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## The effect of equine assisted therapy in children with autism spectrum disorders

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## **Abstract**

**Objective:** To evaluate the effect of equine assisted therapy (EAT) in children with autism spectrum disorders (ASDs).

**Design:** Prospective single-blinded clinical trial.

**Setting/location:** SpiritHorse Therapeutic Riding Center, Corinth, Texas.

**Methods:** Sixty children ranging from 2 to 14 years of age with a diagnosis of ASD participated in this study. During 10 weeks, all patients received EAT once weekly. The Childhood Autism Rating Scale (CARS) was conducted pre- and post-treatment to establish overall change in ASD severity. The Autism Treatment Evaluation Checklist (ATEC) was completed pre-, mid-, and post-treatment for assessing both overall change in ASD severity and the effects on specific areas of functioning (communication, sociability, sensory/cognitive awareness, and physical behavior).

**Results:** After 10 weeks of EAT, a significant improvement in ASD severity was observed.

Improvements in ASD severity were larger for patients who received more EAT lessons and for patients with milder forms of ASDs prior to therapy. Effects on the specific areas of functioning were all significant, with the largest effects on sociability and sensory/cognitive awareness.

**Conclusions:** EAT may be an effective treatment for children with ASDs.

## Introduction

Autism spectrum disorder (ASD) is defined by the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision (DSM-IV-TR) as a cluster of neurodevelopmental disorders. In the present study ASD refers to autistic disorder, Asperger syndrome and pervasive developmental disorder not otherwise specified (PDD-NOS). These disorders are characterized by abnormalities in social interactions, verbal and nonverbal communication and restricted, repetitive and stereotyped patterns of behavior, interests and activities (American Psychiatric Association, 2000).

In 2006, the Centers for Disease Control assessed the ASD prevalence in the US to be 9.0 per 1.000 children aged eight years. The risk is estimated to be 4.5 times higher in males than in females (Rice, 2009). According to this survey the prevalence of ASD is much higher than 20-30 years before. However, due to changes in diagnostic criteria and improved recognition of ASD, this rate may not represent the true increase in the prevalence of ASD. Nevertheless, more children than ever have been diagnosed with ASD (Centers for Disease Control and Prevention<sup>1</sup>; Chakrabarti & Fombonne, 2005; Fombonne, 1999; Nassar et al., 2009; Rice, 2009; Strock, 2008). By current standards ASDs are the second most common serious developmental disabilities after mental retardation (Centers for Disease Control and Prevention<sup>1</sup>).

Over the last few decades a variety of therapies has been proposed to improve the symptoms associated with ASD. Current treatments include occupational therapy, speech and language therapy and behavioral and developmental approaches. Today, one of the most widely accepted effective treatments is applied behavior analysis (ABA) (Lilienfeld, 2005; Strock, 2008). ABA is a therapy method that focuses on positively reinforcing and shaping appropriate behaviors by dividing tasks into small discrete steps and training them in a systematic and precise way (Lilienfeld, 2005; Lovaas et al., 1981, in: Spreckley & Boyd, 2009). However, currently there is no consensus as to which therapy method is most effective (Ospina et al., 2008).

A therapy that is gaining interest in health care is animal assisted therapy (AAT). Animal assisted therapy uses the human-animal bond in the accomplishment of psychosocial goals as an integral part of the treatment process (Gammonley et al., 1996, in: Bizub et al., 2003). Several

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<sup>1</sup> Source: <http://www.cdc.gov/ncbddd/autism/documents/AutismCommunityReport.pdf>, Date 5/ 20/ 2010.

studies showed positive outcomes for AAT in children with ASDs. Martin and Farnum (2002) investigated the effects of interaction with dogs in children with ASDs. Participants were exposed to 3 different conditions: (a) a nonsocial toy (i.e. a ball); (b) a stuffed dog; (c) a live dog. Results demonstrate that, compared to the other conditions, the participants in the live dog situation engaged in more initiating behavior. Participants were more likely to talk to the dog and therapist, had a happier and more playful mood and were more focused and more aware of their social environments. Sams et al. (2006) found that children with autism exhibited a significant greater language use and social interaction when receiving occupational therapy incorporating animals than when they received occupational therapy with standard techniques.

In conclusion, there is evidence that the incorporation of animals in therapy has positive effects on the social functioning of children with ASDs (Bass et al., 2009; Martin & Farnum, 2002; Sams et al., 2006). This finding may be explained by the fact that children who generally show physical and emotional closeness accept a close relationship with an animal more often (Karol, 2007; Rothe et al., 2005). Furthermore, children may expand the relationship that they develop with the animal to humans (Karol, 2007; Katcher, 2000, in: Martin & Farnum, 2002). In summary, animals are believed to enhance the relationship between children with ASDs and their social environments (Martin & Farnum, 2002; Sams et al., 2006), which may result in an improvement in their social functioning.

A subtype of AAT is equine assisted therapy (EAT). EAT is a collective term for all types of therapeutic activities using horses and has as its main goal to use riding as a tool in a therapeutic process (Hakanson et al., 2009; Rothe et al., 2005). Positive effects of EAT have been found on symptoms of cerebral palsy, multiple sclerosis and spinal cord injury. In children with cerebral palsy improvements in posture, gross motor function, functional motor performance and muscle symmetry have been found (Benda et al., 2003; Bertoti, 1988; Casady et al., 2004; Sterba et al., 2002). Silkwood-Sherer and Warmbier (2007) documented a significant decrease in postural instability in individuals with multiple sclerosis. EAT also reduced spasticity of lower extremities in children with spinal cord injury (Lechner et al., 2003; Lechner et al., 2007).

Although the effects of EAT on physical disabilities are well-documented, there is less evidence of its effects on psychiatric disorders. Nevertheless, EAT being a subtype of AAT, it might be hypothesized that EAT has comparable psychosocial effects in children with ASDs. In

addition, EAT is believed to offer several advantages over other AATs in the treatment of children with ASDs. Firstly, the act of riding the horse has the benefit of engaging and motivating the child (Bass et al., 2009; Benda et al., 2003; Rothe et al., 2005). Secondly, as theories of neural functioning in autism are highlighting functional underconnectivity (a lower degree of synchronization) as a general characteristic of the pathophysiology (Castelli et al., 2002; Just et al., 2004; Just et al., 2007; Minshew et al., 2007; Wicker et al., 2008), it has been suggested that some aspects of EAT might result in reversing this underconnectivity. The act of riding a horse entails continuous postural challenges to the rider through movements induced by the horse (Hakanson et al., 2009) and requires bilateral coordination. Although not reported in research, an improvement in bilateral coordination is thought to stimulate the development of new neural connections between the hemispheres. Finally, it is hypothesized that exercise reduces levels of stress hormones that can interfere with brain development (Autism Coach Intervention Protocol for Autism<sup>2</sup>).

Despite a substantial body of case reports and descriptive studies on the benefits of EAT in children with ASDs, research evidence is sparse. Recently, Bass et al. (2009) studied the effect of therapeutic horse riding on social functioning in children with ASDs. Compared to the participants in the waiting-list control group, participants in the experimental group showed greater improvements in sensory integration, directed attention, social motivation and sensory sensitivity, as well as less inattention and distractibility. In conclusion, EAT could be a relevant treatment for children with ASDs.

The purpose of the present study was to examine the efficacy of an EAT program in children with ASDs in order to contribute to current evidence on its effects. Both overall effect on ASD symptomatology and effects on specific areas of functioning (communication, sociability, sensory/cognitive awareness and physical behavior) were evaluated. We hypothesized that the participants would display less autistic behavior after 10 weeks of EAT. Furthermore, if EAT appeared to be an effective treatment, we expected that, based on research evidence, EAT would mainly have positive effects on social functioning,

## Methods

### Participants

Sixty-eight patients diagnosed with ASD participated in this study. Criteria for inclusion were: (1) having a primary diagnosis of ASD confirmed by formal evaluation, (2)  $\leq 17$  years of age, (3)  $\leq 3$  years experience with equine assisted therapy (4) seeking treatment at SpiritHorse Therapeutic Riding Center (Corinth, Texas), (5) having a Childhood Autism Rating Scale (CARS) score of  $\geq 30$ . An individual with a CARS score of  $\geq 30$  is considered as autistic (Schopler et al., 1988). Because of the limited number of patients without previous exposure to equine assisted activities, patients with 3 or less years of experience with EAT were also included in order to increase the reliability of study results.

Patients who received any new form of therapy or changed medication during, or one month prior to this study were excluded from participation. Patients were also excluded if physical disorders restricted them in riding the horse or if they received less than 8 EAT lessons.

Parents of all potentially eligible participants received a letter informing them about the study and inviting them for the participation of their child. Parents were informed about the procedure and the goal of the study and signed an informed consent.

### Measures

#### *Childhood Autism Rating Scale*

The Childhood Autism Rating Scale (Schopler et al., 1980) is a 15-item behavioral rating scale that can be used to administer the severity of the disorder. The scores on the CARS range from 15 to 60, whereas individuals with scores lower than 30 are categorized as non-autistic. A CARS score between 30 and 36.5 indicates mild to moderate autism and scores ranging from 37 to 60 indicate severe autism.

The CARS has a high internal consistency ( $\alpha = 0.94$ ), a good test-retest reliability ( $\alpha = 0.88$ ) as well as a good interrater reliability ( $\alpha = 0.71$ ) (Schopler et al., 1988).

In this study, the CARS was used as the primary outcome measure. Patients were scored on the CARS at baseline and after 10 weeks of therapy. The CARS was conducted at the patient's homes by skilled observers who were not informed about the research procedures. All observers were licensed to conduct the CARS and were experienced with CARS observations.

### *Autism Treatment Evaluation Checklist*

The Autism Treatment Evaluation Checklist (ATEC) (Autism Research Institute<sup>2</sup>, 1999) is a questionnaire specifically developed to measure treatment effects in individuals with ASDs. The questionnaire consists of 4 subscales: 1. speech/language/communication (14 items) 2. sociability (20 items) 3. sensory/cognitive awareness (18 items) and 4. health/physical behavior (25 items). The ATEC total score ranges from 0 to 179 with a maximum score on the subscales of 28 (speech/language/communication), 40 (sociability), 36 (sensory/cognitive awareness), and 75 (health/physical behavior). The higher the subscale and total scores, the more impaired the patient.

The internal consistency of the ATEC is high ( $\alpha=0.94$ ) as well as the internal consistencies of the subscales (speech/language:  $\alpha=0.92$ , sociability:  $\alpha=0.84$ , sensory/cognitive awareness:  $\alpha=0.88$ , health/physical behavior:  $\alpha=0.82$ ) (Autism Research Institute<sup>2</sup>). No information is available about the test-retest reliability or interrater reliability.

The ATEC is designed to be completed by parents or caretakers and was conducted at baseline, after 5 weeks of therapy and after 10 weeks of therapy by the same parent/guardian.

### The therapy program

#### *SpiritHorse therapeutic riding program*

SpiritHorse Therapeutic Riding Center operates during two 10-week therapy periods per year. The therapy program is research-based and very different from the recreational therapy provided by the remainder of the industry. The therapy program consists of a pre-program and 76 therapy steps which include different kinds of EAT activities. During the pre-program the patient may gradually become comfortable with the horse by leading, grooming, tacking up and mounting the horse. The main goal of the pre-program is to allow the patient to bond with the horse, learn to complete sequential tasks, and build confidence. The length of the pre-program depends on the patient's reaction to the horse.

Patients may start with the 76 steps of the therapy program when their fear for the horse has diminished. In this part of the program the patients are gradually taught to ride a horse. In every step of the therapy program, the patient is challenged to accomplish postural exercises in

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<sup>2</sup> Source: [http://www.autism.com/ind\\_atec\\_report.asp](http://www.autism.com/ind_atec_report.asp), Date: 5/20/2010.

order to increase their bilateral coordination. Specific methods based upon research from universities and medical schools are woven into the steps. The patient is only allowed to move on to the next step when he or she has fully mastered the previous step. In every new therapy period, the last 5 mastered steps of the previous period are repeated.

Each therapy lesson is highly structured and starts with leading, grooming and tacking up the horse and ends with tacking off and brushing the horse. The parents/guardians are intensively involved in the therapy and work together with the therapist to achieve the child's full participation.

#### *Frequency of therapy*

During 10 weeks, the patients received individual therapy once weekly. The duration of each therapy was one hour.

#### *Therapists*

All therapists completed a full-time 5-week training course in order to master the SpiritHorse therapy methods. All therapists had at least ½ year experience with EAT (range 0.5-7 years).

#### Statistical analysis

SPSS 17.0 statistical software was used for data analyses. Between-group differences on baseline CARS were analyzed by independent samples t-tests or one-way analysis of variance (ANOVA). Within-group differences on the CARS were analyzed by a paired-samples t-test. To test if other variables (age, gender, type of ASD, ASD severity, years of EAT experience, number of EAT lessons during this study and concurrent therapies) affected treatment outcome, a multiple linear regression analysis was performed.

The total ATEC and the ATEC subscales were also examined on between-group differences at baseline. As between-group differences on baseline total ATEC were observed for patients with different types of ASDs, a 3x3 mixed-model ANOVA with a between factor 'type of ASD' and a within factor 'time' was utilized to ascertain interaction and main effects. Between-group analysis revealed differences between boys and girls on the subscale communication. For this reason, within-group differences were analyzed using a 2x3 ANOVA with a between factor 'gender' and a within factor 'time'. To examine within-group differences

on the subscales sociability, sensory/cognitive awareness and physical behavior, a repeated-measures ANOVA was performed.

Treatment effects were analyzed two-tailed with a significance level of  $p < 0.05$ . Effect sizes were reported for both outcome measures in terms of Cohen's  $d$ . Minimal change for a clinically significant improvement was computed for both outcome measures. Clinical significance was calculated using the reliable change index, as proposed by Jacobson et al. (1984, in: Jacobson & Truax, 1991).

## Results

Sixty-eight patients with ASD participated in this study. One patient dropped out and 7 patients were excluded from statistical analysis for the following reasons: receiving less than 8 EAT lessons (n= 3) or changing medication or concurrent therapy during present study (n= 4). Of the 60 patients (female/male= 11/49; age=  $7.0 \pm 3.0$  years, range= 2-14) who completed the study, 47 patients received at least one concurrent therapy (applied behavior analysis, speech therapy or occupational therapy). Thirty-eight patients were diagnosed with autistic disorder, 10 patients with Asperger syndrome and 12 patients with PDD-NOS. Before participating in this study, the mean experience with EAT was 1.1 year (SD= 1.1, range= 0-3). The mean number of EAT lessons was 9.2 (SD= 1.0, range= 8-10). The main demographics and clinical characteristics of the patients are presented in table 1.

**Table 1. Demographics and clinical characteristics**

	[n=60, mean $\pm$ SD (range)]
Age (years)	$7.0 \pm 3.0$ (2-14)
Gender ratio (f/m)	11/49
Type of ASD	Autistic disorder (n=38), Asperger syndrome (n=10), PDD-NOS (n=12)
EAT experience (years)	$1.1 \pm 1.1$ (0-3)
Number of EAT lessons	$9.2 \pm 1.0$ (8-10)
Patients receiving concurrent therapies*	n= 47

Abbreviations: ASD, autism spectrum disorder; PDD-NOS, pervasive developmental disorder - not otherwise specified; EAT, equine assisted therapy

\*Concurrent therapies are: applied behavior analysis, speech therapy, occupational therapy; either alone or combined

### Childhood Autism Rating Scale (CARS)

The baseline CARS scores ranged from 30.5 to 53.5 with a mean score of 38.0 (SD= 4.4). Twenty-five patients fell within the range of mildly to moderately autistic and 35 patients fell within the severely autistic range. A boxplot analysis revealed one outlier at baseline (CARS= 53.5, autistic disorder, boy). This patient was excluded from statistical analysis.

Between-group differences on baseline CARS were analyzed. Baseline CARS scores did not differ between boys and girls (resp.  $37.8 \pm 4.4$  and  $39.0 \pm 4.6$ ;  $t = -0.83$ ,  $p = 0.41$ ), between patients with or without concurrent therapies (resp.  $37.7 \pm 4.2$  and  $39.3 \pm 5.1$ ;  $t = -1.14$ ,  $p = 0.26$ ) and between patients with different types of ASDs ( $F(2,56) = 2.58$ ,  $p = 0.09$ ). The mean scores of patients with autistic disorder, Asperger syndrome and PDD-NOS were respectively 39.0 (SD= 4.6), 35.9 (SD= 3.8) and 37.0 (SD= 3.7).

From pre- to post-treatment a mean decrease of 2.3 points in CARS score was found ( $t = 10.6$ ,  $p = 0.00$ ,  $d = 0.46$ ). Necessary changes in CARS score corresponding with a small, medium and large effect size, were 1.00, 2.51, and 4.01, respectively. At post-treatment, 9 patients were categorized as being non-autistic, 27 patients as being mildly to moderately autistic and 23 patients as being severely autistic. Reliable change was reached with a decrease of at least 4.5 points on the CARS and 9 patients (15.3%) reached this clinically significant improvement. The mean pre- and post-test scores, effect size and clinical significance of the CARS are presented in table 2. Seven of the 9 clinically significant improved patients moved to a different category on the CARS; 4 patients moved from ‘severely autistic’ to ‘mildly/moderately autistic’ and 3 patients from ‘mildly/moderately autistic’ to ‘non-autistic’. The pre- and post CARS scores of the patients with clinically significant improvement are illustrated in figure 1.

**Table 2. Pre- and post- test scores, effect size and clinical significance of the CARS (n=59)**

<b>Baseline</b> <b>[mean <math>\pm</math> SD (range)]</b>	<b>10 weeks</b>	<b>p-value</b>	<b>Effect size</b>	<b>Minimal change for clinically significant improvement (points)</b>	<b>Clinically significant improved (n)</b>
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CARS	38.0 ± 4.4 (30.5-50.0)	35.7 ± 5.6 (26-50.5)	0.00	0.46	4.5	9
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Abbreviation: CARS, childhood autism rating scale

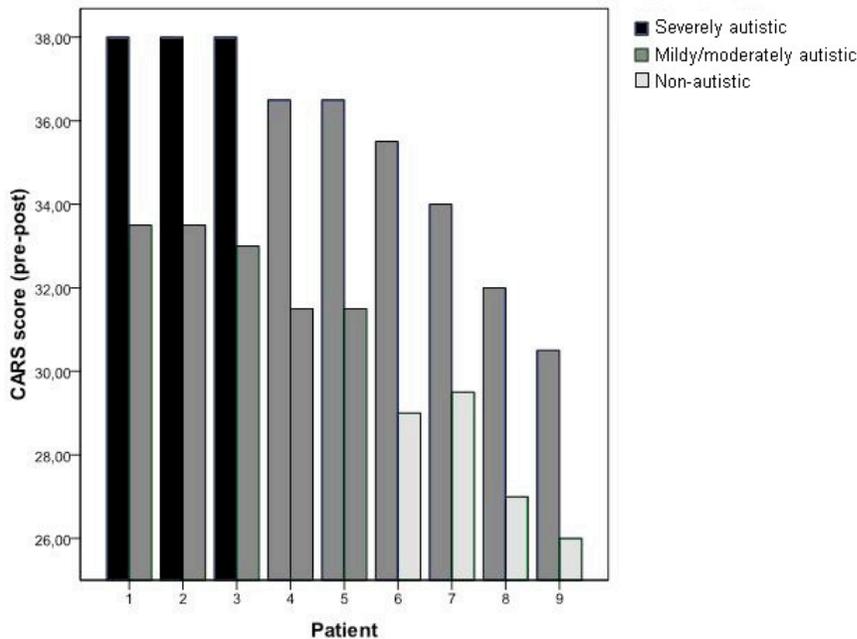


Figure 1. Pre and post CARS scores of patients with clinically significant improvement

There were no differences in mean CARS improvement between boys and girls ( $t= 0.89$ ,  $p= 0.38$ ), between patients with or without concurrent therapies ( $t= -0.05$ ,  $p=0.96$ ) and between patients with different types of ASDs ( $F(2,56)= 2.52$ ,  $p= 0.09$ ). Age and years of EAT experience were not correlated with mean CARS improvement (resp.  $r= -0.08$ ,  $p= 0.56$  and  $r= -0.01$ ,  $p= 0.92$ ). However, there were significant correlations for the number of EAT lessons ( $r= 0.48$ ,  $p= 0.00$ ) and CARS score at baseline ( $r= -0.58$ ,  $p= 0.00$ ). The number of EAT lessons was positively correlated with mean CARS improvement, indicating that receiving more lessons resulted in a larger decrease in CARS score. Baseline CARS score was negatively correlated with the mean improvement on the CARS, meaning that more severely autistic patients benefitted less from EAT. Baseline CARS score explained a larger amount of variance in mean CARS improvement than the number of EAT lessons (resp.  $\beta= -0.48$  and  $\beta= 0.30$ ) (table 3).

A forward multiple linear regression analysis with the variables ‘number of EAT lessons’ and ‘CARS score at baseline’ was performed to predict the mean improvement on the CARS. These variables accounted for 42.2% of the variance in mean CARS improvement ( $F(2,56) = 20.4, p=0.00$ ) (table 3).

**Table 3. Forward multiple linear regression analysis of factors correlated with mean CARS improvement**

Model	Variables	% Explained variance	Unstandardized coefficient		Standardized coefficients ( $\beta$ )	t	p-value
			B	Std. error			
1	Baseline CARS score	34.1	-0.22	0.04	-0.58	-5.43	0.00
2	Baseline CARS score	42.2	-0.18	0.04	-0.48	-4.46	0.00
	Number of EAT lessons		0.65	0.23	0.30	2.80	0.01

Abbreviations: CARS, childhood autism rating scale; EAT, equine assisted therapy

### Autism Treatment Evaluation Checklist (ATEC)

#### Total ATEC

The mean total ATEC score at baseline was 62.2 (SD= 22.4) and varied between 21 and 119.

There were no between-group differences on baseline total ATEC for boys and girls (resp.  $60.0 \pm 21.6$  and  $71.7 \pm 24.5$ ;  $t = -1.58, p = 0.12$ ) and for patients with or without concurrent therapies (resp.  $62.1 \pm 21.2$  and  $62.5 \pm 27.5$ ;  $t = -0.05, p = 0.96$ ). However, differences at baseline were observed for patients with different types of ASDs ( $F(2,56) = 3.89, p = 0.03$ ). Patients with autistic disorder and PDD-NOS (resp.  $64.8 \pm 22.1$  and  $68.3 \pm 17.7$ ) scored higher on the total ATEC than patients with Asperger syndrome ( $45.3 \pm 22.2$ ) (resp.  $p = 0.04$  and  $p = 0.045$ ).

Analysis of the subscales of the ATEC showed baseline differences for patients with different types of ASDs on the subscales communication ( $F(2,56) = 11.35, p = 0.00$ ) and sensory/cognitive awareness ( $F(2,56) = 3.98, p = 0.02$ ). Scores on the subscale communication showed that patients with autistic disorder and PDD-NOS (resp.  $11.9 \pm 6.5$  and  $10.8 \pm 6.0$ ) were more impaired in communication than patients with Asperger syndrome ( $1.8 \pm 3.3$ ) (resp.  $p = 0.00$  and  $p = 0.00$ ). On the subscale sensory/cognitive awareness, patients with autistic disorder ( $16.0 \pm 6.7$ ) had significantly higher scores than patients with Asperger syndrome ( $9.5 \pm 6.7$ ) ( $p = 0.03$ ). Baseline

scores and between-group differences of the total ATEC and the four subscales are presented in table 4.

**Table 4. Baseline scores and between-group differences of total ATEC and subscales**

	[n=59, mean ± SD (range)]		
	Autistic disorder (n=37)	Asperger syndrome (n=10)	PDD-NOS (n=12)
Total ATEC	64.81± 22.15 (24-119) <sup>a</sup>	45.30±22.20 (21-94) <sup>b</sup>	68.25±17.69 (46-93) <sup>a</sup>
Subscale communication	11.89 ±6.50 (0-24) <sup>a</sup>	1.80±3.29 (0-10) <sup>b</sup>	10.83±6.03 (3-23) <sup>a</sup>
Subscale sociability	15.54±5.67 (2-26) <sup>a</sup>	12.10±5.20 (7-22) <sup>a</sup>	15.50±5.99 (4-23) <sup>a</sup>
Subscale sensory/cognitive awareness	16.00±7.18 (4-38) <sup>a</sup>	9.50±6.74 (1-18) <sup>b</sup>	16.25±4.85 (9-24) <sup>ab</sup>
Subscale physical behavior	21.38±11.13 (4-57) <sup>a</sup>	21.90±10.58 (9-46) <sup>a</sup>	25.67±9.74 (13-39) <sup>a</sup>

Abbreviations: PDD-NOS, pervasive developmental disorder - not otherwise specified; ATEC, autism treatment evaluation checklist. Different superscripts indicate between-group differences.

A 3x3 mixed-model ANOVA with a between factor ‘type of ASD’ and a within factor ‘time’ was performed to obtain interaction and main effects. As Mauchly’s test indicated that the assumption of sphericity had been violated ( $\chi^2(5) = 15.36, p = 0.00$ ), the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ( $\epsilon = 0.80$ ). The results showed no interaction between ‘type of ASD’ and ‘time’ ( $F(3.22, 170.45) = 1.93, p = 0.13$ ). The main effects ‘type of ASD’ and ‘time’ were both significant (resp.  $F(2,56) = 4.28, p = 0.02$  and  $F(1.61, 90.05) = 112.11, p = 0.00$ ). The mean total ATEC scores at pre- mid- and post- test for the three types of ASDs are illustrated in figure 2.

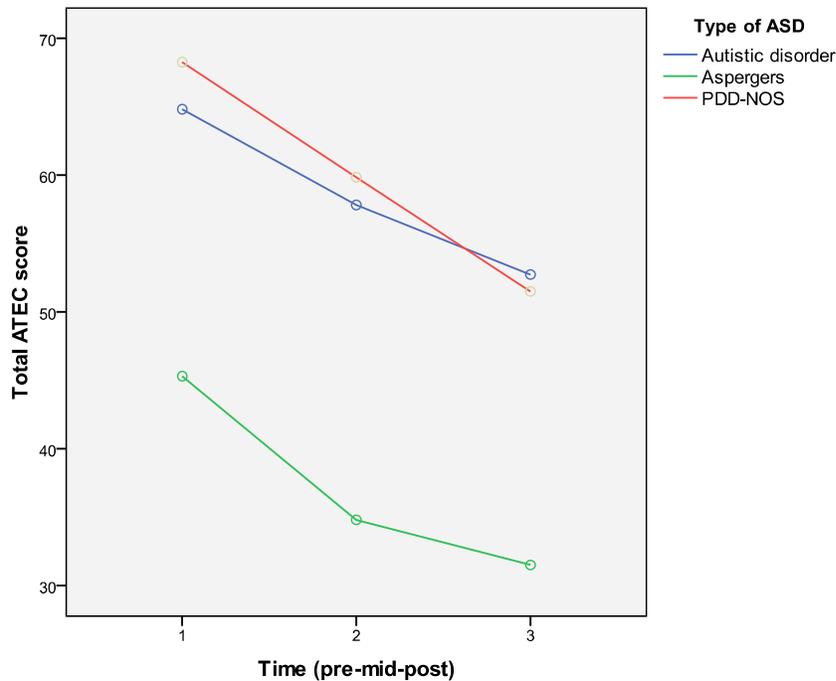


Figure 2. Mean total ATEC scores for the types of ASDs at pre-, mid- and post-test

At mid-test, differences on the total ATEC were observed between patients with autistic disorder or PDD-NOS (resp.  $57.8 \pm 21.9$  and  $59.8 \pm 20.2$ ) and patients with Asperger syndrome ( $34.8 \pm 23.2$ ) (resp.  $p = 0.01$  and  $p = 0.03$ ). At post-test there were between-group differences on the total ATEC for patients with autistic disorder and patients with Asperger syndrome (resp.  $52.7 \pm 22.2$  and  $31.5 \pm 22.6$ ;  $p = 0.03$ ).

Total ATEC score decreased between pre- and mid-test and between mid- and post-test (resp.  $p = 0.00$  and  $p = 0.00$ ). The overall decrease in total ATEC score was 13.3 points ( $d = 0.59$ ). Necessary changes on total ATEC corresponding with a small, medium and large effect size, are presented in table 5. Seventeen patients (28.8%) reached a clinically significant improvement with a decrease of at least 16 points in total ATEC score (table 6).

## Subscales of the ATEC

Patients with a baseline score of 0 on a subscale were excluded from further statistical analysis of that subscale. For this reason, 7 patients (1 autistic disorder, 6 Asperger syndrome) were excluded from the subscale communication, leaving 52 patients for the analysis of this subscale. A boxplot analysis revealed one outlier on the subscales sensory/cognitive awareness and physical behavior. The outlier was removed from both subscales and further statistical analysis of these subscales was performed with the remaining 58 patients.

Mean baseline scores on the subscales are presented in table 6. No subscale showed differences at baseline between patients with different types of ASDs ( $p > 0.05$ ) and between patients with or without concurrent therapies ( $p > 0.05$ ). Baseline differences were observed between boys and girls on the subscale communication (resp.  $10.5 \pm 5.9$  and  $15.8 \pm 7.0$ ;  $t = -2.25$ ,  $p = 0.03$ ). A 2x3 mixed-model ANOVA with a between factor 'gender' and a within factor 'time', showed no interaction between 'gender' and 'time' after correction with Greenhouse-Geisser ( $\epsilon = 0.77$ ) for violation of sphericity ( $F(1.47, 68.95) = 1.15$ ,  $p = 0.31$ ). The main effects 'gender' and 'time' were both significant (resp.  $F(1, 50) = 4.70$ ,  $p = 0.04$  and  $F(1.47, 73.33) = 29.40$ ,  $p = 0.00$ ).

On all four subscales, scores decreased between pre- and mid-test ( $p < 0.05$ ) and between mid- and post-test ( $p < 0.05$ ) (table 6). The change in score on the subscales communication and physical behavior reached a small effect size (resp.  $d = 0.28$ ,  $d = 0.36$ ). On the subscale sensory/cognitive awareness a medium effect size was found ( $d = 0.54$ ) and a large effect size was observed on the subscale sociability ( $d = 0.80$ ). Necessary changes in ATEC subscale scores corresponding with a small, medium and large effect size, are reported in table 5. Two patients (3.8%) reached a clinically significant improvement on the subscale communication ( $> 5$  points), 20 patients (33.9%) on the subscale sociability ( $> 6$  points), 8 patients (13.8%) on the subscale sensory/cognitive awareness ( $> 7$  points) and 2 patients (3.4%) on the subscale physical behavior ( $> 12$  points). For each subscale, effect size and clinical significance are presented in table 6.

**Table 5. Changes on the total ATEC and subscales corresponding with a small, medium and large effect size**

<b>Effect size</b>	<b>Total ATEC (points)</b>	<b>Subscale communication (points)</b>	<b>Subscale sociability (points)</b>	<b>Subscale sensory/cognitive awareness (points)</b>	<b>Subscale physical behavior (points)</b>
Small (0.2)	4.56	1.28	1.10	1.32	1.99
Medium (0.5)	11.39	3.22	2.73	3.31	4.98
Large (0.8)	18.22	5.15	4.37	5.30	7.97

Abbreviation: ATEC, autism treatment evaluation checklist

**Table 6. Pre-, mid- and post-test scores, effect size and clinical significance of the total ATEC and subscales**

	<b>Baseline</b>	<b>5 weeks</b>	<b>10 weeks</b>	<b>p-value</b>	<b>Effect size</b>	<b>Minimal change for clinically significant improvement (points)</b>	<b>Clinically significant improved (n)</b>
	<b>[mean ± SD (range)]</b>						
Total ATEC (n=59)	62.2 ± 22.4 (21-119)	54.3 ± 23.2 (10-118)	48.9 ± 22.8 (8-118)	Resp. 0.00 and 0.00	0.59	16	17
Subscale communication (n= 52)	11.3 ± 6.3 (1-24)	10.4 ± 6.5 (0-23)	9.5 ± 6.6 (0-23)	Resp. 0.00 and 0.00	0.28	5	2
Subscale sociability (n= 59)	15.0 ± 5.7 (2-26)	12.3 ± 6.0 (1-25)	10.6 ± 5.2 (1-20)	Resp. 0.00 and 0.00	0.80	6	20
Subscale sensory/ cognitive awareness (n=58)	14.6 ± 6.4 (1-28)	12.6 ± 6.7 (0-28)	11.0 ± 6.7 (0-28)	Resp. 0.00 and 0.00	0.54	7	8
Subscale physical behavior (n= 58)	21.7 ± 9.8 (4-47)	19.5 ± 9.8 (6-47)	18.2 ± 10.0 (3-47)	Resp. 0.00 and 0.00	0.36	12	2

Abbreviation: ATEC, autism treatment evaluation checklist

A moderate correlation was observed between mean improvement on total ATEC and CARS ( $r=0.37$ ,  $p=0.00$ ) and a substantial correlation between total ATEC and CARS at baseline ( $r=0.59$ ,  $p=0.00$ ).

## Discussion

The results of this study suggest that equine assisted therapy utilizing the SpiritHorse methods may be an effective treatment for children with autism spectrum disorders. After 10 weeks of EAT a significant overall, but small decrease in ASD symptoms was found on the CARS. Fifteen percent of the patients showed a clinically significant improvement. Kern et al. (in press) conducted a comparable study on the efficacy of a 6-month EAT program in children with ASD and reported the same degree of overall improvement in ASD symptomatology. However, neither clinical significance nor effect sizes were documented in that study.

Overall improvement in ASD symptoms appeared to be related to the number of EAT lessons and baseline ASD severity. The overall therapy effect was larger if patients received more EAT lessons. Patients who were more severely autistic prior to therapy benefitted less from EAT than patients with a milder form of ASD. This finding is consistent with earlier studies (Greenspan & Wieder, 1997; Ozonoff & Cathcart, 1998), although these studies did not give an explanation. We hypothesize that children with more severe ASD symptoms (i.e. larger impairments in communication, lower awareness of the environment, higher degrees of inattention), may be harder to reach. This may in turn result in a lower degree of therapy efficacy.

An overall decrease in ASD symptomatology was also established on the ATEC. This outcome corresponded with a medium effect size and a clinically significant symptom reduction in nearly one-third of the patients, thereby reporting a larger overall effect than the CARS.

The difference in therapy efficacy assessed by both outcome measures may be explained by the fact that the ATEC is specifically developed to evaluate the effectiveness of various treatments for ASD individuals and is therefore more sensitive to change than the CARS (The Healing Center<sup>3</sup>). The CARS is, on the other hand, primarily designed to diagnose autism while the ATEC has not yet proven to be a valid diagnostic instrument (The Healing Center<sup>3</sup>). Moreover, the ATEC total score is largely dependent on the patient's health, while health is only a minor element in the CARS. It should also be taken into account that parent-rated measures are not always consistent with clinician-rated measures. More specifically, parents might be more subjective in scoring ASD and could be more inclined to report a treatment effect than clinicians because they want to see improvement in their child. Although reliance on parent report is in

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<sup>3</sup> Source: <http://www.healing-arts.org/children/ATEC.htm> , Date: 5/24/2010

some ways a limitation, parents do have the advantage of observing the child's behavior in diverse environments.

EAT showed positive effects on all four areas of functioning: communication, sociability, sensory/cognitive awareness and physical behavior. Symptom reduction in the areas 'communication' and 'physical behavior' corresponded with small effect sizes. Only a minor percentage of the patients showed a clinically significant improvement in communication and physical behavior. The largest therapeutic effects were established for sociability and sensory/cognitive awareness with a large and medium effect size, respectively. One-third of the patients improved clinically significant in sociability and nearly 15 percent of the patients in sensory/cognitive awareness. Positive effects on social functioning in children with ASD were also reported by Bass et al. (2009), after children having completed a 12-week therapeutic horse riding program. The positive effects on sensory and cognitive awareness of the patients may be explained by the fact that several elements of this category on the ATEC (i.e. awareness of the environment, directed attention, and initiation of activities) are defined as social functioning in other studies.

To date it is not clear if treatment effects of EAT can be attributed to the human-horse interaction, the act of riding the horse, or a combination of both. As several studies showed that the incorporation of animals in therapy has beneficial effects in children with ASD, comparable effects may be expected in the presence of a horse. Questions could be raised, however, whether the act of riding the horse per se also contributed to EAT efficacy. Recently, Wuang et al. (2010) studied the effect of a biweekly simulated horse riding program in children with ASD. They concluded that a 20-week simulated horse riding program had additional effects on sensory integration and motor proficiency, compared to a regular occupational therapy program. Based on the study results of Wuang et al. (2010) it may be assumed that the act of riding the horse also contributes to EAT efficacy.

Wuang et al. (2010) also established positive effects of simulated horse riding on bilateral coordination. With regard to functional neural underconnectivity, which is thought to be a general characteristic of ASD, an increase in bilateral coordination may stimulate the development of new neural connections. However, as precise mechanisms of action of therapeutic horse riding fall outside the scope of this study, evidence for reversing underconnectivity remains elusive.

Results of this study demonstrated that an EAT program had beneficial effects in children with ASD. However, no definitive conclusions can be drawn. Several study limitations warrant mention. Firstly, due to the lack of a (waiting-list) control group, effects cannot be attributed to treatment effects only. Nevertheless, studies that did include a waiting-list control group reported no improvements in autistic symptoms during a waiting period of several months (Bass et al., 2009; Jarusiewicz, 2002; Kern et al., in press). Secondly, the majority of the patients in this study received at least one concurrent therapy. Although patients who received any concurrent therapies did not improve more than patients who only received EAT, study results may have been affected by other therapies.

In conclusion, aforementioned limitations make it difficult to ascertain whether the results can be explained by the therapy or if other variables were involved. However, this study is one of the few to evaluate the effect of EAT on ASD symptomatology. Future single-blind randomized controlled studies with a larger sample size are warranted to further investigate the efficacy of EAT on ASD symptomatology. Studies should also determine if a more intensive EAT program would result in larger therapy gains. As results of our study showed that children with more severe autistic symptoms appeared to benefit less from therapy, future research should take this issue into account. Follow-up studies should be conducted to determine if therapeutic effects can be sustained. Finally, generalizability of the study results is needed. Therefore, studies should increase uniformity of measurement instruments, in order to make comparisons between the efficacy of different treatment modalities.

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