=-0.34; session 3: n=20, Z=-1.660, p=0.051, r=-0.37). In therapy session 4 mothers of girls had also significantly more constant body contact (Mann-Whitney-U Tests n=20, Z=-1.852, p=0.035, r=-0.41) – figure 4.

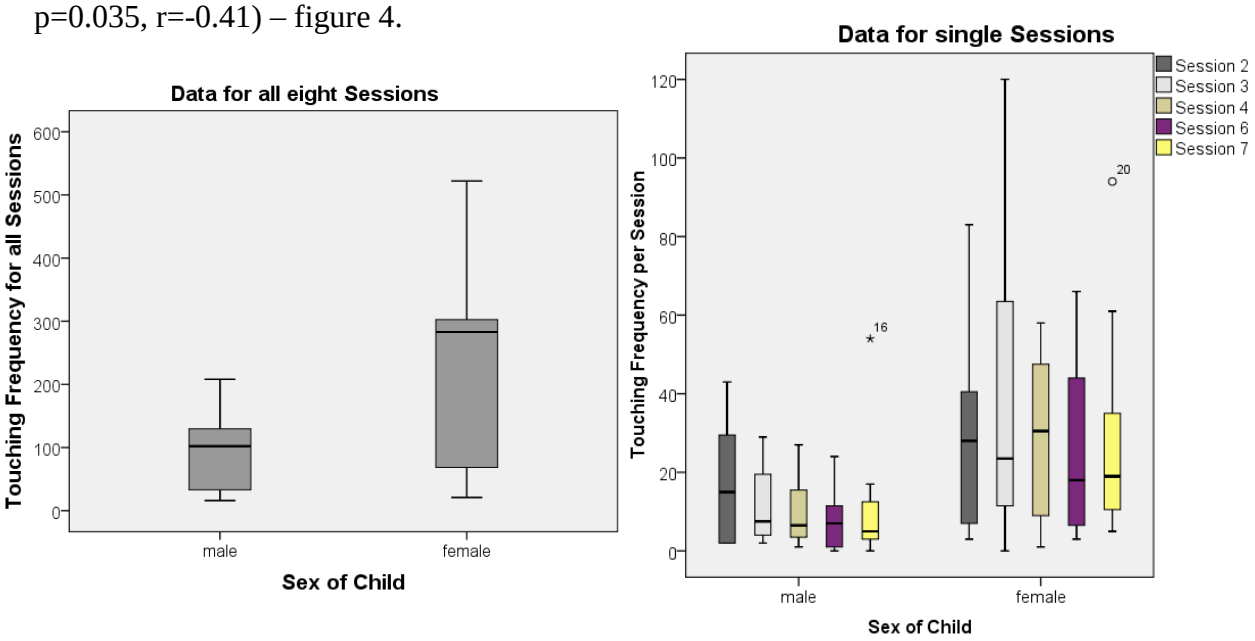


Figure 3 & 4 *Left*: Touching frequency between mothers and children calculated over all eight sessions and grouped accordingly to the sex of the children. As the boxplot shows, medians (indicated by black crossbar) for touching frequency were higher in the group of toddler-girls (Mann-Whitney U Test: n=20, Z=-1.968, p=0.025, r=-0.44). *Right*: Grouped boxplot visualizing the sessions were significant differences in sex-dependent touching-frequency were found: sessions 2, 3, 4, 6 and 7 (Mann-Whitney U Test: n=20, Z=-2.169- -1.509, p=0.015-0.069, r=-0.49- -0.34).

For sessions 1 and 2 Kruskal-Wallis Tests revealed, that mothers and children with a secure attachment bond held significantly longer constant body contact than dyads with disorganized attachment bonds. And these dyads had longer body contact than dyads with insecure avoidant attachment patterns (session 1: n=20, Chi^2=6.382, df=2, p=0.021; session 2: n=20, Chi^2=6.722, df=2, p=0.028). In session 8 the picture was contrasting as mothers and children who showed a disorganized attachment bond had significantly longer constant body contact, than dyads with secure attachment. But again dyads with an insecure avoidant attachment style had the least long body contact (Kruskal-Wallis: n=19, Chi^2=7.159, df=2, p=0.036) – figure 5.

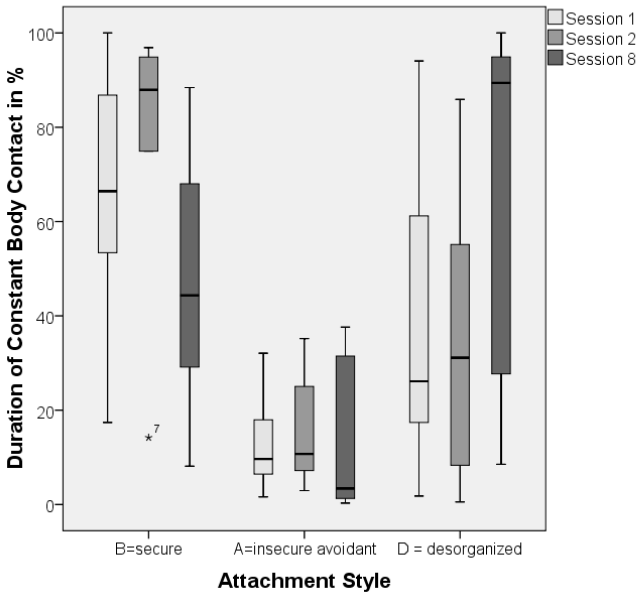


Figure 5 Duration of constant body contact in percent between mothers and children for sessions 1, 2 and 8 grouped accordingly to attachment style affiliation. The boxplot shows that medians (indicated by black crossbars) of body contact duration are highest in secure attached dyads, followed by dyads with a disorganized attachment pattern. The least long body contact was held in insecure-avoidant dyads (Kruskal-Wallis: n≥19, Chi²=6.382-7.159, df=2, p=0.021-0.036).

Setting dependent analysis

To find out if there was a setting dependent difference concerning body contact and touching frequency between mother and child a Mann-Whitney-U Test was applied for each therapy session.

In all eight session body contact between mother and child was significantly higher in the horse-intervention group, as shown in tables 2 and 3 (sessions 1-7: n=20, Z=-3.175- -3.780, p≤0.001, r=-0.71- -0.85; session 8: n=19, Z=-1.879, p=0.032, r=-0.43). Summarizing data for all eight sessions it can be stated that constant body contact occurred significantly longer within horse-intervention group (Mann-Whitney U: n=20, Z=-3.780, p≤0.001, r=-85).

Table 2 *Horse-intervention group*: duration of constant body contact between mothers and children in percent. Given are medians, minima and maxima for all eight session. In comparison with data of the play-intervention group dyads in this group show a significantly higher duration of body contact (ranging between 68.02 and 85.56 percent).

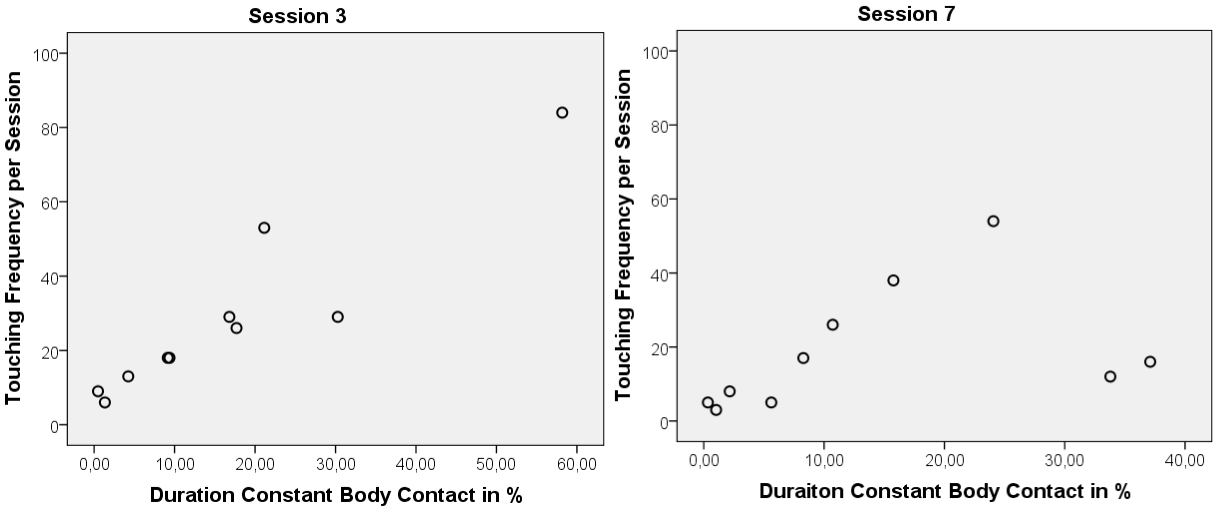
	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	10	10	10	10	10	10	10	9
Missing	0	0	0	0	0	0	0	1
Median	76.79	85.56	78.74	71.91	72.44	73.87	83.58	68.02
Minimum	21.71	35.20	41.19	15.66	22.98	2.38	19.37	29.16
Maximum	100.00	96.90	98.86	97.34	98.32	91.97	98.02	89.84

Table 3 *Play-intervention group*: duration of constant body contact between mothers and children in percent. Given are medians, minima and maxima for all eight session. In comparison with data of horse-intervention group dyads in this group show a significantly lower duration of constant body-contact (ranging between 6.89 and 15.8 percent).

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	10	10	10	10	10	10	10	10
Missing	0	0	0	0	0	0	0	0
Median	15.80	11.32	13.09	6.89	10.24	10.89	9.50	8.70
Minimum	1.60	0.55	0.48	3.28	4.35	1.08	0.34	0.29
Maximum	39.28	32.04	58.17	32.84	40.89	30.63	37.10	100.00

In regard of touching frequency between mother and child results show, that in session 2 mothers of the play-intervention group touched their children more often than mothers in the horse-intervention group (Mann-Whitney-U Test: n=20, Z=-1.668, p=0.050, r=-0.37). Taking a closer look at the play-intervention sample one can see that subject 19 shows the highest frequency of touching her child (87 times during the 2nd session). To check if this mother-child dyad is highly loading, the Mann-Whitney-U Test was repeated after exclusion of subject 19. Thereafter no significant difference in touching frequency between horse- and play-intervention groups could be found.

In play-intervention sessions (2, 4, 5, 6, 7) mothers who had more constant body contact also touched their children more frequently (Spearman correlation: n=10, rs=0.945**-0.689*, p≤0.001-0.028, R^2=0.89-0.47) – shown in figures 5 and 6. Such a pattern could not be detected for horse-intervention dyads.



Figures 6 & 7 Scatterplots for correlative associations after Spearman between the duration of constant body contact in percent and touching frequency between mother and child for session 3 (strongest correlation, Spearman: n=10, rs=0.945**, p=≤001, R^2=0.89) and session 7 (weakest correlation, Spearman: n=10, rs=0.689*, p=0.028, R^2=0.47). The plots show positive correlations between touching frequencies and time spent in constant body contact.

Process

Friedman Tests revealed no significant alterations in time of body contact between mother and child or touching frequency over the course of the eight sessions in both intervention groups (body contact: horse-intervention: n=10, Chi^2=6.333, df=7, p=0.501; play-intervention: n=10, Chi^2=5.500, df=7, p=0.599; touching frequency: horse-intervention: n=10, Chi^2=6.415 df=7, p=0.497; play-intervention: n=10, Chi^2=7.584 df=7, p=0.371).

Additionally Wilcoxon-Matched-Pairs Tests were applied to directly compare sessions 2 and 7 as well as sessions 3 and 7. Sessions 2, 3 and 7 were chosen for following reasons: in session 1 everything was new for mother and child, in session 2 mothers were able to ride for the first time, thus some novelty-effects might have also influenced this session and in session 8 aspects of therapy termination might have influenced the subjects' behavior.
The comparison revealed that in session 7 of play-intervention group mothers touched their children less often than they did in session 2 (Wilcoxon-Matched-Pairs Test: n=10, Z=-1.784, p=0.042, r=-0.56). Such pattern could not be found when comparing sessions 3 and 7 or in horse-intervention group.

Group-specific differences in processes

In a separate step information about setting dependent difference in processes should be gained. Therefore differences between variable values from session 2 und session7 as well as between session 3 and session 7 were calculated. With the delta values of "constant body contact between mother and child" (duration) and "mother touches child" (frequency) again a Mann-Whitney-U Test was applied. Positive results would therefore indicate an increase and negative results a decrease of body contact resp. touching frequency.
Results showed no group specific differences in processes for the mentioned variables.

3.1.2 Vocal exchange between mother and child

Primarily it was examined if any differences in caregiving behavior occurred depending on which therapist was holding the sessions. Mann-Whitney-U Tests revealed significant differences for two sessions: in session 4 mothers who obtained intervention by the

psychotherapist talked more to their children (n=20, Z=-1.739, p=0.045, r=-0.39) and in session 8 they reinforced their children more often (n=19, Z=-2.081, p=0.023, r=-0.48).

As analysis revealed a sex-specific difference in touching frequency it was also tested if the sex of the child influences vocal exchange as well. In regard of the children's sex no significant differences were found (Mann- Whitney-U Tests: n=20, p> 0.05).

As stated for bodily contact, the attachment quality interplays with the quantity of mothers' vocal exchange with their children. Thus looking at the whole data set (variables totaled for all eight sessions), mothers of secure attached children spent more time talking to them than mothers of insecurely attached dyads (Mann-Whitney U: n=20, Z=-2.338, p=0.009, r=-0.52) – figure 8. Looking at single sessions it was found that in sessions 1 and 3 mothers of children with a secure attachment bond talked longer to their children than mothers of dyads with insecure avoidant attachment bonds. Dyads with disorganized attachment patterns showed the lowest duration that mothers spent talking to their children (Kruskal Wallis: session 1: n=20, Chi^2=7.190, df=2, p=0.021; session 3: n=20, Chi^2=6.313, df=2, p=0.035). A tendency in the same direction can be postulated for session 4 (Kruskal Wallis: n=20, Chi^2=5.276, df=2, p=0.067). Analysis comparing just secure vs. non-secure attached dyads show this effect in all sessions except session 8 mothers of secure attached dyads talk significantly more with their children than mothers of non-secure dyads (Mann-Whitney-U Tests: sessions 1-6: n=20, Z=-2.496- -1.862, p=0.006-0.034, r=-0.59- -0.42, session 7: n=20, Z=-1.624, p=0.057, r=-0.36) – figure 9.

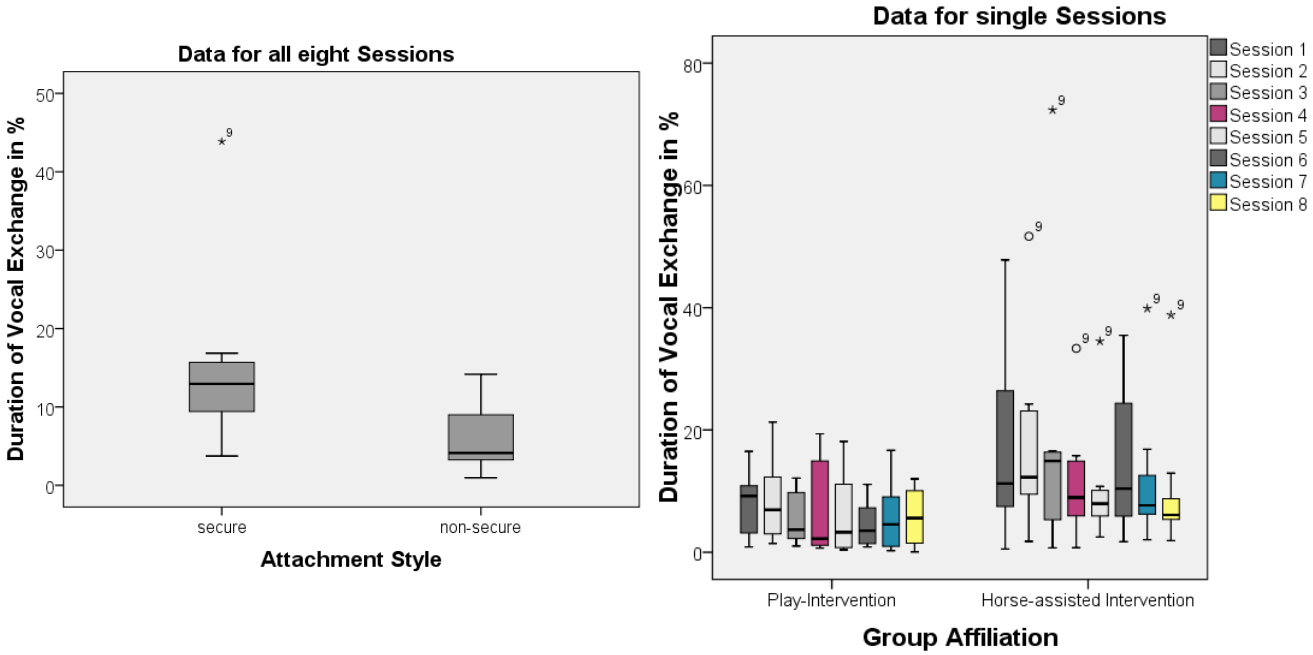


Figure 8 & 9 *Left:* Duration of vocal exchange between mothers and children in percent grouped accordingly to attachment style. Data were summarized for all eight sessions. Medians (indicated by black crossbars) show that mothers with secure attachment spent more time talking to their children (Mann-Whitney U: n=20, Z=-2.338, p=0.009, r=-0.52). *Right:* Boxplots visualizing this effect for single sessions. Significant differences can be stated for sessions 1-7 (Mann-Whitney U: n=20, Z=-2.496- -1.624, p=0.006-0.057, r=-0.59- - 0.36).

Setting dependent analysis

Applications of Mann-Whitney-U Tests revealed certain patterns in vocal exchange between mother and child as well as between mother and therapist. Thus, mothers of the horse-intervention group positively reinforced their children during session 1 more often than mothers of the control group (n=20, Z=-1.745, p= 0.042, r=-0.39). Analyzing summarized duration data for all eight sessions no significant differences in talking durations between the two intervention groups were found (Mann-Whitney U: n=20, Z=-1.436, p=0.083, r=-0.32). But when data were separated for all single sessions it was found that in sessions 3, 5, 6 and 7 mothers of the horse-intervention group spoke more with their children than mothers obtaining play-intervention (sessions 3 and 6: n=20, Z=-1.814, p=0.038, r=-0.41; session 5: n=20, Z=-1.587, p=0.062, r=-0.35; session 7: n=20, Z=-1.587, p=0.072, r=-0.35) – figure 10 and tables 4 and 5.

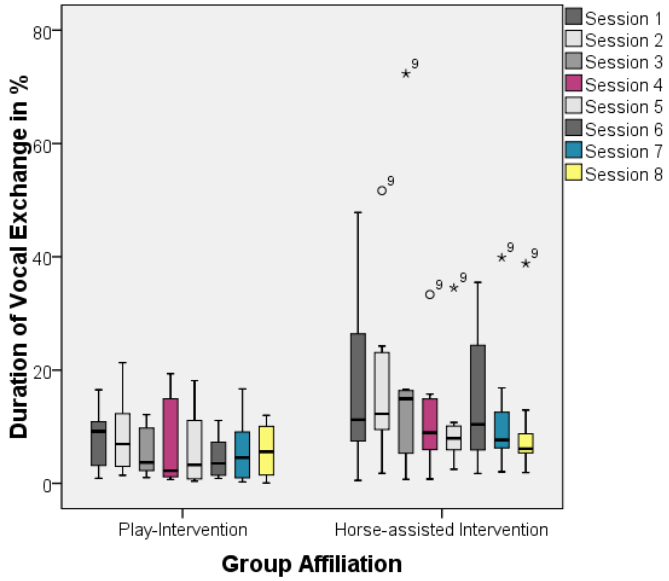


Figure 10 Duration of time that mothers talked to their children (in percent) grouped accordingly to obtained intervention. The boxplot shows that medians (indicated by black crossbars) of the horse intervention group are significantly higher in sessions 3, 5, 6 and 7 (Mann-Whitney U: n=20, Z=-1.814- -1.587, p=0.038-0.072, r=-0.41- -0.35).

Table 4 *Horse-intervention group*: duration of time that mothers talked to their children in percent. Given are medians, minima and maxima for all sessions. Compared with the play-intervention group values show that mothers of the horse-intervention group talked more to their children.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	10	10	10	10	10	10	10	9
Missing	0	0	0	0	0	0	0	1
Median	9.47	12.09	13.27	8.68	7.48	9.12	7.42	6.12
Minimum	0.53	1.78	0.72	0.19	2.50	1.75	2.06	1.91
Maximum	47.82	51.68	72.33	33.34	34.52	35.49	39.87	38.82

Table 5 *Play-intervention* group: duration of time (medians, minima, maxima) that mothers talked to their children in percent. Mothers of this group talked less to their children than mothers of the horse-intervention.

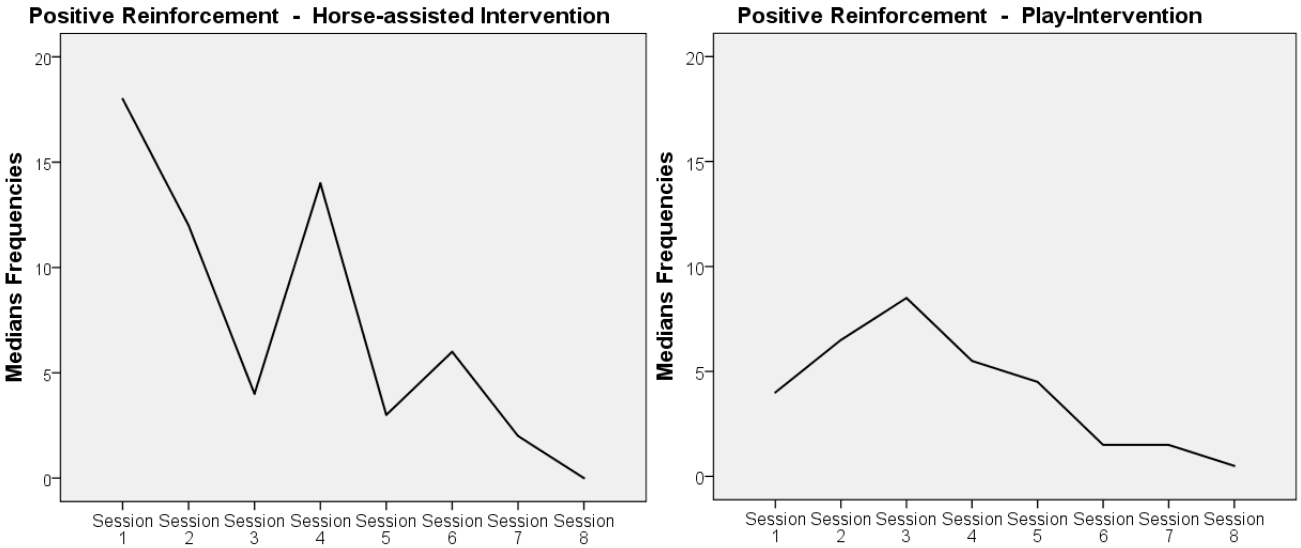
	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	10	10	10	10	10	10	10	8
Missing	0	0	0	0	0	0	0	2
Median	6.37	6.29	4.12	3.11	3.76	3.49	4.56	5.60
Minimum	0.89	1.44	1.03	0.68	0.40	0.87	0.26	0.08
Maximum	16.51	21.30	12.14	19.38	18.13	11.10	16.69	12.01

Regarding positive reinforcement or negative rebuke no significant difference between the two intervention groups was found.

In six out of eight horse-intervention sessions and in four play-intervention sessions a positive correlation between the duration that mothers speak to their children and how often they positively reinforced their children was detected (n=10 per group, rs=0.935**-0.671*, p=0,001-0.034, R^2=0.87-0.45).

Process

Over the course of the eight intervention sessions a decrease of positive reinforcement and negative rebuke between mother and child could be found in both intervention groups as shown in figures 11 & 12 (Wilcoxon-Matched-Pairs Tests comparison sessions 2 and 7: horse-intervention: positive reinforcement: n=10, Z=-2.524, p=0.004, r=-0.80; play-intervention: positive reinforcement: n=10, Z=-2.320, p=0.008, r=-0.73; negative rebuke: n=10, Z=-2.524, p=0.039, r=-0.80; Wilcoxon Matched Pairs Tests comparing variables form session 3 and horse-intervention: positive reinforcement: n=10, Z=-1.601, p=0.061, r=-0.51; negative rebuke: n=10, Z=-1.841, p=0.063, r=-0.58; play-intervention: positive reinforcement: n=10, Z=-2.255, p=0.012, r=-0.71; negative rebuke: n=10, Z=-2.214, p=0.016, r=-0.70; Friedman Test: positive reinforcement: horse-intervention: n=9, Chi^2=21.379, df=7, p=0.003; play-intervention: n=10, Chi^2=15.498, df=7, p=0.030).



Figures 11 & 12 Progression of positive reinforcement frequency within the horse-intervention (left) and play-intervention group (right) over the course of the eight sessions. Lines connect medians for each session. As can be seen a decrease occurred in both intervention-groups (Friedman: horse-intervention: n=9, Chi^2=21.379, df=7, p=0.003; play-intervention: n=10, Chi^2=15.498, df=7, p=0.030.

A comparison between sessions 2 and 7 revealed, that mothers of both groups were talking less to their children in session 7 (Wilcoxon-Matched-Pairs Tests: horse-intervention: n=10, Z=-1.980, p=0.039, r=-0.63; play-group: n=10, Z=-1.980, p=0.032, r=-0.63). But this pattern could not be found in a comparison of talking durations of sessions 3 and 7.

Group specific differences in processes

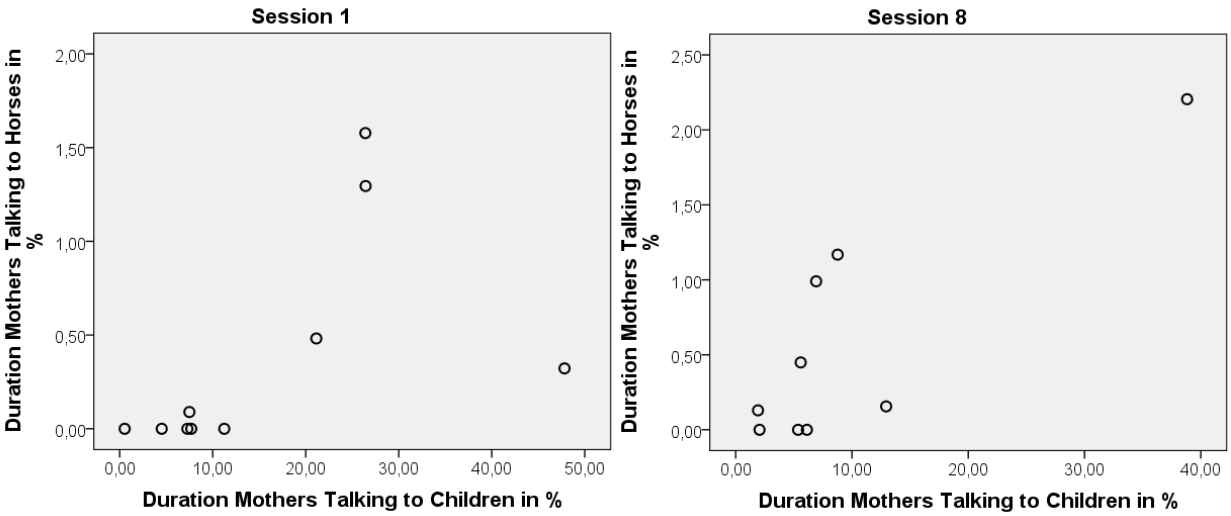
To check on group specific differences in regard of the process over the course of the eight therapy sessions delta values of variables from sessions 2 and 7 as well as 3 and 7 were calculated. Thereafter applied Mann-Whitney-U Tests did not reveal any group specific differences in speaking duration, positive reinforcement or negative rebuke.

3.2 Parallel behavior of mothers towards children and horses

To find out if mothers behavior towards their children was mirrored in their behavior towards the horse Spearman correlations were calculated for the following variables:

Mother touches child	Mother speaks to child
Mother touches horse	Mother speaks to horse
Child touches horse	Mother speaks to therapist

Spearman correlations show that in session 1 mothers who touched the child more often also touched the horse more often (n=10, rs=0.698*, p=0.025, R^2=0.49).For sessions 1, 2, 4, and 8 a positive association between mothers talking duration to their children and to the horse was found (n=10, rs=0.769**-0.712*, p=0.009-0.031, R^2=0.59-0.51) – figure 13 & 14. Thus, mothers who spoke more to the child also talked more to the horse.



Figures 13 & 14 Scatterplots visualizing Spearman correlation-values between durations that mothers spoke to their children and to the horses for session 1 (strongest correlation, Spearman: n=10, rs=0.769**, p=0.009, R^2=0.59) and session 8 (weakest correlation, Spearman: n=10, rs=0.712*, p=0.031, R^2=0.51). Both plots show the positive association between the two variables.

Regarding the process over the eight therapy sessions Friedman Tests (n=9, Chi^2=15.237, df=7, p=0.033) showed an increase of time that mothers spent talking to the horse, shown in figure 15. No such increase of vocal exchange was found between mother and child.

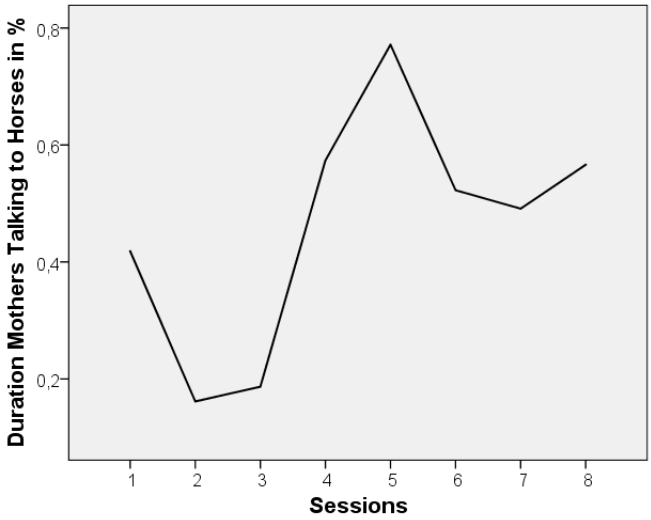
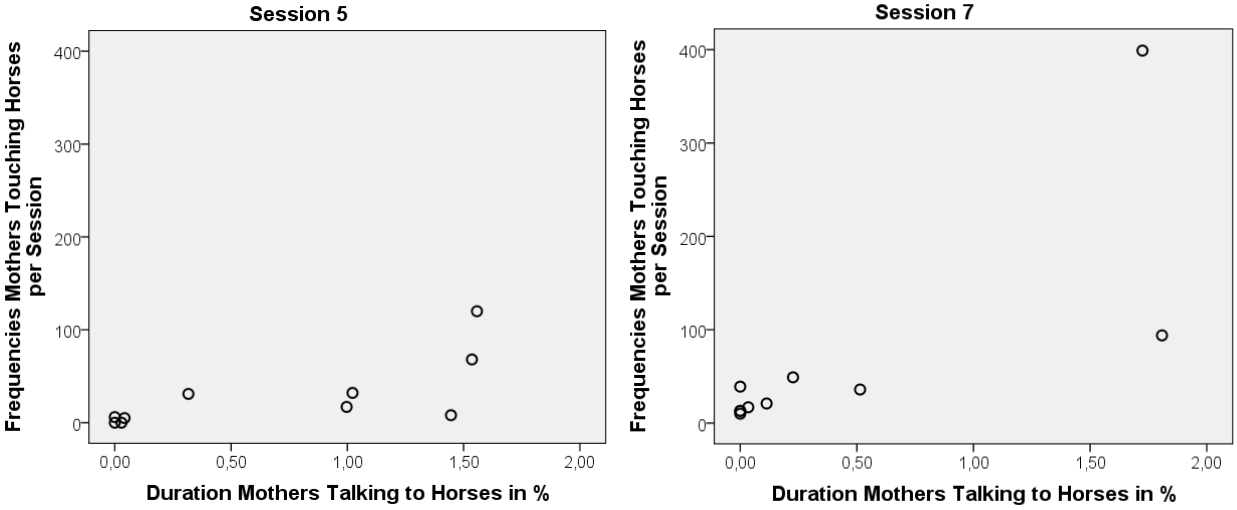


Figure 15 Increase of time (in percent) that mothers talked to the horse over the course of the eight intervention sessions. The line connects medians of every session (Friedman: n=9, Chi^2=15.237, df=7, p=0.033).

In sessions 3, 5 and 7 mothers who spoke more to the horse also touched the horses more often (session 3: n=10, rs=0.804**, p=0.005, R^2=0.65; session 5: n=10, rs=0.888**, p=0.001, R^2=0.79; session 7: n=10, rs=0.803**, p=0.005, R^2=0.64) – figures 16 & 17. No such correlation was found between the variables "mother speaks to child" and "mother touches child".



Figures 16 & 17 Scatterplots show the correlation between the variables "mother talked to horse" and "mother touches horse" for session 5 (strongest correlation, Spearman: n=10, rs=0.888**, p=0.001, R^2=0.79) and session 7 (weakest correlation, Spearman: n=10, rs=0.803**, p=0.005, R^2=0.64). Both plots show the positive association between the two variables.

3.3 Impacts of horse-assisted and play-intervention on stress axis

The following chapter will show results about setting dependent differences in stress levels. First on the HPA-axis (salivary cortisol) as well as the SAM-axis (heart rates, heart rate variability).

3.3.1 HPA-axis – salivary cortisol

The following variables were used in analysis:

Salivette 1	Salivette 2	Salivette 3
Difference salivette 1 & 2 mother	Difference salivette 1 & 3 mother	AUCi mother

Analysis at group level

Man- Whitney-U Tests did not reveal any significant differences of salivary measures at time point one, two or three at group-level. The following figures present medians of salivary cortisol measures over the course of the eight intervention-sessions. As no group-differences were found, data for salivary-cortisol are shown together for both groups in tables 6-8.

Table 6 Salivary cortisol (nmol/L) of all mothers – first measurement. Shown are medians, minima and maxima for all sessions.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	20	19	19	19	20	20	18	17
Missing	0	1	1	1	0	0	2	3
Median	8.38	9.43	8.82	8.15	9.09	7.34	8.07	8.13
Minimum	4.18	4.35	4.18	6.40	4.24	4.18	3.51	3.84
Maximum	23.60	29.60	16.20	17.80	16.50	29.20	14.20	18.00

Table 7 Salivary cortisol (nmol/L) of all mothers – second measurement. Shown are medians, minima and maxima for all sessions.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	19	18	19	18	20	20	19	16
Missing	1	2	1	2	0	0	1	4
Median	10.50	9.53	9.42	10.30	9.55	9.57	9.48	11.00
Minimum	3.51	4.57	4.22	5.00	5.08	4.32	6.09	4.54
Maximum	17.30	19.20	14.30	18.30	15.40	20.20	16.50	18.90

Table 8 Salivary cortisol (nmol/L) of all mothers – third measurement. Shown are medians, minima and maxima for all sessions.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	20	20	19	19	20	20	18	17
Missing	0	0	1	1	0	0	2	3
Median	9.63	10.10	7.18	9.11	9.30	7.90	8.73	9.56
Minimum	3.46	4.25	5.07	3.90	4.24	3.61	4.74	4.53
Maximum	20.60	18.00	14.70	17.30	13.50	15.00	16.10	14.20

But for session 4 values for differences between salivettes 1 and 2 and salivettes 1 and 3 and thus AUCi of mothers were higher in the control group (Diff. Sal. 1/2: n=20, Z=-1.853 p=0.033, r=-0.41; Diff. Sal. 1/3: n=20, Z=-1.739, p=0.043, r=-0.39; AUCi: n=20, Z=-1.944, p=0.027, r=-0.43) – figures 18 & 19.

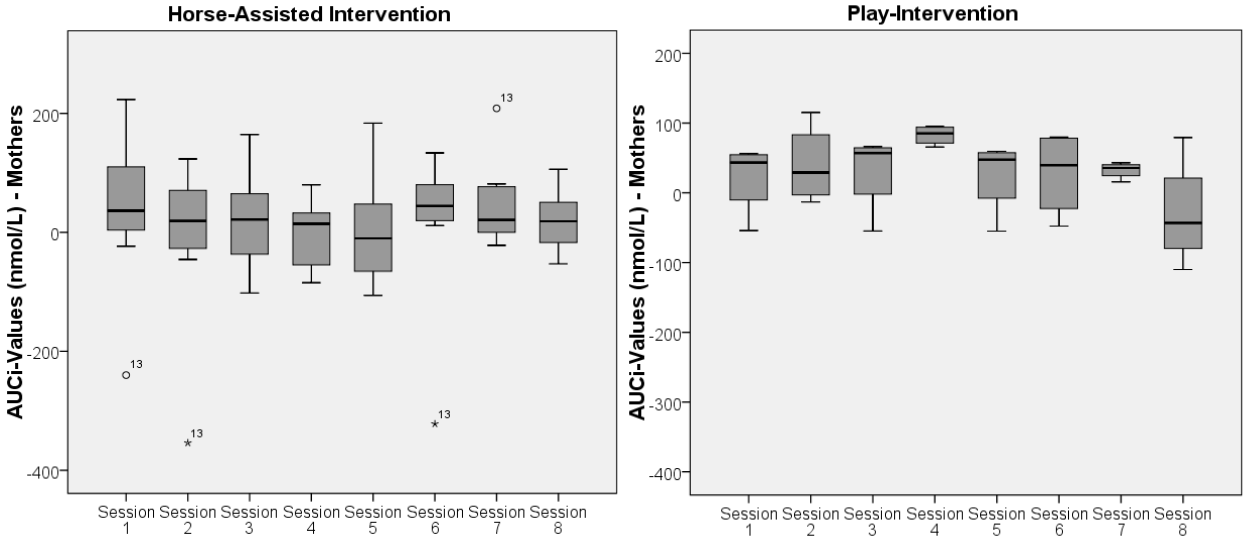


Figure 18 & 19 AUC increase values (nmol/L) for mothers of the horse-intervention (left) and play-intervention (right) groups. Data are shown for all sessions. Boxplots visualize that the medians (indicated by black crossbars) for session 4 differ significantly: the median of the AUCi-values of mothers in play-intervention was higher than of mothers in the horse-assisted intervention (Mann-Whitney U: n=20, Z=-1.944, p=0.027, r=-0.43).

Following tables (9&10) show AUC increase values of mothers for the eight therapy sessions. As negative values indicate a decrease and positive values an increase of salivary cortisol over the course of the session it can be seen that just in session 2 and session 5 of horse-assisted intervention a decrease of stress values occurred on group level.

Table 9 *Horse-intervention group*: Overview AUC increase values (nmol/L) for mothers who obtained horse-intervention. Listed are medians, minima and maxima for all sessions. Although the table shows negative minima-values (indicating a decrease of stress) only in sessions 2 and 5 a negative median for AUCi values indicates a decrease of stress values during the session at group level.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	10	9	10	9	10	10	9	8
Missing	0	1	0	1	0	0	1	2
Median	26.65	-8.30	22.75	5.00	-0.90	33.05	21.00	25.10
Minimum	-240.00	-354.00	-102.00	-84.70	-106.00	-322.00	-22.00	-52.90
Maximum	223.40	123.50	164.40	79.90	183.70	133.60	208.50	106.00

Table 10 *Play-intervention group*: Overview AUC increase values (nmol/L) for mothers who obtained play-intervention. Listed are medians, minima and maxima for all sessions. Although negative AUCi-values occurred, no decrease of salivary cortisol occurred at group level.

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
N Valid	9	9	7	9	10	10	7	8
Missing	1	1	3	1	0	0	3	2
Median	33.00	7.00	37.60	30.40	25.10	35.25	33.50	19.15
Minimum	-54.00	-61.80	-54.80	-5.40	-66.70	-47.70	-22.90	-110.00
Maximum	122.00	115.10	66.20	95.00	158.40	91.50	66.20	90.80

No AUCi-values were calculated for children as too many single-salivary measures were deficient. As calculations would refer to all single measures per subject not enough valid values could have been expected.

Process

Salivette 1 and 2 measures, difference values between salivettes as well as AUCi-values of mothers did not change significantly over the course of the therapy sessions. Also Wilcoxon Matched Pairs Test between values of sessions 2 and 7 as well as 3 and 7 did not reveal any significant differences.

Group specific differences in processes

To gain information about group specific differences in changes of stress reaction on the HPR-axis delta values for AUCi-values and single salivary measures (Sal1-3) of mothers between sessions 2 and 7 as well as sessions 3 and 7 were calculated. With these delta values (positive values indicating an increase, negative values a decrease) Mann-Whitney-U Tests were applied. But no significant differences were found.

Correlations of stress values and behavioral data

In Spearman correlations salivary measures were correlated with behavioral data. Correlations were applied for each group and therapy session separately. In general it attracts attention that, looking at the correlations, within play-intervention more patterns occur, which can be detected for several therapy sessions. Whereas within horse-intervention group less "continuous patterns" occurred.

Body contact and touching

In the first two as well as in the last two sessions of play-intervention a longer period of constant body contact was correlated with a lower stress level in mothers. This is either visible in lower salivary measures, lower delta values between salivettes or lower AUCi-values ($n \geq 8$, rs=-0.875**- -0.633*, p=0.001- 0.034, R^2=0.77-0.40) – exemplified in figure 20. In sessions 4 and 8 the duration of constant body contact and children's salivary measures were also negatively correlated (session 4: n=8, rs=-0.862**, p=0.006, R^2=0.74; session 8: n=9, rs=-0.714*, p=0.047, R^2=0.51).

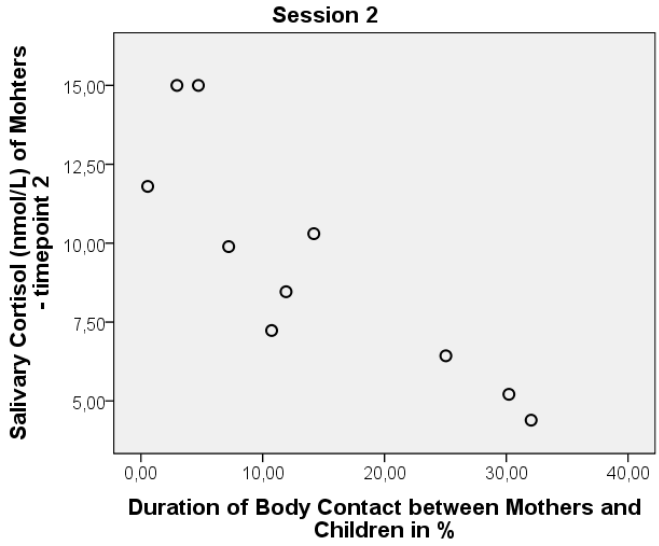


Figure 20 Correlative associations between the duration of constant body contact between mothers and children and mother's salivary cortisol measures after 20 minutes of play-intervention. The scatterplot visualizes the negative correlation between the two variables (Spearman: n=10, rs=-0.875*p=0.001, R^2=0.77).

In session 1 of play-intervention a higher touching frequency correlated positively with AUCi-values of mothers (Spearman Correlation: n=9, rs=0.681*, p=0.022, R^2=0.46), in session 5 touching frequency correlated positively with mothers salivary measure after 20

(n=10, rs=0.640*, p=0.046, R^2=0.41) as well as 40 minutes (n=10, rs=0.811**, p=0.004, R^2=0.66). In sessions 4 (by tendency) and 8 (significantly) however touching frequency and salivary measures of mothers were correlated negatively. Thus the more mothers touched their children the lower were their salivary measures (session 4: n=10, rs=0.604, p=0.065, R^2=0.36; session 8: n=8, rs=-0.786*, p=0.021, R^2=0.62). The same was found for session 1 of horse assisted therapy (Diff. Sal. 1/2: n=10, r=0.644*, p=0.044, R^2=0.41).

Touching the horse

Touching the horse seemed to be differently correlated with HPR-axis measures. In session 1 differences between salivettes 1 and 3 of mothers were lower the more often they touched the horse (Spearman Correlation: n=10, rs=-0.697*, p=0.025, R^2=0.49). Whereas in sessions 4, 5 and 8 touching frequencies and salivary cortisol measures correlated positively. Thus, the more mothers touched the horse, the higher were their cortisol values (session 9: AUCi: n=10, rs=0.561, p=0.058, R^2=0.31; session 5: Sal2: n=10, rs=0.721*, p=0.019, R^2=0.52; Sal3: n=10, rs=0.693*, p=0.026, R^2=0.48; session 8: Sal2: n=8, rs=0.714*, p=0.047, R^2=0.51; Sal3: n=9, rs=0.683*, p= 0.042, R^2=0.47).

3.3.2 SAM-axis – heart data

For the subsequent calculations the following variables were used:

Hear Rate (HR) [beats per minute]	R-R-Interval (RRI) [ms]
pNN50-values [%]	RMSSD-values [ms]

Calculating with heart data, one has to bear in mind that these data are very sensitive to movement of the subjects. Thus, in a first step the intensity of movement of mothers and children was compared between the horse-and play-intervention groups.
In case of mothers and children obtaining horse-assisted intervention the variables “mother sits/stands still” consisted of following single variables: “mother sits/stands”, “just mother on horseback” plus “mother and child on horseback”. The variable “child sits/stands” consists of following single variables: “child sits/stands”, “mother carries child”, “just child on horseback” plus “mother and child on horseback”.

The comparison on group-level reveals that mothers of the horse-intervention group sat significantly less and walked more (Mann-Whitney-U Tests: sessions 1-7: n=20, Z=-3.326- -3.356, p≤0.001, r=-0.74- -0.75; session 8: n=17, sitting: Z=-3.464, p≤0.001, r=-0.84; walking: Z=-2.983, p=0.001, r=-0.72). For children a group specific difference could just be found for session 1: children in the horse-intervention group sat significantly more (Mann-Whitney-U Test: n=20, Z=-1.814, p=0.038, r=-0.41) and walk less (n=20, Z=-1.741, p=0.044, r=-0.39) than in play-group. For sessions 2-7 no differences were found.

Analysis at group level

Mean Heart Rates (HR) of mothers differed according to treatment condition. Thus, heart rates were higher in the horse-intervention group (Mann-Whitney U Test: n=20, Z=-2.685, p=0.003, r=-0.60) – figure 21. Calculated for single sessions it was found that in all sessions except session 6 the differences were significant (Mann-Whitney U Test: n≥16, Z=-2.980- -2.205, p=0.001-0.013, r=-0.70- -0.53) – figure 22. However does a p-value of 0,054 (n=18, Z=-1.640, r=-0.39) for session 6 also indicate a tendency in the same direction: HR-values of mothers in the horse-intervention group are significantly higher than of mothers in play-intervention.

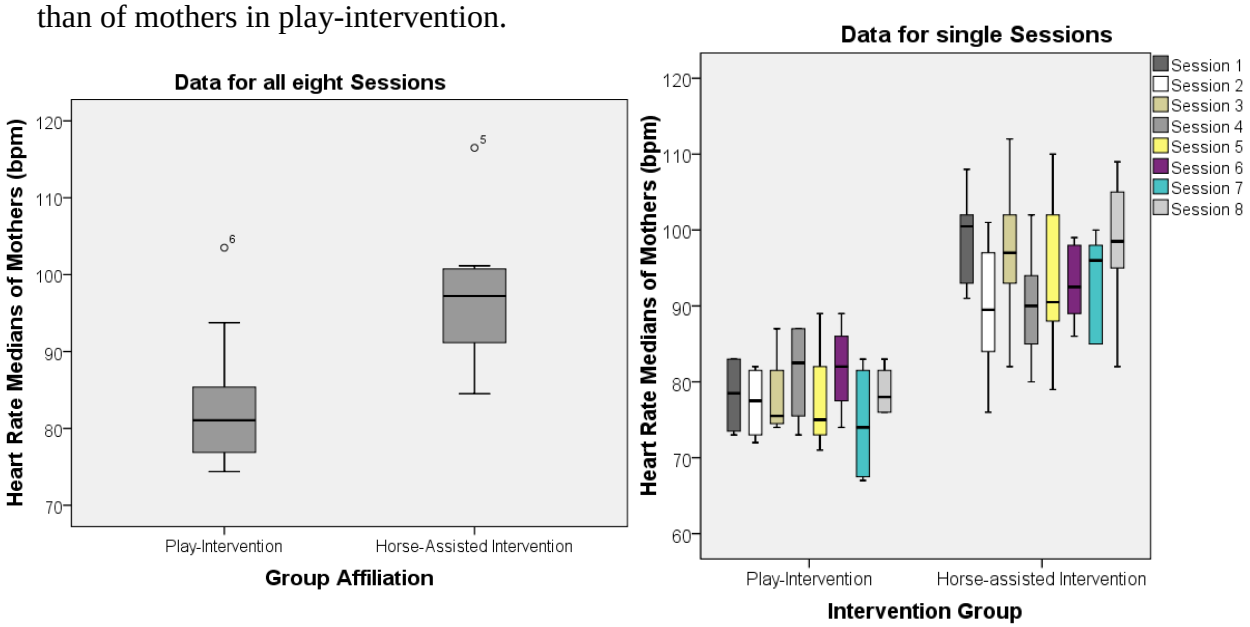
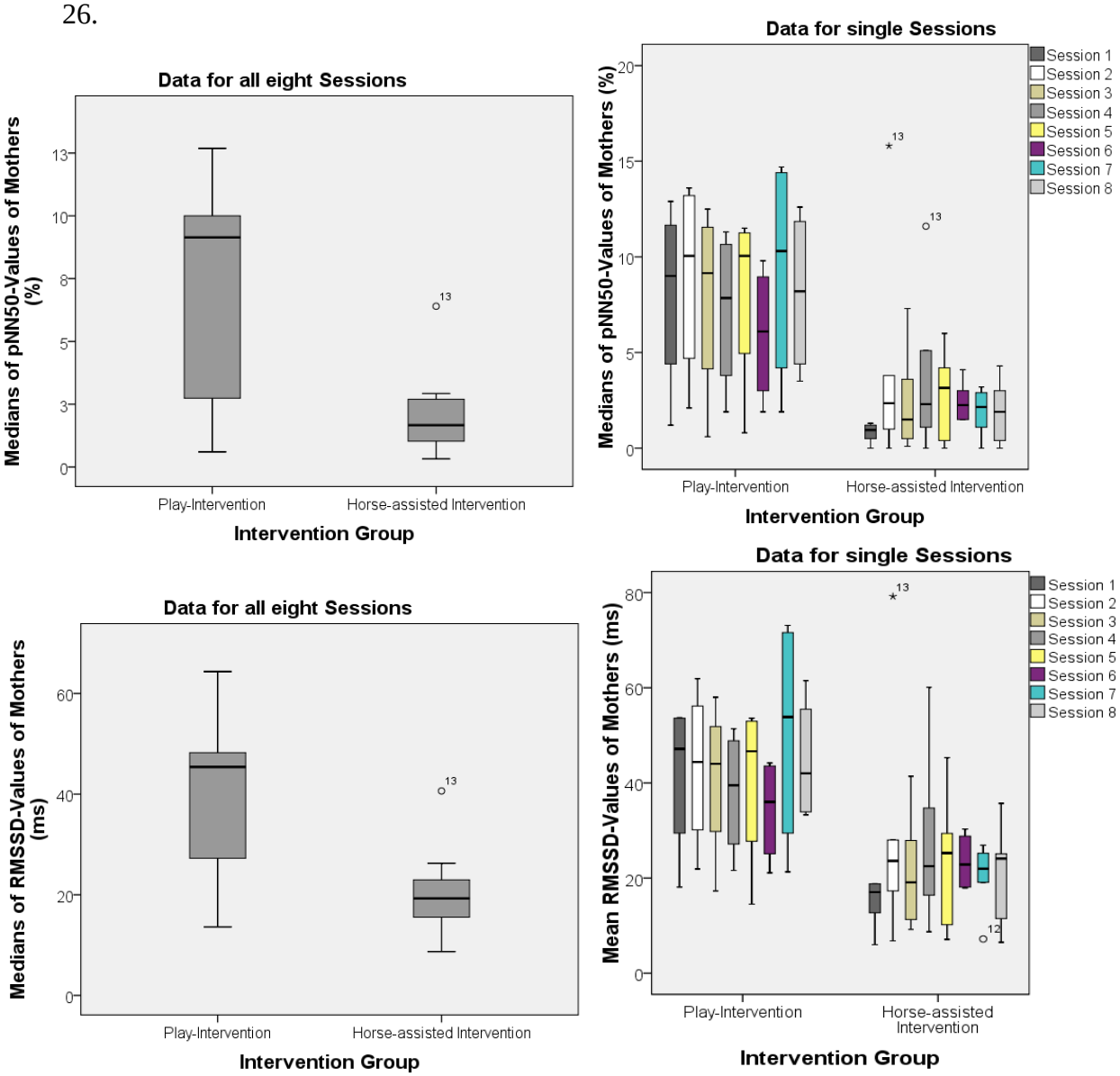


Figure 21 & 22 *Left:* Mean heart rate values of mothers for all sessions grouped accordingly to obtained intervention. The boxplots show that medians (indicated by black crossbars) are higher in the horse-intervention group thus, indicating a higher activation level in this group (Mann-Whitney U: n=20, Z=-2.685, p=0.003, r=-0.60). *Right*: Boxplot visualizing this effect for all single sessions. In all sessions except session 6 the differences in heart rate values were significant (Mann-Whitney U: n≥16, Z==-2.980- -2.205, p=0.001-0.013, r=-0.70- -0.53).

Mean HR for children did not differ significantly for any of the sessions (n≥17).

Overviewing all eight sessions heart rate variability– pNN50-values and RMSSD-values – of mothers obtaining play-intervention were significantly higher in the play-intervention group (Mann-Whitney U Tests: pNN50: n=20, Z=-2.570, p=0.004, r=-0.57; RMSSD: n=20, Z=-2.797, r=-0.63) – figures 23 and 25. When analyzing HRV-data for all single session it was found that the differences were significant in all sessions, except in session 6 (Mann-Whitney-U Tests: pNN50: n≤16, Z=-2.887- -1.958, p=0.001-0.027, r=-0.65- -0.47; RMSSD: n≤16, Z=-2.694- -1.958, p=0.003-0.027, r=-0.62- -0.47) – figures 24 and 26.



Figures 23 - 26 *Left top and bottom:* Medians of heart rate variability values – pNN50 (%) and RMSSD (ms) – of mothers grouped accordingly to obtained intervention and calculated over all eight sessions. Boxplots show that medians (indicated by black crossbars) of the play-intervention group were higher than of the horse intervention group (Mann-Whitney U Tests: pNN50: n=20, Z=-2.570, p=0.004, r=-0.57; RMSSD: n=20, Z=-2.797, r=-0.63). *Right top and bottom:* Boxplots for all sessions visualizing that medians of HRV-values of mothers in play-intervention were in all sessions except session 6 significantly higher thus, suggesting more relaxation (Mann-Whitney U: pNN50: n≤16, Z=-2.887- -1.958, p=0.001-0.027, r=-0.65- -0.47; RMSSD: n≤16, Z=-2.694- -1.958, p=0.003-0.027, r=-0.62- -0.47).

pNN50-values of children in play-intervention group were significantly higher in session 6 and 7 (Mann-Whitney-U Tests: session 6: n=19, Z=-2.30, r=-0.53; session 7: n=20, Z=-1.674, p=0.049, r=-0,37). In sessions 2 – 5 p-values from 0.068-0.088 show a tendency in the same direction (n≤17, Z=-1.522- -1.421, r=-0.35- -0.32).

RMSSD-values of children did differ significantly just in session 6 (Mann-Whitney-U Test: n=19, Z=-1.796, p= 0.039, r=-0.41). For sessions 3, 5 and 7 a tendency can be detected (n≤19, Z=-1.551- -1.429, p= 0.067-0.081, r=-0.36- -0.33). Thus, RMSSD-values of children in the play-intervention group were higher than in the horse-intervention group.

Process

To gain information about alterations of heart rates and heart rate variability values over the course of the eight therapy sessions Friedman Tests were applied separately for the horse-and the play-intervention group. Included into calculations were mean heart rates, pNN50-values and RMSSD-values of mothers and children. For a more detailed view of the process a Wilcoxon Matched Pairs Test for each group was applied using delta values of heart data between sessions 2 and 7 as well as 3 and 7. But both tests revealed no significant differences.

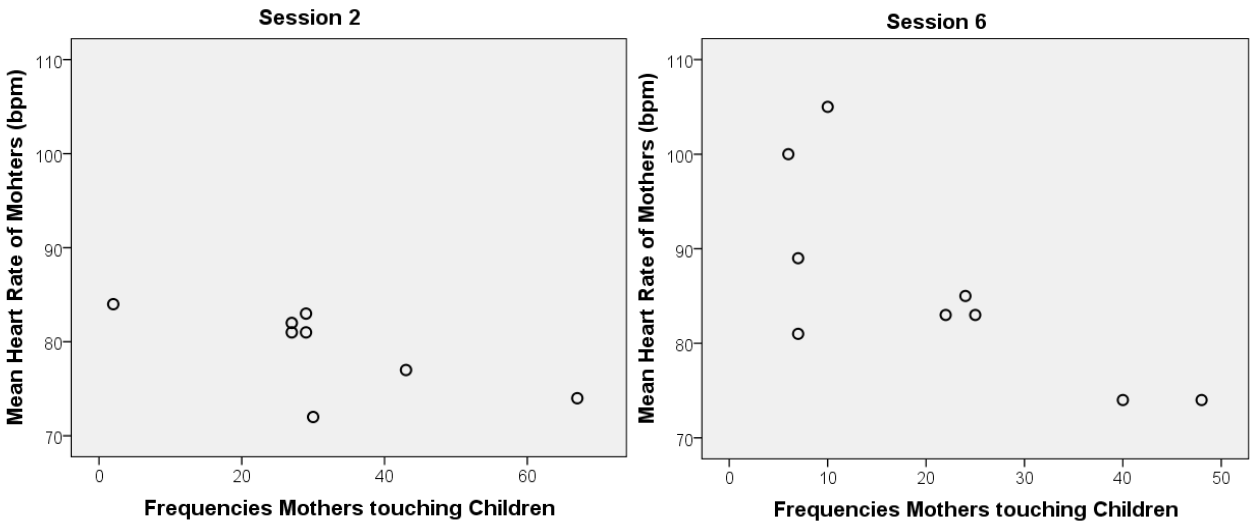
Group specific differences in progress

No group specific alterations in regard of heart rates, pNN50- or RMSSD-values over the course of the eight intervention sessions were found.

Correlations with behavior

Body contact between mother and child

Spearman Correlations revealed that body contact between mother and child seemed to have different correlates. Mothers of the play-intervention group who touched their children often had lower heart rates (session 2: n=8, rs=-0.800*, p=0.017, R^2=0.64; session 6: n=9, rs=-0.684*, p=0.42, R^2=0.47). Thus physical contact between mothers and children and a lower sympathetic activity seemed to be correlated – figures 27 and 28.



Figures 27 & 28 Scatterplots of correlations between touching frequency between mother and child and heart rates (bpm) of mothers obtaining play-intervention (left: session 2, Spearman: n=8, rs=-0.800*, p=0.017, R^2=0.64, right: session 6, Spearman: n=9, rs=-0.684*, p=0.42, R^2=0.47). The point clouds visualize the negative correlation between touching frequency and mothers' heart rate values.

In contrast to this pattern, in children of the play-intervention group a lower parasympathetic activity was associated with longer constant body contact to their mothers. Thus, the more time mothers and children spent in close body contact during the session their pNN50- and RMSSD-values were (by tendency) lower (pNN50-children: session 2: n=7, rs=-0.775*, p=0.041, R^2=0.60; session 4: n=10, rs=-0.831**, p=0.003, R^2=0.69; RMSSD-children: session 1: n=7, rs=-0.750, p=0.052, R^2=0.56; session 3: rs=-0.617, p=0.077, R^2=0.38; session 4: n=10, rs=-0.818**, p=0.004, R^2=0.67) – figure 29.

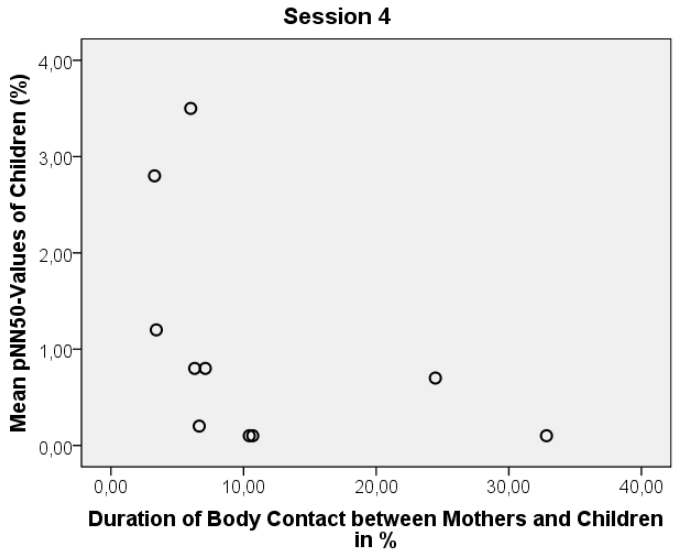


Figure 29 Scatterplot visualizing the correlative pattern between the variable "constant body contact between mother and child" and pNN50-values of children (Spearman: n=10, rs=-0.818**, p=0.004, R^2=0.67). The point cloud shows the negative association between the two variables.

Considering this pattern it could be that discomfort or uneasiness of children were the reasons for their heightened signs of stress and thus, mothers offered more constant body contact to calm their children down. Therefore it was tested if in sessions 2, 3 and 4 an additional correlation between variables "child displays unhappiness" and "constant body contact between mother and child" and "child displays unhappiness" and stress values of children could be found. If so, such correlations would substantiate the hypothesis, that the former presented pattern is the result of mothers calming their children. If no such correlation can be found, it would speak for a heightened stress reaction in children to longer constant body contact with their mothers.

Spearman correlations (applied for play-intervention group) showed no correlations between the duration of children displaying unhappiness and stress-values on the HPA- as well as on the SAM-axis. Furthermore no correlations for the duration of constant body contact resp. frequency of mothers touching children and children's display of unhappiness were found. The only correlations found, were those between children's stress reaction and bodily contact with their mothers explicated before.
Correlations applied for all mother-child pairs revealed a significant correlation between the duration of constant body contact and children's display of unhappiness in sessions 2 and 4 (session 2: n=20, rs=0.623*, p=0.018, R^2=0.40; session 4: n=20, rs=0.572**, p=0.008, R^2=0.33). But divided into both groups this effect diminishes.

In session 5 of play-intervention a negative correlation between the time mothers and children spend in constant body contact and children's heart rate values were found. Thus, the longer the body constant prevailed the lower were the heart rates of children (n=9, rs=0.754*, p=0.021, R^2=0.57) – figure 30. For sessions 6 – 8 no correlations between heart data and body contact between mothers and children were found.

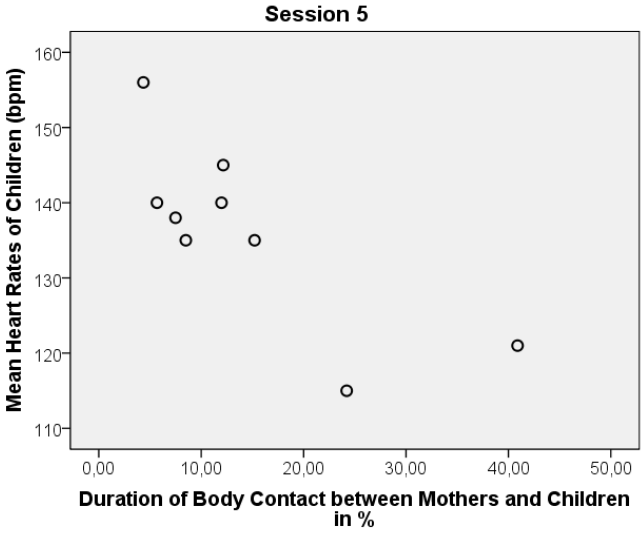
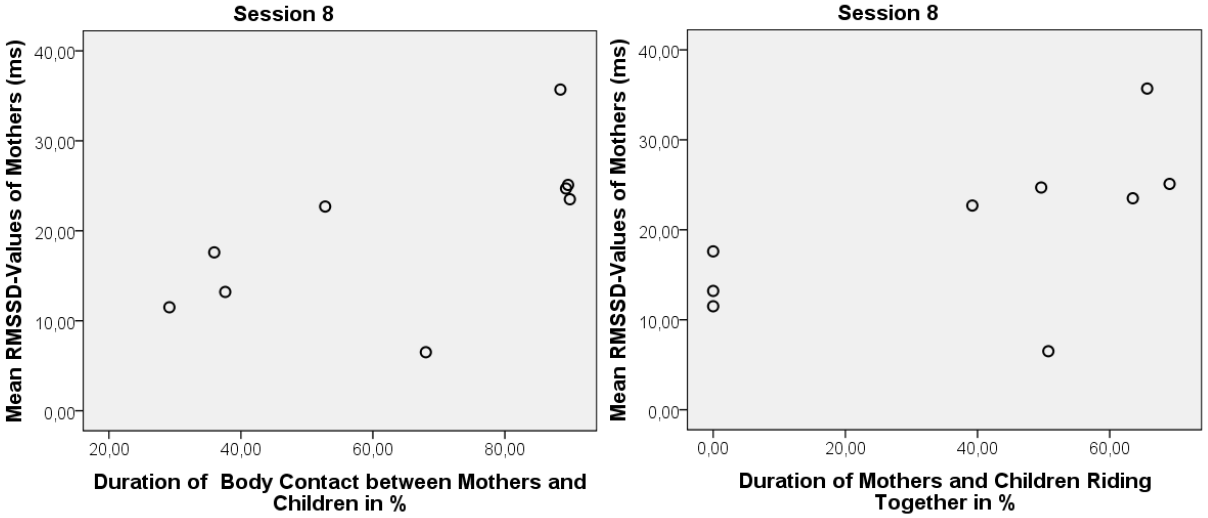


Figure 30 Correlation between the duration of constant body contact between mother and child (in percent) and children's heart rates (bpm). The scatterplot shows the negative association between the two variables (Spearman: n=9, rs=0.754*, p=0.021, R^2=0.57).

In horse-assisted therapy it seems as if close bodily contact between mother and child had different correlates. In session 2 heart rates of mothers and children were higher the more time they spent in close body contact and the longer they sat together on horseback (mothers: n=10, rs=0.661*, p=0.038, R^2=0.44; children: n=10, rs=0.657*, p=0.039, R^2=0.43). In session 8 the RMSSD-values of mothers were significantly higher longer they had constant body contact to their children during this session (n=9, rs=0.667*, p=0.050, R^2=0.44) and the longer they shared time with their children on horseback (n=8, rs=0.678**, p=0.045, R^2=0.46) – figures 31 and 32. This result would indicate a connection between constant body contact and relaxation in mothers.



Figures 31 & 32 *Left*: Correlation between the duraiton of constant body contact between mothers and children (in percent) and RMSSD-values (in ms) of mothers (Spearman: n=9, rs=0.667*, p=0.050, R^2=0.44). *Right*: correlation between duration of mother and child riding together and RMSSD-values (in ms) of mothers (Spearman: n=8, rs=0.678**, p=0.045, R^2=0.46). Both plots show the positive association between these variables.

Vocal exchange between mother and child

In sessions 1 and 3 of play-intervention a correlation between the durations that mothers talked to their children and heart rates was found. Thus a longer talking-duration was associated with lower mean heart rates of children, as shown in figure 33 (session 1: n=8, rs=-0.733*, p=0.025, R^2=0.54; session 3: n=10, -0.738*, p=0.037, R^2=0.54).

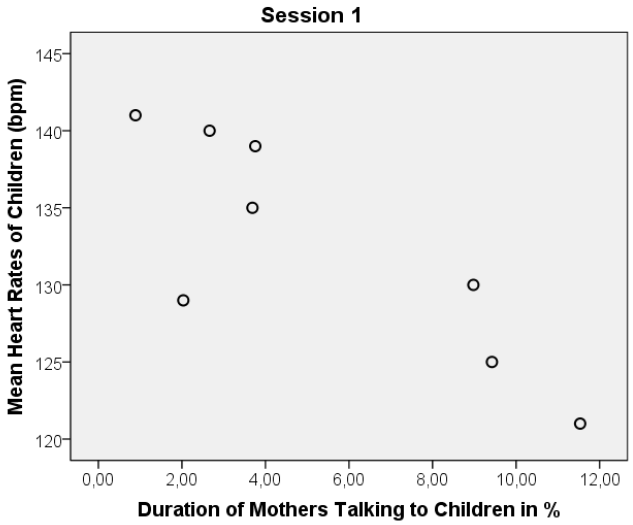


Figure 33 Correlation between the duration of vocal exchange between mothers and children (in percent) and mean heart rates of children in session 1. The point cloud visualizes the negative association between these variables (Spearman: n=8, rs=-0.733*, p=0.025, R^2=0.54).

Motherly contact to the horse and its impacts on stress response

To find out if body-contact to the horse facilitated stress-reduction Spearman Correlations were applied using following variables:

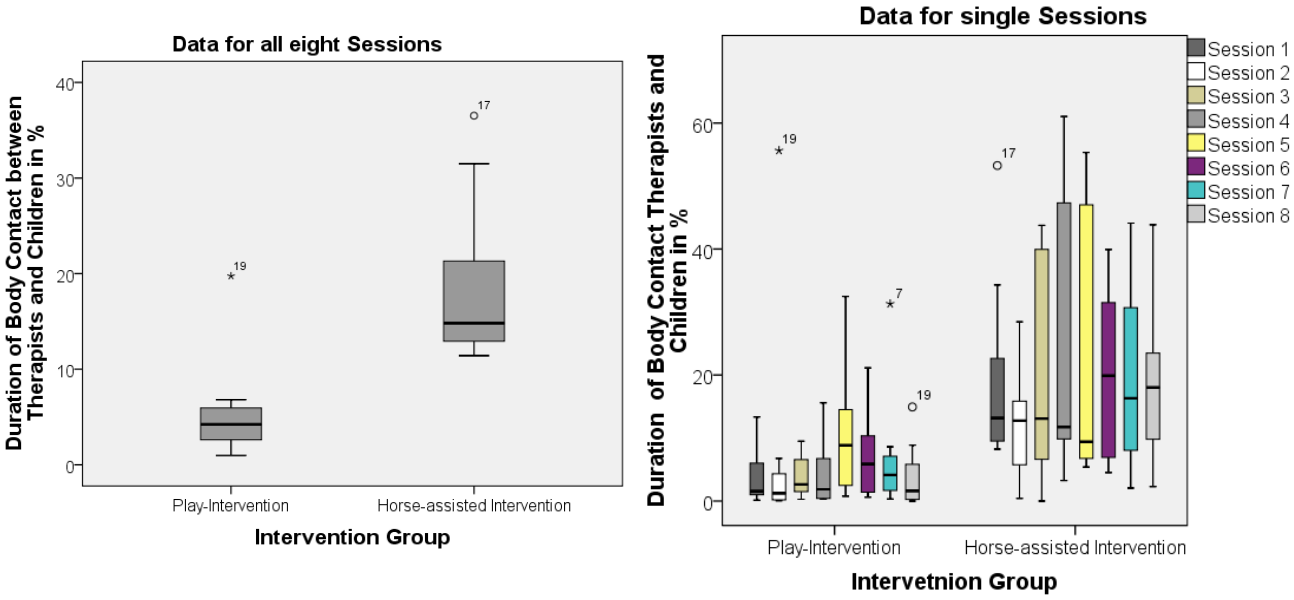
Mother touches the horse	Only mother on horseback	Mother and child on horseback
HR (mother)	RRI (mother)	SD (mother)
pNN50 (mother)	RMSSD (mother)	

In session 2 mothers who often touched the horse showed significantly lower pNN50-values (n=10, rs=-0.685*, p=0.025, R^2=0.47). In session 6 mothers by tendency showed a higher HR the more often they touched the horse (n=9, rs=0.654, p=0.056, R^2=0.43). But it is questionable if mothers who were more stressed more often touched the horse or if the high touching-frequency mirrored a decrease of relaxation.

3.4 Relation to the therapist

Via Mann-Whitney-U Tests it was analyzed if there was a setting specific difference in the durations of constant body contact between therapists and children and of vocal exchange between therapists and mothers or children.

A test overviewing durations of all eight sessions revealed that during horse-assisted intervention therapists held longer constant body contact to the children than in play-intervention (Mann-Whitney U Test: n=20, Z=-3.326, p≤0.001, r=-74), shown in figure 34. Analysis for single sessions revealed that in all sessions except session 5 this pattern was significant (Mann-Whitney U Tests: n≥18, Z=-3.175- -2.192, p≤0.001-0.014, r=-0.71- -0.49) – figure 35.



Figures 34 & 35 *Left:* Boxplot showing the duration of constant body contact between therapists and children (in percent) arranged accordingly to intervention-group and calculated for all sessions. As can be seen, medians (indicated by black crossbars) are higher in the horse-intervention group (Mann-Whitney U Test: n=20, Z=-3.326, p≤0.001, r=-74). *Right:* Boxplot visualizing medians for all single sessions showing the significant difference in all sessions, except session 5 (Mann Whitney U: n≥18, Z=-3.175- -2.192, p≤0.001-0.014, r=-0.71- -0.49).

Analysis overviewing all eight sessions showed that mothers in play-intervention talked significantly more to the therapist than mothers obtaining horse-assisted intervention (Mann-Whitney U Test: n=20, Z=-2.419, p≤0.007, r=-0.54) – figure 36. Taking a closer view findings show that this pattern occurred from session 2 onward. In sessions 2 to 4 there was only a tendency (Mann-Whitney-U Tests: n=20, Z=-1.587- -1.512, p=0.062-0.072, r=-0.35- -0.34) but in sessions 5 to 8 this tendency changed into significance (Mann-Whitney-U Tests: n≥18, Z=-2.694- -1.965, p=0.003-0.026, r=-0.65-0.44) – figure 37.

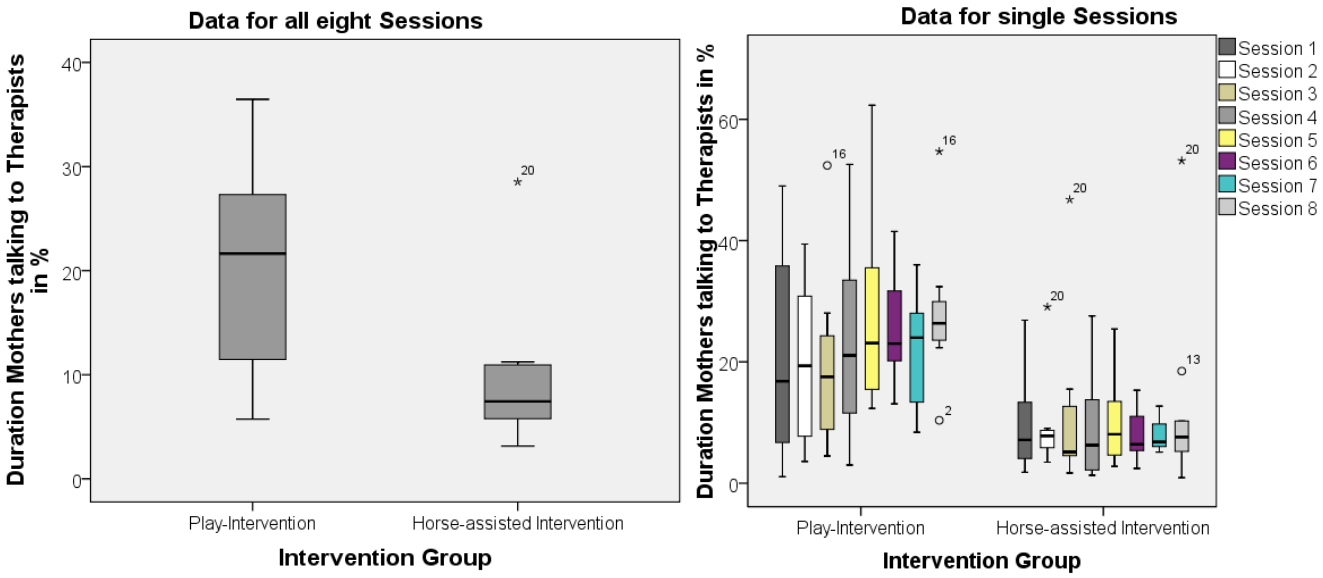


Figure 36 & 37 *Left:* Boxplot showing the duration of mothers talking to therapists (in percent) arranged according to intervention-group. As medians (indicated by black crossbars) show, mothers in play-intervention spent more time talking to the therapist than mothers obtaining horse-assisted intervention (Mann-Whitney U Test: n=20, Z=-2.419, p≤0.007, r=-0.54). *Right:* Boxplot visualizing durations for single sessions showing the change from a tendential to a significant difference at group-level (Mann-Whitney U: n≥18, Z=-2.694- -1.9512, p=0.003-0.072, r=-0.65-0.34).

In three play-interventions sessions (1, 6, 7) a tendency of an positive association between talking-duration between mother and therapist and the duration of therapists holding constant body contact to their children was found (Spearman Correlation: n≥19, rs=0.612-0.588, p=0.060-0.074). In session 8 mothers tended to speak more to the therapist the more constant body contact the therapist had to their children (Spearman Correlation: n=19, rs=0.667, p=0.071).

In sessions 1 (by tendency), 4, 5, 6 and 8 therapists in horse-intervention group talked more to the children (Mann-Whitney-U Tests: n≥17, Z=-2.570- -1.663, p=0.012-0.053, r=-0.57--0.37). In session 6 therapists in play-intervention spent more time talking to mothers than in horse-assisted therapy (Mann-Whitney-U Test: n=20, Z=-1.739, p=0.045, r=-0.39).

4 Discussion

In this chapter the findings of this study will be discussed against the theoretical background presented in chapter one.

Prior to the discussion of results referring to the stated hypothesis some general aspects that attracted attention during analysis will be mentioned:
Looking at the findings it appears that within play-intervention more (correlative) patterns occur than within horse-assisted intervention. A possible reason for this circumstance could be that the play-intervention setting is more homogenous over the course of the sessions and that mother-child dyads are less influenced by external factors (weather, actions in the surrounding of the setting as such etc.).
Significant therapist-effects at group level were just found in three sessions. Once mothers obtaining intervention from the occupational therapist touched their children more often, in two sessions mothers obtaining intervention from the psychotherapist talked or positively reinforced their children more often. These findings suggest that in some occasions the two therapists seem to provoke caregiving behavior of mothers in different ways – either more bodily or more vocal exchange between mother and child. But as this pattern did not seem to be continuous a comparison between therapist-groups seem to be justified.

Discussion of the effects of equine-assisted early intervention on caregiving behavior

One aim of this study was to extract effects of an equine-assisted intervention on mothers' caregiving behavior. George and Solomon (2008, 835) designate among other bodily contact and vocal exchange as motherly caregiving behavior.
As findings show mother-child dyads obtaining horse-intervention held significantly longer constant body contact than dyads of the control-group. Effect sizes indicate a very strong effect in this regard. Over the course of the eight intervention sessions no change in duration of constant body contact or touching frequency occurred in either of the settings.
Examining setting specific aspects two reasons that can help explaining this pattern can be detected. First, many children were not jet able to walk (constantly) on their own. Thus, were carried by their mothers, or led by the hand when approaching the horse or when walking through the riding grounds. This aspect of carrying and leading was not that dominant within the room where play-intervention took place. Furthermore equine-assisted

intervention as such provides more possibilities for mothers and children to spend time holding body contact e.g. when sitting together on horseback, or when mothers safeguard their children while riding.
In regard of vocal exchange mothers of the horse-assisted intervention positively reinforced their children more often during the first session and thereafter spoke more to their children than mothers of play-intervention (medium effect). Considering the whole interventional course findings show that the frequencies of positive reinforcement and negative rebuke decreased (strong effect) and the duration of vocal exchange between mothers and children did not change significantly.
An explanation for this pattern could be that the setting of a horse-assisted intervention is more stimulating than a room equipped with toys. For most dyads the encounter with a horse was something new and thus a certain novelty-effect could stimulate vocal exchange between mother and child during this mutual experience. Also the decrease of reinforcement and rebuke in both groups could be explained as during the first sessions mothers may encouraged the children more to engage in the new situation or rebuked them to set rules within the new surroundings. Thus a decrease of such behavior could indicate an established routine of the dyads within the settings.

As durations of body contact and vocal exchange did not change over the course of the eight sessions the differences on group level should be rather interpreted due to the different framework conditions within horse-assisted and play-intervention than due to an instantaneous impact of the equine-assisted intervention on mothers caregiving behavior.

Two other aspects than the setting influenced motherly caregiving during the sessions: the sex of the child and the particular attachment style:

As findings show, baby-girls got touched more often during some sessions (medium effect). This result is according to a study conducted by Goldberg and Lewis (1969, 29). They argue that this sex-specific difference in touching-frequency mirrors early sex-role learning (Goldberg & Lewis, 30).

During the two introductory sessions, mother-child dyads with secure attachment held longer constant body contact and mothers talked more to their children. Dyads with

disorganized attachment style held longer constant body contact than dyads with an insecure avoidant attachment pattern but showed comparatively the least time talking to their children. Though in the last session, dyads with disorganized attachment style kept the longest constant body contact. Insecure avoidant dyads kept the least long constant body contact during the first two and the last session but constituted the midfield in regard of vocal exchange.

These findings can be interpreted in different ways. On one hand this pattern could suggest that, when encountering a novel situation, mothers of securely attached children might function more as a safe haven were children in case of weariness turn to (Julius et al. 2013, 117). On the other hand less body contact can indicate a more of exploration within the new surroundings, with mothers functioning as a secure base (Ainsworth et al. 1978, 255f). But as it can be assumed that in insecure attached dyads secure base functions might not be fully intact the first argument could be considered more accurate. A further reason could be that the intervention showed first impacts on motherly caregiving behavior and thus more body contact occurred during last sessions.

In mother-child-dyads with insecure avoidant attachment the comparatively low constant body contact could denote that those pairs rely less on closeness in unfamiliar situations (Ainsworth 1984; Julius et al. 2013, 111f&116f; Ziv et al. 2000, 153&155).

But the maximum of constant body contact of mother-child-pairs with disorganized attachment pattern during the last session could indicate a contrasting effect. Thus, it could be that these mothers profit from bodily contact to their children during the termination of the intervention. This would correspond with findings of heart-data analysis, that show that constant body contact was associated with an increased parasympathetic activity in mothers (not necessarily in children) and thus could indicate relaxation.

Summarizing it can be stated that the horse-assisted intervention constitutes a setting where mothers find more possibilities to hold constant body contact with their children and to talk to their children than in a play-interventional setting. “Being carried”, physical contact, rhythm and furthermore “being part” of motherly activity establishes an atmosphere of togetherness (Klüwer 2008, 13). A study conducted by Anisfeld et al. (2008, 1617) shows that being carried induces motherly responsiveness and promotes attachment security on a long-term range and these aspects predominate the horse-assisted setting.

Discussion of setting-specific impacts on human stress-axis

Another question of this study was the impact of equine-assisted therapy on clients' stress reaction and therefore getting insight on underlying mechanisms of animal-assisted interventions.

Contrasting to Barker et al.'s study (2005), who found reduction of stress after petting a dog, touching the horse, seemed to influence stress specific reaction in mothers differently. In some sessions mothers who touch the horses more often show heightened salivary cortisol and higher heart rates, in other sessions they than show lower salivary measures and heightened heart rate variability measures (medium and high effect).

Comparing the two settings results show that a significant different impact on HPA-axis occurred just in session 4. In this session salivary cortisol levels of mothers obtaining horse- intervention rose just slightly thus, AUCi-values for mothers in play-intervention were significantly higher (medium effect). Data also show that in two out of eight horse-assisted interventions salivary cortisol levels dropped at group level throughout the particular session. A decrease of salivary cortisol levels at group-level did not occur in the play-intervention.
On SAM-axis level, data indicate that mothers and children showed higher relaxation during play-intervention which is shown by higher heart rate variability values and lower heart rates of mothers compared to those who obtained horse-assisted intervention. Just in session 6 differences were not significant on group level. Taking a closer look on the data no exceptional observation could be made that could explain why there were no group-specific differences in heart data during session 6. Maybe a certain external parameter induced a lower sympathetic (higher parasympathetic) activity in mothers on that day. As shown by Yamamoto et al. (2007, 199) changes in heat conditions can alter physiological activity. Maybe temperature was lower that day thus, heart rates decreased.

These differences on SAM-axis level could be based on the fact, that especially mothers were physically more active throughout horse-assisted sessions. They walked more and, also when sitting on horseback, muscular stimulation (balance, coordination, balance) was higher (Klüwer 2008, 14, Klüwer 2005, 7) than when sitting e.g. on the ground. Thus,

higher heart rates could indicate, as Kučera (2006, 3) explains, a higher level of sympathetic activity. Also Kaminsky et al. (2002) found enhanced heart rates within a dog-assisted setting. Authors explain these findings with a higher (pre-) anticipation of subjects to the time with the animals. But horses also hold a greater danger potential as dogs and as mothers had no pre-experience with horses a heightened sympathetic activation of mothers obtaining horse-assisted intervention could also indicate stress due to fear or heightened caution.

Thus, findings of this study are contrasting to studies conducted by Allen et al. (1991), Allen et al. (2002), Barker et al. (2005), Beetz et al. (2011, 2012b) who found a significant stress-alleviating effect in an animal-assisted setting. But as in two out of eight horse-assisted sessions and in non out of eight play-assisted intervention a decrease of salivary cortisol was found it might be, that stress-alleviating effects of EAT are masked by higher heart rates and lower heart rate variability values which occurred due to a higher physical activity, anticipatory effects or precaution in this group.

Connections between caregiving behavior and stress response

Findings of this study show correlative patterns between caregiving behavior and stress-axis activity. Within the play-intervention group constant body contact between mother and child was correlated with relaxation in mothers, as shown via lower salivary cortisol and heart rates as well as higher heart rate variability values (pNN50, RMSSD), especially during the first and final sessions (medium and high effects). In equine-assisted intervention a contrasting picture occured: in some sessions more body contact was associated with lower relaxation of mothers and children, indicated by a heightened heart rate the longer the body contact prevailed. In the final session tough, a longer duration of constant body contact between mother and child (on as well as off horseback) was correlated with heightened RMMSD-values of mothers. Effect sizes indicate a medium effect. Congruous with these results, especially mothers and children of disorganized dyads showed a longer duration of constant body contact during the final session.
These findings could either suggest that mothers who are less stressed were able to maintain longer body contact or that the mothers were able to gain social support from their children especially when arriving in a new surrounding or when departure impended. This effect might be based on a stress-alleviating oxytocin release subsequent to

somatosensory stimulation between mother and child often outlined in literature (Diamond 2001, 286; Heinrichs et al. 2009, 553; Julius et al. 2013, 60; Stock & Uvnäs-Moberg 1988, 29; Turner et al. 1999, 97; Unväs-Moberg 1997a, 38; Unväs-Moberg 1997b, 146; Unväs-Moberg et al. 2008, 199).

But constant body contact seems to have a different impact on children obtaining play-intervention, as longer constant body contact was associated with lower hear rate variability values, thus, indicating a more stressful reaction of children within initial sessions. In contrast, for session 5 longer constant body contact was associated with a heightened parasympathetic activity in children. For further sessions no correlations were found (medium and high effects).
These findings can be interpreted in two ways: either children were more excited within the new situation and thus, maintained more body contact to their mothers (mother as safe haven) or the low parasympathetic activity in children indicated a decrease of relaxation due to a longer enduring constant body contact with their caregivers. The second interpretation would match descriptions that children with a non-secure attachment pattern cannot gain a calming effect from the presence of the caregiver but are rather stress in their company (Julius et al. 2013, 111f&116f). This interpretation also matches a qualitative observation during a session where heart rates of a child immediately decreased after its mother rode off with the horse on her own. But still, results are ambiguous as after the initial phase children also seemed to gain relaxation by bodily contact with their mothers.

In sessions 1 and 3 vocal exchange between mothers and children was correlated with a lower sympathetic activity of children. Effect sizes indicate a high effect. This finding could suggest that vocal exchange reduces stress-reactivity in children during a (relatively) novel situation.

In regard of these findings it can be stated that mothers' caregiving behavior seems to have different and ambivalent correlates with stress reactivity on SAM- and HPA-axis levels. Some findings indicate that body contact and vocal exchange induces relaxation in mothers and children, some findings are contrasting and indicating a decrease of relaxation in children due to constant body contact with their mothers.

Discussion of the effects of equine-assisted early intervention on client-therapist relations

In regard of the relation between clients and therapist this study revealed that mothers obtaining play-intervention spent more time talking to the therapist than mothers of equine-assisted intervention (medium and high effect). Notably they talked more to the therapist the more bodily contact between therapist and children occurred (high effect). Thus, body contact between therapist and child might facilitated trust and thus conversation between mother and therapist. But although therapists held longer constant body contact to the children during horse-assisted intervention conversation between mothers and therapists was less than in the control group.

These findings are contrasting to claims in literature where the presence of an animal should increase trust and bonding to the therapist (Beetz 2010, 13; Julius et al. 2013, 147; Zilcha-Mano et al. 2011, 551). The different pattern within this study might occurred as therapists and mothers spent more time talking to the children during the equine-assisted intervention (medium and high effect), may leaving less time for conversation between mother and therapist. Within play-intervention a close relation between therapist and child seemed to function as an "ice-breaker" for establishing a relation to the therapist.

Relation between clients and horses

Looking at the course of the eight intervention-sessions mothers spent an increasing amount of time, talking to the horse. This behavior may indicate that mothers started to establish a relation to the horse and even may consider it as an object of attachment (Barker & Baker 1988, 46; Kurdek 2008, 249; Kurdek 2009, 439; Levinson 1969 cit. in Zilcha-Mano et al. 2011, 54; Yorke et al. 2012, 6). It was also shown that mothers who talked a lot to their children also talked a lot to the horse. This could either elucidate a general behavioral pattern of mothers or implicate that mothers mirror their behavior towards children and horses and thus accept horses as an attachment partner.

Limitations of the study

In regard of the relatively small sample size of this study, one has to bear in mind that results have to be interpreted judiciously. Another aspect that limits the validity of the results to a certain amount is the relatively short timeframe (8 weeks) in which dyads

obtained interventions. Thus, it seems a too short timeframe for a long term change in motherly caregiving behavior which is stated to be a neuronal deeply anchored behavioral system (Julius et al. 2013, 84). But the study demonstrates differences in the onset of interventional processes within a horse-assisted or a play-setting.

Conclusio

As was found in this study equine-assisted setting promotes body contact and vocal exchange within mother-child dyads. Thus such a setting might be on a longer range suitable to induce a change in maternal caregiving behavior and furthermore attachment patterns of their children. Contrasting to findings of previously conducted studies the horse-assisted intervention was not associated with a significant decrease of clients' stress-reactivity during the sessions. Findings show that play-intervention promoted relaxation in clients to a greater degree. Furthermore the presence of the horse did not facilitate an enhanced report between clients and therapists, as mothers obtaining play-intervention spent more time talking to the therapists.

Consequently to these findings an intervention for insecurely attached mother-child dyads could be conceptualized in a different way. As children with insecure attachment might not directly profit from longer periods of constant body contact with their mothers and furthermore play-intervention facilitates conversation between mother and therapist and a more relaxed atmosphere it might is recommendable to offer a mixed interventional approach when working with mother-child pairs with insecure attachment. In such case a starting period in a play-setting could help to establish trust and familiarity between clients and therapists which thereafter could constitute a foundation for equine-assisted procedures which then offers more opportunities for bodily and vocal exchange between mothers and infants.

As mentioned before, an eight-week intervention seems a very short timeframe to trace long-lasting effects of an equine-assisted intervention on behavioral levels. Thus it would be recommended to apply long-term studies to gain further insight into underlying mechanisms of such kind of interventions.
Furthermore this study shows that an intervention that takes place outside, in spacious grounds and with an animal is much more influenced by external factors than an

intervention in a more experimental setup. Thus, results might are blurred or certain patterns covert. But it is these aspects among others that distinguish horse-assisted interventions from other interventions.

Maybe, a way to gain more insight into intervention-related effects and external influences when analyzing study-records could be a mixed methods approach. Therefore qualitative data about clients' subjective perception and evaluation of interventional activity could be collected and combined with quantitative assessed data.

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Appendix I

The following table shows the most important coded behavioral variables and their closer definition.

Variable	Definition	Condition
Movement		
M stands	Mother is sitting or standing still	Duration
M walks	Mother is walking	Duration
M runs	Mother is running	Duration
Ch. sits	Child is standing, sitting or lying on the floor	Duration
Ch. walks	Child is walking or crawling	Duration
Ch. runs	Child is running or crawling very fast and excitedly	Duration
Body contact		
Constant Contact M+Ch.	Constant body contact between mother and child, e.g. when carrying, sitting on the lap etc.	Duration
Constant Contact Th.+Ch.	Constant body contact between therapist and child, e.g. when carrying, sitting on the lap or safeguard the child on horseback etc.	Duration
M touches H	Mother is touching, kissing or stroking the horse	Event
M touches Ch.	Mother is touching, kissing or stroking the child: is also coded when already constant body contact between mother and child occurs.	Event
Ch. touches H	Child is touching, kissing or stroking the horse	
M feeds H	Mother is feeding the horse with a treat in the end of the session	Event
Ch. feeds H	Child is feeding the horse with a treat in the end of the session	Duration
Vocal exchange		
Th. speaks +M	Therapist is speaking to the mother	Duration
Th. speaks +Ch.	Therapist is speaking to the child, or vocalizes towards the child	Duration
M speaks+Th.	Mother is speaking with the therapist	Duration
M speaks+Ch.	Mother is speaking with or vocalizing towards the child	Duration
Th. sings	Therapist is singing	Duration
M sings	Mother is singing	Duration
Pos.	Mother positively reinforces the child, f.eg. if child is doing something right	Event
Neg.	Mother negatively rebukes the child, f.eg. if child is doing something wrong	Event
M speaks to H	Mother is speaking with or vocalizing towards the horse	Duration
Distance between mother and child		
1	Direct body contact between mother and child	
2	Child is within an arm length of its mother but without direct body contact	Duration
3	Child is further than an arm length away from its mother but still within a 3 meters radius	Duration
4	Distance between mother and child is greater than 3 meters	Duration
Positions mother and child		
M carries Ch.K	Mother is carrying her child	Duration
Ch. at hand	Mother is leading the child at hand	Duration
Mother and child on horseback		
M+Ch. on H	Mother and child are sitting together on horseback	Duration
M safeguarding Ch.	Mother holds child while they are sitting together on horseback or while only the child is sitting on horseback	Duration
Startling moments		
H startled	Horse startles during the session	Event
M startled	Mother is frightened	Event
Ch. Startled	Child is frightened	Event

Playing		
M plays	Mother is playing on her own	Duration
Ch. Plays	Child plays on its own	Duration
M plays +Ch.	Mother is playing together with child	Duration
Th. plays +Ch.	Therapist is playing with the child	Duration
Expression of displeasure		
M ☹	Mother cries or articulates her displeasure	Duration
Ch. ☹	Child is crying or whimpering	Duration
Expression of joy		
Ch. ☺	Child is happily vocalizing	Duration
Absence		
M out	Mother is out of sight within the video clip	Duration
Ch. out	Child is out of sight within the video clip	Duration

Curriculum Vitae – Mag. Denise Viktoria Hebesberger

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Date of Birth: 18th of October 1984

School Education

1991 – 1995	Elementary School in Micheldorf/Upper-Austria
1995 – 1999	Bundesrealgymnasium in Kirchdorf/Krems
1999 – 2003	Bundesoberstufenrealgymnasium in Kirchdorf/Krems

Studies at the University of Vienna

2004-2005	**Communication science**
2004-2012	**Diploma-study of Pedagogy** (psychoanalytical pedagogy, special educations), graduation with excellent success *Diploma Thesis:* Psychoanalytic-pedagogical Counseling of Parenting for Families with Children diagnosed with ADHD. ADHD between Medicine and Psychoanalytical Pedagogy.
2005-2013	**Diploma-study of Biology** (Zoology): *Diploma Thesis:* Behavioral and Physiological Effects of Horse-assisted Therapy for Mother-Child Pairs with Insecure Attachment

Additional Qualifikation

At the University: Classes for e-learning platform applications

- FRONTER – Instruction Class
- Step@nline-Lerndorf – Instruction Class

Österreichisches Kuratorium für therapeutisches Reiten und Voltigieren (ÖKTR):
Training for becoming a vaulting-therapist (2012 – 2013)

Scientific Work Experience and Internships

September 2007 Research Internship **Sigmund-Freud-Institut,** Frankfurt/Main: „ADHD-Prevention Study“ and „Psychotherapy and Depression“ Head of Research: Prof. Dr. Marianne Leuzinger-Bohleber

2007 - 2008	Research Assistance on the **Department of Educational Science**, University of Vienna: „The development of the mother-infant relation“ Head of Research: Dr. Kornelia Steinhardt
2008	Research Assistance at the **Department for Neurology**, University Clinic Vienna: “Studies of Neuro-Feedback-Training” Head of Research: Dr. Doris Moser
2008, 2008/2009 & 2010	Tutor at the **Department of Educational Science**, University of Vienna, in collaboration with Frau Dr. Christa-Monika Reisinger, M.Ed.
2009	Tutor at the **Department of Educational Science**, University of Vienna, in collaboration with Dr. Kornelia Steinhardt
2009	Research Assistance at cooperative Studies between **University of Vienna** and **University of Rostock**: „Impacts of dogs on children’s stress-coping“ Heads of research: Dr. Andrea Beetz and Prof. Kurt Kotrschal

Work Experience

Since 2012	Vaulting-therapist, „Mit Pferden stärken“ (NÖ)
2012-2013	Vaulting-therapist and riding instructor, Center for animal-assisted pedagogy (Vienna)
2011 – 2012	Assistance of leisure educational activities, Wiener Familienbund
2010 & 2011	Leader of leisure educational activities for children and youth in public areas, Wiener Familienbund
2010 – 2011	Educational aid at elementary school-level

Internships – Therapeutic Vaulting and Riding

2011	Semester-Internship at „e.motion“ (Vienna)
2007	Summer-Week fulltime Internship at „e.motion“ (Vienna, NÖ)
2005 & 2006	Lucky-Horse-Ranch (OÖ)
2005	Center for animal-assisted pedagogy, Vienna

ꕤ Oktober 2013 ꕤ