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The Effect of Therapeutic Horseback Riding on Social Functioning in Children with Autism

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Abstract This study evaluated the effects of therapeutic horseback riding on social functioning in children with autism. We hypothesized that participants in the experimental condition ($n = 19$), compared to those on the wait-list control ($n = 15$), would demonstrate significant improvement in social functioning following a 12-weeks horseback riding intervention. Autistic children exposed to therapeutic horseback riding exhibited greater sensory seeking, sensory sensitivity, social motivation, and less inattention, distractibility, and sedentary behaviors. The results provide evidence that therapeutic horseback riding may be a viable therapeutic option in treating children with autism spectrum disorders.

Keywords Children · Autism · Therapeutic horseback riding · Social functioning · Equine assisted activities

Introduction

Recent attention has focused on animal-assisted therapy as a therapeutic option for a wide range of developmental disabling disorders. Animal assisted therapy, defined as using animals within a goal oriented setting to implement treatment, has been shown to significantly benefit cognitive, psychological, and social domains (Fine 2006). Studies also suggest that animal assisted therapy influences physiological factors such as lowered blood pressure, heart rate, and decreased anxiety levels (Morrison 2007). The current study attempted to build on existing animal research by examining the effects of therapeutic horseback riding on social functioning in children with autism spectrum disorder.

Therapeutic horseback riding, a subtype of animal assisted activities, has also been used to treat populations with physical and mental disabilities. Therapeutic horseback riding is defined as using horseback riding treatment to improve posture, balance, and mobility while developing a therapeutic bond between the patient and horse (All et al. 1999). Therapeutic horseback riding stimulates multiple domains of functioning and may be especially well-suited for children with neurological disorders who frequently present with a combination of motor, cognitive, and social disabilities.

Autism is a developmental disorder characterized by deficits in social, communication, and motor skill functioning (American Psychiatric Association 1994). The classic features of autism include lack of social awareness and communication, deficits in sensory integration, and an inability to initiate directed attention. Although there are a wide variety of treatment strategies, there is no consensus to date as to which treatment modality is most effective (Lord and McGee 2001, p. 42). It is possible that animal-assisted activities provide a multisensory environment that will prove beneficial to children with profound social and communication deficits. We propose that therapeutic horseback riding may be effective in improving social cognition in children with autism spectrum disorders.

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Equine Therapy in Developmentally Disabled Populations

With a few exceptions, the literature in this area is limited to case reports and descriptive studies. For example, Bizub et al. (2003) examined the effect of a therapeutic horseback riding program on five adults with longstanding histories of psychiatric disabilities. Three men and two women participated in a 10 weeks equine therapy program consisting of one session per week for 2 h. Each session was divided into three parts: bonding activities, mounting skills, and post-processing group activities. At the end of the intervention, participants showed higher levels of self-esteem, social engagement, and self-efficacy; however, no quantitative results were available.

Hippotherapy, which incorporates the horse as a part of the patient's plan of care, is administered by an occupational, speech pathologist, or physical therapist, has been used with language impaired children. Macauley and Guiterrez (2004) investigated the effect of animal-assisted therapy versus traditional therapy on three young boys with language learning disabilities. The hippotherapy intervention lasted for 6 weeks with each weekly session occurring for 1 h. Participants worked toward their individualized goals during the mounted sessions as a part of the intervention program. Each participant had specific goals that focused on increasing receptive and expressive language, reading, and writing skills. The participants' parents were questioned both pre- and post-intervention to evaluate whether hippotherapy had increased their children's language skills. Parents in the hippotherapy group reported an increase in their child's overall speech and language abilities. The results indicated that hippotherapy was more successful than traditional therapy in improving participants' self-concept.

Sterba et al. (2002) hypothesized that hippotherapy would significantly increase gross motor functioning in seventeen children with cerebral palsy with varying levels of gross motor functioning. The eighteen week intervention program consisted of weekly 1 h sessions. Five domains were assessed using the Gross Motor Function Measure: (a) lying and rolling, (b) sitting, (c) crawling and kneeling, (d) standing, and walking, running, and (e) jumping. The investigators reported hippotherapy significantly increased all domains of gross motor functioning.

Animal Assisted Therapy with Autism Spectrum Disorder

Other studies have examined the effects of animal assisted therapy in children with autism spectrum disorders. Martin and Farnum (2002) evaluated whether therapy that involved interacting with dogs would lead to an increase in social initiation among children diagnosed with pervasive developmental disorders. Participants were exposed to three different conditions: (a) a ball; (b) a stuffed dog; (c) a live dog. Ten participants were evaluated for prosocial and nonsocial behaviors. Prosocial behaviors were defined as laughing and engaging with the experimental object. Nonsocial behaviors included ignoring questions and hand flapping. During the 15 weeks intervention, children were exposed to all three conditions. Researchers found that participants in the live dog condition engaged in more initiating behavior. They were more likely to talk to the dog, keep a focused gaze, and engage the experimenter in discussion about the dog, compared to participants in either the stuffed dog or ball conditions.

Sams et al. (2006) investigated the effects of occupational therapy by incorporating animals versus standard occupational therapy techniques. They hypothesized that the animal integrated therapy would elicit more social interaction and language use. Their sample consisted of twenty-two children ranging in age from 7 to 13 years, all of whom had been diagnosed with autism spectrum disorder (ASD). Over the course of 15 weeks, participants took part in two weekly occupational therapy sessions, one with an animal present, and one without. Activities targeted sensory integration, language use, sensory skills, and motor skills. Researchers found that children engaged in significantly greater use of language and social interaction during the animal occupational therapy relative to the standard occupational therapy. The authors argued that the live-animal-therapy should be an established occupational intervention for children diagnosed with ASD.

The current study examined the effects of a 12 weeks therapeutic horseback riding intervention on social functioning in children with ASD. We hypothesized that children exposed to therapeutic riding exercises would exhibit improvements in social functioning compared to participants who did not receive the treatment.

Method

Participants

Thirty-four children diagnosed with ASD participated in the study at the Good Hope Equestrian Training Center in Homestead, Florida. Participants were recruited from the Agency of Persons with Disabilities and from the University of Miami's Center for Autism Related Disabilities. All participants met criteria for DSM-IV-TR (American Psychiatric Association 2000) autism spectrum diagnosis. Parents had to consent to pre-testing, 12 weeks of therapeutic horseback riding, and one post testing session.

Selected participants had no previous exposure to equine assisted activities.

Once participants had obtained medical approval from their doctors, they were randomly assigned to either the experimental or control group. The experimental group consisted of 2 girls and 17 boys ranging from 5 to 10 years of age ($M = 6.95$, SD = 1.67), while the wait-list control group was made up of 3 girls and 12 boys ranging from 4 to 10 years age ($M = 7.73$, SD = 1.65). Almost all participants had undergone conventional therapies (see Table 1). Participants received the intervention at no cost after they assented and parents signed consent forms. All pre-test measurements were given to parents in both the experimental and control group before the intervention sessions were initiated. Post-test assessment of both groups took place at the completion of the 12 weeks intervention.

Measures

The Social Responsiveness Scale (SRS) and Sensory Profile (SP) were used to assess social functioning at pre- and post-intervention.

Social Responsiveness Scale

The Social Responsiveness Scale (Constantino 2002) is a 65-item questionnaire that measures the severity of autism spectrum disorder symptoms. Raw scores may be computed for five treatment subscales: social awareness, social cognition, social communication, social motivation, and autistic mannerisms. According to the SRS manual, social awareness is operationally defined as the "ability to pick up on social cues;" social motivation is defined as "the extent to which a respondent is generally motivated to engage in social-interpersonal behavior;" and social cognition is defined as "expressive social communication" (Constantino 2002, p. 17). The measurement is administered to parents or teachers, who rate participants' on a 4-point Likert scale ranging from 0 (*never true*) to 3 (*almost always true*). Examples of questions include: "Seems much more fidgety in social situations than when alone" (social motivation subscale); "Doesn't recognize when others are trying to take advantage of him or her" (social cognition subscale); and "Doesn't seem to mind being out of step with or not on the same wavelength as others" [social awareness subscale] (Constantino 2002, p. 17).

The SRS has high overall internal consistency ($\alpha = .97$), and retest temporal stability in males and females ($r = .85$ and $r = .77$, respectively). Internal consistency for each treatment scale was also tested and yielded high Cronbach alpha scores, with social communication being the highest [$\alpha = .92$] (Constantino 2002).

Table 1 Diagnostic profiles for experimental and control participants

	Experimental $n = 19$	Control $n = 15$
Severity		
Verbal	9	6
Nonverbal	10	9
Diagnosis		
Asperger's	1	1
Mild	6	5
Moderate	10	6
Severe	2	3
Therapy		
None	8	3
Occupational therapy (OT)	6	5
OT/speech therapy (ST)	2	0
OT/ST/physical therapy (PT)	0	1
OT/PT	2	5
Speech only	1	1

Sensory Profile

The Sensory Profile (Dunn 1999) is a 125-item questionnaire that is administered to parents or teachers. The measurement uses a 5-point Likert scale ranging from 1 (*always*) to 5 (*never*). The questions address overall social functioning and the degree to which children exhibit problems in (a) sensory processing, (b) modulation, and (c) behavioral and emotional responses. The SP is composed of nine subscales: sensory seeking, emotionally reactive, low endurance/tone, oral sensory sensitivity, inattention/distractibility, poor registration, sensory sensitivity, sedentary, and fine motor/perception. We chose to focus on five of the nine subscales: fine motor/perception, sensory seeking, attention and distractibility, sensory sensitivity, and sedentary. These specific subscales were selected because they provided the best snapshot of an ASD profile. Internal consistency for the SP ranges from .47 to .91.

Procedure

The administrative staff at the Good Hope Equestrian Training Center (GHETC) was responsible for administering all informed consent forms. Each child in the treatment group received a therapeutic riding session for 1 h per week over the span of 12 weeks. Two sessions had to be rescheduled because of poor weather conditions. Although horse assignments were initially randomized, some adjustments were made based on the size and weight of the participant.

Therapeutic Horseback Riding Sessions

Mounting/Dismounting

The trained GHETC instructors assisted the subjects in mounting and dismounting their program horse. These processes were verbalized to participants using step-by-step instructions. The mounting/dismounting segment of the program lasted 5 min and was aimed at stimulating verbal communication, proprioception, and vestibular processing.

Exercises

After successfully mounting the horse, the subjects performed at least 10 min of warm-up exercises to stretch their bodies in preparation of the riding class. The participants routinely performed a series of the following exercises: arm circles (forward and backward), trunk twists, opposite toe touches and two-point. Through the direction of the riding instructors, the trained side walkers provided the riders verbal, modeling and/or physical prompts as needed to assist them in acquisition of these exercises. These exercises were designed to condition the participant for the physical demands of the intervention.

Riding Skills

The subjects participated in 15 min of riding skills each session, which were specifically designed to stimulate sensory seeking, as well as gross and fine motor domains. Participants were instructed to perform the following skills: direct rein, open guided rein, two-point, and use of proper riding aids (leg, seat, hand and voice), upward and downward transitions (halt/walk/trot, trot/walk/halt), as well as posting at the walk and trot. These activities were designed to target balance and coordination.

Once participants had learned to walk, trot, and halt on their horse, they were then asked to verbalize the command at the same time. For those participants who were non-verbal, the instructor and volunteers prompted participants to use basic sign language in order to indicate they understood the command, i.e., place hands side-by-side, palms down, and move each hand up and down to request the horse to walk forward. The participants also took part in a "two point pole" exercise where the participant were instructed to guide the horse over five poles placed on the ground while maintaining his or her position on the horse. This segment of the intervention sought to improve planning and spatial reasoning.

Mounted Games

The next segment of the therapeutic riding session lasted for approximately 20 min and focused on individualized and group games while on the horse. The games were led by the instructors and focused on social and communication skills. Examples of games included "Simon says," catch and throw, red light/green light, and letter games. These activities were selected because they targeted different aspects of verbal communication. "Simon says" promoted body coordination and gross motor development. Red light/green light sought to stimulate motor development as well as social communication between other participants, their peers, volunteers and the instructor. The letter games promoted social verbalization and also gave non-verbal participants the opportunity to expand their skills by working toward sounding out the letters. For the non-verbal participants, the instructor would place the participant's hand on their throat while saying each letter, so that they could feel the vibration of the sound. They would then say a word that began with that letter so that participants could simultaneously increase their vocabulary. Nonverbal participants were also encouraged to draw the letter in their air. These exercises sought to target participants' communication skills and gross/fine motor coordination.

Horsemanship Activities

During the last part of the horsemanship segment, participants took part in grooming activities. Children learned how to properly groom and care for their horse by learning to identify grooming tools (curry comb, hoof pick, body brush, mane/tail comb, face brush, etc.) and bathing tools (sponge, water, shampoo, bucket, sweat scraper, etc.). Participants were also taught which part of the horse was most closely associated with human anatomy (i.e., the hoof of a horse is like what human body part?). Participants were asked to verbally express or point to the analogous part.

Throughout each of the 1 h sessions, participants were verbally and physically reinforced (for example, with high-fives and hugs) upon completion of each exercise. Instructors and volunteers made efforts to maintain eye contact with all participants throughout the therapy session.

Post Session Questionnaire Follow-up

Following the 12 weeks intervention, parents in both groups completed all post-test measurements.

Data Analysis

A 2 × 2 mixed design repeated measure analysis of variance (ANOVA) was carried out to examine whether the treatment resulted in an increase in social functioning for the experimental group compared to the control group. Significant interactions were followed up with paired sample t tests. The degrees of freedom varied across the different subscales because there were missing responses to some of the subscales.

We used η^2 as a measure of the effect size in the analysis of variance. This statistic represents the proportion of variance in the dependent variable explained by the treatment. Following the paired t-tests we used d as a measure of effect size, representing the standardized increase from the pre test to post test.

Results

Means and standard deviations on all subscales administered pre- and post-intervention for the experimental and control groups are reported in Table 2. With respect to the Sensory Profile overall score, there was a statistically significant group x time interaction, $F(1, 31) = 10.98$, $p = .002$, $\eta^2 = .26$. As follow-up to the interaction, paired samples t tests revealed that the experimental group significantly increased between pre- and post-testing, $t(18) = -7.29$, $p < .01$, $d = -.059$, while the means of the control group only marginally increased, $t(13) = -1.77$, $p = .101$.

As a follow up to the significant difference in change on the total score, interactions between group and time were examined for each subscale separately. Interaction effects for four out of the five subscales were significant: sensory seeking, $F(1, 30) = 17.09$, $p < .01$, $\eta^2 = .40$, attention and distractibility, $F(1, 29) = 19.17$, $p < .01$, $\eta^2 = .40$; sensory sensitivity, $F(1, 31) = 31.01$, $p < .01$, $\eta^2 = .50$; and sedentary, $F(1, 31) = 18.59$, $p = < .01$, $\eta^2 = .375$. There was no significant interaction for the fine motor/perceptual subscale ($p > .05$).

Paired sample t-tests for the experimental group uncovered statistically significant treatment effects for the four subscales: sensory seeking, $t(18) = 4.85$, $p < .001$; inattention/distractibility, $t(17) = 5.19$, $p < .001$, sensory sensitivity $t(18) = 6.20$, $p < .001$; and sedentary, $t(18) = 4.93$, $p < .001$. Conversely, the control group did not exhibit significant change from pre to post on the same subscales: sensory seeking, $t(12) = 1.00$, $p = .337$; attention/distractibility, $t(12) = .001$, $p = 1.00$; sensory sensitivity, $t(13) = 1.47$, $p = .165$, and sedentary, $t(13) = 1.00$, $p = .336$.

A statistically significant group x time interaction was also present in the SRS overall score, $F(1, 20) = 4.92$, $p = .038$, $\eta^2 = .20$. As follow-up to the significant interaction, simple effects paired sample t tests uncovered that the experimental group means significantly increased, $t(10) = 2.87$, $p = .017$, $d = .66$, while the means for the control group remained unchanged, $t(10) = .108$, $p = .916$, $d = .02$.

Interactions between group and time were examined across all three subscales of the SRS. The interaction effect of the social motivation subscale was significant, $F(1, 25) = 4.80$, $p = .038$, $\eta^2 = 161$. No significant interactions were found in the social cognition and social awareness subscales.

Table 2 Means and standard deviations for the experimental and control groups

Subscale	Experimental $n = 19$				Control $n = 15$			
	Pre		Post		Pre		Post	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Sensory profile**	237.6	55.9	269.4	51.6	240.9	50.9	245.7	50.3
Sensory seeking**	58.4	10.6	62	9	53.9	10.9	53.2	10.5
Inattention/distractibility**	21	7.1	27	4.6	21.6	4.6	21.4	4.5
Sensory sensitivity**	15.7	3.6	17.2	2.6	16.1	4.6	15.7	4.8
Sedentary**	13.5	5	16	3.3	11.9	5.1	11.3	4.8
Fine motor/perception	8.9	3.5	9.4	3	8.6	2.9	8.7	3.1
Social response scale*	85.9	37.5	73.6	24.1	89.3	35.4	94.4	32.1
Social cognition	20.8	7.3	16.1	5.8	11.5	3.6	18.9	6.6
Social awareness	12.1	4.7	9.9	2.7	11.5	3.6	11.1	3.2
Social motivation*	17.3	7.1	12.5	5.9	18.2	7.1	16.2	6.7

** $p < 0.01$; * $p < 0.05$

As follow up to the significant interaction, two paired sample *t*-tests uncovered that change from pre-to-post was statistically significant for the experimental group, $t(13) = 3.93$, $p < .003$, but not for the control group, $t(12) = .284$, $p = .782$.

Discussion

The results of this study suggest that therapeutic horseback riding may be an efficacious therapeutic option for children with autism spectrum disorders. More specifically, compared to wait-listed participants in our control group, autistic children in the experimental group improved in critical areas such as sensory integration and directed attention. Participants also demonstrated improved social motivation and sensory sensitivity, as well as decreased inattention and distractibility.

The observed increase in social functioning may be attributed to a variety of factors. It is possible that exposure to the horse was simply stimulating. The multisensory nature of the therapeutic horseback riding argues that this experience may have been a very stimulating event that was directly associated either with the physical presence or natural movement of the horse. The act of riding the horse may have been perceived as a rewarding stimulus that accounted for higher levels of motivation and social engagement.

One of the classic indicators of autism is the child's fixation with object-oriented, rigid routines. The treatment effect on the sedentary subscale of the SP, defined as the ability to break away from one's sedentary routine in favor of active activities, was significant. It is possible that these results were obtained because interaction with a horse demands a high level of active and physical engagement. The kinesthetic stimulation that is provided by horseback riding is unique compared to generic forms of physical therapy. It is also possible that the horse, a perceived novel stimulus, may have encouraged participants to break away from their previous sedentary routines.

Overall, participants demonstrated a sustained level of directed attention and focus that is not usually seen in children with autism spectrum disorders. It is possible that that the highly structured intervention captivated their attention and elicited a sustained level of focus. Participants were instructed to listen to directions, verbalize commands to their horse, and identify shapes and horse anatomy. This required participants to engage actively and maintain a direct level of involvement.

Although significant results were found in five out of the eight domains, the treatment effects on three subscales were not significant: fine motor/perceptual, social cognition, and social awareness. Therapeutic activities were primarily directed toward sensory stimulation and did not emphasize fine motor and perceptual skills. Also, the intervention lasted only 12 weeks. It is possible that if the therapeutic horseback riding sessions had lasted for a longer period of time, these domains may have been influenced. This is a plausible hypothesis because the social motivation subscale was significant.

There is general agreement that the cause of autism is multifactorial. Once believed to be psychogenic in origin, new research has focused on possible neurobiological links (Keller and Persico 2003). Although a variety of neuroanatomical structures have been proposed, cerebellar abnormalities have been consistently identified as a hallmark feature (Pierce and Courchesne 2001). Courchesne et al. (1988) reported that in 95% of postmortem autism cases the cerebellum was malformed. Autopsy studies reveal Purkinje and granule cell loss and hypoplasia of the posterior cerebellar vermis and hemispheres.

It is well-documented that the cerebellum is primarily involved in motor control and locomotion. The cerebellum also has reciprocal pathways with the visual, auditory, and somatosensory cortices (Zhua et al. 2006). More recently, the cerebellum has also been implicated in social, cognitive, and emotional functions (Bauman and Kemper 2005). Shih et al. (2008) showed that the cerebellum plays a critical role in sensory acquisition and discrimination.

Cerebellar abnormalities may be a significant factor in explaining the externalizing symptomology of autism. Levisohn et al. (2000) reported a case in which classic features of autism were observed following the removal of a cerebellar tumor (i.e., gaze aversion, social withdrawal, and stereotyped movements). Schmahmann and Sherman (1998) investigated the effect of cerebellar abnormalities in twenty patients and found that patients with prominent lesions on the posterior lobe of the cerebellum and the vermis had more pronounced changes in executive functions such as verbal fluency and other changes in personality. Schmahmann and Sherman proposed the "cerebellar cognitive affective syndrome," characterized by (a) disturbances in cognitive function, (b) impaired spatial cognition and visiospatial memory, (c) personality changes such as flat affect and inappropriate social behavior, and (d) language difficulties.

Although there is not an extensive literature on cerebellar abnormalities, these studies are compelling. Our findings are compatible with the view that the cerebellum plays a critical role in both motor and social domains. It is possible that therapeutic horseback riding, an activity that demands motor learning skills, motor control, and social engagement, is linked to cerebellar functioning. Although no measurements were used to directly ascertain the degree of cerebellar involvement, the literature reviewed above lends support to this interpretation. Therefore, it is reasonable to suggest that the significant treatment effects found in the social motivation, sedentary behaviors, and sensory seeking subscales may be, in part, attributed to cerebellar stimulation.

There were several limitations to this study. Most noticeably, there was no information about medication regimens. We do not know how many children were on medication, and if so, what kind and/or how much medication they were receiving throughout the intervention. It was also unknown if parents of participants in either the experimental and control groups were taking part in any therapy or self-help classes. As a result, we could not control for these variables which may have acted as potential confounds. The lack of additional data makes it difficult to ascertain if the results can be explained by the horseback riding intervention or if other extraneous variables were involved. Although this experiment was a pilot study, our attrition rate was another limiting factor. Six participants dropped out of the experimental group and three from the control group. This was believed to be due to the lack of incentive for participation and the location of the intervention site, as the GHETC is in a rural area on Miami-Dade County.

Future studies should increase the length and number of sessions in order to test whether a more intense form of treatment would result in greater improvement in social functioning. A more comprehensive assessment would be beneficial in understanding how treatment is directly affecting specific domains of social functioning.

This study is the first of its kind to evaluate and quantify the impact of horseback riding on social functioning. Our results indicate that therapeutic horseback riding may be a beneficial intervention for children with autism spectrum disorder. Future studies are needed to further assess its therapeutic effects.

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