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**THE EFFECTS OF HIPPO THERAPY ON CHILDREN AND ADOLESCENTS
WITH AUTISM: A SYSTEMATIC REVIEW**

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**The effects of hippotherapy in children and adolescents with autism: a
systematic review**

by

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Report

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Dedication

I would like to dedicate this report to my loving family for the unconditional support and encouragement for the duration of my extended educational career. I would not be in this field if it were not for the persuasion and guidance of my mom who convinced me to take a CSD class my sophomore year of undergrad. This report is also dedicated to my wonderful boyfriend Nick, who has supported me throughout my entire undergraduate and graduate careers. Thank you for our weekend visits, they will always mean so much to me.

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Abstract

The effects of hippotherapy in children and adolescents with autism: a systematic review

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Abstract: The purpose of this systematic review was to investigate the effectiveness of hippotherapy, also known as horse- or equine-assisted therapy, for improving the socialization and communication behaviors of children diagnosed with Autism Spectrum Disorders (ASD). The PubMed research database was used to search for relevant studies. Six studies were evaluated and demonstrated overall mixed findings for the use of hippotherapy as an effective treatment technique for communication and socialization skills. To further analyze the strength of these findings, the selected studies were evaluated for limitations related to outcome measure selected and treatment design. The present analysis revealed four main limitations: 1) lack of established treatment protocol led to differences with how hippotherapy was delivered; 2) most assessment measures were based on parent report; 3) small sample sizes; and 4) multiple treatment interference. While these

limitations do not detract from the information gleaned from the treatment and research, implementing a standard protocol would make the replicability easier for future clinicians.

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Introduction

WHAT IS AUTISM?

Autism spectrum disorder (ASD) is a developmental disorder characterized by impairments in social communication, social interaction, and language. ASD is a lifelong disorder, typically diagnosed in early childhood, and is apparent across a person's life span. Social interaction and communication deficits include pragmatics, joint attention, conversational challenges, relating to others, reduced sharing of interest, and difficulty recognizing, understanding, and relating to others mental and emotional state (American Psychiatric Association, 2013; Belkadi, 2006).

Language deficits associated with ASD include limited receptive skills that make following directions and understanding difficult. Expressive language skills can also be impaired in the form of limited oral expression, syntax, morphology, and lexicon. Impairments related to speech include phonology, phonetics and articulation (American Psychiatric Association, 2013). In addition to limited social interaction and communication, ASD is also characterized by behaviors that are classified as restrictive, repetitive, and stereotypical. Among other difficulties, non-verbal deficits are also common in those with ASD such as lack of eye contact, limited use of facial expression, and reduced use of gestures. Overall, these deficits make it difficult for those with autism to form and maintain relationships because of diminished interest in peers and initiating communication appropriately.

CAUSE AND PREVALENCE

According to Weitlauf et al (2014), the prevalence of ASD in the United States is 1 in 68 children. More males are affected (1 in 42) than females (1 in 189), but the cause of this is unknown (Weitlauf et al., 2014). Present research on the cause of ASD has determined that there is a strong genetic component, with heritability estimated to be between 40 and 90 percent (Geschwind, 2011). At least 100 genes have been identified that are related to the inheritance of ASD, but environmental exposures and context also play a role in the development and the genetic expression of ASD (Marshall & Scherer, 2012). Environmental exposures include pesticides, exposure to mercury, maternal conditions (diabetes, hypertension, obesity, and influenza), and maternal and paternal age (Shelton, Tancredi & Hertz-Picciotto, 2010; Shelton, Hertz-Picciotto, & Pessah, 2012; Krakowiak et al., 2012). In relation to genetic and environmental factors, Gronberg et al (2013), found that being the sibling of a child diagnosed with ASD increases the chances of being identified with ASD from 6.7 to 18.7 percent.

DIAGNOSIS

Individuals suspected of having ASD are often referred to speech-language pathologists or other health professionals. A comprehensive language assessment usually includes case history, naturalistic observation, parent/caregiver/teacher report, and standardized and dynamic assessment measures. During an evaluation by a speech-language pathologist, receptive and expressive language, literacy, pre-

linguistic behaviors, social communication, and conversational skills are typically assessed. According to Matson and Goldin (2013), current assessment measures have demonstrated that children can be identified with ASD as early as the age of two.

Common standardized assessments of ASD include the *Autism Diagnostic Observation Schedule, Second Edition* (ADOS2; 2012) and the *Childhood Autism Rating Scale, Second Edition* (CARS2; 2010). Both assessments include clinician elicited and scored sections, with the CARS-2 also providing a parent/caregiver questionnaire. In addition to these specifically ASD assessments, other age-appropriate language and pragmatic skill measures can be given to determine additional levels of functioning.

TREATMENT

Without early intensive intervention, ASD symptoms may persist and increase in severity (Matson and Goldin, 2013). Therefore, early identification and intervention are critical for providing individuals with ASD the skills to increase their independence and socialization skills. The severity and manifestation of symptoms of ASD in children leads parents and caregivers to a variety of treatment approaches. Unfortunately, the recommendation for interventions that are not supported by evidence-based practice lead families to waste time and money when those resources could have been used on interventions empirically supported. This includes behavioral, psychosocial, educational, and medical approaches (Opsina et

al., 2008). Typical goals for intervention include improving social communication and interactions to help children with ASD attain greater independence and functional skills. While there is no cure for ASD, early intervention has been demonstrated to result in the best treatment outcomes.

In recent years, the use of animal-assisted intervention (AAI) has become a popular trend. According to a study conducted by Davis et al (2013), a variety of animals may be incorporated into therapeutic activities, including dogs, guinea pigs, dolphins, rabbits, llamas, and horses. Dogs are most commonly used because they are easily attainable, small, and most people are familiar with them. AAI reportedly occurs in a variety of settings including hospitals, schools, libraries, and even prisons (Davis et al., 2013). Reported benefits of AAI include allowing feelings of relaxation and companionship to occur so therapy can take place. AAI is often used for speech/language, occupational and physical therapy purposes. Animals provide a non-judgmental, non-threatening and accepting partner for a variety of therapeutic activities. Therefore, this type of intervention for individuals with ASD may reduce the effects of social anxiety while communicating. AAI as an alternative approach for ASD intervention is appealing because of evidence supporting the human-animal interaction theory (Davis et al., 2013). This theory is described in detail in the following section.

HUMAN-ANIMAL INTERACTION THEORY

The human-animal interaction theory suggests that a relationship between humans and animals can result in positive physical and psychological outcomes (Davis et al., 2015). The theory states that humans view animals as a non-judgmental communication and social partner (Esposito et al., 2011; Kruger & Serpell, 2010). Other features of this theory include that the animal serves as a mediator or a translational object for social demands and needs (Kruger & Serpell, 2010). Other studies report that reduced blood pressure and heart rate have resulted in the presence of an animal (Bass, Duchowny, & Llabre, 2009; Viau et al., 2010). Overall, animals are important psychologically and culturally to humans, though this relationship is complex and reciprocal.

WHAT IS HIPPO THERAPY?

Hippotherapy, also known as equine-assisted and horse therapy has been used by physical, occupational and speech therapists. In Greek, the word “hippo” means horse. Therefore, this is the origin of the term “hippotherapy”. The technique uses the movements of the horse to provide motor and sensory input. An aim of therapy is often to establish a foundation that improves neurological function and sensory processing, which can be generalized to a variety of daily activities (Koca & Ataseven, 2015). When utilizing hippotherapy, the movement of the horse is the means to a treatment goal, unlike therapeutic horseback riding which teaches specific skills. In addition to clients with ASD, hippotherapy has been implemented

with patients with cerebral palsy, multiple sclerosis, stroke, traumatic brain injury, behavioral and psychiatric disorders (Koca & Ataseven, 2015).

CURRENT STATE OF THE LITERATURE

Currently, most of the research on horse-assisted therapy focuses on children with cerebral palsy. Children with cerebral palsy can make significant gains in motor control and posture due to the gross motor movements involved in horseback riding (Koca & Ataseven, 2015). The majority of the literature supports the fine and gross motor skill gains made from hippotherapy in children with a variety of disorders. Additionally, Animal-Assisted Intervention (AAI) in individuals with ASD has increased in recent years. Dog-assisted therapy has become the most common because dogs are easily accessible, cost less, and require less space and equipment to perform therapy (Davis et al., 2015). Currently, systematic reviews have been completed on AAI's with dogs and horses that focus on fine and gross motor skills and reading skills. To date however, a systematic review of the social gains made in children with ASD through hippotherapy has not been completed.

This systematic review aims to answer the following questions:

- 1) Is hippotherapy effective in improving the communication and socialization skills of children and adolescents with ASD?
- 2) What are the limitations present in the current research on hippotherapy?

Method

SEARCH STRATEGY

Identification of relevant and appropriate studies was completed through an electronic literature search using the PubMed database. This search engine was selected because of databases' inclusion of a wide array of journals in the area of ASD, and speech and language. Additionally, this full access to this database is available through the University of Texas library system.

SEARCH TERMS

The following terms were included in the initial search: *autism*, *social*, *communication*, and *hippotherapy* or *horse therapy* or *equine therapy*. During the initial search, 24 abstracts were identified for possible inclusion in this systematic review. The database search occurred between December 2016 and February 2017.

SELECTION CRITERIA

In order to be included in this meta-analysis, the following criteria was applied:

1. Article published in English in a peer-review journal
2. Participants are children aged preschool through high school diagnosed with ASD
3. Intervention involves the use of practice characteristics for horse therapy and specifically targets socialization and communication.

4. Outcomes of the practice must be described, including a description of post-treatment assessment of the socialization and communication skills of participants.
5. Article published between January 2007 and January 2017

STUDY RATING

Based on the framework established by Davis et al. (2013), study outcomes were coded as 1) positive, 2) negative, or 3) mixed. If the study outcomes determined that participants made statistically significant improvements in on all dependent variables related to communication and social skills, then the study was coded as positive. Studies that resulted in all dependent variables related to communication and social skills as not statistically significant were coded as negative. Finally, those studies that resulted in some participants improving and others not improving were coded as mixed.

Results

The initial search included the following terms: *autism*, *hippotherapy*, *equine therapy*, and *horse therapy*. This initial search generated 24 articles. With the addition of the terms *social* and *communication*, eight citations were generated. From these eight articles, six were deemed appropriate for the purposes of this study, based on the selection criteria. Table 1 outlines these studies in terms of participant characteristics, dependent and independent variables, and study outcomes.

PARTICIPANTS

A total of 193 participants received a form of hippotherapy across the six selected studies. The sample size per study ranged from four to 116 participants. The age of participants ranged from four to 16 years old. Of the 193 participants, 162 were male (84%) and 31 were female (16%). Sex was reported in all studies. Among the studies, 191 (99%) of the participants reported to be diagnosed with ASD and two (1%) of the participants were diagnosed with PDD-NOS. Participants across all studies were selected for the various studies based on a diagnosis of ASD or PDD-NOS from a psychologist, speech-language pathologist, or other healthcare professional. The range of severity of deficits ranged from mild (verbal) to severe (non-verbal).

DEPENDENT VARIABLES

The purpose of this systematic review was to summarize the effects of hippotherapy on children and adolescents with ASD, but a variety of dependent variables were reported across the studies. In all six studies, a review of the effect of hippotherapy on social skills (e.g., eye contact, interaction with others, taking turns, sharing, interactive play, reading emotion) was included. Additionally, all studies reported changes in verbal communication skills such as spontaneity of speech, number of different words, and imitation. In addition to social and communication skills, four studies (66%) of the selected studies also measured physical outcomes such as posture, fine and gross motor control, and sensory sensitivity.

OUTCOME MEASURES

A variety of assessment measures were employed across the studies. Five of the selected studies (83%) used more than one form of assessment, with only one study using one assessment (Keino et al., 2009). The measures used were as follows: *Social Responsiveness Scale*, *Vineland Adaptive Behavior Scales*, *Peabody Picture Vocabulary Test*, *Systematic Analysis of Language Transcripts*, *Aberrant Behavior Checklist*, *Sensory Profile*, *Autism Spectrum Quotient-Child*, *Autism Spectrum Quotient-Adolescent*, and *Empathising quotient/systemizing quotient* (Constantino, 2002; Sparrow, Cicchetti & Balla, 2005; Duun & Dunn,

2007; Miller & Chapman, 2000; Aman et al., 1985; Dunn, 1999; Keino et al., 2002; Auyeng et al., 2008; Baron-Cohen et al., 2006; Auyeng et al., 2009).

A variety of measurement methods were used across the studies. In three studies (50%), outcome measures were based both on parent report, as well as direct measures including standardized assessments, checklists or rating scales. In the remaining three studies (50%), outcome measures solely included parent/participant report solely. All studies employed parent/participant report in their measurement of dependent variables.

INTERVENTION FEATURES

Three (50%) of the selected studies implemented the use of randomized control trials, while the other three (50%) performed quasi-experimental studies. Additionally, due to the nature of hippotherapy, all experimental trials were completed at a horseback riding facility. These facilities were equipped with all necessary equipment, space and personnel for horseback riding. Every study used the same type of staff for therapy sessions. This included two walkers for the safety of the rider, a leader for the horse, and an instructor/interventionist. Four studies (66%) studies described the training of the interventionist. Two studies (33%) did not describe the interventionist beyond that they were trained in horseback riding. Three studies (50%) used instructors trained in Professional Association of Therapeutic Horsemanship International (PATH), with one of these instructors also being a licensed occupational therapist. One study used leaders certified by the

British Horse Society (BHS) or Riding for the Disabled (RDA) as interventionists (Anderson and Meints, 2016).

Different group sizes were reported across the studies. In four studies (66%), the intervention was delivered in individual group sessions. In one study, sessions varied between one individual participant and two participants in a semi-private lesson, depending on scheduling (Lanning et al., 2014). Only one study did treatment in groups of two to four regularly (Gabriels et al., 2015).

Duration and frequency also differed across the six selected studies. Generally, the intervention was delivered once a week. The shortest program lasted five weeks with sessions lasting three hours per week (Anderson and Meints, 2016). Three studies (50%) followed a 12-week intervention format with therapy lasting 45-60 minutes each week. One study (16%) implemented a 10-week program with sessions lasting 45 minutes (Gabriels et al., 2015). One study (16%) followed a very different format in terms of duration (Keino et al., 2009), with a range of 12 to 48 months with sessions lasting an hour per week. The study did not describe the reason for stopping treatment or the parameters for the varied duration of the treatment across participants.

The area of greatest difference in intervention was in terms of therapy tasks and activities. Every study reviewed basic horseback riding skills of mounting and dismounting, due to the safety concerns of riding a horse. In addition to riding skills, every study used intervention time to teach grooming, stable management, and

horse safety. This targeted vocabulary for anatomy and equipment, as well as practiced following directions. In terms of therapy tasks used for the therapeutic riding portion, five studies (83%) incorporated the use of games such as Simon Says, Red light/Green light, and obstacle courses. These activities were tailored to the individual participants to promote communication, language, and socialization skills. One study (16%) gave general statements about the therapy tasks without specific descriptions (Gabriels et al., 2015).

STUDY FINDINGS

This review identified and evaluated six studies that examined the effects of hippotherapy in children and adolescents with ASD. Table 2 summarizes the findings from the selected studies in terms of targeted communication and social skill outcomes, as observed or reported by the researchers. Three of the six studies (50%) found positive results and the remaining three studies (50%) resulted in mixed results. Rival explanations that may potentially compromise or challenge the reported findings are listed in the last column of the table.

Communication skill findings. Only two of the studies reported improved communication skill findings for children and adolescents with ASD who received hippotherapy (Ajzenman, Standeven & Shurtleff, 2013; Gabriels et al., 2015). The researchers reported improvements in the following domains of language and communication: receptive language skills (e.g., attending, following directions), and expressive language skills (e.g., number of different words, initiation of

spontaneous language). The remaining four studies did not find improvements on their selected measures of communication. Overall, two studies reported that participants demonstrated improvements in language and communication domains; therefore, the results of this study are characterized as mixed in terms of using hippotherapy for increasing communication in individuals with ASD.

Socialization skills findings. All six of the included studies reported improvements in socialization skills of participants. These socialization skills are characterized as the following: increased participation and social communication, less difficult social interactions, more self-regulation and attention, improved eye contact, and tolerance of change. Overall, the current research supports using hippotherapy as means of improving socialization skills in children and adolescents with ASD.

While the data may suggest that hippotherapy increases socialization skills, an important point must be made about this interpretation. All reported improvements should be interpreted within the contexts of the studies. Therefore, study design, sample size, data collection method, and outcome measurements used by researchers should be read with caution. All the studies presented with flaws, some more than others, which could compromise the claims in support of hippotherapy.

Discussion

LIMITATIONS

Multiple threats to internal and external validity, as well as the presence of rival explanations for the reported outcomes are present in all six studies. These major threats and rival explanations are outlined in Table 2 and described in further detail in the subsequent sections

Non-standardized treatment protocol. Due to a lack of an established treatment protocol, there were vast differences in the way hippotherapy was delivered. For example, in the study completed by Gabriels et al (2015), the treatment was performed in groups. This treatment method allows for participants to have more interaction with peers, potentially increasing their gains in communication and socialization in comparison to other studies that delivered therapy in individual sessions. This difference in treatment administration creates difficulty in comparison of treatment methods.

In addition to differences in treatment protocol, the study completed by Keino et al (2009) reported no clear treatment method at all. The four participants stayed in therapy for years, all at variable lengths. The authors did not report the reasoning for stopping treatment with any of the participants except for one who moved away. The undetermined length of time creates complications with replicability and the general causes of improvement. With a study that lasts multiple

years, maturation and the influence of other treatment methods create issues because the cause of growth cannot be isolated.

Another difference in treatment protocol across the studies included the interventionist. One study did not describe the qualifications of the interventionist (Keino et al, 2009). Interventionists across the studies included an occupational therapist, speech therapist, or trained horse professionals. The majority of the studies identified the training of the interventionist (PATH, BHS, or RDA), but the type of training varied. Interventionists were most commonly trained in PATH, but this training was not consistent across studies. Little to no information was provided in the studies about what a certification in PATH, BHS, or RDA entails, except for the study by Anderson and Meints (2016), which briefly describes PATH. Without understanding of these trainings, there is limited understanding of the interventionists' role, as well as the basis for which this type of therapy is based on. Overall, more information about the goals of the different training programs, as well as consistency with interventionists would improve treatment fidelity and replicability of the intervention.

Measurement of outcomes. All the studies included were subject to researcher bias because the practitioners and investigators were knowledgeable of the type of treatment participants were assigned to and the potential outcomes of intervention. In the studies where data was collected and coded via videotape, the researcher obviously knew whether the participant received therapy or not. This is

especially evident because all the studies that included the use of a comparison group did not allow the control to have contact with real horses. They participated in activities with a stuffed horse or other horse related activities without a live horse. Therefore, the expectancies of the investigator may have influenced how behaviors were coded.

In addition to researcher bias, respondent bias was also present. All selected studies incorporated parent and/or participant report of their performance pre- and post-intervention. An important note to make here is that participants willingly signed up for the study with the expectation that gains would be made. Participants/caregivers were aware of the study's purpose and likely to demonstrate respondent bias. An example of this is evident in the Keino et al (2015) study. The scale on which parents were asked to rate their child included the following as examples: 1) Human relationship with family while engaging in horseback riding, 2) Imitation (physical movement while riding), and 3) Emotional expression (way of smiling on horseback). When individuals expect to witness improvements, they will report the presence of improvements (Pratkanis, Eskenazi, and Greenwald, 1994).

Small sample size. Overall, most of the studies selected had very small sample sizes. Across the six studies included, only 193 participants were included. This number is relatively small in comparison to the number of studies selected. One study included 127 participants, but none of the other studies came even close

to a sample that large (Gabriels et al, 2015). Most of the included studies had sample sizes used less than 20 participants. The use of small sample sizes reduced the power of the studies and the weight their outcomes hold.

Multiple treatment inference. None of the selected studies controlled for simultaneous exposure to other therapies. While none of the studies specifically mentioned that participants were in fact receiving other treatments, they all reported the likelihood was high. This flaw in research design has the potential to dictate if treatment outcomes were due to hippotherapy or other therapies. The difficulty in separating hippotherapy treatment effects from outside factors detracts from the reliability of the studies.

Other possible threats to study validity. The novelty of riding horses may also have influenced the participant's behavior – for good or for bad. With the exception of the Keino et al (2015) study, which specifically stated they used participants who were accustomed to riding horses for at least a year, horses were novel animals to participants. The studies reported heightened excitement and/or problem behaviors throughout the duration of the studies. Horses are very different than dogs and cats, which people typically encounter on a daily basis. Therefore, the excitement and novelty of them is a factor to be considered.

Other issues arise with those studies that lacked control/comparison groups. Three studies incorporated a comparison group, but the remaining three used quasi-experimental research designs. This use of one group does not allow for a

conclusive decision that hippotherapy is the cause of improvements in socialization and communication skills. Due to this, ruling out maturation or other factors that occurred simultaneously with the intervention cannot be ruled out.

Conclusion

This research synthesis focuses on the effects of hippotherapy in children and adolescents with ASD on social and communication skills. The purpose of this analysis was to investigate the current state of the literature on hippotherapy in order to determine the intervention's implication for practice. Practitioners of hippotherapy have promoted the intervention to be effective as a main form of therapy for individuals with ASD. After extensive analysis, the available body of evidence does not conclusively support that hippotherapy is effective for improving the communication skills of children and adolescents with ASD. Conversely, the selected literature does appear to suggest that hippotherapy may improve the social skills of those with ASD. This type of intervention should be used with caution and is recommended as a supplementary treatment method to more empirically based therapy methods. Overall, outcomes of this study conclusively determine that hippotherapy may improve socialization skills, but not communication skills in children and adolescents with ASD.

Hippotherapy is not only used with children and adolescents with ASD, but with youth who have emotional and behavioral disorders. In a literature review conducted by Smith-Osborne and Selby (2010), they examined the current research of the psychosocial benefits of hippotherapy in children with emotional and behavioral disorders such as Post-Traumatic Stress Disorder (PTSD), Attention Deficit Disorder (ADHD), and mood disorders. The targeted psychosocial

outcomes included social skills, aggression, and self-esteem. Similar to the results of this literature review, Smith-Osborne and Selby (2010) found mixed results. Some of the selected studies indicated positive changes, while others had null results. These similarities support the notion that hippotherapy should not be the main intervention method to improve social and communication skills in various populations.

IMPLICATIONS FOR FUTURE RESEARCH

The six studies selected for inclusion in this review did not yield conclusive evidence that hippotherapy is effective in improving communication skills of children and adolescents. Therefore, further research on methods of specifically targeting language and communication while performing hippotherapy is warranted. Many studies included communication measures secondary to physical and social outcomes, but few included specific language goals for participants. Additionally, future research can be improved by using adequate sample sizes in order to increase the power of the study. With larger sample sizes, the use of control or comparison groups will be easier. By using a control or comparison group, future studies will increase their level of evidence. Such research designs could control for intervention variation, treatment fidelity, and determine the true effects of the intervention. Treatment studies that are better designed are needed to determine if hippotherapy is an effective intervention for improving communication skills in children and adolescents with ASD.

TABLE 1 – Summary of Reviewed Studies

Study	Participants	Dependent Variables	Measures	Study Outcomes	Research Design
Anderson S. & Meints, K. (2016)	11 males 4 females 5-16 years old	- Traits of ASD - Empathising & systemizing - Socialization - Communication	ASQ-C ASQ-A Empathising /systemising quotient VABS II	Mixed	Quasi-experimental
Ajzenman, H., Standeven, J., & Shurtleff, T. (2013)	3 males 3 females 5-12 years old	- Receptive & expressive communication - Socialization - Attention	VABS II CACS	Positive	Quasi-experimental
Bass, M., Duchowny, Llabre, M. (2009)	29 males 5 females 4-10 years old	- Social motivation, awareness & cognition	SP SRS	Positive	Randomized control
Gabriels et al., 2015	101 males 15 females 6-16 years old	-Social cognition - Social communication - Self-regulation	PPVT VABS II SALT ABC-C SRS	Mixed	Randomized control
Keino et al., 2009	4 males 0 females 4-9 years old	- Social skills & engagement - Attention - Verbal & Non-Verbal communication	HEIM Scale	Mixed	Quasi-experimental
Lanning et al., 2014	9 males 8 females 4-15 years old	- Emotional & social functioning	PedsQL CHQ	Positive	Randomized control

TABLE 2 – Major Study Findings & Threats to Validity

Study	Primary Findings	Communication Findings	Socialization Findings	Rival Explanations
Anderson S. & Meints, K. (2016)	Reduction in maladaptive behaviors and improvement in empathizing	None reported	Alleviates some symptoms of ASD that make socializing difficult	Respondent bias No control Small sample size
Ajzenman, H., Standeven, J., & Shurtleff, T. (2013)	Improvement in postural control, adaptive behaviors, and participation in ADL	Improvement in receptive skills –attending & following directions	Increased participation, social interaction, attention & coping	Small sample size Respondent bias Lack of uniformity of sessions Treatment fidelity
Bass, M., Duchowny, Llabre, M. (2009)	Increased social motivation & sensory sensitivity and decreased inattention & distractibility	None reported	Improvement in social functioning, attention, focus & social cognition	Small sample size Placebo effect Possible multiple treatment interference Attrition
Gabriels et al., 2015	Decrease in irritability and hyperactivity; improvements in social cognition and communication	Increase of NDW and spontaneous language	Increased self-regulation, social communication & social cognition	Respondent & investigator bias Lack of observational measures
Keino et al., 2009	Improved social and communication behaviors, as well as behavioral improvements	None reported	Improved eye contact, tolerance of change, interpersonal relationships & greetings	Maturation Lack of uniformity of sessions Small sample size
Lanning et al., 2014	Positive treatment effects in social, physical, and school functioning, and overall mental health and behavior	None reported	Increased social functioning & attention	Small sample size Placebo effect Respondent bias Single evaluator

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