Basic neurobiological and psychological mechanisms underlying therapeutic effects of Equine Assisted Activities (EAA/T)

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A review on the psychological effects of horseback riding, hippotherapy, or therapeutic riding yielded relatively few (<15) studies meeting the criteria of a minimum of five participants and publication in a peer reviewed journal in English or German. Results regarding psychological effects indicate that interactions between humans and horses might have the potential to reduce anxiety (Honda & Yamazaki 2006; Gohler & Ohms 1974), stress (including blood pressure and other autonomic functions; Hammer, Nilsgard, Forsberg, Pepa, Skargren & Öberg 2005), pain (Hammer et al. 2005), anger and aggression (Kaiser, Spence, Lavergne & Bosch 2004) and depression (Scheidhacker 1991), to facilitate social communication (Bass, Duchowny, & Llabre 2009; Gohler & Ohms 1974), trust in others (Yorke, Adams, & Coady 2008), learning (Bass, Duchowny, & Llabre 2009), and to improve the mood (Honda & Yamazaki 2006). Since most studies lacked larger samples and in particular, control groups, it remains unclear whether these reported curative effects can be attributed specifically to the assistance by a horse or the human-horse-relationship.

On this basis we designed two studies investigating whether effects of Equine Assisted Activities can be attributed to a common underlying mechanism. We have developed a model that integrates the reported effects and applies to human-animal interactions and relationships in general (see Julius, Beetz, Kotrschal, Turner & Uvnäs-Moberg, in press). A common mechanism as a basis for the effects reported so far can only be assumed if humans and animals can engage in social relationships. Findings from behavioral and evolutionary biology indicate that there are basic and universal physiological structures and mechanisms underlying social behavior in humans as well as animals. Many structures and functions of behavior, physiology, and brain, which are relevant in a social context, are shared between humans and animals. Therefore, human and animals, if properly socialized, can establish an interspecies social relationship which can affect social behavior and development of humans.

One of the central common principles underlying relational behavior of humans and non-human mammals is the oxytocin system. Oxytocin decreases anxiety (Neumann, 2008) and the activity of the HPA axis and thus reduces and buffers stress (e.g. operationalized via salivary or plasma cortisol; Neumann et al. 2000). Furthermore, it decreases the activity of the sympathetic nervous system, which results in a lower blood pressure, and increases activation in the parasympathetic nervous system (Uvnäs-Moberg, 1998). In humans, oxytocin is associated with a similar effect spectrum i.e. social interaction and competence is increased and anxiety and stress levels (cortisol) are decreased (Heinrichs et al. 2003; Domes et al. 2007; Guastella et al. 2008; Jonas et al. 2008) and trust in others is enhanced (Kosfeld et al. 2005). Oxytocin is massively released during labor and in response to suckling, but also in response to less intense sensory stimulation, such as warmth or touch (Uvnäs-Moberg, 1998; Uvnäs-Moberg, 2004). Altogether, the present evidence suggests that oxytocin has important modulatory effects on social behavior (less aggression, facilitation and stimulation of social interaction and communication), stress coping (stress reduction), emotional states (less depression, increased trust in others), pain (reduces pain, elevates pain threshold), and the autonomous nervous system.

Since most of these effects have been reported in the literature on curative effects of human-horse-relationships we assume that the oxytocin system is the central underlying neurobiological structure. If this is true and if central mechanisms of human-human and human-animal relationships are shared this raises the question, why the oxytocin system should be activated in human-animal relationships while it is not activated in human-human-relationships in certain patients. If the oxytocin system was activated in all human-human-relationships, no therapeutic approaches including animals such as horses were needed.
To answer this question we make a connection between the neurobiologically defined oxytocin system and the psychologically defined attachment and caregiving systems.
In defining attachment between children and their caregivers Bowlby (1988) refers to the ethological concept of "behavioral systems", which, from an evolutionary point of view, are phylogenetically old and have a survival value. Attachment originally referred to a persistent emotional tie between a child and a caregiver, but today, the concept of attachment has been expanded to include also other types of relationships, such as partner relationships. The function of the attachment system is to maintain or establish the proximity between a child and its attachment figure, when the child is stressed or in danger in order to regulate the stress

and to protect the offspring. Since the attachment system - as all behavioral systems - is flexible, this system does not only adapt to supporting conditions, but also to a negative environment. Exposure of the child to parental rejection, neglect, inconsistent behavior or even abuse, will lead to the development of an insecure or disorganized attachment. Children with these forms of attachment do not experience relief of fear and stress in the company of their parents. According to George and Solomon (2002) the caregiving system of the parent is an independent behavioral system, but linked with the attachment system. The caregiver's behavior is reciprocal to the child's attachment behavior and the most important factor accounting for the quality of the child's attachment to a caregiver. Current data strongly support that attachment as well as caregiving are connected to the oxytocin system (see Uvnäs-Moberg 2003) and that humans establish attachment as well as caregiving relationships with animals (Kurdek 2008, 2009a,b; Shore, Douglas & Riley 2005). Kurdek (2008, 2009 a, b) showed that generalized, insecure attachment and caregiving patterns with regard to human-human-relationships do not correspond with the attachment and caregiving patterns humans develop with their pets (Kurdek 2009 a, b). In fact, the prevalence of secure attachment and flexible caregiving towards pets is four times higher than that of a secure attachment and flexible caregiving in human relationship. Attachment and caregiving patterns towards humans are obviously not transmitted to the relationship with a pet. These results are of great interest since attachment or caregiving patterns, developed on basis of experiences with the parents, are usually transferred to other close human-human-relationships, e.g. with professional caregivers such as teachers (Achatz 2007), which further jeopardizes the development of children with an insecure/disorganized attachment.
Since the transmission of insecure attachments to human-animal relationships is unlikely, also insecurely attached humans should still be open to positive interactions and trusting relationships with animals, which can activate the oxytocin system with its positive effects for an adaptive and healthy development. This might be especially true for the human-horse relationship since it is characterized by close physical contact, e.g. when being carried by a horse as well as caring for a horse.

Therefore, in the current research projects, we hypothesized that therapeutic human-horse contacts have a positive modulatory effect on stress, trust, and psychological health, in particular in humans with insecure or disorganized attachment patterns, whose oxytocin system - which we propose as the connecting basis for these effects - is normally not activated by close human contact. Since direct measurement of oxytocin in plasma would require taking

several blood samples which can by itself cause stress, the activation of the oxytocin system was indirectly operationalized via measuring a set of indicators capturing the well investigated effects of oxytocin on stress (cortisol, heart rate), trust, and social behavior.

Empirical support of our hypothesis would provide a theoretical basis for the effects of EAA and prove the enormous therapeutic potential for persons with social and emotional disorders. Human therapists or other health care professionals could utilize the elevated oxytocin in the close and physical contact to the animal, which facilitates trust also in other humans. The endocrinological changes further promote social interaction. Under these circumstances the insecurely attached person's attachment system can be confronted with new experiences in human-human relations supporting psychological development.

Study 1: The effect of EAA on mothers and their at-risk toddlers

In the first study we investigated 20 toddlers (age 1-2) and their mothers who showed dysregulation in their interaction or attachment with their child or risk factors in their background such as parental mental disorders, substance abuse, child abuse and neglect, domestic violence. One group of ten dyads was exposed to eight weekly sessions of Equine Assisted Activity (EAA, N=10) the control group of ten dyads to eight weekly sessions of a play-based early intervention. Both treatments focused on promoting a secure mother child bond, and sensitive caregiving of the mother.

Our hypothesis was that the dyads in the EAT group would show more improvement in the mother-child relationship and interaction due to the activation of the oxytocin system by the interaction with the horse, than the control group without animal support. Furthermore, we proposed that the EAA sessions would result in reduced stress (as assessed by heart rate and cortisol) in comparison to the play-interaction sessions. A further hypothesis was that there would be a link between these psychophysiological effects and interactions between therapist, mother, child and horse.

Data Collection

During a pre-test, conducted one week before the first EAA-session and lasting about 90 minutes, data on attachment of mother and child and demographic data were obtained via the

Adult Attachment Projective, the Strange Situation Test, and the CARE-Index (see below). With the exception of the AAP, the same data were obtained in a post-test one week after the end of therapy. Instead of the AAP, a questionnaire on how much the mothers liked the therapy, on what they did not like, observed changes in her child etc. was given. In addition to the planned procedures several questionnaires capturing the caregiving representation of the mothers towards their child, perceived developmental irregularities/behavior problems of the child, and background information on the delivery of this child, mental health problems of the mother, and similar were obtained. Also during and after the intervention additional questionnaires for the therapists and mothers were employed to collect further data on the quality of the therapeutic relationship.

Instruments in pre- and posttest

The CARE-Index (Crittenden 1984)

The CARE Index is the simplest and most versatile of the attachment measures. It assesses mother-infant interaction from birth to about two years of age based on a short, videotaped play interaction of 3-5 minutes. The measure assesses mothers on three scales: sensitivity, covert and overt hostility, and unresponsiveness. There are also four scales for infants: cooperativeness, compulsive compliance, difficultness, and passivity. These scales tend to be related to the maternal scales in the order listed.

The Strange Situation Test (SST; Ainsworth 1978)

The Strange Situation Procedure is a laboratory procedure used to assess infant attachment style. The procedure consists of eight episodes of separations of mother and infant for up to two minutes and reunions, in the presence of a female stranger and without the presence of a stranger. The behavior of the child during separation, but in particular during the reunion allows a classification in the four categories secure, insecure-avoidant, insecure-ambivalent, and disorganized. The SST is videotaped and coded from the tape. It is the standard procedure for assessing attachment in infants.

Adult Attachment Projective (AAP; George, West, and Pettem 1997)

The AAP is a projective approach to assess the inner representation with regard to attachment that has been developed and validated with the Adult Attachment Interview (AAI), the standard method of assessing attachment representations in adults (George & West 2001). It

allows the distinction of the representations secure, insecure-dismissing, insecure-preoccupied, and disorganized/unresolved attachment trauma. The AAP consists of eight drawings of attachment relevant situations (with exception of the warming up picture). The participant is asked to tell a story to each picture stimulus, addressing the actions, thoughts and feelings of the depicted persons. The coding of the transcript assesses attachment relevant content such as mentioning of using attachment figures as haven of safety, of internalized secure base, of synchrony between persons and two different defensive strategies, cognitive disconnection and deactivation, to keep the attachment system organized during story telling.

The Child Behavior Checklist (CBCL, Achenbach 1991)

The CBCL is a widely used and validated instrument to assess the problem behavior of children age 1 ½ - 5 years. Due to the length of the questionnaire only 15 items were selected which had been proven useful in a previous study. These included externalizing and internalizing behavior problems, such as being anxious, constipated, crying a lot, avoiding eye contact etc.

The mother-child questionnaire

This questionnaire, designed by the authors, collected data on current delivery mode, problems after delivery, other pregnancies, fear of loss of the child, current relationships, loss of a parent, abuse in childhood.

Maternal Attitude towards the own Child (designed in accordance with the Caregiving Questionnaire, Kunce & Shaver 1994)

This 28-item questionnaire assesses the caregiving representation of the mother towards her child. It was designed as a translation of the Caregiving Questionnaire of Kunce & Shaver 1994, and adapted for the mother-child relationship, since the original assessed caregiving in partner-relationships.

Data collection in the post-test/after end of therapy

Questionnaire about the therapy (posttest)

This questionnaire asks about observed changes in the child, trust towards the child, the like and dislike of therapy sessions.

Questionnaire for therapists: After the end of therapy, the two therapists were asked to answer a questionnaire for each mother-child dyad in their group, about main topics of therapy, knowledge about abuse history and current problems, mental disorder of mother and child (which were often not indicated on the questionnaires for the mothers), and like and dislike of the mother and the child.

Questionnaire "My therapist and I": This questionnaire was adapted from the questionnaire "My teacher and I" (Pianta 2001), and assesses trust towards the therapist. Mothers were asked to answer this questionnaire after the 2nd and the 5th and the 8th therapy session. The questionnaire consists of 16 items asking the patient about his relationship to his therapist, e.g. if the patient thinks that the therapist likes him, if the therapist praises him, pays attention to him, and if the patient trusts the therapist. Items can be answered with "not true", "a bit true", or "completely true". The "My therapist and I" – questionnaire has been used in a pilot study with good scale reliabilities (Cronbach's alpha >.85) for the subscales closeness, dependency, and conflict. The scale was adapted for adults.

Data collection during therapy sessions

Behavior coding from videos

All therapy sessions were videotaped from beginning to end by aid of HD digital video cameras. Relevant behaviors of the focal human subject or the dyad, and the interactions with the therapist were coded by aid of Solomon Coder (A. Peter 2010) in a way that phases of the sessions can be separately analyzed. Over 70 behavioral parameters and variables were coded. In the case of the coded variables, frequencies and percentage of time of total observation time or per phase are available. All coders achieved good observer reliability and inter-observer agreement on all items at the beginning and at the end of coding.

Heart rate and heart rate variability

Heart rate was measured via a chest belt (Polar) and directly transferred to a wrist watch. From that, data were read into a computer after the sessions. A Polar precision performance (Polar Electro) device was used, which also allows for a measurement of heart rate variability, an even better indicator of relaxation respectively the activation of the sympathetic/parasympathetic nervous system than mere heart rate. Due to fitting problems of the chest belt in the toddlers and robbing on the floor or being picked up by the mother, errors in measurement occurred frequently which had to be filtered from the data later.

Salivary cortisol

For measuring cortisol saliva samples of the human subjects, samples are taken at fixed time intervals over the course of the pre- or post-test/therapy sessions. Saliva samples were taken from the mothers by letting them chew on sterile cotton pads (salivettes). The children's saliva was collected via large medicinal Q-tips. Saliva sampling from the toddlers was often quite difficult, resulting in less than the required amount of saliva in about 20% of the samples. Instead of 4 samples each therapy session, only three samples were taken, since in particular the children were irritated by the sampling during therapy. Thus, samples were taken before the beginning of therapy, about 20 min later, and after the end of therapy, 40 min later. Samples were stored frozen at -20 degrees Celsius until analysis. Enzyme immunoassays (EIA) were used to analyze the cortisol levels from the saliva samples.

Summary of Results

Both interventions, EAA and a usual play-therapeutic approach, improved the mother-child relationship with regard to attachment and caregiving over the course of eight therapy sessions. While most differences between the intervention groups did not reach statistical significance on the psychological measures, which is likely due to the relatively small sample sizes, there is one advantage of the EAA: mothers of boys improved more with regard to their compulsive caregiving than in the control group. Our observations showed that the boys were clearly very active in the EAA and the mothers learned that they needed their space and that controlling them via caregiving rather leads to tension in the mother-child relationship. A play therapy context does not provide the same possibility for the child to move around and to show that he dares and enjoys getting some distance from the mother for exploration and then to return to her.

With regard to the physiological measure cortisol, heart rate and heart rate variability, results show that only in EAA, communication in the triad therapist-mother-child is linked to more relaxation, while this is not the case in the play therapeutic approach. Furthermore, also physical closeness and contact seems to be more positively perceived in EAA, being linked to more relaxation (higher HRV, decrease in cortisol/smaller increase). On the background of our theory this could point to an activation of the oxytocin-system. Even though activity levels in the EAA-group were higher, some decreases in cortisol levels were observed. And oxytocin is also known to facilitate friendly communication and interaction, relaxation, trust, and is linked to positive physical contact. Even though the different activity levels in the

groups make an interpretation more difficult, the physiological measures point to an advantage of EAA, setting the stage for more positively perceived communication and interaction.

From the feedback of the mothers we learned that most of the participants in the EAA would have wished for a few sessions without the horse in the beginning, in order to feel more comfortable and trusting with the therapist first. While they liked riding and interacting with the horse, it was also quite a stress factor in the first sessions. Also, in the last therapy session, where conclusions of what changed, what needs to be done in the future, were drawn, the mothers would have preferred a less distracting, closed indoor surrounding.

Therefore, for future projects that would like to employ EAA to promote the mother-child bond in this age group of children, we would recommend a combination of therapeutic approaches, starting with 3-4 sessions in a traditional surrounding and context of play therapy, followed by 3-4 EAA sessions and a final session in a quiet, non-distracting surrounding without the horse. Overall, all mothers preferred the EAA, the EAA-group enjoyed the experiences with the horse, and our data point to advantages of EAA for communication and interaction of the mother-child dyad. Also, the motivating factor of EAA should not be underestimated when working with clients of this background. To achieve significant changes in the psychological measures on caregiving and attachment, to really change attachment and caregiving towards more security in those, mainly at-risk, dyads within only 8 therapy sessions was a great success.

Study 2: The effect of EAA on children's relationship to the therapist

In the second study, 16 insecurely attached boys with severe behavioural or emotional problems received either Equine Assisted Activities (EAA) or an Agility/Play Therapeutic Approach. It was investigated whether the interaction with the horse would increase trust towards the therapist and the willingness to open up to the therapists after EAA.
Our hypothesis was that children in the EAA group would develop more trust and/or trust to the therapist faster, and improve more with regard to their problem behavior and emotion recognition than the play-therapy group. We also proposed that the EAA group will show less stress/more relaxation during therapy sessions (cortisol and heart rate, indirectly indicating the activation of the oxytocin system). Furthermore, we proposed a link between these

psychophysiological effects and direct child-horse interaction (touch, attachment or caregiving behaviors).

Data Collection

During a pretest the children were tested with the SAT for their attachment representation. Furthermore, they did the Reading-the-mind-in-the-eyes-Test (RMIE), and their teachers filled out the CBCL-TRF. With the exception of the SAT, these instruments were also used in a posttest after end of therapy. In addition the children answered a questionnaire about their relationship to the therapist after session 1 and 8. During the therapy sessions heart rate (HR) and cortisol levels were obtained (Polar-Device, salivary cortisol). Behavior was videotaped during the whole session. And after each session the child answered question about a picture with an attachment relevant situation (taken from the SAT).

Instruments

Separation Anxiety Test (SAT; Julius, Kißgen, Klicpera 2009)

Like the AAP, the SAT is a projective picture task for the assessment of the attachment representation in children (age 6-12). The pictures, showing either a boy or a girl, are separated from an attachment figure for a shorter or longer period of time. The child is asked how the child in the picture feels, is thinking, what the child is doing next, and how the story ends. The narrative is transcribed and coded for secure, avoidant, ambivalent, or disorganized attachment.

After each therapy session, one picture was taken from the SAT and the answers of the child were coded for the scales resistance (in telling something about the picture and similar own experiences), emotional openness, secure attachment, and attempts to control the interviewer. These scales were developed base on the answers and in accordance with the criteria usually used to score the SAT.

The Child Behavior Checklist (CBCL, Achenbach 1991) – Teacher Report Form (TRF)

The CBCL-TRF is a widely used and validated instrument to assess the problem behavior of children and juveniles, including externalizing and internalizing behavior problems. A teacher who knows the child rated the child’s behavior on a list of 120 behavior descriptions. This instrument was used to measure a child’s behavior change over time or to evaluate a treatment.

Reading the Mind in the Eye Test (RMET; Baron-Cohen, Wheelwright et al. 2001)

The children's version of the Reading in the Mind Test (RMET-C, Baron-Cohen, Wheelwright, Spong, Scahill & Lawson 2001) is an adaptation of the well-known adult version (Baron-Cohen et al. 1997). It comprises 28 photographs of the eye region of the face. The child is asked which of four words best describes what the person in the photo is thinking or feeling. Only one of the four words is correct. The position of the four words is randomized for each item. The RMET-C has been validated for children from age 10 to 12.

My Therapist and I (Julius 2007/2010 unpublished)

The questionnaire consists of 16 items asking the patient about his relationship to his therapist, e.g. if the patient thinks that the therapist likes him, if the therapist praises him, pays attention to him, and if the patient trusts the therapist. Items can be answered with "not true", "a bit true", or "completely true". The "My therapist and I" – questionnaire is an adaptation from the questionnaire "My teacher and I" that has been used in a pilot study with good scale reliabilities (Cronbach's alpha >.85) for the subscales closeness, dependency, and conflict. The scale is designed for children age 7-16.

Behavior coding from videos

All therapy sessions and the SSP were videotaped from beginning to end by aid of HD digital video cameras. Relevant behaviors of the focal human subject or the dyad, and the interactions with the therapist were coded by aid of Solomon Coder (Andras Peter) in a way that phases of the sessions can be separately analyzed. A total of 70 behavioral parameters will be coded and an additional 15 variables will be observer rated on a scale of 1-5 (e.g. intensity of emotional expression). In the case of the coded variables, frequencies and percentage of time of total observation time or per phase are available. All coders were synchronized, observer reliability and inter-observer agreement on all items was tested at the beginning and at the end of coding via a set of video tapes.

Heart rate equipment

Heart rate was measured via a monitor (chest belt) and directly transferred to a wrist watch. From that, data were read into a computer after the sessions. A Polar precision performance (Polar Electro) device was used.

Salivary cortisol

For measuring cortisol saliva samples of the human subjects, samples are taken at fixed time intervals over the course of the therapy sessions. Saliva samples were taken from the participants by letting them chew on sterile cotton pads (salivettes). Samples were stored frozen at -20 degrees Celsius until analysis. Enzyme immunoassays (EIA) were used to analyze the cortisol levels from the saliva samples.

Summary of Results

There were no significant results regarding emotion recognition, trust towards the therapist, and problem behavior, even though teachers reported less aggression (non-significant) in the intervention group.

Overall, towards the end of therapy, the EAA-group showed significantly more openness and readiness to talk about emotionally relevant topics elicited by the SAT-pictures. In the interest of the children's socioemotional development this is of utmost importance and also indicated more trust towards the therapist and willingness to open up to her. Furthermore, data point at a development towards more secure strategies in handling attachment relevant situations in the EAA group – either due to the security-promoting effects of communication with the therapist during EAA, or possibly due to the activation of the OT-system via contact with the horse.

The overall results on stress operationalized via salivary cortisol document neither a clear advantage nor disadvantage of EAA in comparison to the control treatment. Heart rate variability, however, points towards less stress during the therapy and during the picture-task after therapy in the EAA-group.

Behavior observations revealed that children in the EAA-group were more active, and also had more nonverbal contact (eye contact, touch) with their therapist, especially during the first few therapy sessions, while this effect disappeared in the later therapy sessions. Physical relaxation as indicated by heart rate and heart rate variability was related to more openness during the SAT-picture task in the EAA-group, and also to interaction with the horse.

The majority of results of study 2 supported our assumption that EAA promotes more relaxation, more (nonverbal) communication with the therapist, and more openness to talk about relevant topics. Even though statistically non-significant, there was a trend towards a decrease of aggression in the EAA-group. However, due to difficult behavior of this special

sample of juveniles with emotional and behavior disorders (missing days at school, dropping out, missing data due to little cooperation for saliva sampling) the number of participants for the analyses were often quite low, and only really strong effects reached statistical significance. In general, the results indirectly point towards the activation of the OT-system via contact with the horse, however, especially stroking the horse, not as much the riding per se.

Conclusion from both studies

In both studies within this research project we intended to investigate basic mechanisms of Equine Assisted Activities/Equine Assisted Therapy rather than effects of EAA on the problem behavior, which was, however, included. Findings from both studies document that indeed the EAA-groups do show better communication and interaction of all involved parties, on average lower stress levels or higher relaxation, and - probably resulting from this - more readiness to open up to the therapist. Even though methods did not allow assessing changes in the oxytocin-system directly, our data on the stress-related parameters, communication/interaction and trust/opening up point towards an activation of this system, since experimental research has shown that oxytocin is related to those effects in humans.

A direct physical interaction with the horse seems to be a key factor for the relaxation effects in the investigated juveniles, who open up more after the EAA, talk more about emotionally relevant topics and thus have a chance to improve in their mental health by integrating traumatizing experiences or living conditions.

In the mother-child dyads it became obvious that the mother is the key towards changes within the relationship. Since children of this young age are difficult to handle on the horse at the beginning and mothers are usually very careful and anxious it seems to be more suitable to start with a few sessions without the horse, to establish trust towards the therapist in a quiet and safe surrounding, before entrusting oneself and the toddler to the care of the therapist and horse handler. Then, however, working with the horse provides a wonderful possibility to make new and exciting experiences together, to practice separations and reunions on the riding square, and to synchronize with each other via the pace of the horse (and singing).

Working with horses in EAA/EAT obviously provides a key factor, which is absent in more traditional therapeutic approaches. The involvement of the horse especially promotes

relaxation, communication and interaction, and trust of the client to the therapist. And the quality of the therapeutic relationship has been identified as the most important factor for the success of therapeutic approaches. Therefore, if some preconditions are met (such as absence of allergies, fear of horses, a minimum age of 1-2 years), EAA has an advantage over traditional therapies. Even though this could not be investigated in our project with a short intervention time of 8 sessions only, we assume that by working with horses the time to establish a good therapeutic relationship is diminished and probably the time needed for therapy to show effects is as well.