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Effects of hippotherapy on the motivation and social interaction/social communication for children with Autism Spectrum Disorders

by

Cecilia Llambias

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Abstract

Engagement in purposeful activities is essential for development and is difficult for children with autism spectrum disorders (ASD) who also have impairments of social interaction and communication. In hippotherapy, riding and other horse related activities can be used to promote children's engagement and communication skills. A multiple baseline design across eight children ages 4 to 7 years was used to assess the effects of hippotherapy. Intervention effects were strong for 7 children's engagement and 4 children's responses to requests (responsivity). Limited effects were found for expressive communication. Parent and teacher reports pre- and post- intervention indicated positive changes. Hippotherapy may be a valuable addition to conventional treatments to increase engagement for children with ASD. Factors related to the environment, therapeutic strategies, and participants must be considered. The study's results will assist clinicians and parents of children with ASD in making decisions about the use of hippotherapy, an alternative therapy approach.

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CHAPTER 1

INTRODUCTION

Problem statement

Animal assisted therapies for children with autism spectrum disorders (ASD) are relatively new. Even though the use of animals to promote health date from a long time ago (Macauley & Gutierrez, 2004), research about the effects of these therapies for children with ASD has been more recent. In a systematic review, O'Haire (2013) found that therapies with animals produce benefits in several areas of functioning known to be impaired for this population. However, most of the extant research is criticized due to methodological weaknesses. Of the 14 studies reported, O'Haire found that those incorporating horses as part of therapeutic horseback riding (THR) had the strongest methodology, but only four studies with rigorous methodology were found (i.e., Bass, Duchowny & Llabre, 2009; and Gabriels, Agnew, Holt, Shoffner, Zhaoxing & Ruzzano, 2012). This indicates the emerging state of this field.

THR is a group approach to riding lessons for people with disabilities. Hippotherapy is a little different. Hippotherapy is a physical, occupational or speech therapy treatment that includes the horse and its environment to improve skills. It is delivered one-on-one and rehabilitation professionals combine strategies taken from their disciplines with the use of the animal as part of an integrated treatment program.

Only one study reported the effects of hippotherapy for children with ASD (Taylor, Kielhofner, Smith, Butler, Cahill, (…), & Gehman, 2009). Since hippotherapy is carried out in individual sessions instead of groups, it was expected that better and faster results would be obtained with this type of horse intervention approach (Dawson & Burner, 2011). However, a clearer understanding of the mechanisms related to hippotherapy's intended outcomes and evidence of effectiveness are needed.

Purpose and significance of the study

The main objective of this study was to explore the effects of hippotherapy on the motivation and social communication /social interaction for children with ASD. The specific objectives of the study were to identify whether there was an:

1. Increase in motivation and
2. Increase in social interaction/social communication in children with ASD due to the presence, contact, caring for and riding of a horse;

This project expands on the only other study that specifically examined the effects of hippotherapy on the motivation of children with ASD (Taylor et al., 2009) using a more rigorous design (single case multiple baseline versus pre- post one group design) with more specific behavioral measurements. It extends the outcomes of interest by also looking at effects on social communication /social interaction.

This study contributes to the body of evidence of rehabilitation science and therapies with animals for children with ASD delivered by occupational

therapists, highlighting the applicability of therapeutic strategies taken from this discipline in hippotherapy. This study adds to the literature by thoroughly describing the participants and therapeutic intervention and implementation procedures.

Introduction outline

This introductory chapter presents several aspects related to the use of hippotherapy to promote motivation and communication skills for children with ASD delivered by occupational therapists. First, an overview of the place of animal assisted therapy in the current rehabilitation context is described. Second, a definition of ASD, its impact on development, and the most recommended therapeutic interventions to address ASD symptoms are summarized. Third, the significance of occupational therapy as a rehabilitation medicine profession and its contribution to hippotherapy is presented. Fourth, the three theories (i.e., Model of Human Occupation (MOHO), Self Determination and Sensory Integration) that underlie this study are introduced, with descriptions of similarities and differences in the way they contribute to our understanding of motivation and its role in children's development. Fifth, the importance of addressing communication skills for children with ASD in occupational therapy interventions is explored. Sixth, the history, research evidence and the present state of incorporating horses into therapeutic interventions for children with special needs, and particularly children with ASD is summarized. The introduction concludes highlighting the choice of research designs used in this

study for investigation of conditions such as ASD and for establishing the validity of a new intervention.

Overview of hippotherapy in the current rehabilitation context

Information about the use of horses to promote health dates from the fourth century BC with the Greek philosopher Hippocrates (Macauley & Gutierrez, 2004). However, the field has had variable attention over the years. Currently, there is an increasing interest in the introduction of animals into therapeutic sessions. One of the reasons for this phenomenon could be that animal assisted therapies aims at contemporary views of the response to the complex issues related to chronic pathologies or incurable conditions. Years ago, a person with a disability was often confined to an institution. Today, the response of health services to people with special needs is a more humane response.

The current goal in rehabilitation is to promote the inclusion of people with special needs and foster their participation in society, instead of excluding them from it (Mullins, Chaney, & Frank, 1996). Here is where rehabilitation professionals play their main role. They teach skills, look for options and break barriers to include people with special needs in everyday and common activities (Seelman, 2000). Many times this results in interventions delivered in settings that simulate the environments where people live or going to the client's location (e.g., home, school, work) to deliver the intervention on-site. However, there are implications of this inclusion for the person with special needs and for their family. They must cope with many challenges everyday resulting in stress.

Providing interventions in a way that also fosters fun, relaxation and well-being is essential. Rehabilitation services in natural environments and with natural elements, in which the clients have opportunities for fun and joy may play a fundamental role.

Hippotherapy offers a combination of professional rehabilitation services in a natural environment (American Hippotherapy Association, 2006). One of the benefits is the location of the therapy that will not be associated by the client with unpleasant health environments, such as hospitals. For the person with special needs, hippotherapy is associated with having fun, riding a horse and being in contact with nature, even though it encompasses many rehabilitation activities and exercises. This is important in that these types of therapies may help to relieve some of the stress that people with special needs experience. In the case of children with special needs, the benefits of hippotherapy are also recognized by their parents. They often describe their excitement when watching their child spending time in contact with an animal, who is perceived as a friend, and the amount of skills that he/she learns during the session. Even though therapy with animals usually does not replace traditional rehabilitation services, its therapeutic camouflage as a recreational activity seems to greatly benefit the children and their families. For many parents the sessions in the hippotherapy environment are associated with an opportunity for them to release stress distracting their minds from problems and responsibilities. They enjoy walking around the stables while their child is receiving the session, petting the horses, or sitting on a bench enjoying the sun or the fresh air.

Benefits of Animal Assisted Therapies for children have been reported in many areas of functioning. These include improvements in balance, gross and fine motor skills, cognitive, social and communication, self-esteem and wellbeing among others (Endenburg & van Lith, 2011). Due to these reported benefits, animal assisted therapies have lately received special attention. In the past 5 years, animal assisted therapy using horses and children with ASD have involved two main formats: therapeutic horseback riding (THR) (Bass et al, 2009; Gabriels et al., 2012) and hippotherapy (Taylor et al. 2009).

Hippotherapy allows rehabilitation professionals to deliver a unique kind of intervention approach in which the interplay between the horse, the child and the therapist facilitates in-depth work on the client's impairments with the additional benefit of being perceived as a type of recreational and leisure activity. THR is also a recreational activity. It is a group approach to teach riding lessons to people with disabilities. It is delivered by THR instructors who receive 2 months of training which may limit their ability to assess deficits and identify intervention. In contrast, hippotherapy is delivered by rehabilitation professionals in individual settings. This individualized approach allows the therapist to work more efficiently on the needs of each child, setting specific goals and tailored strategies. The individualized and therapeutic approach of hippotherapy may be more beneficial for children with more special needs or severe condition/deficits.

Autism Spectrum Disorders

Definition and impacts

Autism Spectrum Disorders (ASD) is a term used to describe a set of childhood disorders that are characterized by the presence of stereotyped and repetitive patterns of behaviors with restrictive interests and fixed routines and impairments in social communication and social interactions (American Psychology Association, 2013). Children with ASD lack motivation to engage in purposeful activities and in communication and social encounters. They often focus on seemingly non-purposeful behaviors that interfere with their engagement in purposeful activities. These behaviors interfere with the child's ability to successfully participate in age- related activities (play, school and social) affecting development. ASD is usually diagnosed in early childhood and can be accompanied by language or other impairments. It occurs more frequently in males than females with a ratio of 4:1 (Fombonne, 2003).

The fact that the causes of ASD are still unknown as is its cure (Dawson & Burner, 2011) is a concern for parents of children with ASD. Instead of finding a solution that may solve the problem, parents have to face the fact that the condition has no cure and that no single intervention has been proven successful for all children (Brooke, 2009; Flynn & Healy, 2012; Umbraguer, 2007). Replicated research indicates that the best approach includes an intense and early combination of behavioral and educational interventions (Brooke, 2009; Umbraguer, 2007; Waltz, 2002) which contributes to the stress and burden of care of parents. Supporting family members to adjust to a child with ASD and to

address the many issues that they have to face is one of the roles of occupational therapists when working with children with ASD (Galvin, 2001).

Therapeutic interventions for children with ASD

As described later in chapter 2 and 3, interventions for children with ASD encompass two lines or styles of work known as traditional behavioral approaches and contemporary or social-pragmatic developmental approaches (Prelock & Nelson, 2012). Traditional approaches are focused on teaching skills and the intervention is mostly controlled by the therapist. In them, the therapist teaches skills such as enhancing eye contact, vocabulary, and taking turns in conversations, among others. Contemporary interventions are child-centered and are delivered usually in naturalistic settings. Strategies include following the child's lead, using the child's interests, and preferred toys and materials, and giving opportunities to choose. Most of the strategies in the contemporary approaches include some components of motivation (Lequia, 2009). Authors agree that these two types of intervention are not exclusive and that the best approach is a combination of both joined with addressing the symptoms early and intensively (Prelock & Nelson, 2012; Prizant & Wetherby, 1998). The central hypothesis of the present research is that hippotherapy interventions planned with the combination of both intervention types may greatly improve intervention efficacy. The philosophy and strategies of occupational therapists offer a unique contribution to the field of hippotherapy.

Occupational therapy

Occupational therapy (OT) is one of the primary disciplines within rehabilitation medicine. OT is a discipline that has its center in facilitating people with disabilities' participation in society (Kientz & Miller-Kuhaneck, 2001). For this discipline, occupation refers to any activity that people do in their daily life. This can be for instance play, study, eating, rest, work, visiting friends, or watching TV. Thus, every person participates in society through the activities that constitute their daily occupations. When a person is not able to successfully perform some of these daily activities, OT takes place. Occupational therapists (OTs) work to prevent, make possible or make easier people with special needs' participation in society. Facilitating people with special needs' participation in society is the heart of the OT as discipline and its main contribution to society.

Working in pediatrics, OTs provide ways to improve deficit areas, teaching and practicing skills or modifying environments to make the children's participation successful (Dunn, 2011). When using the methods of hippotherapy, OTs assess the severity of impairments and work on those skills that are relevant to the activities involving the animal (such as saddling, grooming, riding) but with the goal that what is learnt or improved can also be carried over to the children's everyday environments. For example, improvements in balance may help the children to better ride a bike or to sit properly on a school chair. Regarding the present study, hippotherapy interventions delivered by an OT focused on enhancing the children's motivation for engaging in purposeful activities and in communication and social skills with the goal that skills achieved

during the hippotherapy sessions would be carried over to other environments such as home or school.

Philosophy and Models of Practice of OT

OT professionals base their clinical reasoning and decision making on concepts that are consistent with the philosophy of their profession (Dunn, 2011). Their philosophy can be summarized as the interrelationship between three main areas: person, occupation, and environment. *Person* encompasses the people (with their skills and deficits), *occupation* refers to the tasks that they want to perform (activities) and *environment* refers to the places in which these tasks are performed (contexts). To guide practice, OTs utilize models of practice. Models help OT to put into practice the philosophical concepts in specific situations, pathologies or conditions, describing practice, giving tools for assessment and guiding intervention. Relevant to the present work is the Model of Human Occupation (MOHO). This model is based in the importance of the person's motivation for participation in daily occupations (Dunn, 2011). It is one of the most important models of practice for OT.

Model of Human Occupation

The MOHO understands human beings in a holistic manner. A person is an open system that continually modifies the environment and is modified by it (Kielhofner, 2008). Human beings are conceptualized with three components: *volition* refers to the person's motivation for doing things (occupations), *habituation* refers to the ways that people organize their actions or occupations into patterns and routines, and *performance capacity* is the person's physical or

mental skills that underlie any occupation. Essential to this study is the concept of volition. For the MOHO, motivation is related to the innate, universal and intense need for action that makes up human beings. This desire for action is reduced in children with ASD due to their behavioral difficulties that interfere with their motivation to engage in age-related activities.

One of the most important contributions of the MOHO is its conceptualization of motivation as a cyclical process. The cycle forms an increasing spiral. When people participate in any daily life activity, they receive feedback from the environment and from themselves that leads to the next action. Through this feedback, the person chooses and decides their own actions being an active protagonist in his/her own life. This results in a continuous reshaping of the person's motivation and skills. As new skills are learnt and developed, they reshape the person's habits and routines. This results in people being more motivated and engaged in their life.

In conditions such as ASD, motivation for participation in activities is reduced or is oriented to activities without a clear purpose. In fact, this lack of motivation for purposeful activities reduces the positive feedback, feedback that Kielhofner views as enabling an increase in motivation and therefore growth and development. For this reason the MOHO highlights enhancing children's motivation as a first step in the rehabilitation process. To do so, the model suggests that OTs base their intervention in aspects that are relevant for each particular child. The therapist should start by asking the children, or their parents, about the child's interests, wishes and likes using questions such as: "What

occupation does this person enjoy doing?", "What aspects of these occupations does the person enjoy the most?", "what are your interests?", "What parts do you like more?" (Dunn, 2011, pp. 44). Using the person's preferred activities and or asking the person to make choices is part of enhancing his/her personal motivational process. By making choices and following their interests the children develop a sense of efficacy that this model called personal causation. It refers to the motives that promote the person's active participation in his/her life.

Concepts of this model are essential for fostering motivation, successful participation, personal growth and life satisfaction for all people. However, for clients such as children with ASD, whose motivation is reduced, these strategies are of utmost importance. By using strategies planned with the MOHO concepts, the therapist fosters a learning environment that enables deep changes in the person. These changes will reach their highest level when the child's motivation for participation in activities is shown not only in the environment in which the changes were learnt but is carried over to other environments. This is the highest goal of the OT for intervention. Other theories also highlight the importance of motivation.

Views of motivation from other theories

Self Determination Theory

Self Determination Theory divides motivation into intrinsic and extrinsic types. Important to the present work is the role of intrinsic motivation. Intrinsic motivation consists of the things that one personally values and likes to do. It is doing an activity because it is interesting and satisfying in itself. It includes

people's curiosity and interests, creativity, wish to explore, to know, and to learn (Deci & Ryan, 1985). The theory highlights the role of intrinsic motivation as indispensable for cognitive and social development and emphasizes that this type of motivation is so essential to people that it is considered a principal source of vitality and enjoyment throughout life. The same is observed in the MOHO. For people to find satisfaction in their occupations, the actions or occupations that people perform have to be in accordance to their personal wishes, thoughts, feelings, values and capacities. Because participation in activities is so important in development, interventions for children with ASD must look for activities that are interesting for them and provide a desire for action and participation. Including animals in interventions for these children may be relevant due to children's attraction to animals that make Animal Assisted Therapy an intrinsically motivated activity. However, interventions also must aim for acquisition of skills that are important for their development and participation. Here is where the role of extrinsic motivation has a place (Ryan & Deci, 2000).

Extrinsic motivators such as rewards or reinforcement provoke interest in the activity, even though the activity may not be attractive at first. Through extrinsic motivation, therapists teach children with ASD the necessary skills for their functional participation in daily life, until these skills are valued by them. Once they value the skill and it becomes part of the children's own values, extrinsic motivation is not needed.

Other important concepts of Self Determination theory are inner growth tendencies. Inner growth tendencies are inherent human gifts that provide people

with the potential of mastering their skills (Deci &Vansteenkiste, 2004). These inherent tendencies result in optimal development and well-being. However, they do not occur in people automatically; they need the nutrients from having three basic psychological needs met. These basic psychological needs are the need for competence, autonomy and relatedness (Deci &Vansteenkiste, 2004; Ryan & Deci, 2000). Autonomy refers to the universal need to be causal agents of one's own life, a concept also highlighted by the MOHO. It is the will that can accompany any act. Competence refers to the feeling of self-confidence about being able to behave in a particular way or make something. Relatedness refers to the universal willingness to interact, be connected to, and experience caring for others (Baumeister & Leary, 1995). SDT seeks to identify which features of an environment or social context are needed in order to meet these three psychological needs.

The three psychological needs develop differently in different social contexts. However, the fulfillment of these needs depends on how much the environment offers opportunities to satisfy the needs. If the environment is positive, it will facilitate active individual engagement and psychological growth. If the environment is negative, it will lead to lack of integration, defensiveness, and needs-substitutes. Social contexts produce people more or less self-motivated, energized and integrated in their life. Regarding children with ASD, it is important that intervention provides them opportunities for the fulfillment of the three psychological needs. Strategies must focus on promoting expression of wishes and likes and successful interactions and communication opportunities.

This will lead children to be more motivated to interact with the environment and people. Once the therapist achieves the child's engagement, she may introduce opportunities to increase autonomy, competence and relatedness. Examples of such opportunities include offering choices, providing gradual challenges to increase their feelings of competence, providing positive feedback, increasing self-confidence and self-esteem, helping the children to develop communication skills to increase their relatedness and offering controlled and strategic opportunities where the children can enjoy time shared with others (Ryan & Deci, 2000). The meeting of these needs will result in stronger inner growth tendencies and consequently in an increase of development and wellbeing. It will produce an increase in motivation.

Thus, therapists should provide opportunities for fulfillment of the psychological needs, which will result in children being more intrinsically motivated and more active and joyful. Hippotherapy provided by an occupational therapist could be an excellent environment for meeting these three psychological needs. In addition, the opportunity to care for another generally facilitates engagement in activities. Part of a hippotherapy session relates to horse care. Thus, hippotherapy fosters intrinsic motivation and gives children with ASD a varied range of opportunities to participate in purposeful activities.

There are several aspects in which these two theories relate each other. The MOHO highlights the exceptional role that motivation has in people's lives and how its growth will produce changes not only within the therapeutic environment but also in other environments. Self Determination Theory divides

motivation in two types, intrinsic and extrinsic, highlighting the importance of intrinsic motivation. Both theories state that motivation is something inherent to human life and to each person. The MOHO calls it an "intense need to act" (Kielhofner, 2008, pp.12) and the SDT calls it intrinsic motivation or the internal motives that one has to act and which will result in the person's optimal development and well-being. Both theories also emphasize that motivation or the motives that everyone has for acting are individual and are related to specific traits inherent to each person. Also, both theories highlight that for finding satisfaction in their life, people have to be motivated by personal interests, wishes or likes and that this will result in personal growth and development. Both theories emphasize the role of the environment in which the activity is performed. The MOHO emphasizes that it is from the environment that the person gets the feedback that will lead to the new action. SDT says that it is by the environment that the person fulfills the psychological need of autonomy, competence and relatedness. Both theories agree that the environment is what provides the feedback on our participation, nurturing us for future actions.

Sensory Integration Theory

Sensory Integration theory also describes motivation as an essential part of any intervention for children with ASD and gives strategies to enhance it. Similar to the already mentioned theories, sensory integration describes motivation as the inner drive for participation in activities (Bundy & Murray, 2002). Inner drive is the excitement and effort manifested during an activity. For this theory, the most important goal is to promote purposeful and satisfactory adaptive responses to the

environment because it will enhance the children's inner drive (Bundy & Koomar, 2002). An adaptive response refers to the correct and adjusted response to environmental demands. The therapist selects activities to stimulate intrinsic motivation and play, and promote the children's successful responses. However, as a difference from the previous two theories, this theory considers deficits in the sensory integration process observed in some children and how they interfere with the children's successful participation in their environments. For children with ASD, these deficits are seen in reduced motivation to participate in activities, to try new things, or to meet challenges due to deficits in their sensory processing skills (how the children process information from the environment). Interventions based on this theory seek to enhance the children's sensory processing, which will lead to stronger inner drive (Bundy & Murray, 2002).

Deficits in sensory modulation are common in children with ASD (Bundy & Koomar, 2002; Mailloux, 2001). Modulation allows filtering of irrelevant stimuli, maintaining an optimal level of arousal or alertness that facilitates attention to the environmental demands and therefore allows adaptive responses (Lane, 2002). The first symptom of modulation deficits is an unbalanced level of arousal. Children may have a very high or very low arousal level. Children with very high arousal levels need strong stimuli to perceive information. In contrast, children with very low arousal levels are very sensitive to stimuli. For both, activities of daily life are challenging. Strategies to modulate the arousal levels principally include activities to stimulate the vestibular and proprioceptive systems, because these systems regulate arousal. When children with sensory

modulation deficits achieve an appropriate arousal level, they improve their attention and interaction with their environment. In interventions using hippotherapy, the horse's gait and speed stimulates the vestibular system, which promotes sensory modulation, resulting in either calming effects by means of a quiet and continued gait or an alerting effect by a fast walk or trot. Activities that stimulate the propioceptive system include movement against gravity such as standing up in the stirrups.

A third aspect of sensory integration theory that is relevant to the study is the relationship of vestibular stimulation with communication. Stimulation of this system promotes visual contact with people and objects, and communication (Lane, 2002). Several authors report an increase in the number of words and in communication in children after vestibular stimulation (Kantner, Kantner, & Clark, 1982; Magrun, Ottenbacher, Ray, King & Grandin, 1988). Studies about vestibular stimulation from occupational therapy interventions for persons with cognitive delays suggest that it increases the production of words (Kantner et al., 1982; Magrun et al., 1981). Ray et al. (1988) found similar results of vestibular stimulation for a child with autism.

As a summary, the three theories highlight the importance of motivation in people's lives. MOHO and SDT address the topic in a general way, and without specifying difficulties inherent to any condition. Sensory integration theory directly addresses how to enhance children's participation by understanding some of their difficulties to participate and giving strategies to improve the deficits. Putting into practice the concepts offered by these three theories could greatly

impact the results of any therapeutic session for children with ASD. Adding the component of an animal and working in its environment may make this impact even greater.

Communication and social skills interventions for children with ASD by OT

Communication skills are not a main focus of OT interventions, but are recognized as essential and necessary. Usually, pediatric OTs focus on enhancing the client's ability for daily living skills such as independently eating, dressing or moving, along with a focus on the fine motor skills necessary for their successful participation in any daily living and school tasks. Communication skills are the main focus of Speech Language Pathologists. However, communication and social skills are a relevant component of any intervention for children, as the rehabilitation provider needs to communicate with the child. Therefore, it is important that all professionals use strategies to address communication deficits for enhancing these children's basic everyday skills. This can result in collaboration among disciplines that will greatly enhance services.

At some ages the need to prepare the children for the next step in life is more apparent. Working with preschool age children, the age of the children in the present study, is one such age. Children are close to entering school where their deficits in communication and social skills may result in severe learning delays and emotional stress. They are gradually beginning to spend more time with their school social group. They will have to engage in more complex types of play, respond to the school curricula and be able to develop and maintain friendships (Greene, 2001). In this life step, they will begin to develop a sense of

self confidence and self-efficacy based on the feedback that they receive from peers and teachers rather than solely from their families. It is here where the lack of communication and social skills may have a dramatic effect for children with ASD due to their lack of motivation or interest in activities and in communication exchanges. Early and preschool intervention must help the children to be ready for the challenges that they will encounter at school. Participating in sessions with others, learning new skills, playing and doing different activities in different settings, and practicing communication exchanges in novel environments increases the children's opportunities to practice social and communication skills and flexibility. This will prepare them to successfully confront new situations that they will encounter. OTs must promote and maintain communication exchanges with children with ASD.

Several strategies can be used to promote social skills. For instance, promoting eye contact, making requests in clear and slow speech, allowing each child sufficient processing time, using techniques such as intonation or tactile touching to promote focus and attention, teaching turn taking, expanding their vocabulary, correcting unclear speech and reinforcing and rewarding the use of acquired skills are some of the strategies that OT have to foster communication (Prelock &Nelson, 2012). In addition, when the therapist plays games or participates in activities with the child, the child's socialization skills are practiced. Promoting active engagement in a shared activity or task, developing friendship and helping the child to appropriately express affect, being alert to the child's spontaneous communication attempts and responding to them, fostering

initiations, and leading the child to active participation in the tasks will make any therapeutic session a rich communication environment. In it, the child will practice and enhance communication and social skills no matter which main area the therapist is addressing. In hippotherapy, a third communication partner is present, a horse, to which the child is also able to communicate and learn body language to interpret feelings and wishes, making the communication opportunities even greater. Working with an animal produces excitement and will elicit communications from them such as what the animal is doing, how the animal may feel and what the animal would like. All these situations foster the children's communication exchanges and socialization.

Engagement in activities as a visible indicator of children's motivation

Since motivation is an abstract concept, it needs to be measured by observable behaviors. Engagement in purposeful activities or tasks is one of the components of motivation (Kielhofner, 2008). It is observed and is quantified within psychological and educational studies by measuring the amount of time that a child spends in a purposeful activity (Bagatell, 2012).

One current social problem that has led educators and researchers to increase their efforts in the study of engagement in early childhood is related to concerns about the high rates of drop out among high school students (Battin-Pearson, Newcomb, Abbott, Hill, Catalano, & Hawkins, 2000; Fitzpatrick, 2012). These studies about conventional students may provide some clues for rehabilitation professional to understand engagement. Several authors have investigated the personal and environmental features that influence learning in

early childhood to identify child and environmental characteristics that predict success in early school years (Duncan, Dowsett, Claessens, Magnuson, Huston, Klebanov, & Brooks-Gunn, 2007; Lemelin, Boivin, Forget-Dubois, Dionne, Séguin, Brendgen, Vitaro, F., (...), & Pérusse, 2007; Romano, Babchishin, Pagani & Kohen 2010). Attention to task is one of the most important predictors (Duncan et al., 2007) and facilitates engagement in tasks, and this is directly related to learning and development (Gallotta, Guidetti, Franciosi, Emerenziani, Bonavolontà, & Baldari, 2012).

Educators and rehabilitation professionals desire to help young children to acquire skills at this age is based in the neuroplasticity concept (Pascual-Leone, Freitas, Oberman, Horvath, Halko, Eldaief, Bashir, (...), & Rotenberg, 2011). Neurocognitive theories indicate that there is a window of relative plasticity during early childhood. At this time, the children's brain is more malleable and they acquire more easily new behaviours, knowledge, and skills. In addition, cognitive neuroscience research also suggests important changes occur in child cognition during the preschool age (Feldman 2009; Marcovitch & Zelazo 2009). These authors suggests that at this age, children become much more skillful at using focused attention and working memory to solve problems (Feldman 2009 et al., 2009). This enhancement in attention and working memory in early childhood predicts children's consequent use of inhibitory control, which appears later in the preschool years and is so important for maintaining longer focus on tasks (Feldman et al., 2009). Inhibitory control refers to the brain's ability to filter stimuli that are irrelevant to the task (Davidson, Amso, Anderson, & Diamond,

2006), skill that is in deficit in children with ASD, as mentioned in the above sensory integration theory paragraphs (Bundy & Murray, 2002). Given the enormous importance of this period on the children's life and the relevant role that attention and inhibition have as bases in learning, it is important that professionals involved in the rehabilitation of children with ASD maximize the use of strategies that help the children to improve these areas. The use of vestibular stimulation to modulate children with ASD's arousal levels and enhance attention is one possible option. But also, all strategies afore mentioned to promote children's engagement are essential to maximize the children's potential at this stage in life.

Incorporating animals into therapy sessions

As mentioned before, incorporating animals into therapy sessions is believed to be a powerful intervention tool, especially for children with disabilities. Children have an innate attraction to animals (Kahn Jr., 1997; Lee, 2012). For children with special needs, this attraction may facilitate their participation in therapy activities with benefits for psychological, sensory, motor, cognitive, communication and social functioning, mood and well-being, with reduction of spasticity, perception of pain, stress, anxiety, and depression (Endenburg & van Lith, 2011; Jorgenson, 1997; Muñoz Lasa, Bocanegra, Valero Alcaide, Atín Arratibel, Varela Donoso & Ferriero, 2013).

For children with ASD, several authors agree that they get along better with animals than with people (Grandin, Fine, & Bowers, 2010; Martin & Farnun, 2002; O'Haire, 2013; Pavlides, 2008; Redefer & Goodman, 1989; Sams, Fortney,

& Willenbring, 2006). The animals' body-language communication system is simpler than the human system (Grandin et al., 2010). Others suggest that some children with ASD use animals as transitional objects, which lead to successful interactions with people (Fine, 2010; Katcher & Wilkins, 2000).

Therapies with horses

The first mention of the use of the horse in health was found in a book of the Greek philosopher Hippocrates in 460-377 BC. He mentioned riding as an excellent exercise to maintain health and recover from illnesses. In more recent times, therapeutic horseback riding (THR) became known through Lis Hartel, a Danish equestrian athlete who had paralysis as a consequence of polio and won a silver medal in dressage in the 1952 Olympics (Cawley, Cawley, & Retter, 1994). Her success gave rise to interest in use of the horse to rehabilitate muscle impairments. Studies about the results of THR began to flourish, especially related to motor dysfunctions such as cerebral palsy. In 1969, the nowadays most worldwide recognized association of therapeutic riding activities, Path-international (Ex-Narha), was established (Path-International, n.d.). Hippotherapy was added later with the wish of many rehabilitation professionals to combine their skills with the use of a horse to improve the clients' functioning (American Hippotherapy Association, 2006). THR is group riding lessons for people with disabilities and hippotherapy is delivered by rehabilitation professionals and work in individualized goals in one-on-one settings.

Regarding the conditions studied, hippotherapy and THR are beneficial to improve motor deficits in conditions such as cerebral palsy. The first article found

using the Scopus search engine dates from 1972. In 1995 the first systematic review about THR was published (Mackinnon, Noh, Laliberte, Lariviere & Allan, 1995). It addressed a wide range of diagnoses such as cerebral palsy, learning disabilities, brain syndrome, mental retardation and multiple sclerosis. Eleven studies were included, but most of them were studies presented in a national THR conference. The review was divided in two groups based on whether the study addressed physical or psychosocial outcomes. Physical benefits included improvements in posture control, muscle strength, weight bearing, sitting balance, gait, and gross and fine motor skills. Psychosocial benefits included increasing self-confidence, self-esteem and motivation as well attention span, concentration and interest in learning. In addition, Dismuke (1984) found significant improvements in language skills and bilateral motor coordination, visual perception and left/right discrimination. MacKinnon et al. reported that the studies had weak scientific rigor, small sample sizes and heterogeneous participants, with researchers relying on non-standardized measures to evaluate changes. Two systematic reviews were published in 2007 about THR and hippotherapy for cerebral palsy (Snider, Korner-Bitensky, Kammann, Warner, & Saleh; 2007; Sterba, 2007). Nine studies were included in Snider et al.'s review and Sterba's review included two additional studies (N=11). Both reviews divided the articles into hippotherapy (Sterba, n=5) and THR (Sterba, n=6). Snider et al. suggested that the level of evidence for hippotherapy and THR for improving motor outcomes for children with cerebral palsy was moderate to good, with 9.8 out of a maximum of possible 16 points. This rating suggests level 2-3 from the 4 levels of

evidence for systematically validating and disseminating new interventions developed by Smith, Scahill, Dawson, Guthrie, Lord, and Odom (2007). This model is explained later. Both Sterba and Snider et al. identified the need for further studies with larger samples, blinded raters and non-riding controls. Sterba also suggested the need to compare hippotherapy and THR. Zadnikar and Kastrin (2011) carried out a meta-analysis to assess the extant literature about the effects of hippotherapy and THR on postural control or balance in children with cerebral palsy including only studies that had a control group. They found 10 articles that met the criteria and concluded that the effectiveness of hippotherapy or THR for children with cerebral palsy was statistically significant. Four studies that had been published since the prior reviews were included. In a recent review of 9 articles, Whalen and Case-Smith, (2012) carried out a new systematic review considering the type of cerebral palsy in the outcomes' finding. Four new studies were included in this review, but 3 studies reviewed by Zadnikar and Kastrin (2011) were not included. Authors concluded that hippotherapy and THR were beneficial to improve gross motor function for children with spastic cerebral palsy or Gross Motor Function Classification System levels IV, ages 4 years and above. Thus, a level of gross motor function and a minimum age was defined. They concluded that the current literature on hippotherapy and THR was still limited. Thus, with a difference of five years, there was no improvement in the level of evidence for the two types of therapy with horses for children with CP and studies had weaknesses. No studies included in their review used the same protocol, treatment duration or frequency. They suggested that the next step was to carry

out replication of studies using the same treatment protocols utilized in their review, using randomized trials with larger samples that systematically vary by age and level and type of disability to confirm the results. In total, four systematic reviews and one meta-analysis about the effects of THR and hippotherapy for children with cerebral palsy were conducted since 2007, and authors concluded that, even though it appears that hippotherapy and THR have positive effects on gross motor function in children with CP, the literature is still limited and studies with greater scientific rigor were needed.

THR and hippotherapy have been also used with other children including those diagnosed with Down syndrome, Attention Deficit Hyperactivity Disorder (ADHD) and ASD (Bongers & Takken, 2012; Cuypers, De Ridder, Strandheim, 2011; Glazer, Clark, & Stein, 2004). Even when motivation was not one of the outcomes of these studies, the authors often comment on the effects of the animal on self-esteem, self-confidence and/or quality of life, not only for the children but also for their entire families. Bongers and Takken (2012) measured the physiological demands of THR in a group of 7 children ages 8 to 18 years old who were wheelchair-dependent with moderate to severe motor impairments. They found that the families perceived the THR program as beneficial in improving the children's quality of life, health, and function with an increase in self-confidence and self-esteem. Parents reported the children showing signs of happiness and relaxation, feeling like anyone else when on top of the horse as differences were lessened, improving as well health and function. These anecdotal findings are consistent with Davis, Davies, Wolfe, Raadsveld, Heine, (…) &

Graham (2009). However, the quantitative part of Davis et al.'s study did not find significant differences in the children's quality of life. Cuypers et al. (2011) investigated the effects of THR on behavior, health related quality of life and motor performance of 5 children with ADHD, ages 10-11. Participants received eight 1-hour weekly THR sessions. Significant differences were found in the outcome areas. Limitations of this study were a quasi-experimental design and the small sample size.

Macauley and Gutierrez (2004) studied the effectiveness of hippotherapy on children with language-learning disabilities. Three children (9-12 years old) participated. A client satisfaction questionnaire was completed by children and their parents. A speech language pathologist carried out the sessions. Authors observed positive changes in the speech and language skills of the children after 6 weeks of 1-hour weekly hippotherapy. Changes were also seen in the children's motivation and attention.

Psychological benefits of hippotherapy sessions were also found for children in other situations such as children affected by grieving (Glazer et al, 2004). In the qualitative analysis of the benefits of hippotherapy, Glazer et al.'s study revealed that the perceived benefits of the program were on confidence, trust, and communication skills. Parents and guardians reported an increase in the children's self confidence and self-esteem together with an increase in expressions of joy and pride due to the children's accomplishments in the hippotherapy activities.

In conclusion, there is less evidence for the effects of THR and hippotherapy for children with ASD or conditions other than for those involving motor difficulties. Smith and colleagues (2007) developed a model for systematically validating and disseminating the effectiveness of new interventions. The model has four levels of evidence. Level 1 refers to formulation and systematic application of a new intervention. In this level studies are mostly Single Case Research Design (SCRD) or between groups designs conducted to assess the efficacy of a new intervention, refine techniques and document clinical significance effects. Level 2 is characterized by manualization and protocol development. At this level, efficacious intervention techniques are assembled into a manual or protocol, treatment fidelity measures developed, acceptability of the new intervention by clinicians and families assessed and statisticians consulted to estimate sample size for a Randomized Control Trail (RCT) among others. Level 3 is made up of more rigorous study designs such as RCTs to test the efficacy of a new intervention in a large-scale trial and demonstrate consistency of effects across sites. Level 4 constitutes community effectiveness studies. In this level RCT or between groups studies are carried out to assess whether competent clinicians in the community can implement the new treatment. There is level 3 evidence for hippotherapy and THR related to cerebral palsy (Smith et al., 2007) with at least three randomized control trials (RCT) (Zadnikar & Kastrin, 2011). In addition, four systematic reviews and one meta-analysis have been carried out in this topic. Manualization and protocol

development are still needed. Evidence for the use of THR and hippotherapy for children with ASD is less.

The benefits of THR and hippotherapy for children with ASD are described briefly in chapter 2 and 3. In summary, these two types of therapies with horses are effective for several impairments of children with ASD such as improving social interaction and communication, problem behaviors, autistic severity, stress and anxiety. The current state of evidence of these two therapies comes from the recent first systematic review published by O'Haire (2013).

Current status of Animal Assisted Therapy (AAT) as a validated intervention for persons with ASD

In O'Haire's review, from the 152 articles located, only 14 met the inclusion criteria. Six studies utilized dogs, 6 studies included horses, 1 included guinea pigs and 1 study included several animals (dogs, llamas and rabbits). The first study including dogs dates from 1989 (Redefer & Godman) and the first including horses from 2009. From the studies that included horses, 4 were using THR, 1 used hippotherapy and 1 used Psycho-educational horseback riding.

As mentioned in O'Haire (2013), several limitations were found in the AAT literature that slows the growth of this discipline and results in criticism. There is no uniformity in the definition or use of the general term of AAT or for the terms used for the different types of AAT. This creates confusion. In addition, there are no two studies that replicate the key components of AAT which are the type of animal, the setting, the professional, and the duration. Finally, the

methodology or procedures used are usually poorly addressed and described. Articles often have insufficient information about the participants, the settings, the target outcomes, the training of the professionals, the activities used or protocol followed.

The limitations of AAT for children with ASD situate this type of intervention in an initial phase of research. This is also supported by the four-phase model for developing and testing the efficacy of a new intervention recommended by Smith et al. (2007). To be able to move forward, studies of AAT need to use more robust research designs and to compare AAT to other alternative interventions (for example swimming) to demonstrate its efficacy more rigorously.

There is less criticism of AAT using horses compared to AAT with other animals. The best scientifically positioned modality is THR. THR for children with ASD has four studies that used large samples and strong methodology in which intervention was compared to a control or non-intervention group (Bass et al., 2009; Gabriels et al., 2012; Kern et al, 2011; Ward et al. 2013). In a RCT, Bass et al. (2009) investigated the effects of 12 weeks of THR on 34 children (5-10 years old) with ASD. The children had THR 1h/week for 12 weeks. Sessions were delivered in groups of 19 children. Children in the THR group showed increased social motivation, and decreased sensation seeking and sensitivity, sedentary behaviors and inattention. Kern et al. (2011) examined the effects of equine-assisted activities on 20 children with ASD, ages 3-12. Children were evaluated at four time points: (1) before beginning a 3-to-6 month waiting period,

(2) before starting the riding treatment, and (3) after 3 months and (4) 6 months of riding. Participants completed 24 1h/week sessions. Pretreatment was compared to post treatment with each child acting as his or her own control. Authors found a reduction in the severity of autism symptoms after 3 months and 6 months of riding. Significant improvements were also found in mood and muscle tone. The parent-rated quality of life measure showed improvement, including the pretreatment waiting period. In another study, Gabriels et al. (2012) explored the effects of 10 1h/week THR sessions on a sample of 42 children with ASD (ages 6-16) compared with a waitlist control group (n=16). Authors used an AB design and sessions consisted of groups of 3-4 children. Participants receiving THR showed significant improvements in irritability, lethargy, stereotyped behaviors, hyperactivity, expressive language, motor skills and verbal praxis motor planning. Finally, Ward et al. (2013) examined the association between THR and social communication and sensory processing in 21 children with ASD receiving 1h/week THR for 6 weeks followed by a 6 week break, 4 weeks of THR followed by a 6 week break and then 8 weeks of THR. Significant improvements were observed only during intervention. Gains were not maintained when intervention was withdrawn. Limitations of this study included lack of a control group. Thus, THR has more evidence than hippotherapy. The findings of THR are encouraging. Since hippotherapy is carried out by a therapist and is individualized, it is expected that better and faster results will be obtained with this kind of therapy for children with ASD (Dawson & Burner, 2011).

Hippotherapy has been studied only by Taylor, Kielhofner, Smith, Butler, (…), & Gehman in 2009. In a pre-mid-post design, these authors investigated the effects of 16 45min/week sessions of hippotherapy on the volition/motivation of 3 children with ASD, ages 4-6. Compared to baseline, motivation increased for two of the children. Effects were measured in therapeutic play sessions with a standardized protocol. Sessions were videotaped and coders were blind to the participants' condition. This study had limitations such as a very small sample size and a questionable methodology.

Thus, the evidence for hippotherapy is still lacking. However, well developed single case research designs may contribute to building up the evidence base and addressing the aspects of hippotherapy that are not well developed yet. Studies need to address the efficacy of this intervention and to investigate what aspects need to be improved. The purpose of the present study was to examine the effects of hippotherapy on the motivation and social communication and social interaction of young children with ASD.

Research Designs

Two research designs were used in the current study: Single Case Research Design (SCRD) and pre-post one group design. SCRD, with its repeated observations over time, allows observation of the children's patterns of performance within the study and also across its different phases (Kazdin, 2011; Kratochwill, Hitchcock, Horner, Levin, Odom, & Rindskopf, 2010). It allowed a closer look at aspects of the child such as changes between phases or small changes within phases that were not anticipated. In addition, the detailed

description of each participant allowed observation of their specific responses to intervention and also if similarities or differences among participants produced a similar pattern of responses to intervention or not. The details of the multiple baseline design used are mentioned in the following two chapters.

According to Smith et al. (2007), quality indicators of SCRD of psychosocial interventions for individuals with ASD include: 1) the use of a reversal or multiple baseline design; 2) specific inclusion and exclusion criteria for enrollment as well as documentation of drop-outs and intervention failures; 3) well defined samples (i.e., standardized test to confirm diagnosis, standardized tests of intelligence and adaptive behavior to document developmental level); 4) replication of intervention effects across three or more participants; 5) assessment of generalization of results or maintenance of effects over time; 6) measurement of outcome conducted blind to the purpose of the study; and 7) fidelity of intervention implementation monitored through direct observation. These seven items were included in the present study.

A pre post design allowed a look at the sample as a group (Graveter & Wallnau, 2009). Even though the use of this design did not capture details of the children's intervention responses, it allowed the researchers to have information about how the intervention may have affected the participants' behaviour in environments other than the horse arena in a simple and practical way. In addition, the decision of collecting only pre and post intervention data from the teachers was determined due to the difficulty in asking teachers to complete more frequent measurements over the summer when hippotherapy was delivered.

Although we used pre-post design, results of the parents and teachers' questionnaires must be used with caution given the limited numbers and the impossibility to blind responders to condition.

Overview of the thesis

The thesis follows a paper based format of two papers. The first paper (Chapter 2) presents the results and clinical implications of the single subject design used to measure the effects of hippotherapy on the engagement for purposeful activities of 8 children with ASD, ages 4.5-7. Generalization of results was assessed by the parents and teachers responses on two questionnaires. They were analyzed using paired sample t-tests. This chapter will be submitted for publication. The second paper (Chapter 3) measured the effects of hippotherapy on the social communication and social interaction of children with ASD, using same sample and same designs as chapter 2. As well as in Chapter 2, parents and teachers completed a questionnaire addressing outcomes. This chapter represents a stand-alone journal submission. Chapter 4 provides a general discussion of the results, clinical implications and directions for future research.

References

American Hippotherapy Association (2006). *American Hippotherapy Association, Treatment Principles Manual-Level I, 2011, 3rd ed*. Fort Collins, Colorado: Education Curriculum Committee of the American Hippotherapy Association.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders (DSM 5th ed.).*Washington, DC: Author.

Bagatell, N. (2012). Engaged moments: Mediated action and children with autism in the classroom setting. *OTJR Occupation, Participation and Health, 32 (1),* 258-265.

Bass, M.M., Duchowny, C.A., & Llabre, M.M. (2009). The effect of therapeutic horseback riding on social functioning in children with autism. *Journal of Autism and Developmental Disorders, 39* (9), 1261-1267.

Battin-Pearson, S., Newcomb, M.D., Abbott, R.D., Hill, K.G., Catalano, R.F., Hawkins, J.D. (2000). Predictors of early high school dropout: A test of five theories. *Journal of Educational Psychology, 92 (3)* , 568-582

Baumeister, R., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*, 497–529.

Bongers, B.C., Takken, T. (2012). Physiological demands of therapeutic horseback riding in children with moderate to severe motor impairments: An exploratory study. *Pediatric Physical Therapy 24 (3),* pp. 252-257.

Brooke, S. (2009). The use of the creative therapies with Autism Spectrum Disorders. Springfield, IL: Charles C Thomas.

Bundy, A. & Koomar, J. (2002). Orchestrating intervention: the art of practice. In A.Bundy, S. Lane, & E. Murray (Eds.), *Sensory integration, theory and practice (2nd ed.*,pp. 242-259). Philadelphia, PA: F.A. Davis.

Bundy, A. & Murray, E. (2002). Sensory integration: A. Jean Ayres' theory revisited. In: A. Bundy, S. Lane & E. Murray (Eds.). *Sensory Integration, theory and practice* (2nd ed., pp. 3-33) Philadelphia , PA: F.A. Davis.

Cawley, R. Cawley, D., & Retter, G. (1994). Therapeutic horseback riding and self-concept in adolescents with social educational needs. *Anthrozoos, 7(2),* 129-133.

Cuypers, K., De Ridder, K., & Strandheim, A. (2011). The effect of therapeutic horseback riding on 5 children with attention deficit hyperactivity disorder: A pilot study. *Journal of Alternative and Complementary Medicine, 17 (10),* 901-908.

Davidson, M.C., Amso, D., Anderson, L.C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence

from manipulations of memory, inhibition, and task switching. *Neuropsychologia, 44 (11),* 2037-2078.

Davis, E., Davies, B., Wolfe, R., Raadsveld, R., Heine, B., Thomason, P., Dobson, F., & Graham, H.K. (2009). A randomized controlled trial of the impact of therapeutic horse riding on the quality of life, health, and function of children with cerebral palsy. *Developmental Medicine and Child Neurology 51 (2),* 111-119.

Dawson, G., & Burner, K. (2011). Behavioral interventions in children and adolescents with autism spectrum disorder: A review of recent findings. *Current Opinion in Pediatrics, 23* (6), 616-620.

Dismuke, R. (1984). Handicapped riding. *The Quarter Horse Journal, 34-37.*

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behaviour*. New York: Plenum.

Deci, E. L., & Vansteenkiste, M. (2004). Self-determination theory and basic need satisfaction: Understanding human development in positive psychology. *Ricerche di Psichologia, 27,* 17–34. Retrieved from http://www.selfdeterminationtheory.org/SDT/documents/2004_DeciVansteenkiste_SDTandBasicNeedSatisfaction.pdf.

Duncan, G.J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P., & Brooks-Gunn, J. (2007). School readiness and later achievement. *Developmental Psychology, 43,* 1428–1446.

Dunn, W. (2011). *Best practice occupational therapy for children and families in community settings.* NJ, USA: SLACK.

Endenburg, N., & van Lith, H.A. (2011). The influence of animals on the development of children. *Veterinary Journal, 190 (2),* 208-214.

Feldman, R. (2009). The development of regulatory functions from birth to 5 years: Insights from premature infants. *Child Development, 80,* 544–561.

Fine, A. H. (2010). Incorporating animal-assisted therapy into psychotherapy: guidelines and suggestions for therapists In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)* (pp. 169–191). San Diego, CA: Elsevier.

Fitzpatrick, C. (2012). What if we considered a novel dimension of school readiness? The importance of classroom engagement for early child adjustment to school. *Education as Change, 16 (2),* 333-353

Flynn, L., & Healy, O. (2012). A review of treatments for deficits in social skills and self-help skills in autism spectrum disorder. *Research in Autism Spectrum Disorders, 6* (1), 431-441

Fombonne, E. (2003). Epidemiology of autism and other pervasive developmental disorders: an update. *Journal of Autism and Developmental Disorders, 33,* 365-381.

Gabriels, R. L., Agnew, J. A., Holt, K. D., Shoffner, A., Zhaoxing, P., & Ruzzano, S. (2012). Pilot study measuring the effects of therapeutic horseback riding on school-age children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6(2),* 578–588.

Gallotta, M.C., Guidetti, L., Franciosi, E., Emerenziani, G.P., Bonavolontà, V., Baldari, C. (2012). Effects of varying type of exertion on children's attention capacity. *Medicine and Science in Sports and Exercise 44 (3),* pp. 550-555.

Galvin, D. (2001). The family of a child with autism. In H. Miller-Kuhaneck, *Autism, a comprehensive occupational therapy approach (1st ed.)*(pp. 48-53). Baltimore, Maryland: American Occupational Therapy Association.

Glazer, H., Clark, M.D., & Stein, D. (2004). The impact of hippotherapy on grieving children. *Journal of Hospice & Palliative Nursing. 6 (3),* 171-175

Grandin, T. Fine, A. H. & Bowers, C.M. (2010).The use of therapy animals with individuals with autism spectrum disorders. In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)* (pp. 247-264). San Diego, CA: Elsevier.

Gravetter, F.J. & Wallnau, L.B. (2009). *Statistics for the behavioral sciences (8th ed.).* Belmont, CA: Wadsworth.

Greene, S. (2001). Social skills interventions for children with autism and Asperger's disorder. In: H. Miller-Kuhaneck, *Autism, a comprehensive occupational therapy approach* (1st ed.)(pp. 153-171). Baltimore, Maryland: American Occupational Therapy Association.

Jorgenson, J. (1997). Therapeutic use of companion animals in health care. *Journal of Nursing Scholarship, 29 (3),* 249-254.

Kahn Jr., P.H. (1997). Developmental psychology and the biophilia hypothesis: Children's affiliation with nature. *Developmental Review, 17 (1),* 1-61.

Kantner, R.M., Kantner, B., & Clark, D.L. (1982). Vestibular stimulation effect on language development in mentally retarded children (semicircular canals, therapy, PICAC). *American Journal of Occupational Therapy, 36* (1), 36-41.

Katcher, A.H. & Walkins, G.G (2000). The centaur's lessons: therapeutic education through care of animals and nature study. In A. Fine (Ed.), *Handbook on animal assisted therapy (3rd ed.)* (pp. 153-178). San Diego, CA: Elsevier.

Kazdin, A. E. (2011). *Single-case research designs: methods for clinical and applied settings (2nd ed.).* New York, NY: Oxford University Press.

Kern, J.K., Fletcher, C.L., Garver, C.R., Mehta, J.A., Grannemann, B.D., Knox, K.R., Richardson, T.A., & Trivedi, M.H. (2011). Prospective trial of

equine-assisted activities in autism spectrum disorder. *Alternative Therapies in Health and Medicine, 17 (3),* 14-20.

Kielhofner, G. (2008). *Model of Human Occupation: Theory and Application* (4th edition). Baltimore, MD: Lippincott Williams & Wilkins.

Kientz, M. A., & Miller-Kuhaneck, H. (2001). Occupational Therapy Evaluation of the child with autism. In: H. Miller-Kuhaneck, *Autism, a comprehensive occupational therapy approach (1st ed.)*(pp. 55-84). Baltimore, Maryland: American Occupational Therapy Association.

Kratochwill, T.R., Hitchcock, J., Horner, R.H., Levin, J.R., Odom, S.L., Rindskopf, D.M., et al. (2010). Single-case designs technical documentation. Resource document. What Works Clearinghouse. http://ies.ed.gov.login.ezproxy.library.ualberta.ca/ncee/wwc/pdf/wwc_scd.pdf. Accessed 7June 2013.

Lane, S.J. (2002). Sensory Modulation. In A. Bundy, S. Lane & E. Murray (Eds.), *Sensory integration, theory and practice* (2nd ed.) (pp. 101-120). Philadelphia, PA: F.A. Davis.

Lee, P.C. (2012). The human child's nature orientation. *Child Development Perspectives, 6 (2),* 193-198.

Lemelin, J.-P., Boivin, M., Forget-Dubois, N., Dionne, G., Séguin, J.R., Brendgen, M., Vitaro, F., (...), Pérusse, D. (2007). The genetic-

environmental etiology of cognitive school readiness and later academic achievement in early childhood. *Child Development 78 (6),* 1855-1869.

Lequia, J. (2011). Motivation, interest and attention: re-defining learning in the autism spectrum. *International Journal of disability, development and education, 58* (4), 405-408.

Macauley, B. L., & Gutierrez, K. M. (2004). The effectiveness of hippotherapy for children with language-learning disabilities. *Communication Disorders Quarterly, 2 (A),* 205-217.

MacKinnon, J.R., Noh, S., Laliberte, D., Lariviere, J., Allan, D.E. (1995). Therapeutic horseback riding: A review of the literature. *Physical and Occupational Therapy in Pediatrics 15 (1),* 1-15

Mailloux, Z. (2001). Sensory Integration. In: H. Miller-Kuhaneck, *Autism, a comprehensive occupational therapy approach (1st ed.)* (pp. 101-131). Baltimore, Maryland: American Occupational Therapy Association.

Magrun, W.M., Ottenbacher, K., McCue, S., & Keefe, R. (1981). Effects of vestibular stimulation on spontaneous use of verbal language in developmentally delayed children (sensory integration, speech, mental retardation, language acquisition). *American Journal of Occupational Therapy, 35* (2), 101-104.

Martin, F., & Farnum, J. (2002). Animal-assisted therapy for children with pervasive developmental disorders. *Western Journal of Nursing Research, 24(6),* 657–670.

Marcovitch, S. & Zelazo, P.D. (2009). A hierarchical competing systems model of the emergence and early development of executive function. *Developmental Science 12*, 1–18.

Mullins, L.L., Chaney, J.M., & Frank, R.G. (1996). Rehabilitation medicine, systems, and health: A biopsychosocial perspective. *Families, Systems and Health 14 (1),* pp. 29-41.

Muñoz Lasa, S., MáximoBocanegra, N., Valero Alcaide, R., AtínArratibel, M.A., Varela Donoso, E., Ferriero, G. (2013) Intervencionesasistidasporanimales en neurorrehabilitación: unarevisiónde la literaturamásreciente[Animal assisted interventions in neurorehabilitation: A review of the most recent literature]. *Neurologia*. Article in Press.

O'Haire, M.E. (2013). Animal-assisted intervention for Autism Spectrum Disorder: A systematic literature review. *Journal of Autism and Developmental Disorders, 43 (7), 1606-1622.*

PATH-International-Ex Narha, (n.d.) Retrieved from http://www.pathintl.org/resources-education/resources/eaat/198-learn-about-therapeutic-riding.

Pavlides, M. (2008). *Animal-assisted interventions for individuals with autism*. London: Jessica Kingsley Publishers.

Prelock, P.J., & Nelson, N.W. (2012).Language and communication in autism: An integrated view. *Pediatric Clinics of North America 59 (1),* 129-145.

Prizant, B.M., & Wetherby, A.M. (1998). Understanding the continuum of discrete-trial traditional behavioral to social-pragmatic developmental approaches in communication enhancement for young children with autism/PDD.*Seminars in speech and language, 19 (4),* 329-352; quiz 353; 424.

Ray, T.C., King, L.J., & Grandin, T. (1988). The effectiveness of self-initiated vestibular stimulation in producing speech sounds. *Journal of Occupational Therapy Research, 8* (3), 186–190.

Redefer, L. A., & Goodman, J. F. (1989). Brief report: Pet-facilitated therapy with autistic children. *Journal of Autism and Developmental Disorders, 19(3),* 461–467.

Romano, E., Babchishin, L., Pagani, L.S., & Kohen, D. (2010). School readiness and later achievement: Replication and extension using a nationwide Canadian Survey. *Developmental Psychology 46 (5),* 995-1007.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55,* 68–78.

Sams, M. J., Fortney, E. V., &Willenbring, S. (2006). Occupational therapy incorporating animals for children with autism: A pilot investigation. *American Journal of Occupational Therapy, 60(3),* 268–274.

Seelman, K.D., & Jaeger, R.(2000). Rehabilitation science. *Technology and Disability, 12 (2-3),* 77-83.

Smith, T., Scahill, L., Dawson, G., Guthrie, D., Lord, C., & Odom, S. (2007). Designing research studies on psychosocial interventions in autism. *Journal of Autism and Developmental Disorders, 37(2),* 354–366.

Snider, L., Korner-Bitensky, N., Kammann, C.,Warner, S., & Saleh, M. (2007). Horseback riding as therapy for children with cerebral palsy: Is there evidence of its effectiveness? *Physical & Occupational Therapy in Pediatrics, 27(2),* 5–23.

Sterba, J. A. (2007). Does horseback riding therapy or therapist-directed hippotherapy rehabilitate children with cerebral palsy? *Developmental Medicine and Child Neurology, 49,* 68–73.

Taylor, R.R., Kielhofner, G., Smith, C., Butler, S., Cahill, S.M., Ciukaj, M.D., & Gehman, M. (2009) Volitional change in children with autism: A single-case design study of the impact of hippotherapy on motivation. *Occupational Therapy in Mental Health, 25,* 192-200.

Umbarger, G. (2007). State of evidence regarding complementary and alternative medical treatment for autism spectrum disorders. *Education and Training in Developmental Disabilities, 42* (4), 437–447.

Ward, S.C., Whalon, K., Rusnak, K., Wendell, K., & Paschall, N. (2013). The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. *Journal of Autism and Developmental Disorders*, 1-9. In Press.

Whalen, C.N., & Case-Smith, J. (2012). Therapeutic effects of horseback riding therapy on gross motor function in children with cerebral palsy: A systematic review. *Physical and Occupational Therapy in Pediatrics 32 (3),* 229-242.

Waltz, M. (2002). *Autistic Spectrum Disorders: understanding the diagnosis and getting help* (2nd Ed.). Beijing; Sebastopol, CA: O'Reilly.

Zadnikar, M., & Kastrin, A. (2011). Effects of hippotherapy and therapeutic horseback riding on postural control or balance in children with cerebral palsy: A meta-analysis. *Developmental Medicine & Child Neurology, 53 (8),* 684-691.

CHAPTER 2

HIPPOTHERAPY FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS: INCREASING ENGAGEMENT FOR PURPOSEFUL ACTIVITIES.

Introduction

Animal assisted therapies (AAT) have captured the attention of clinicians who assist those with disabilities, researchers, and the general public in the last decade (Connor & Miller, 2000). It is believed that incorporating animals into therapy is a powerful intervention tool, especially for children with disabilities. Children have an innate attraction to animals (Kahn Jr., 1997; Lee, 2012). This attraction may facilitate participation in therapy activities with benefits for psychological, sensory, motor, communication and social functioning (Bass, Duchowny, & Llabre, 2009; O'Haire, McKenzie, Beck, & Slaughter, 2013). However, AAT is still a very new field and little rigorous research has systematically investigated its benefits. The extant studies have been criticized due to weak study methodology, poorly specified focus, and insufficient detail to allow replication in terms of the type of activities included, the strategies used by the therapist, or features of study participants (Esposito, Mccune, Griffin, & Maholmes, 2011; O'Haire, 2013). The studies have identified benefits of AAT for children with disabilities. A common benefit related to increased motivation, even though this outcome was not the primary focus of the studies.

Motivation is a broad construct generally described as how a behavior gets started, is energized, sustained, directed, and stopped (McClelland, 1985). At its center is the innate, universal, and intense need for action of all human beings (Kielhofner, 2008). Kielhofner views this desire for action as the basis of motivation for activities that make up everyday life. Similarly, intrinsic motivation is the motivation that is driven by internal motives (Deci & Ryan, 1985). Intrinsic motivation consists of the things that one values and likes to do because the activity is interesting and satisfying in and of itself. Intrinsic motivation includes curiosity, creativity, and the wish to explore, to know, and to learn and it is considered indispensable for cognitive and social development and a principal source of enjoyment and vitality throughout life. There is evidence that people who are intrinsically motivated seem to remain engaged in tasks longer (Wigfield, Guthrie, Tonks & Perencevich, 2004).

Kielhofner (2008) describes a motivation cycle. In it, the person interprets his or her own actions through feedback from the environment and from oneself. When interactions are successful, feedback increases the motivation to undertake a new action. As this cycle repeats, the increase in motivation drives the person to undertake new actions which results in greater motivation. Thus, the cycle forms a growing spiral. With more motivation, more satisfaction and happiness are experienced. Children's motivation may move from a simple exploration level (child shows curiosity and preferences, initiates actions), to increase in engagement in purposeful tasks, practicing skills and solving problems followed by a higher level in which the children use imagination, modify the environment,

seek challenges and pursue an activity to completion. As mentioned above, engagement in purposeful activities is one component of motivation (Kielhofner, 2008). It is observed and quantified within studies by measuring the amount of time that a child spends in an activity. When engagement in purposeful activities is reduced, it is considered atypical. In conditions such as autism spectrum disorder (ASD), children have impairments that interfere with their ability to engage in purposeful activities, impacting their development.

One main area of impairment of children with ASD is their stereotyped and repetitive patterns of behavior and restricted interests (American Psychiatric Association, 2013). These behaviors are often characterized as non-purposeful and can be major obstacles for learning, and therefore their development and participation. Fostering engagement results in increased attention and focus and vice versa and is essential for learning (Kinnealey, Pfeiffer, Miller, Roan, Shoener, & Ellner, 2012; Patten & Watson, 2011). Consequently, therapists strive to increase their engagement for purposeful activities, both alone and in social settings (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010). One goal is to identify purposeful activities that interest the child with ASD and engage him or her for longer periods of time. Several authors have addressed ways to increase the engagement of children with ASD (Adamson, Deckner, & Bakeman, 2010; Keen, 2009; Kinnealey et al., 2012; Landa, Holman, O'Neill, & Stuart, 2011; Nicholson, Kehle, Bray & Heest, 2011). Strategies to promote engagement emphasize the use of social pragmatic developmental or contemporary approaches rather than traditional behavioral approaches (Prelock & Nelson, 2012; Prizant & Wetherby,

1998). They include offering choices (Lough, Rice & Lough, 2012), using gradual reinforcement delay (Reichle, Johnson, Monn, & Harris, 2010), following the child's lead, using the child's preferred activities, objects and interests (Boyd, Conroy, Mancil, Nakao, & Alter, 2007; Dunst, Trivette, & Masiello., 2011), breaking activities into steps (Grindle, Hastings, Saville, Hughes, Huxle, Kovshoff, Griffith, (...), & Remington, 2012), and utilizing the just right challenge (Lane, 2002). Including animals in therapy sessions may be another strategy. In hippotherapy, the variety and novelty of stimuli and activities in which they can be involved (such as saddling, grooming or riding) may interest these children and increase their motivation to participate in purposeful activities.

Strategies from sensory integration theory can also promote engagement. Children with ASD have sensory integration or modulation deficits (Bundy & Murray, 2002; Mailloux, & Smith Roley, 2001). Modulation allows filtering of irrelevant stimuli, and maintaining an optimal level of arousal that facilitates attention to the environmental demands (Lane, 2002). Strategies to modulate arousal include activities to stimulate the vestibular and proprioceptive systems that regulate arousal. With an appropriate arousal level, children's attention and interaction with their environment improves, resulting in longer engagement in tasks (Lawton-Shirley, 2002; Mailloux, & Smith Roley, 2001). In hippotherapy, the horse's gait and speed stimulates the vestibular system, resulting in either calming effects by means of a quiet unvarying gait or an alerting effect by a fast walk or trot. Offering the just right challenge is another sensory integration strategy. By successfully completing challenging activities, such as controlling

the horse or controlling their body on the horse, the riders develop feelings of accomplishment, self-confidence and mastery, which positively influence their motivation and engagement in the hippotherapy activities.

There are several benefits of domestic animals for children's development (Endenbur & van Lith, 2011; Muñoz Lasa, Máximo Bocanegra, Valero Alcaide, Atín Arratibel, Varela Donoso & Ferriero, 2013). For children with disabilities, contact with animals can produce improvements in gross and fine motor skills, cognitive skills, social functioning, mood and well-being, with a reduction of spasticity, perception of pain, stress, anxiety, or depression (Jorgenson, 1997).

It is important to distinguish between animal assisted therapies (AAT) and animal assisted activities. AAT is a goal-directed intervention that utilizes an animal as a tool in the treatment of a person with a disability (Kruger & Serpell, 2006). The animal is an integral part of the treatment and therapy is delivered by a professional with special training in AAT. In contrast, animal assisted activities are activities in which animals and people with disabilities participate together. There are no individual goals for the patient's progress and delivery by a health professional is not needed.

Several studies have investigated the effects of animals for children with ASD. For instance, some research has revealed that animals provide a feeling of comfort and safety, reducing anxiety and stress (Dimitrijević, 2009). Children with autism or ASD appear to get along better with animals than with people (Grandin, Fine, & Bowers, 2010; Martin & Farnun, 2002; O'Haire et al., 2013;

Pavlides, 2008; Redefer & Goodman, 1989; Sams, Fortney, & Willenbring, 2006). Others suggest that children with autism or ASD use animals as transitional objects, which lead to successful interactions with people (Fine, 2010; Katcher & Wilkins, 2000). In a recent systematic review of AAT, O'Haire (2013) reported benefits such as an improvement in communication, mood, and social interaction with a reduction of lethargy, hyperactivity and stress. Martin and Farun (2002) compared the effects of a dog, a stuffed dog, or a ball for 10 children with ASD (ages 3-13). With a dog, children had an increased social awareness and focus and a more playful mood. Redefer and Godman (1989) investigated the behaviors of 12 children with autism (ages 5-10) during and after 15-20 minutes of dog assisted therapy. Compared with baseline, being with a dog significantly increased prosocial behaviors and decreased isolation with more initiations of activities. Sams et al. (2006) compared language use and social interaction for occupational therapy intervention with and without llamas for 22 children with ASD (ages 7-13). There were significant differences favoring sessions including animals. O'Haire et al. (2013) found increased prosocial behavior in 99 school age children with ASD in the presence of guinea pigs compared to toys as well as an increase of positive affect and a decrease of isolated behaviors or negative affect.

Research related to horses and children with ASD is emerging. Among the types of interventions involving horses, therapeutic horseback riding (THR) and hippotherapy are the most commonly used. THR is a group approach to riding lessons for people with disabilities. Since THR is delivered by a THR instructor,

the assessment of the client's deficits and the use of therapeutic strategies might be limited. The group approach might slow the rehabilitation process in specific areas, but many clients benefit from the social stimulation of this group approach. Teaching riding skills is not the main goal in hippotherapy, but teaching this skill may be part of the therapeutic process. Hippotherapy is physical, occupational or speech therapy treatment that includes the horse and its environment to improve skills. It is delivered one-on-one, and is part of an integrated treatment program with specific goals and strategies based on each client's needs. In hippotherapy the background, responsiveness and therapeutic skills of the therapist influence the outcomes. In a randomized controlled trial, Bass et al. (2009) investigated the effects of 12 weeks of THR on 34 children (5-10 years old) with ASD. Children in the THR group showed increased social motivation, and decreased sensation seeking and sensitivity, sedentary behaviors and inattention. Gabriels, Agnew, Holt, Shoffner, Zhaoxing and Ruzzano (2012) explored the effects of 10 weeks of THR on a sample of 42 children with ASD (ages 6-16) compared with a waitlist control group (n=16). Participants receiving THR showed significant improvements in irritability, lethargy, stereotyped behaviors, hyperactivity, expressive language, motor skills and verbal praxis motor planning. Limitations of this study include raters not being blinded to participants' condition. Ward, Whalon, Rusnak, Wendell and Paschall (2013) examined the association between THR and social communication and sensory processing in 21 children with ASD receiving THR for 6 weeks followed by a 6 week break, 4 weeks of THR followed by a 6 week break and then 8 weeks of THR. Significant improvements

were observed only during intervention. Gains were not maintained when intervention was withdrawn. Limitations of this study included lack of a control group. Since hippotherapy is individualized, it is expected that better and faster results will be achieved with this modality (Dawson & Burner, 2011).

Taylor, Kielhofner, Smith, Butler, Cahill, Ciukaj and Gehman (2009) investigated the effects of 16 weekly sessions of hippotherapy on the volition/motivation of 3 children with ASD and found an increase for two of the children. Effects were measured in therapeutic play sessions with a standardized protocol. Sessions were videotaped and coders were blind to the participants' condition. This study had limitations such as a very small sample size and a questionable methodology. The present study extends the work of Taylor et al. in several ways: increased sample size, a rigorous single case research design with sufficient data points per phase and measurement of motivation during the hippotherapy sessions and at the children's home.

The purpose of our study was to investigate the additive benefits of including a horse within therapy (i.e., hippotherapy) on the motivation of young children with ASD. Since motivation is a broad construct, we focused on one primary observable aspect, engagement in activities, as well as measuring motivation more generally from parents' and teachers' observations.

The hypotheses were that: 1) during hippotherapy, there would be an increased engagement in activities and (2) after hippotherapy, the increases in

engagement in activities would be sustained as measured by observations and by parents' and teachers' report.

Methods

Participants

Children with ASD were recruited from a therapeutic riding association's waiting list or through a letter of invitation from the local autism society. An invitation letter was sent to interested acquaintances of parents who responded (snowball sampling). To be included, children needed a diagnosis of ASD by a qualified clinician or a multidisciplinary assessment team; have delays in spoken language, be ages 3 to 8 years; understand English; have no hippotherapy or therapeutic riding for at least 3 months prior to the study; be interested in horses; and one parent be able to complete questionnaires. Parents needed to authorize video recording of their child. Exclusion criteria were severe or repeated aggressive behavior; exceeding the riding association's weight requirements for riding the horses; and comorbidities (e.g., deafness, blindness) that could interfere with the aims of the study.

Interested parents contacted the first author. A phone interview was followed by two screening meetings. The first screening meeting (a free play session) was conducted at the university. A second screening meeting at the equine center ensured children's interest in and acceptance of riding a horse. Children who were not willing to ride at this time were excluded. Eleven children did not meet the criteria due to not completing the screening process, unwilling to

ride during the first screening, or concerns about comprehension of English instructions.

Eight children (3 girls, 5 boys) aged between 4.5 and 7 years (*M* = 5 years) participated and are described in Table 2.1, using an artificial name to preserve their anonymity. All of the children were diagnosed in a multidisciplinary assessment which included the Autism Diagnostic Observation Schedule- Module I ADOS-I for 6 children and all children had a severe language delay confirmed in the past two years. Spoken language of the children was classified using the benchmarks criteria of Tager-Flusberg and colleagues as follows: one child was in phase one or preverbal; one child was in phase one but beginning to use words; three children spoke primarily using single words (phase 2), although two of them used 2-3 word sentences occasionally; one spoke in 2-3 word combinations (phase 3) with vocalizations and jargon when excited; and two currently communicated in full sentences (phase 4) but needed help to construct proper sentences or build a conversation (Tager-Flusberg, Rogers, Cooper, Landa, Lord, Paul, Rice, (...) & Yoder (2009). Five of the eight children also had echolalia. English was spoken at home for all children; a second language was also spoken with Qiang and Juan. Three children had severe cognitive delays, two children had possible severe cognitive delays although standardized tests could not be completed, one child had borderline scores on a standardized test of intelligence, and two children did not have cognitive assessment reports. Seven children had fine motor delays that were mild (n=2), moderate (n=1), severe (n=1), or not classified (n=3). Five children had confirmed gross motor delays that were mild

(n=1), moderate with low muscle tone (n=1), or severe (n=3). Assessment information was obtained from reports such as Individualized Program Plans or Specialized Services (e.g., psychological, speech) reports. All assessments were completed within the past two years. Two children had a secondary diagnosis of attention deficit-hyperactivity disorder (ADHD) and were on medications (Ritalin, Asperidone or Clonidine). Three children were given Melatonin for sleep issues (Deb, Jen and Larry).

(Insert Table 2.1 about here)

Settings

Baseline and follow up data were collected in a room with colored gym mats, balls, boxes with toys and school materials, a table and some chairs. A swing, trampoline, and/or a hammock were also available during some sessions.

For intervention, activities began in an outdoor arena for almost two months until cold weather forced a move to the indoor arena and stables. Arenas were prepared with cones, poles and colored buckets. There were letters and pictures in different locations on the fence/wall. The outdoor arena was unshared providing a quiet environment, promoting focused attention. The indoor arena was shared with a group of 5 therapeutic riding students, with the hippotherapy session at one end of the arena and, in contrast to the outdoor arena, much noisier. Fine motor activities occurred in a quiet area of the stables at a table with chairs or in the arena. Well trained, calm, therapeutic riding horses were used. The horses were not consistent between sessions. The first author, a therapist certified as a Path International therapeutic riding instructor (Path-international, n.d.) and a

member of the American Hippotherapy Association (American Hippotherapy Association, 2006), carried out the sessions. All sessions, baseline and hippotherapy, were video recorded.

Outcome measures

Engagement was defined as the child attending to, being absorbed or being involved in appropriate interactions with the physical or social environment (Bagatell, 2012), an activity (the requested action), the therapist, or horse. If the child made no attempt to leave the activity, responded to requests, interacted with the therapist or horse whether by responding or initiating, this behavior was scored as "engaged". A child was "not engaged" if he/she showed stereotyped behaviours unrelated to the activity (e.g., flapping hands, flicking fingers, spinning), wandered away from or left the activity or interaction partner (person or horse), had a tantrum or cried, ignored attempts to capture attention, resisted guidance into the activity, looked away/avoided eye contact, played alone, or did not respond to the request. The percentage of time engaged during randomly selected segments was the outcome measure.

Secondary data collection tools were the Pediatric Volitional Questionnaire (PVQ) and the Aberrant Behavior Checklist (ABC). They were used to assess motivation at home using parent report and at school using teacher report before, during, and after intervention. Parents completed the questionnaires once a week during baseline and follow-up, and once every two weeks during intervention. Parents based their answers on the children's behaviors during the week the questionnaires were delivered. Five teachers completed the

questionnaires before and after the intervention. The absence of teacher data for the three remaining children was due to a change of teacher midway through the study for one child and completion of the pre intervention questionnaires only after intervention had begun for two children.

The *Pediatric Volitional Questionnaire 2.1* (PVQ) (Geist, R., 1998) is an observational assessment of children's motivation. It provides insight into a child's motives and interests, and information about how the environment enhances or attenuates motivation by assessing how a child interacts and reacts within his/her environment. There are 14 items addressing 3 volitional levels: exploration (n= 6), competence (n= 5) and achievement (n= 3). Responses are on a four-point scale: passive, hesitant, involved, and spontaneous. Higher scores indicate higher levels of motivation. The PVQ is reported to be valid, reliable and sensitive when completed by professionals who know the children (Andersen, Kielhohner & Lai, 2005; Harris & Reid, 2005). In this study, parents completed the questionnaires keeping the day of the week as consistent as possible. Internal consistency for all of the parents' items was .85- .91.

The *Aberrant Behavior Checklist-community* (ABC-C) (Aman, Singh, Stewart, & Field, 1985a) is a symptom checklist for assessing problem behaviors of children and adults with mental retardation, ages 5 to 58 years old. It can be completed by parents, teachers and health care providers in 10 to 15 minutes. It consists of 58 items scored on a four-point scale ranging from 0 (not a problem) to 3 (problem is severe) with five subscales: Irritability/Agitation/Crying (n=15), Lethargy/Social Withdrawal (n= 16), Stereotypic Behavior (n= 7),

Hyperactivity/Non-Compliance (n= 16), and Inappropriate Speech (n= 4). Lower ABC-C scores indicate fewer problem behaviours. It has high internal consistency (.86-.94) for its subscales, satisfactory reliability and widely recognized validity (Aman, Burrow & Wolford, 1995; Aman, Singh, Stewart & Field,, 1985b; Freund & Reiss, 1991; Rojahn, Rowe, Kasdan, Moore, & van Ingen, 2011; Schroeder, Rojahn, & Reese, 1997). Its validity has been demonstrate also for children (ages 3 and up) (Karabekiroglu & Aman, 2009; Rojahn & Helsel, 1991).The Lethargy/Social withdrawal subscale was used in this study due to its relation to motivation. Items included "Listless, sluggish, inactive", "does nothing but sit and watch others", "unresponsive to structured activities", and "inactive, never moves spontaneously". Lethargy subscale had a Cronbach's alpha of .81.

Field notes were also collected during the entire study. These included notes about the setting (e.g., indoor or outdoor; unusual circumstances), children's unusual behavior (positive or negative), conversations with parents or teachers, and notes about materials/activities used and plans for the next session.

Design

Single case research design is a good starting point for evaluating new interventions (Horner, Carr, Halle, McGee, Odom, &Wolery, 2005; Smith, Scahill, Dawson, Guthrie, Lord & Odom, 2007). A multiple baseline design was selected as it was hypothesized that engagement would not return to baseline levels after intervention (Kazdin, 2011). There were three phases: baseline and intervention a return to the baseline condition in follow up. The present study followed the standards of the What Works Clearinghouse panel regarding number

of phases, replications, and data points per phase (Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf, et al., 2010). The follow up occurred once a week for one month after the intervention concluded.

Procedures

All sessions followed a consistent protocol. In order to assess the contribution of an animal in therapeutic sessions, baseline sessions were designed to mimic the conditions and therapeutic activities that made up the hippotherapy sessions. Variation and novelty promote motivation, as does physical activity (Ryan &Deci, 2000) and therefore the hippotherapy and baseline sessions needed to be similar on these variables. To mimic the variation of activities in hippotherapy (on the horse and off the horse), baseline sessions consisted of gross motor/ physical activities (GM) and fine motor or cognitive (FM) activities. Each type (GM and FM) was available for at least 20 minutes each but no more than 30 minutes, making all sessions no more than one hour for all phases. To mimic the novelty of the hippotherapy sessions, a new toy and/or activity was offered in the baseline sessions for both GM and FM sections. In addition, the therapist used strategies to promote participation drawn from behavioral or developmental approaches during all sessions. All the strategies supported motivation and included offering choices (Lough et al., 2012), using gradual reinforcement delay (Reichle et al., 2010); following the child's lead; using the child's preferred activities, objects and interests (Boyd et al., 2007; Dunst et al., 2011); breaking activities into steps (Grindle et al., 2012); verbal support and reinforcement; visual organizers; use of Picture Exchange Communication System; and grading

the sensory stimulation such as changing voice tone and use of touch to get the child's attention.

Baseline and follow-up sessions occurred at the university. Each baseline session consisted of 45 to 60 minutes of free play guided by the first author. Specific activities varied depending upon the interests and age of the child. GM activities included activities such as jumping, rolling, catching and tossing balls and sports such as soccer and basketball. FM activities were object oriented play that included cognitive elements and were often carried out on a table. Examples of activities were matching or memory activities, copying designs, puzzles, crafts, or play with cars and dolls. During this phase, strategies were used to promote participation and play.

Hippotherapy intervention sessions occurred at the equine center once a week and lasted between 45-60 minutes. The sessions were conducted one-on-one and followed the session guidelines of the Canadian Therapeutic Riding Association and American Hippotherapy Association (AHA). An implementation fidelity checklist was developed and included the essential components of a hippotherapy session, according to the AHA guidelines (Appendix A). The intervention combined on and off horse activities, providing an even but flexible time for both. One of the main benefits of therapy with animals is the involvement of the children in caring for animals. Therefore, activities off the horse involved grooming or feeding the horse. Other off horse activities were saddling and leading the horse as well as art and cognitive activities related to horses. On horse activities consisted of improving balance and muscle strength, learning riding

skills and activities related to the perception of the horse's movement and gaits. Children played games while they rode, such as carrying an object from one part of the arena to the other or grabbing rings. One person led the horse with two side walkers for safety who were directed by the therapist. There were changes in gait (walk, trot), speed (slow, fast) and pattern (figures). During the initial part of each child's intervention, activities were directed and controlled to promote safety and show the children what was allowed and what was not (e.g., shouting, kicking or biting the horse, controlling reins properly). After these more directed sessions, all the activities were planned to address the targeted behaviors. There were opportunities to explore and show interest, make choices, solve problems, practice skills and show initiative. The environment promoted play, enjoyment, learning and progress according to the needs of each child. In this study, all children had the same goals but the strategies used were different according to each child's needs. The strategies used promoted participation and enhanced motivation. In addition, strategies taken from sensory integration were incorporated. For example, during the hippotherapy session if a child responded to the adult's request, the activities continued and new requests were offered. However, if the child did not respond to the adult requests even with strategies such as attempts to capture his/her attention by repetitions, calling or touching, the therapist implemented one or two minutes of trotting (vestibular and proprioceptive stimulation) or activities that involved greater physical challenge such as walking the horse in circles and serpentines or changing the speed of the horse's walk to increase the child's attention. To make intervention similar to baseline, leader and

side walkers were asked to not talk to the children during the sessions. The activities in each session were summarized to ensure that all children received similar types of activities but geared for their needs and age level.

Follow-up consisted of 4 free play sessions to observe if any effects of hippotherapy were sustained for at least a month after intervention. The follow-up phase occurred at the same place utilizing the same procedures as in baseline. For all phases, the order within the sessions varied. Sometimes sessions began with GM or on horse activities and sometimes with FM or off horse activities.

In keeping with the multiple baseline design, the children received a different amount of baseline and hippotherapy sessions, but the same number of follow up sessions. Children had 9 to 11 baseline sessions as it was necessary to ensure stability before moving to intervention and 9 to 12 intervention sessions. Those who started intervention earlier received more intervention sessions. During the intervention phase, two children were absent once due to medical issues. In addition, sessions were cancelled on one day due to a blizzard, resulting in four children missing their last intervention session.

Data collection and coding

The video recording captured a frontal view of the child as well as child and therapist interactions and verbalizations.

Raters coded the data from the digital video recordings. A randomly selected (using random numbers functions) 5 minute segments from the first 15 minutes of each section (GM/on horse and FM/off-horse) of a session was coded.

This resulted in two 5-minute videos per session through all phases. Each 5-minute video was divided into 5-second intervals using the Picture Motion Browser software from Sony. Each 5 second interval received a dichotomous code as the child was considered engaged or not engaged. The percentage of intervals in which the child was engaged was calculated. All segments were scored by the principal rater and a minimum of 25% per phase scored by a second rater.

Rater bias was minimized through blinding to the purpose of the study. It was not possible to blind the rater to whether the child was in free play or hippotherapy or whether the video was from baseline or follow-up free play. To address this potential for bias, inter and intra rater was monitored carefully and kept high to ensure raters' adherence to the coding rules. Reliability checks occurred randomly during all phases. Inter and intra-rater calculations were based on the criteria from Richards, Taylor, Ramasamy and Richards (1999). Inter-rater agreement was 96.7% (88-100) for occurrence and non-occurrence of the behaviors. Discrepancies in behaviors were discussed among the two raters to reach consensus and the consensus score was used. The first author resolved any unclear situations. Discrepancies among coders occurred mostly due to rapid changes in the child's behavior or an unusual form of the target behaviors. Intra-rater agreement was 96.7 % (85-100).

Implementation fidelity

The implementation fidelity check list included 17 items considered essential for hippotherapy interventions and for the outcomes of the study

(Appendix A) and was checked for 16 sessions (two per child) which were randomly selected using the random numbers function in Excel software (2010 version). Checks were completed observing at least 15 minutes of each type of activity (GM/FM) per session and scoring yes if the item was accomplished. Overall treatment fidelity was 93%. The primary variation from the planned protocol was the duration of time spent in fine motor /off horse activities. The goal had been to spend at least 15 minutes in these activities. The fidelity check identified instances where the children completed 10 to 14 minutes instead. There was also one instance when Deb spent most of one session in off horse activities due weather conditions in the outdoor arena. One component of the intervention was to follow the child's lead and less time in fine motor/off horse activities is likely related to the children's preferences for activities. Overall the intervention sessions followed the protocol.

Data analysis

Data were graphed and visually analyzed using recommended guidelines (Kazdin, 2011; Portney & Watkins, 2000). Visual analysis included interpretation of level, variability and trend within phases, and the analysis between phases consisted in observation of changes in level, trends, variability, immediacy of effects, proportion of overlap and consistency of the data from baseline to intervention phases (Kratochwill, Hitchcock, Horner, Levin, Odom, & Rindskopf, 2010; 2013). Improved Rate Difference (IRD) calculations supported the findings of the visual analysis giving a measure of intervention effectiveness (Parker, Vannest & Brown, 2009; Parker, Vannest & Davis, 2011). With regard to

interpreting the IRD, Parker et al. (2009) suggest small effects = 0 to .49; moderate effects =.50 to .69, and strong effects are.70 or more. As recommended in Parker et al. (2011), Confidence Intervals (CI) were set at 95% and they were calculated using WinPEPI software for epidemiologists version 11.32 (Abramson, 2011). Data from questionnaires were analyzed using paired t-tests (Gravetter & Wallnau, 2009) in SPSS (version 20th). The t-test is robust enough to withstand violations of assumptions but the results of the analyses should be interpreted with caution due to the small sample size. To control for multiple comparisons, the p-value was adjusted to p = .017.

Results

Figure 2.1 presents the percentage of time that children were engaged in the expected activities. Visual analysis suggests that hippotherapy had a strong effect on the percentage of time children were engaged compared with baseline. The average percentage of intervals in which the children were engaged was 69.9% (Anna), 54.72% (Qiang), 76.09% (Cole), 56.06% (Deb), 77.82% (Juan), 94.50% (Fred), 58.10% (Jen) and 51.85% (Larry). In the intervention phase, the average was 98.88% (Anna), 98.14% (Qiang), 98.75% (Cole), 96.95% (Deb), 99.27% (Juan), 97.06% (Fred), 95.50% (Jen) and 97.61% (Larry). With the exception of Fred, the smallest increase in engagement was 21percentage points (Juan) and the largest was 46 percentage points (Larry). At follow-up, results indicate that for all children, engagement remained similar to that seen in intervention.

Differences in level from baseline to intervention were clear for all participants except Fred. Comparing intervention to follow up, Qiang was the only child that showed a large drop in his engagement levels during follow up phase. He had difficulties with transitions and this is evident in his first follow-up session. However, he was able to cope with this change much faster than during baseline, and his engagement returned to almost intervention levels for the remainder of the follow-up sessions. For the rest of the children, engagement remained high during follow-up phase indicating that changes were maintained once intervention was removed.

Regarding trend, Anna, Qiang, Cole, Deb, Juan, Jen and Larry showed a decreasing trend during baseline (-1.3 to -1.1) while Fred showed no trend. The intervention phase trends showed a neutral slope for all children. Thus, with the increased level of engagement in the intervention phase, this stable level indicates that the children's engagement was more consistently positive in the intervention phase. Follow up trends were also neutral for all children except Qiang, who showed an increasing trend. This trend indicates that he was returning to his intervention level of engagement after the first session.

With regard to intervention effect size, seven of the eight children showed a strong intervention effect with IRD of 100% and Confidence Intervals of either 0.91-1 or .90-1. For Fred, hippotherapy had a small effect. The mean percentage of intervals in which he was engaged increased from 94.5% in baseline to 97% in intervention. Fred’s IRD was 1.82 % CI [-0.27 - 0.64].

For parent questionnaires, scores from the first measurement of baseline and the last measurement of intervention were analyzed. For the PVQ parents reported statistically significant increases in the total score as shown in Table 2.2. The ABC-C Lethargy subscale scores also showed statistically significant improvements.

For teacher's questionnaires, no statistical comparisons were made because of the very small sample size. As shown in Table 2.2, mean post test scores for the ABC-C decreased indicating fewer perceived problem behaviours while motivation remained virtually unchanged as measured by teacher report on the PVQ.

Positive effects of the hippotherapy sessions were noted during the sessions and also by parents and teachers. As Burrows, Adams, & Spiers (2008) suggests, when therapies influence aspects that are relevant in the life of the children, these effects are seen also in children's other activities and environments including their home, family and school. In addition to the quantitative results, parents shared their observations through notes or forwarding teachers' notes. The parents reported that: "It is a fact now: the day after hippotherapy is his best day at school" and "After the hippotherapy session, once he is in the car, he doesn't stop talking until he goes to bed" (Qiang's mom); "I never saw him so engaged in an activity and so calm as when he is on the horse" (Larry's mom), "Dear mom, Cole had another great day at school today. He is much better with transitions, he is enjoying the activities and having very good mood days, and he is participating much more. He has become a happy boy" (Cole's teacher). Mothers reported that

Anna, Qiang, Deb, Jen and Larry were talking more, with more initiations in communications, new words or longer sentences. Three teachers came to observe what the children were doing in the sessions since changes in behavior were observed at school.

According to the field notes, the children showed a strong preference for some of the hippotherapy activities and in particular trotting. Trotting helped the children learn to manage their balance and remain on the horse. Once they mastered this task (3rd session), all the children started to ask for trotting from the time they were seated on the horse. All children showed signs of enjoyment such as smiles, laughing or even singing while trotting. Saddling and feeding the horse were other preferred activities. These activities were included in the sessions as much as possible.

Discussion

The main purpose of this study was to examine the additive benefits of including a horse within therapeutic interventions (i.e., hippotherapy) on the motivation of young children with ASD. Engagement in activities was the primary observable behavior. Analysis of the data showed that 7 children made significant improvements as indicated by the proportion of time they were engaged in activities during hippotherapy sessions compared with baseline. One child, whose level of engagement was always high and stable with ceiling effects from baseline onwards, did not show differences.

There are several possible explanations for the observed changes in the children's engagement. Presence of a horse, is one possible explanation. For centuries, people have used animals to promote health and wellbeing (Jorgenson, 1997). Developing relationships and interactions with animals give children social support and provide psychological and physical benefits (Fine, 2010; Kahn, 1997; McCardle, McCune, Griffin, Esposito & Freund, 2011). The natural and innate attraction toward living creatures may motivate children to engage in animal related activities. This study's findings are consistent with the positive effects in mood and motivation found in other studies of therapies incorporating animals for children with ASD (Bass et al., 2009; Gabriels et al., 2011; Martin &Farun, 2002; O'Haire et al., 2013; Sams et al., 2006; Ward et al., 2013). As Endenburg and van Lith (2011) suggest, the consistency of positive effects across studies suggests the existence of a real effect. The consistency is noteworthy given that the studies had several differences between them such as differences in the animal used, types of therapy approaches (THR/ hippotherapy) and/or research methods. Findings may be due to changes in children's motivation which may be a central benefit of AAT.

Novelty may be another possible explanation. According to the Self Determination theory, novelty influences intrinsic motivation (Deci & Ryan, 1985; Ryan & Deci, 2000). In our study, riding and the associated activities were novel as none of the children had participated in hippotherapy or THR previously. To control for the novelty of hippotherapy, a new toy or activity was included in each baseline session. However, the level of novelty between baseline and

hippotherapy likely still varied. Novel activities in baseline had familiar elements while in hippotherapy there were elements that were entirely unfamiliar such as the smell and feel of the saddle leather, the iron of a stirrup, the texture of hay and oats, and the warmth and movement of the horse's body. There were novel sensory stimuli and physical challenges. The novelty in combination with the attraction to the horse may have intrinsically motivated the children, increasing their engagement. It was anticipated that if the children's engagement was influenced by the novelty of riding, it would be reduced after the children habituated to riding. This was not the case. Engagement remained high over the 2.5 months of hippotherapy. The positive effects of riding were also noted in the field notes which indicated that for most of the children the quality of their participation increased with more enthusiasm and initiative as they learned and mastered skills, asking for more. Activities with horses involve elements and experiences that are unique. However, riding was not the only thing that may have engaged the children.

The variety of activities offered in the study could also help explain the results. The activities during all phases included both gross motor and fine motor activities with a new activity every session in all phases. However, as graphical data shows, there was a trend of decreasing motivation during baseline, but a high and stable trend during intervention for most of the children. Therefore providing a variety of activities is not a sufficient explanation.

The positive effects of physical exercise may also influence the children's engagement. After physical exercise, brain functions such as concentration,

attention, memory, perceptual and verbal skills improve (Chaddock, Pontifex, Hillman, & Kramer, 2011; Chang, Tsai, Chen, & Hung, 2013; Pontifex, Raine, & Johnson, 2011). Riding a horse provides a great deal of physical demands and challenges, which means that by having fun riding a horse, the children also received the additional benefit of doing physical exercise.

It is important to consider why the children preferred specific hippotherapy activities, such as feeding the horse. This activity and other activities related to caring for the horse were likely satisfying due to their novelty but also due to looking after the horse, helping them to focus on activities with others and for others. The children would standstill looking at the eating horse until the feeding pot containing apples or carrots that they had brought was emptied. For one of the children this led to variations in his diet with better food transitions at school. Cole was excited in a cooking class when his teacher showed the ingredients of an apple pie. He exclaimed "Oh my Gosh, apples!" eating some bits of the pie later. This seemed to indicate that some aspects of the hippotherapy sessions were retained and linked to other environments and activities.

Another explanation for the results is that the activities may have addressed the children's sensory needs. Children with ASD often have sensory processing dysfunctions (Rogers & Ozonoff, 2005; Wiggins, Robins, Bakeman, & Adamson, 2009) with a weak inner drive. Purposeful activities may strengthen their inner drive to participate in sensorimotor activities (Bundy & Murray, 2002) and promote purposeful adaptive responses (adjusted and correct) to the environment (Bundy & Koomar, 2002). Use of activities that promote appropriate

sensory processing may help children achieve adaptive and successful responses strengthening their inner drive (Bundy & Murray, 2002).

Many children with ASD have difficulty filtering irrelevant stimuli and maintaining an optimal level of arousal or alertness to the environmental demands to allow adaptive responses (Lane, 2002). Optimal arousal level is what allows the children to produce appropriate responses and therefore more successful participation. Strategies to modulate arousal levels include activities such as the horse's gait that stimulate the vestibular or proprioceptive systems. During hippotherapy, the therapist varied the vestibular and proprioceptive stimulation according to the needs of each child. This had positive effects on the children's attention with more focus on the activities resulting in more successful responses, increasing their self-confidence and motivation. During baseline the children received vestibular stimulation (e.g., on a trampoline) only if the child selected an activity with that input. During hippotherapy all children had vestibular stimulation graded by the therapist. During baseline, the duration of the self-selected vestibular stimulation was often shorter than during hippotherapy. The vestibular stimulation provided by the trot was likely stronger and longer and combined with other sensations such as speed. During follow up, a swing was introduced as a possible activity and it was often chosen by the children. It may provide similar vestibular activity to riding a horse but with less proprioceptive input and of shorter duration. According to Bundy and Koomar (2002), children with ASD often need intense experiences. Intense vestibular and proprioceptive stimulation are easily offered and graded while riding a horse. When a child had a

decrease in their attention, one or two minutes of trotting were implemented, resulting in the child being more focused on the requested activity.

Offering the just-right challenge was another sensory integration strategy implemented. It included a careful assessment of the child's abilities and needs, as well as the demands of the activities. Challenges are attractive and increase participation. During the sessions, children participated in activities that were graded according to their skill level. In addition, several activities involved physical challenges. Once the children controlled their balance, they participated in activities that required more effort such as riding with and without the help of their hands, riding backwards, catching balls or standing in stirrups while the horse was walking. Field notes indicated that in these activities, children showed enthusiasm and excitement confirming the theories that support the value of challenges to motivate children.

Another explanation may relate to the high levels of stress and anxiety of children with ASD (White, Oswald, Ollendick, & Scahill, 2009). Participation in activities that promote relaxation and contact with nature may be beneficial. In hippotherapy, children usually experience enjoyment and pleasure and perceive the therapy as a form of recreation. Studies from self-determination theory also demonstrate the positive effects of outdoor activities. Natural elements promote wellness and are energizing (Ryan, Weinstein, Bernstein, Brown, Mistretta, & Gagné, 2010), resulting in increased motivation. These effects are even more apparent when the activity involves social elements and physical exercise (Frederic & Ryan, 1995) and could explain why hippotherapy was beneficial. It

involved social and physical activities done in outdoor and natural environments that may help the children to connect with natural elements (horse, environment). Other studies have also found that effective use of physical activities promotes attention and academic engagement (Oriel, George, Peckus, & Semon, 2011).

Theories of attention restoration also offer an explanation about the important role of nature. Attention is a limited resource (Kaplan, 1995). Rest and activities that do not need effort to maintain attention can help to restore focusing skills. Attention Restoration Theory suggests that green and natural environments are effective because activities in these environments usually utilize less mental effort. To promote attention restoration during the hippotherapy sessions, the horse was walked a lap around the arena in between activities or after the children had performed a difficult activity. In the outdoor arena, the quiet environment facilitated relaxation. During this lap the children were asked to just let the horse carry them. They could observe the natural environment with other horses grazing, green pastures, the sky, birds, and trees. This "free of tasks lap", which usually lasted around two minutes, seemed to have a positive and calming effect that prepared the children for the next activity.

Children with ASD often feel overwhelmed by the stimuli in the environment. Outdoor environments are beneficial but they are also challenging due to the amount of uncontrollable stimuli such as the noise and movements of animals, the wind, and temperature changes. If there is too much stimulation, ways to reduce the impact are needed. In our study, hippotherapy sessions moved to an indoor arena due to the cold weather. This space was shared with a group of

therapeutic riding students. Field notes revealed that even though children were still engaged in the activities, the therapist had to make much more effort to keep them focused. The outdoor environment seemed to exert more positive effects on the children, even though there were more uncontrolled stimuli, than the noisy and busy indoor arena. Similar to Bagatell (2012) and Ruble and Robson (2007) these observations indicate that the quality of the children's engagement was related to the environment and personal factors. However, results of this study also show that it is possible to adapt the therapy and the strategies to less than ideal circumstances.

Another important aspect to consider is the therapeutic and learning environment. The main requirement to promote participation and learning is an environment where children feel able and where self-confidence together with some freedom is fostered (Keay-Bright & Howarth, 2012). Activities need to fit with their personal traits, including their ideas, wishes and ways to do an activity. This promotes participation since modifying and making changes in the environment is an essential feature of all human nature and produce satisfaction. It is also linked with creativity that is another aspect that fosters intrinsic motivation. As Kishida & Kemp (2009) suggest, promoting feelings of self-confidence and independence is important to promote motivation to participate in activities. This can be achieved by providing opportunities for success, creativity and initiations. Children with ASD often feel overwhelmed by the tasks. Offering positive learning environments is essential. During the sessions, a learning and supportive environment was maintained.

The individualized sessions may also be another important factor. Individualized sessions allow the therapist to focus on each child, observing their specific needs. ASD is a spectrum and heterogeneity is one of its features. Each child is unique. As Ruble and Robson (2007) indicate, engagement is a state construct that takes into account external and internal factors as well as personal traits. Motivation and the factors and needs that promote it likely differ for each person. Hippotherapy is an individualized intervention. The therapist used strategies that were most appropriate and useful for each child. Working one-on-one allowed children the time that they needed to observe, to organize and plan their responses. Some children also had delayed responses. The use of time is more productive in individualized sessions since the activities follow the child's rhythm. When working in groups, one of the children may participate while the rest of the group waits for their turn. For children with attention difficulties this can be a real challenge. For some children and for some goals, working in groups is beneficial, provided the entire group can be involved in some way. Waiting time may be counterproductive if children cannot benefit from modeling**.**

As Szatmari (2004) suggests, it is the professional's or educator's responsibility to understand the uniqueness of children with ASD, what motivates them, what they can do and what can be an overwhelming challenge. Results of this study suggest that utilization of an animal in a therapeutic session can be a powerful motivator for some children with ASD. However, the use of the animal and the environment has to be carefully selected and monitored to help the child to reach their maximum potential. The combination of novelty and variation of

activities in an individualized setting with the inclusion of an animal that provides vestibular and proprioceptive stimulation seems to have improved the children's motivation. The amount and the timing of the vestibular and proprioceptive stimulation, success on physically challenging activities, a supportive learning environment and matching of strategies and stimulation relative to the child's needs and the environment or context all seem important. Future research is needed to consider the effects of each of these aspects individually. In addition, combination of all these strategies in other types of environments such as playground or school needs evaluation as well.

Generalization of findings

Generalization of the intervention effect was measured in three social contexts: play room (during follow-up), home and school environments. Changes in the children's motivation during intervention were maintained during the follow-up sessions in the presence of a familiar adult. Statistically significant changes in the scores on the PVQ revealed that changes in the children's motivation were observed in their home. Changes in the Lethargy subscale of the ABC-C were observed at home and school. Consistency of results in all social contexts is a good indicator of the magnitude of the behavioral changes (Portney & Watkins, 2000).

Social validity of hippotherapy was observed by the parents' excellent attendance. In addition, during the intervention phase, parents and teachers often reported changes in the children at home and school. Finally, after the study

concluded, 5 of the 8 parents registered their children in hippotherapy programs or THR due to the lack of hippotherapy.

Limitations

There were several limitations. It was difficult to blind the raters to phases, and for this reason inter-rater reliability needed to be very high. The sample size was small limiting generalization of the results. The follow up period was only one month long limiting the understanding of the longer term effects. The adult who delivered the sessions was kept constant over all phases to ensure that changes were not due to characteristics of the adult. However, increased familiarity with the adult may have contributed to the results. Finally, the ability of the children to run away or avoid the therapist was restricted in the hippotherapy sessions by being on the horse and therefore the child might have been more likely to be engaged. However, this was likely not the explanation because the data indicated that the children were engaged not only in 'on' horse activities but also in the 'off' horse activities when there were opportunities to leave the therapy area. As the PVQ was created to be completed by trained professionals, the validity of having parents complete the PVQ questionnaire rather than a professional is another limitation of this study. Internal consistency was good but validity needs to be examined. Another limitation is the possible existence of Hawthorne effect and social desirability in the parents' questionnaire responses. For this reason, each time questionnaires were given to the parents, the author reinforced the rules for responding to the questionnaires. Mean values for teachers' questionnaires were close to the parents' values. Teachers answered the

questionnaires without being told the study phase and did not have any relationship with the therapist who carried out the intervention. They answered the questionnaires two and a half months after the first response limiting possible recall bias since it was difficult for them to remember what they had answered in the first measurement. Therefore similar values between teacher and parent ratings increase confidence in the parent ratings.

Future directions

Our findings support the benefits reported in other hippotherapy or THR studies (Bass et al., 2009; Gabriels et al., 2011; Taylor et al., 2009; Ward et al, 2013). However, the current study needs to be replicated with a larger and more heterogeneous sample. Controlling for increasing familiarity with the adult should be addressed in future studies. In addition, other variables seemed to have an important relationship to improvements in motivation and they need to be studied individually. Changes in self-esteem and self- confidence need to be considered. The difficulties of children with ASD frequently result in a lack of success in their daily environments (home and school). This can impair their self-esteem and self-confidence and result in frustration. In hippotherapy, the attraction to an animal within a therapeutic environment may foster participation and their success may increase self-esteem and self-confidence. Close observation of these two variables would be an important next step. Another possible research area is the effects of activities that involve animals in children with ASD who have difficulties in praxis or motor areas. Specific aspects of hippotherapy need further investigation such as the quality of the child's response after different types/amounts of

vestibular stimulation; i.e., duration (in minutes) and quality (fast/slow) of horse's walk or trot and the child's response speed, accuracy and duration of attention span. Next steps for hippotherapy as well as for THR include the creation of specific standardized protocols and manualization of each intervention approach, a necessary step for growth of the field (Smith et al, 2007). This will help researchers and therapists to apply the same conditions and strategies across studies allowing replication of.

Conclusion

The findings of this study indicate that for young children with ASD and impaired communication skills, hippotherapy appears to increase engagement for participating in activities. Even though the mechanisms underlying these changes need further exploration, observations provide some clues for understanding how or why the changes were produced. When working in therapies with animals, it is important to understand which conditions make these therapies most effective. Interaction with an animal, novelty and variation, the strategies used, the vestibular stimulation, and the environment all appear to be essential. In addition, positive experiences in an environment may facilitate the children's participation in other environments, such as home and school. As Kielhofner (2008) suggested, children's motivation to participate in activities increases by providing activities resulting in positive feedback. By doing so, the children may be more motivated to participate in the varied activities that they encounter in life. This study emphasizes that it is not only the animal itself, but also the selection of specific

techniques and strategies in combination with the attraction and the features of the animal that may make hippotherapy a successful intervention tool.

References

Abramson, J.H. (2011). WINPEPI updated: computer programs for epidemiologists, and their teaching potential. Epidemiologic Perspectives & Innovations 2011, 8, 1.

Adamson, L.B., Deckner, D.F., &Bakeman, R. (2010). Early interests and joint engagement in typical development, autism, and Down syndrome. *Journal of Autism and Developmental Disorders, 40 (6)*, 665-676.

Aman, M.G., Burrow, W.H., & Wolford, P.L. (1995). The Aberrant Behavior Checklist-Community: Factor validity and effect of subject variables for adults in group homes. *American Journal on Mental Retardation, 100(3),* 283-292.

Aman, M.G., Singh, N.N., Stewart, A.W., & Field, C.J. (1985a). The Aberrant Behavior Checklist: A behaviour rating scale for the assessment of treatment effects. *American Journal of Mental Deficiency, 89(5),* 485-491.

Aman, M.G., Singh, N.N., Stewart, A.W., & Field, C.J. (1985b). Psychometric characteristics of the Aberrant Behavior Checklist. *American Journal of Mental Deficiency, 89(5),* 492-502.

American Hippotherapy Association (2006). *American Hippotherapy Association, Treatment Principles Manual-Level I, 2011, 3rd ed*. Fort Collins, Colorado: Education Curriculum Committee of the American Hippotherapy Association.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM 5th ed.).Washington, DC: Author.

Andersen, S., Kielhofner, G., & Lai, J.-S. (2005). An examination of the measurement properties of the Pediatric Volitional Questionnaire. *Physical and Occupational Therapy in Pediatrics, 25 (1-2),* 39-57.

Bagatell, N. (2012). Engaged moments: Mediated action and children with autism in the classroom setting. *OTJR Occupation, Participation and Health, 32 (1),* 258-265.

Bass, M. M., Duchowny, C. A., & Llabre, M. M. (2009). The effect of therapeutic horseback riding on social functioning in children with autism. *Journal of Autism and Developmental Disorders, 39(9),* 1261–1267.

Boyd, B.A., Conroy, M.A., Mancil, G.R., Nakao, T., & Alter, P.J. (2007). Effects of circumscribed interests on the social behaviors of children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37 (8),* 1550-1561.

Bundy, A. & Koomar, J, (2002). Orchestrating intervention: the art of practice. In A.C. Bundy (Ed.), *Sensory integration, theory and practice (2nd ed*.) (pp. 242-259). Philadelphia, PA: Davis.

Bundy, A. & Murray, E. (2002). Sensory integration: A. Jean Ayres' theory revisited. In A.C. Bundy (Ed.), *Sensory Integration, theory and practice (2nd ed.)*(pp. 3-33). Philadelphia, PA: Davis.

Burrows, K. E., Adams, C. L., & Spiers, J. (2008). Sentinels of safety: Service dogs ensure safety and enhance freedom and well-being for families with autistic children. *Qualitative Health Research, 18(12),* 1642–1649.

Chaddock, L., Pontifex, M.B., Hillman, C.H., & Kramer, A.F. (2011). A review of the relation of aerobic fitness and physical activity to brain structure and function in children. *Journal of the International Neuropsychological Society 17 (6),* 975-985.

Chang, Y.-K., Tsai, Y.-J., Chen, T.-T., & Hung, T.-M. (2013). The impacts of coordinative exercise on executive function in kindergarten children: an ERP study. *Experimental Brain Research, 225,*187–196.

Connor, K., &Miller, J. (2000). Animal-assisted therapy: an in-depth look. *Dimensions of critical care nursing: DCCN, 19 (3),* 20-26.

Dawson, G., & Burner, K. (2011). Behavioral interventions in children and adolescents with autism spectrum disorder: A review of recent findings. *Current Opinion in Pediatrics, 23* (6), 616-62.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.

Dimitrijević, I. (2009). Animal-assisted therapy - A new trend in the treatment of children and adults. *PsychiatriaDanubina, 21 (2),* 236-241.

Dunst, C.J., Trivette, C.M., &Masiello, T. (2011). Exploratory investigation of the effects of interest-based learning on the development of young children with autism.*Autism, 15 (3),* 295-305.

Endenburg, N., & van Lith, H.A. (2011). The influence of animals on the development of children. *Veterinary Journal, 190 (2),* 208-214.

Esposito, L., Mccune, S., Griffin, J.A., Maholmes, V. (2011). Directions in human-animal interaction research: Child development, health, and therapeutic interventions. *Child Development Perspectives, 5 (3*), 205-211.

Fine, A. H. (2010). Incorporating animal-assisted therapy into psychotherapy: guidelines and suggestions for therapists In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)* (pp. 169–191). San Diego, CA: Elsevier.

Frederick, C.M. & Ryan, R.M. (1995). Self-determination in sport: a review using cognitive evaluation theory. *International Journal of Sport Psychology, 26,* 5-23.

Freund, L. S., & Reiss, A. L. (1991). Rating problem behaviors in outpatients with mental retardation: use of the Aberrant Behavior Checklist. *Research in Developmental Disabilities, 12(4),* 435-451.

Gabriels, R. L., Agnew, J. A., Holt, K. D., Shoffner, A., Zhaoxing, P., & Ruzzano, S. (2012). Pilot study measuring the effects of therapeutic horseback riding on school-age children and adolescents with autism

spectrum disorders. *Research in Autism Spectrum Disorders, 6(2),* 578–588.

Geist, R. (1998). The validity study of the pediatric volitional questionnaire. Unpublished master's thesis, University of Illinois at Chicago, Chicago, IL.

Grandin, T. Fine, A. H. & Bowers, C.M. (2010). The use of therapy animals with individuals with autism spectrum disorders. In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)*(pp. 247-264). San Diego, CA: Elsevier.

Gravetter, F.J. &Wallnau, L.B. (2009*). Statistics for the Behavioral Science (8th ed.).* Belmont, CA: Wadsworth.

Grindle, C.F., Hastings, R.P., Saville, M., Hughes, J.C., Huxley, K., Kovshoff, H., Griffith, G.M., (...), Remington, B. (2012). Outcomes of a behavioral education model for children with autism in a mainstream school setting. *Behavior Modification, 36 (3),* 298-319.

Harris, K., & Reid, D. (2005). The influence of virtual reality play on children's motivation. *Canadian Journal of Occupational Therapy, 72,* 21–29.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., &Wolery, M. (2005). The use of single subject research to identify evidence-based practice in special education. *Exceptional Children, 71(2),* 165–179.

Jorgenson, J. (1997). Therapeutic use of companion animals in health care. *Journal of Nursing Scholarship, 29 (3),* 249-254.

Kahn Jr., P.H. (1997). Developmental psychology and the biophilia hypothesis: Children's affiliation with nature. *Developmental Review, 17 (1),*1-61.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15 (3),* 169-182.

Karabekiroglu, K. &Aman, M.G. (2009).Validity of the Aberrant Behavior Checklist in a clinical sample of toddlers.*Child Psychiatry and Human Development, 40 (1),* 99-110.

Kasari, C., Gulsrud, A.C., Wong, C., Kwon, S., &Locke, J. (2010). Randomized controlled caregiver mediated joint engagement intervention for toddlers with autism. *Journal of Autism and Developmental Disorders, 40 (9),* 1045-1056.

Katcher, A.H. & Walkins, G.G (2000). The centaur's lessons: therapeutic education through care of animals and nature study. In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)* (pp. 153-178). San Diego, CA: Elsevier.

Kazdin, A. E. (2011). *Single-case research designs: methods for clinical and applied settings (2nd ed.).* New York, NY: Oxford University Press.

Keay-Bright, W., & Howarth, I. (2012). Is simplicity the key to engagement for children on the autism spectrum?. *Personal and Ubiquitous Computing, 16 (2),* 129-141.

Keen, D.(2009). Engagement of children with autism in learning. *Australasian Journal of Special Education, 33,* 130-140.

Kielhofner, G. (2008). *Model of Human Occupation: Theory and Application (4th Ed.).* Baltimore, MD: Lippincott Williams & Wilkins.

Kinnealey, M., Pfeiffer, B., Miller, J., Roan, C., Shoener, R., & Ellner, M.L. (2012). Effect of classroom modification on attention and engagement of students with autism or dyspraxia. *American Journal of Occupational Therapy, 66 (5),* 511-519.

Kishida, Y., & Kemp, C. (2009). The engagement and interaction of children with autism spectrum disorder in segregated and inclusive early childhood center-based settings. *Topics in Early Childhood Special Education, 29 (2),* 105-118.

Kratochwill, T.R., Hitchcock, J.H., Horner, R.H., Levin, J.R., Odom, S.L., Rindskopf, D.M., et al. (2013). Single-case intervention research design standards. *Remedial and Special Education, 34 (1),* 26-38.

Kratochwill, T.R., Hitchcock, J., Horner, R.H., Levin, J.R., Odom, S.L., Rindskopf, D.M., et al. (2010). Single-case designs technical documentation. Resource document. What Works Clearinghouse.

http://ies.ed.gov.login.ezproxy.library.ualberta.ca/ncee/wwc/pdf/wwc_scd.pdf. Accessed 7June 2013.

Kruger, K.A., & Serpell, J.A. (2006). Animal-Assisted interventions in mental health: definitions and theoretical foundations. In A.H. Fine (Ed.), *Handbook on Animal-assisted Therapy: Theoretical Foundations and Guidelines for Practice (2nd Ed.)*, (pp. 21–38). San Diego, CA: Academic Press.

Landa, R.J., Holman, K.C., O'Neill, A.H., & Stuart, E.A. (2011). Intervention targeting development of socially synchronous engagement in toddlers with autism spectrum disorder: A randomized controlled trial. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 52 (1)*, 13-21.

Lane, S.J. (2002). Sensory modulation. In A.C. Bundy (Ed.), *Sensory integration, theory and practice* (2nded.) (pp. 101-120). Philadelphia, PA: Davis.

Lawton-Shirley, N. (2002). In A.C. Bundy (Ed.), *Sensory integration, theory and practice (2nd ed*.) (pp. 242-259). Philadelphia, PA: Davis.

Lee, P.C. (2012). The human child's nature orientation. *Child Development Perspectives 6 (2)*, 193-198.

Lough, C.L., Rice, M.S., &Lough, L.G. (2012).Choice as a Strategy to Enhance Engagement in a Coloring Task in Children with Autism Spectrum Disorders. *Occupational Therapy International, 19 (4)*, 204-211.

Mailloux, Z. & Smith Roley, S. (2001). Sensory Integration. In: H. Miller-Kuhaneck, Autism, a comprehensive occupational therapy approach (1st ed.) (pp. 101-127). Baltimore, Maryland: The American Occupational Therapy Association.

Martin, F., & Farnum, J. (2002). Animal-assisted therapy for children with pervasive developmental disorders. *Western Journal of Nursing Research, 24(6),* 657–670.

McCardle, P., McCune, S., Griffin, J.A., Esposito, L. & Freund, L. S. (2011). *Animals in our lives: Human–animal interaction in family, community, and therapeutic settings.* Baltimore, MD: Brookes Publishing.

McClelland, D. C. (1985). *Human motivation.* Cambridge, UK: Cambridge University Press.

Muñoz Lasa, S., MáximoBocanegra, N., Valero Alcaide, R., AtínArratibel, M.A., Varela Donoso, E., Ferriero, G. (2013). Intervenciones asistidas por animales en neurorrehabilitación: una revision de la literature más reciente [Animal assisted interventions in neurorehabilitation: A review of the most recent literature]. *Neurologia*. Article in Press.

Nicholson, H., Kehle, T.J., Bray, M.A., & Heest, J.V. (2011). The effects of antecedent physical activity on the academic engagement of children with autism spectrum disorder. *Psychology in the Schools, 48 (2),* 198-213.

Oriel, K.N., George, C.L., Peckus, R., Semon, A. (2011). The effects of aerobic exercise on academic engagement in young children with autism spectrum disorder. *Pediatric Physical Therapy 23 (2),* 187-193

O'Haire, M.E. (2013). Animal-assisted intervention for Autism Spectrum Disorder: A systematic literature review. *Journal of Autism and Developmental Disorders, 43 (7), 1606-1622.*

O'Haire, M.E., McKenzie, S.J., Beck, A.M., Slaughter, V. (2013). Social behaviors increase in children with autism in the presence of animals compared to toys. *PLoS ONE 8 (2),* e57010.

Parker, R.I., Vannest, K.J., &Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children, 75 (2),* 135-150.

Parker, R.I.,Vannest, K.J., &Davis, J.L. (2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification, 35 (4),* 303-322.

PATH-International-Ex Narha, (n.d.). Retrieved from http://www.pathintl.org/resources-education/resources/eaat/198-learn-about-therapeutic-riding.

Patten, E., Watson, L.R. (2011). Interventions targeting attention in young children with autism. *American Journal of Speech-Language Pathology 20 (1),* pp. 60-69.

Pavlides, M. (2008). *Animal-assisted interventions for individuals with autism*. London: Jessica Kingsley Publishers.

Pontifex, M.B., Raine, L.B., Johnson, C.R. (2011). Cardiorespiratory fitness and the flexible modulation of cognitive control in preadolescent children. *Journal of Cognitive Neuroscience, 23,* 1332–1345.

Portney L.G. & Watkings, M.P. (2000). *Foundations of clinical research: Applications to practice (2nd ed.).* New Jersey, NJ: Prentice Hall.

Prelock, P.J., & Nelson, N.W. (2012). Language and communication in autism: An integrated view. *Pediatric Clinics of North America 59 (1)* , pp. 129-145.

Prizant, B.M., & Wetherby, A.M. (1998). Understanding the continuum of discrete-trial traditional behavioral to social-pragmatic developmental approaches in communication enhancement for young children with autism/PDD. *Seminars in speech and language 19 (4),* pp. 329-352; quiz 353; 424.

Redefer, L. A., & Goodman, J. F. (1989). Brief report: Pet-facilitated therapy with autistic children. *Journal of Autism and Developmental Disorders, 19(3),* 461–467.

Reichle, J., Johnson, L., Monn, E., & Harris, M. (2010).Task engagement and escape maintained challenging behavior: Differential effects of general and explicit cues when implementing a signaled delay in the delivery of

reinforcement. *Journal of Autism and Developmental Disorders, 40 (6),* 709-720.

Richards, S. B., Taylor, R.L, Ramasamy, R., & Richards, R.Y. (1999). *Single subject research*. London. UK: Singular Publishing Group.

Rogers, S.J., & Ozonoff, S. (2005). Annotation: what do we know about sensory dysfunction in autism? A critical review of the empirical evidence. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 46 (12),* 1255-1268.

Rojahn, J.,& Helsel, W.J. (1991). The Aberrant Behavior Checklist with children and adolescents with dual diagnosis. *Journal of Autism and Developmental Disorder, 21 (1),* 17-28.

Rojahn, J., Rowe, E.W., Kasdan, S., Moore, L., & van Ingen, D.J. (2011). Psychometric properties of the Aberrant Behavior Checklist, the Anxiety, Depression and Mood Scale, the Assessment of Dual Diagnosis and the Social Performance Survey Schedule in adults with intellectual disabilities. *Research in Developmental Disabilities, 32 (6),* 2309-2320.

Ruble, L.A., &Robson, D. M. (2007). Individual and environmental determinants of engagement in autism. *Journal of Autism and Developmental Disorder, 37 (8),* 1457-1468.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55,* 68–78.

Ryan, R.M., Weinstein, N., Bernstein, J., Brown, K.W., Mistretta, L., & Gagné, M. (2010).Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology, 30 (2),* 159-168.

Sams, M. J., Fortney, E. V., & Willenbring, S. (2006). Occupational therapy incorporating animals for children with autism: A pilot investigation. *American Journal of Occupational Therapy, 60(3),* 268–274.

Schroeder, S. R., Rojahn, J., & Reese, R. M. (1997). Brief report: Reliability and validity of instruments for assessing psychotropic medication effects on self-injurious behavior in mental retardation. *Journal of Autism and Developmental Disorders, 27(1),* 89-102.

Smith, T., Scahill, L., Dawson, G., Guthrie, D., Lord, C., Odom, S., Rogers, S., & Wagner, A. (2007). Designing research studies on psychosocial interventions in autism. *Journal of Autism and Developmental Disorders, 37 (2*), 354-366.

Szatmari, P. (2004). *A mind apart: Understanding children with autism and Asperger Syndrome*. New York, NY: Guilford Press.

Tager-Flusberg, H., Rogers, S., Cooper, J., Landa, R., Lord, C., Paul, R., Rice, M., (...), Yoder, P. (2009). Defining spoken language benchmarks and

selecting measures of expressive language development for young children with autism spectrum disorders. *Journal of Speech, Language, and Hearing Research 52 (3),* 643-652.

Taylor, R.R., Kielhofner, G., Smith, C., Butler, S., Cahill, S.M., Ciukaj, M.D., & Gehman, M. (2009) Volitional change in children with autism: A single-case design study of the impact of hippotherapy on motivation. *Occupational Therapy in Mental Health, 25,* 192-200.

Ward, S.C., Whalon, K., Rusnak, K., Wendell, K., & Paschall, N. (2013). The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. *Journal of Autism and Developmental Disorders,* 1-9. In Press.

White, S.W., Oswald, D., Ollendick, T., & Scahill, L. (2009). Anxiety in children and adolescents with autism spectrum disorders. *Clinical Psychology Review, 29 (3),* 216-229.

Wigfield, A., Guthrie, J. T., Tonks, S., & Perencevich, K. C. (2004). Children's motivation for reading: Domain specificity and instructional influences. *Journal of Educational Research, 97(6),* 299-309.

Wiggins, L.D., Robins, D.L., Bakeman, R., & Adamson, L.B. (2009). Brief report: Sensory abnormalities as distinguishing symptoms of autism spectrum disorders in young children. *Journal of Autism and Developmental Disorders, 39 (7),* 1087-1091.

Table 2.1.Participant Information

Child	Age, Other diagnoses	Assessments[a]	Communication/ socialization during baseline	Behavioral challenges during baseline	School, Therapy, Other activities
Anna	4-10	Cognitive skills: 4 months below age; disordered, scattered learning profile (BSID-III). Needs extra time, support or repetition in learning new skills, or in generalization of skills. Communication: Severe communication Disorder (CELF-P2). Adaptive skills: >2 SD below mean (PEDI) Motor skills: mild fine motor delay (PDMS)	Responded to 85% of requests when an action response was required; 60% when a verbal response was required. Single words utterances. Frequent echolalia from cartoons.	Needed assistance with activity transitions. Gets stuck on activities of choice. Comfort in routine activities. Hums, covers ears or makes sounds during activities she doesn't like.	Kindergarten 12 h/wk. Regular class with 1:1 aide Monthly consults with behaviorist, SLP, OT, and teacher
Qiang	5-3 Severe anxiety disorder with OCD features. Gross and fine motor dyspraxia.	Communication: severe delay in expressive& receptive language (PLS-4, EOWPVT-R); severe phonological disorder (HAPP) Functioning skills: Parent/teacher scores: Atypicality: $95^{th}/91^{st}$, withdrawal $74^{th}/99^{th}$, functional communication $1^{st}/1^{st}$, social skills Parent 4^{th}, adaptability $8^{th}/2^{nd}$, daily living scores Parent 6^{th} (BASC II-PRS) Motor skills: moderate delay (PDMS-2)	Responded to 70% of requests. Stereotyped language. Uses 2-3 word phrases, mostly one word. Had difficulty building a conversation. Social responsiveness very limited when adult does not follow his interests. Repeats sentences when excited. Echolalia.	Needed mother visible to avoid anxiety. Always carried his transitional object to regulate his anxiety. OCD features. Lack of variation in play.	Preschool 12 hr/week with aides in class. SLP on regular basis. SLP, OT and behavioral therapistat home, 1-2 times/week. Gymnastic summer camp
Cole	5-8	Language: severe delays in expressive and receptive language (PLS-4). Severe phonological delay. Motor skills: fine motor, $<1^{st}$percentile; gross motor, 19^{th} percentile (PDMS-2).	Responded to 90% of requests. Often needed requests broken steps. Echolalia. Mostly one word utterances. Some 2-3 word phrases. Longer phrases	Easily overstimu-lated. Severe emotional displays in transitions. Rubs hands when upset or excited. Strong	Early Education 4hr for 4 days/wk.(5children) Community aide 3 times/wk.

			include babbling and jargon with only some words clear. Repeats words when unhappy or excited.	interest in trains and buses.	Behaviorist, SLP, OT twice/month. Gymnastic summer camps
Deb	5-1	Cognitive: unable to complete standardized tests due to significant behavior challenges. Language: severe delay (RITLS) Motor skills: overall delay in motor skills (PDMS 2)	Responded to 60% of requests for action and 10% when a verbal response was required. Used some single words, no sentences, often babbled. Clear preference for solitary play. Liked to direct play.	Emotional dysregu-lation. Anxiety. Impulsivity. Difficulty accepting rules. Meltdowns. Used songs to finish activities such as "clean-up".	Early Education 20hr/week. Special Services at home by one aide 3 times (2 hrs.) /week supervised by SLP, OT, PT & behavioral interventionist.
Juan	7-8 ADHD, Crigler-Najor type 2	Cognitive: Unable to complete assessment (2011, no reason reported). Adaptive functioning: extremely low range. Results suggest significant impairment in intellectual functioning. Safety concerns (2011). <u>2012 IPP report</u>: Communication: some speech sounds/articulation delay (HPA). Requires support for reciprocal conversations. Socialization: improved when supported by structured activities, although attention seeking behaviors are displayed. Motor skills: within average range (non-standardized test). School tests: below grade level (HLAT); at grade level (DRL), above grade level (SS).	Responded to 95% of requests. Usually communicated well, but repetitive choice of topics. No variation in conversations always asked the same questions and gave same responses.	Very impulsive and active. Safety and body awareness concerns. Sudden activity changes. Short attention span. Lack of variation in play, fixed focus on an animal and trains.	Elementary school in regular classes with educational aide. Specialized services 4 times (1hr)/ week (OT, SLP, BA and aide) Swims1/wk. Outdoor soccer in community

Fred	6-1	Language: severe expressive and receptive language delay (CELF-P2). Communication: severe overall communication delay and echolia (FAP-P). Motor skills: mild fine motor delay; moderate gross motor delay with low tone (PDMS-2)	Responded to 99% of requests. Used lots of words but words were usually incorrectly combined. Needed to be asked to repeat statements. After request for repetition, he spoke clearly 75% of the time. Echolalia.	Engaged in all activities. Preferred cognitive games. Needed support/ verbal praise to participate in gross motor activities. Motor imitation was difficult	Early Education 15hr/week. Mixed class with aide and consultant Special Services at home: SLP, OT, PT and psychologic al services Gymnastic & swimming lessons
Jen	5-1	Cognitive: Mental development at 29 months level when 44 months chronological age; disordered learning pattern (BSID-3 CS) Language: severe delay (RITLS) Motor skills: overall delay motor skills (PDMS 2).	Responded to 60% of requests for actions and 5% of requests for a verbal response. Non-verbal. Knew only 2 or 3 words; lots of babbling. Sometimes took hand to obtain something desired. Limited attempts to involve a second person. Preferred solitary play, following own interests.	Usually very quiet. Restricted interests, repetitive play in terms of toys, activities. No visual contact. No meltdowns.	Early Education 20hr/week. Special Services at home by one aide 3 times (2 hrs.)/week supervised by SLP, OT, PT & behavioral intervention-ist.
Larry	5-5 ADHD as secondary diagnosis	Cognitive: extreme low range (WPPSI-III); mild intellectual disability (ABAS 2) Language/ Communication: equivalent to 3-1 age (PLS-4). Receptive and expressive language very low (MSEL). Interpersonal relationships and play: low (VABS) Functioning skills: elevated	Responded to the requests 50%. Frequently needed help to focus. Noticeable delay in response. Used 2-3 word phrases. Echolalia speech from cartoons or songs. Pointed or led	Very busy, usually jumping all the time. Very short attention span. Obsessive with numbers and letters. No temper tantrums.	Preschool 20 hr/week with special needs consultant integrated in class OT twice/ week. OT/SLP and intervention-ist4 days/

	hyperactivity, impulsivity and inattention (BASC 2). Motor skills: gross motor adequate (VABS), fine motor delay (PDMS 2)	you to show what he wanted. Made up words.	wk. Swimming and gymnastic Riding two wheeled bike 3 times/week

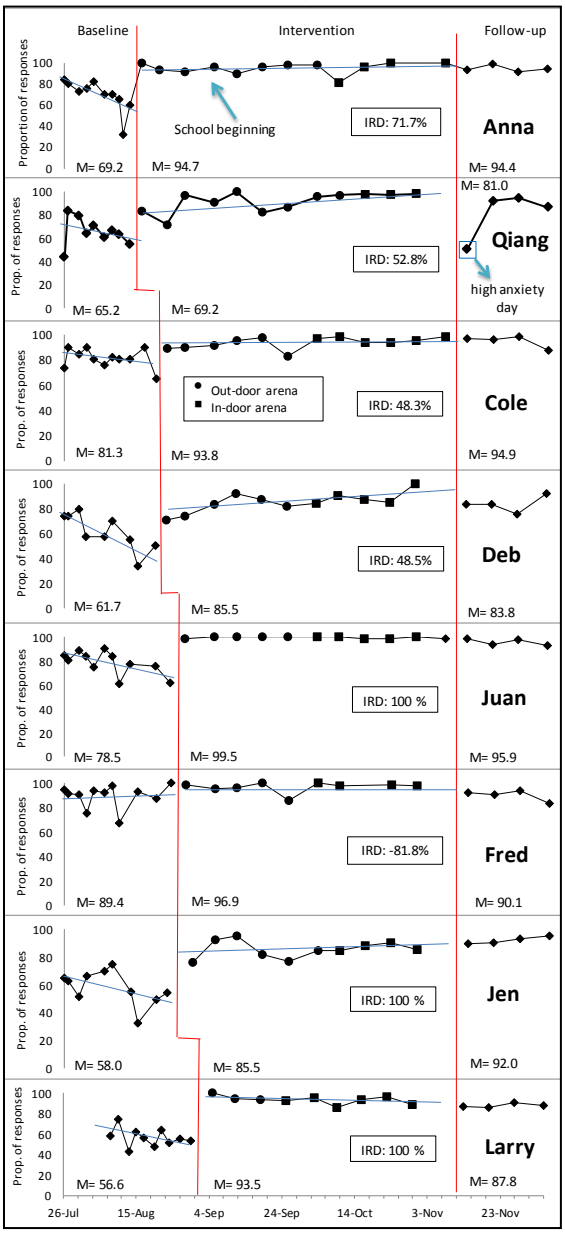
[a]ABAS 2, Adaptive Behavior Assessment System (2nd edition); ; BASC-2-PRSP, Behavior Assessment System for Children 2nd edition- Parent Rating Scale Preschool (P) and Teacher Rating Scale (T); BSID-3-CS, Bayley Scales of Infant Developmental-3rd edition, Cognitive Scale; CELF P2, Clinical Evaluation of Language Fundamentals-Preschool 2;FAP-P, Functional Assessment Protocols-Parent report, Behavioral observations; DRL, Dolsch Reading List; EOWPVT-R, Expressive One-Word Picture Vocabulary Test-Revised; HCAPP, Hodson Computer Analysis Phonological Processes; HLAT interim Benchmark Sample; HPA, Hodson Phonological Assessment; PEDI, Pediatric Evaluation of Disability Inventory; PDMS 2, Peabody Developmental Motor Scale, 2nd edition and PDMS 2-FM, PDMS2- Fine Motor subscale;PLS-4, Preschool Language Scale 4th edition; RITLS, Rossetti Infant Toddler Language Scale; SS, Schonell Spelling;WPPSI-3, Wechsler Preschool and Primary Scale of Intelligence-3rd ed; VABS, Vineland adaptive behavior scales (2nd edition).

Table 2.2. Parents and teachers' questionnaire responses.

Questionnaire	Means& SD		T-test value	P value (one tail)
	Pre	Post		
Parent PVQ*	33.00(9.71)	44.25(8.89)	t (7) = -3.18	p = .0155
Parents ABC ** Lethargy	10.44(7.22)	4.00(4.00)	t (7) = 3.32	p = .0128
	Means & SD			
	Parents		**Teachers**	
	pre	**post**	**pre**	**post**
ABC Irritability	12.5 (9.01)	7 (6.05)	7.20 (4.60)	3.40 (3.44)
ABC Lethargy	10.44 (7.22)	4.00 (4.00)	14.00(13.47)	7.40 (9.07)
ABC Stereotypy	5.06 (4.38)	4.88 (3.52)	4.40 (4.39)	3.60 (5.41)
ABC Hyperactivity	22.44 (8.41)	12.38 (8.75)	11.00 (1.00)	9.00 (6.36)
ABC Inappropriate Speech	5.25 (3.06)	2.38 (2.56)	4.40 (3.78)	3.80 (1.30)

* Pediatric Volitional Questionnaire 2.1, higher scores indicate more motivation
** Aberrant Behavior Checklist-community; lower scores indicate fewer problem behaviors

Figure 2.1.Percentage of engagement in activities.



APPENDIX A. Implementation Fidelity checklist.

1	Did the session involve a horse or elements of horses' life and environment?
2	Was the session one-on-one?
3	Did each type of session (GM-FM) last at least 15-20 minutes?
4	Did the activities provide opportunities for fun, enjoyment or the rider's active participation?
5	Were the activities explained in a clear and understandable way according to each child's cognitive and developmental level making sure that the child could understand the requested activity or task (this includes asking volunteers if the question was understandable due to English pronunciation or construction of the question when a child seemed to do not understand)?
6	If necessary, did the therapist provide prompts to the rider to complete the activities?
7	Did the therapist provide feedback and positive reinforcement to the rider?
8	When on horse, did the session include different gaits or speeds, opportunities to promote children's balance and /or steering (steering was taught only in the last sessions)?
9	When off horse, did the session include the horse or horse environment materials and promote activities such as working with textures, cognitive tasks, fine motor skills, or purposeful activities such as feeding, grooming or saddling the horse or playing games about aspects or materials of the horses' world?
10	Did the sessions offer variability in activities or toys used (this means the therapist offered different types of activities during a session instead of asking the child only to ride or be on the horse?
11	Did the group (therapist and helpers) around the children foster a positive learning or joyful environment?
12	Were the side walkers not talking to the child unless the therapist requested it?
13	Did the riders use a helmet during the on horse activities?
14	Were the sessions on the horse provided with safety procedures? This means a leader close to the head of the horse at all times and one or two side walkers at the side of the horse and child?
15	Were the sessions off the horse provided with safety procedures? This means someone was always with the child when the child was on the ground and the child was never left alone close to the horse if the horse was present.
16	Did the horse demonstrate good temperament and docility?
17	Were the horses treated in a good manner by the therapist and helpers?

CHAPTER 3

DOES HIPPOTHERAPY IMPACT THE COMMUNICATION SKILLS OF CHILDREN WITH AUTISM SPECTRUM DISORDERS?

Background

Social communication and social interaction deficits are primary impairments of children with autism spectrum disorders (ASD) (American Psychiatric Association, 2013). Understanding verbal and nonverbal communication and responding appropriately in a purposeful way is challenging for individuals with ASD. Deficits in communication negatively impact the development and quality of life of these children (Cappadocia & Weis, 2010; Corbett, Schupp, Levine, & Mendoza, 2009). When evaluating new or alternative interventions for children with ASD such as the use of animals, it is important to consider the impact of the intervention on the core deficits related to communication.

Several authors suggest that many children with ASD get along better with animals than with people (Grandin, Fine, & Bowers, 2010; Martin & Farnun, 2002; Pavlides, 2008; Redefer & Goodman, 1989). This attraction may facilitate communication and social functioning (Bass, Duchowny, Llabre, 2009; O'Haire, 2013). Hippotherapy incorporates interactions with a horse into intervention. Horses are social animals, sensitive to their companion and responsive to care and affection. They can be used to facilitate social relationships between the child, the

animal and the therapist resulting in bonds that can lead to later improvements in communication and interactions with peers, family and others. This study evaluated the effects of hippotherapy on the communication skills of young children with ASD.

Intervention strategies that foster social communication and interaction skills for children with ASD vary and include use of peers, groups, or adult mediated interventions (Flynn & Healy, 2012). Two main types of intervention include traditional behavioral approaches and contemporary or social-pragmatic developmental approaches (Prelock & Nelson, 2012). Traditional behavioral approaches (also called Applied Behavioral Analysis) encompass highly structured programs delivered one-on-one (Goldstein, 2002). In contemporary approaches, the child is the center of the intervention and both the therapist and child share control of the session. The therapist follows the child's lead, gives opportunities to choose, and uses child preferred toys, materials and activities. Several authors recommend a combination of strategies from both types of approaches (Prelock & Nelson, 2012; Prizant & Wetherby, 1998).

Spontaneous communication is often reduced if not nonexistent in children with ASD (Duffy & Healy, 2011; Meadan, Halle, & Kelly, 2012). These are communication behaviors that are not initiated following a request, prompt or help. Children with ASD usually need prompts to elicit communication (Chiang, 2009). However, spontaneous communications are important to express needs and desires and to interact with others. Difficulties in this area affect social communication skills. Traditional behavioral approaches used to improve

communication in children with ASD focus on teaching basic skills such as eye contact and attention, higher skills such as verbal imitation, receptive and expressive skills, and pretend play. However, these interventions seem to have a negative effect on children's spontaneity since they are highly structured (Goldstein, 2002). To promote spontaneous communications, child-centered intervention approaches are recommended. According to Duffy and Healy (2011), no single intervention to address spontaneous communication is effective for all children. These authors recommend understanding the factors underlying communication impairments, such as deficits in joint attention, limited observational and imitative skills and motivation. They suggest that interventions must begin early and be intensive and caution that the time required to develop social communication skills to an acceptable social level is often underestimated. The central hypothesis of the present study is that combining the traditional and contemporary strategies with the use of an animal may be beneficial in fostering communication skills in children with ASD.

When working in therapy with animals, the adult and children's responsiveness to one another is central for the development of communication for children with ASD (Landry, Smith, & Swank, 2006; Warren & Brady, 2007) and the animal is basically a facilitator. Adult responsiveness is the adult's sensitivity and ability to recognize and appropriately respond to the children's communication attempts (Warren, Brady, Sterling, Fleming & Marquis, 2010). Several studies have demonstrated the correlation of adult responsiveness with acquisition of language, social interaction and cognitive skills and decreased

emotional and behavioral problems for children with disabilities including ASD (Goldberg, Corter, Lojkasek, & Minde, 1991; Siller & Sigman, 2008; Yoder & Warren, 2001).

Adult responsiveness has been also studied in terms of the quality and amount of input that the children with ASD receive (Siller, Hutman, & Sigman, 2013; Warren, Gilkerson, Richards, Oller, Xu, Yapanel, & Gray, 2010). Irvin, Hume, Boyd, McBee and Odom (2013) suggest children with ASD need not only an environment rich in communication and social stimuli but also a supportive adult who fosters communication. In typical development, the adult's response to the child's communication fosters communication development. Positive feedback is essential (Prelok & Nelson, 2012; Tamis-LeMonda, Bornstein, & Baumwell, 2001). The communication deficits of children with ASD may limit the amount of stimulation that they elicit, exacerbating their deficits (Irvin et al., 2013; Warren et al., 2010). Using the Language Environment Analysis (LENA) software, Warren et al. (2010) examined social differences in the daily environment of preschool children with ASD. Adults used significantly fewer words when addressing children with ASD compared to typically developing children, with fewer child vocalizations and conversational turns. The communication difficulties of children with ASD may result in decreased social stimulation from adults. The authors emphasized the importance of the cumulative effects of participating in activities in rich and highly stimulating social environments. However, Irvin et al. (2013) investigated the amount of adult words as measured with the LENA for preschool children in a class for children

with ASD. They found that the number of words was related to the child's cognitive level. Thus, it is not simply the number of adult words that needs to be considered but rather the match of the adult's words to the child's cognitive level resulting in a social environment suited to their abilities. In hippotherapy, the activities involve communication between the therapist and the child. The therapist needs to deliver information in a way that fosters the children's comprehension and attention. Hippotherapy may be a rich communication learning environment for children with ASD, provided that communication exchanges are in accordance with each child's needs.

The child's responsiveness also plays an important role in social interaction and language acquisition. Emotional exchanges between the child and the adult in early life are the foundations of the children's communication skills (Emde, R., 1983). Children with ASD have difficulties in social emotional relatedness skills with deficits in mirroring the social partner's emotional expressions, displaying less attention and positive affect to the social partner (Dawson, Toth, Abbott, Osterling, Munson, Estes, & Liaw, 2004). This can include limited expressions of affect (Joseph & Tager-Flusberg, 1997), ignoring others, or even displaying negative responses to the other's presence (Yirmiya, Kasari, Sigman & Mundy, 1989). These deficits result in reduced opportunities to develop a strong basis for emotional exchanges and later social interaction and communication skills (Scambler, Hepburn, Rutherford, Wehner & Rogers, 2007). Thus, promoting children's responsiveness through attractive activities that promote interaction with a highly responsive adult (mother/caregiver/therapist)

may help children with ASD to increase their sensitivity, attention to the social partner and skills to recognize and respond to others' communication bids.

Activities that promote vestibular stimulation increase communication and visual contact with people and objects (Lane, 2002). Ray, King and Grandin (1988) reported an increase in the number of words used by a child with autism after vestibular stimulation. Studies of vestibular stimulation for persons with cognitive impairments suggest that it increases the production of words (Kantner, Kantner, & Clark, 1982; Magrun, Ottenbacher, McCue, & Keefe, 1981). In hippotherapy, vestibular stimulation provided by the horse may result in increased communication for children with ASD.

Natural and outdoor environments can also influence communication (Frederic & Ryan, 1995). Self Determination Theory provides a framework for explaining the positive effects of outdoors environments particularly when the activity involves social elements and physical exercise as these elements contribute to vitality and wellness (Frederic & Ryan, 1995; Ryan, Weinstein, Bernstein, Brown, Mistretta, & Gagné, 2010). Hippotherapy is a social, physical and outdoor activity that connects the person with a horse and its natural environment and may provide an important adjunct to individualized therapies that aim to enhance communication in children with ASD.

Contact with animals can benefit development (Endenbur & van Lith, 2011), with improvements in gross and fine motor skills, cognitive skills, social functioning, mood and well-being, and reduction of spasticity, pain, stress,

anxiety, or depression (Jorgenson, 1997). An animal assisted therapy (AAT) is a goal-directed intervention that utilizes an animal as an integral part of the treatment of a person with a disability (Kruger & Serpell, 2006). Temple Grandin has proposed that the body-language communication system of animals is simpler than that of humans, making it is easier for children with ASD to understand (Grandin et al., 2010). Others argue that animals can be used in the transition to successful interactions with people (Fine, 2010; Katcher & Wilkins, 2000). In AAT, a therapy session includes social stimulation from the animal and the therapist and helpers (Martin & Farnum, 2002). In a recent systematic review, O'Haire (2013) reported benefits of animal assisted therapy for children with ASD such as an improvement in communication, mood, social interaction and a reduction of lethargy, hyperactivity and stress. Several studies e investigated changes in communication behaviors in the presence of dogs or other animals such as llamas, rabbits or guinea pigs (Martin & Farnum, 2002; O'Haire, McKenzie, Beck & Slaughter, 2013; Redefer and Godman; 1989; Sams, Fortney & Willenbring, 2006). Authors found that the presence of the animals elicited more communication and interaction not only towards the animals but also to the therapist when comparing sessions with the animals to sessions with toys or conventional therapy sessions. However, these studies had several limitations such as lack of blinding, lack of standardized measures, small samples and lack of a control group.

Several studies have investigated the effects of therapy with horses on social communication and social interaction of children with ASD. It is important

to highlight the difference between hippotherapy and therapeutic riding (THR). In THR, the main goal is to teach riding skills to people with disabilities in small groups. The instructor is trained in teaching riding to people with disabilities but not in rehabilitation practices. Therefore, the assessment of deficits and strategies used for THR instructors to address the deficit areas might be limited. In addition, the difficulty to work in individualized goals for each client in a group session make the individual rehabilitation process much slower. However, for some condition, THR may result in greater gains due to the influence of the social group. Hippotherapy is different. In hippotherapy, the rehabilitation professional utilizes the horse as a tool to address functional impairments and to teach new skills that are not limited to riding skills. The rehabilitation professional trained in hippotherapy works one-on-one in individualized goals such as for example increasing comprehension, participation and responses, increasing length of utterances within the context of riding, increasing the use and variation of words combinations, etc. The background and therapeutic skills of the therapist play an important role in the outcomes.

There is evidence that THR has some effects on communication even without specific therapeutic goals addressing communication. Gabriels, Agnew, Holt, Shoffner, Zhaoxing, and Ruzzano (2012) found effects of THR on expressive language skills and verbal praxis for school-age children and adolescents with ASD. Ward, Whalon, Rusnak, Wendell and Paschall (2013) examined the association between THR and social communication and sensory processing in 21 children with ASD receiving THR for 6 weeks followed by a 6

week break, 4 weeks of THR followed by a 6 week break and then 8 weeks of THR. Significant improvements were observed only during intervention. Improvements were not maintained during the intervention breaks. These studies measured communication after therapy and not during therapy and were limited by the lack of a control group and lack of blinding. A recent study measured the effects of 9 weekly sessions of THR in a small group of 4 children with 3 children as controls using a multiple baseline research design (Jenking & DiGennaro Reed, 2013). The effects were measured after the sessions using center-based activities for changes in affect, responding to others' initiations, spontaneous initiations, off-task behaviors, compliance and problem behavior. Parents and teachers completed two standardized measurements. THR did not produce any effects.

The present study investigated the benefits of hippotherapy for communication of young children with ASD. It was hypothesized that: (1) during and after hippotherapy, there would be an increase in child responsivity as indicated by an increased proportion of responses to requests and an increase in expressive communication as measured by the frequency of spontaneous communications, child vocalizations, and adult-child conversational turns; and (2) after hippotherapy, there would be an increase in social communication as measured by the parents' and teachers' responses on a questionnaire.

Methods

Design

A multiple baseline design across participants was used (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005; Kazdin, 2011). It consisted of three

phases: baseline, intervention, and return to baseline condition. Participants were in baseline until stability was achieved or until they showed a trend contrary to that expected in intervention. Intervention was introduced in a staggered fashion with two children entering intervention at the same time. If more than two children were stable at the same time, two children were randomly selected to start. The study followed the standards set for single case research design (Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf, & Shadish, 2010; 2013). Visual and statistical analysis was used to establish the existence and the size of the intervention effect. Follow up sessions occurred once a week for four weeks after the end of intervention. A before and after group design was used for capturing parents' and teachers' perceptions of the effect of the program on speech/ language/ communication and sociability.

Participants

Participants were eight children (3 girls, 5 boys) between 4.5 and 7 years of age (M = 5 years). All participants had a diagnosis of ASD by a multidisciplinary assessment. Children were recruited from a therapeutic riding association center's waiting list or by a letter of invitation from the local Autism Society. Respondents forwarded this letter to acquaintances. The study was approved by the university Research Ethics Board. Consent forms were signed by participants' parents/legal guardians and teachers. Procedures and requirements of the riding association were followed. Criteria for participation included diagnosis of ASD by a qualified clinician or by a multidisciplinary assessment; delays in spoken language; ages 3 to 8 years; understanding of English; had received no

hippotherapy or therapeutic riding for at least 3 months prior to the study; interested in horses; and having one parent willing to complete questionnaires. Parents authorized video recording of their child. Exclusion criteria were the child having severe or repeated aggressive behavior and comorbidities that could interfere with the aims of the study (e.g., deafness, blindness).

Interested parents contacted the author. A three step screening process consisted of: 1) a phone interview; 2) a first screening meeting during a free play session at a university lab; 3) a second screening meeting at the therapeutic riding center to ensure children's interest and acceptance of riding a horse. Eleven children did not meet the inclusion or screening criteria due to lack of completion of the screening process, reluctance to ride during the first screening, or concerns about comprehension of English instructions.

Individual characteristics of the children are described in Table 3.1. All children received a pseudonym. The diagnosis of ASD for 6 participants included completion of the ADOS-I. Juan and Larry had a secondary diagnosis of Attention deficit-hyperactivity disorder and were on medications. Deb, Jen and Larry were given Melatonin for difficulty sleeping. English was spoken at home for all children except for Juan and Qiang who had English as a second language. None of the children had any experience with horses or riding interventions. All children had a severe language delay. Spoken language of the children was classified using the benchmarks criteria of Tager-Flusberg and colleagues as follows: one child was in phase one or preverbal; one child was in phase one but beginning to use words; three children spoke primarily using single words (phase

2), although two of them used 2-3 word sentences occasionally; one spoke in 2-3 word combinations (phase 3) with vocalizations and jargon when excited; and two currently communicated in full sentences (phase 4) but needed help to construct proper sentences or build a conversation (Tager-Flusberg, Rogers, Cooper, Landa, Lord, Paul, Rice, (...) & Yoder (2009). Five of the eight children also had echolalia. Three children had verified severe cognitive delay, two children had possible severe cognitive delays though standardized tests could not be completed, one child had borderline delays based on a standardized test of intelligence, and two children did not have a cognitive assessment. Assessment information was collected from reports such as Individualized Program Plans or Specialized Services plans (e.g., psychological, speech) completed within two years prior to the study beginning. None of the participants dropped out of the study.

Settings

The study was conducted in two settings. *Baseline* and follow-up were in a university lab that had gym mats, table and chairs, balls, sport materials, and boxes of toys and school materials. A swing, a dome, a trampoline, and/or a hammock were also available during some sessions. *Intervention* was at a well-established therapeutic riding center with outdoor and indoor arenas. Poles, barrels, cones, figures with letters and animals and colored buckets were in the arenas. The outdoor arena was usually unshared and was used as much as possible to provide a quiet environment. The indoor arena was shared with a group of 5 THR students. When sessions were indoors they were at one end of the arena

while the THR group occurred at the other end. Fine motor activities occurred in the arena or in a quiet area of the stables where a table and chairs were available. The horses were well trained THR horses. The author, an occupational therapist, Path International certified therapeutic riding instructor and member of the American Hippotherapy Association, carried out the sessions. All sessions during all phases were video recorded.

Measures

During hippotherapy, responses to requests, spontaneous communications, child vocalizations, conversational turns and adult words were measured. Social communication and social interactions were also measured at the children's home and school through parents' and teachers' questionnaire responses completed prior to and after intervention.

Dependent variables measured from video recordings

There were two communication related variables scored by trained coders. *Proportion of responding to requests* (RTR): This variable measured the children's responsiveness defined as the child's sensitivity and ability to recognize and appropriately respond to the adult requests, based on Warren and colleagues' definition of adult responsiveness (Warren, Brady, Sterling, Fleming & Marquis, 2010). This variable was scored "yes" if the child performed the verbally or non-verbally requested action without any prompting or with minimal support (i.e., one repetition of the request after allowing time for the child to respond). Close approximations for the requested action were accepted. Getting the child's attention (e.g., saying the child's name or touching the child) was not

coded as a request. If the child showed attention to the therapist or volunteer but did not respond to a repeated request, did something different than what was requested, or required physical prompts, this was scored as a "no". In order to ensure rater reliability a timing procedure was established for measuring requests that used reinforcements. This item was scored as a proportion of the number of requests in the video segment.

Frequency of Spontaneous Communication was defined as sounds, gestures or signs initiated by the child that were not a response to a partner's immediately prior utterance and sought another's attention to communicate something (Duffy & Healy, 2011). Words had to match the situation to be counted. Gestures, signs or actions by the child to show the therapist something he wanted were counted if the meaning was clear. Utterances that were not counted included utterances without an understandable social meaning (e.g., humming during the walk or trot; shrieking); unintelligible sentences or words without a clear meaning; and tantrums and screams. Child talking "alone" was not counted, unless the coder could tell that the child was talking to the therapist.

Data collected with LENA

Communication data was also collected using the Language Environment Analysis digital language processor (LENA). The recording device weighs 2 ounces, can capture up to 16 hours of data, and was worn by the child. The LENA software was used to measure the number of child vocalizations, adult words and conversational turns. The software automatically quantifies the child's language environment from the recorded data. ***Child Vocalizations*** refers to speech sounds

including words, vocalizations, babbling and single sounds but excludes crying, whining, and other sounds such as breathing or burping. ***Adult Words*** refers to the number of words spoken by an adult within a 6 foot radius of the device and was used to describe the opportunities for verbal responses or interaction. ***Conversational Turns*** are reciprocated speech segments between the child and the therapist in which one responds to the other within 5 seconds. This was a measure of one aspect of expressive communication. The LENA software reports results per month, per day, per hour or per five minutes. The results per 5 minutes segments are reported to allow comparison with spontaneous communication and response to requests.

The LENA's validity and reliability has been assessed in home and school environments. The number of adult words based on transcription of a 12 hour recording was compared with the LENA report indicating an average accuracy of 98% (Xu, Yapanel, & Gray, 2009). It has been tested with specific populations such as persons with ASD (Dykstra, Sabatos-Devito, Irvin, Boyd, Hume, & Odom, 2012; Irvin et al., 2013; Warren et al., 2010). McCauley, Esposito and Cook (2011) assessed reliability and validity in preschool classrooms with five-minute segments from 30 recorded sessions by comparing the coding of an observer with counts from the LENA with a correlation of .81 ($p < .01$) across the adult, child, and other variables. Inter-rater reliability was carried out on 12% of the recordings and Kappa was reported as .90 (McCauley et al., 2011).

Parent and Teacher questionnaire

Data about children's changes outside the hippotherapy environment were collected using the Autism Treatment Evaluation Checklist (ATEC). This measure was developed by Rimland and Edelson (n.d.) in 1999 to evaluate the effectiveness of treatments for children and adults with autism. It is a one-page non-copyrighted checklist to be completed by parents, teachers and/or primary caretakers to monitor the progress of their children over time. There are 77 items addressing speech/ language/ communication (n= 14), sociability (n=20), sensory and cognitive awareness (n= 18), and health and physical behavior (n= 25) subscales with an overall total score that has a maximum of 179. The variables used in this study were the global score and the subscales speech/ language/ communication and sociability. Rimland and Endelson (2007) examined internal consistency using a split-half test on over 1,300 ATECs and found high internal consistency (.94 for the global score). Studies have addressed its validity. Memari, Shayestehfar, Mirfazeli, Rashidi, Ghanouni and Hafizi (2013) studied 134 children, ages 6-15 and found good internal consistency for the global score (Cronbach's coefficient alpha= .93; Guttman split-half method= .77) and subscales (speech= .89; sociability= .86). Test-retest reliability using Intraclass Correlation Coefficient was good (speech= .87, sociability= .93, global score= .89) (Memari et al., 2013).

Although parents completed the questionnaire once a week during baseline and once every two weeks during intervention and follow-up, only the first baseline questionnaire and the last intervention questionnaire were used in the current analysis. The first baseline questionnaire represented the child's skills

before any interactions had occurred with intervention staff and the last intervention questionnaire represented the cumulative effects of the intervention and interactions. Parents were instructed to complete the ATEC based on the children's behaviors during the week the questionnaires were delivered. Teachers completed the questionnaire once before and after intervention. Five teachers completed the questionnaires. The teacher of one child could not be contacted and the teacher of two children completed the pre intervention questionnaires only after intervention had begun.

Mothers' journal

During the intervention phase, mothers were asked to complete a journal describing any changes observed in the child's behaviors after the therapy session and during the following day. Some mothers reported changes also by email or in conversations which were recorded in field notes.

Field notes

Field notes were collected by the therapist during the entire study. This included notes about the setting, children's unusual behavior, conversations with parents or teachers, and notes about materials/activities used.

Procedures

During all phases, sessions followed a consistent protocol. In order to evaluate the contribution of an animal in therapeutic sessions, baseline sessions were designed to mimic the conditions that made up the hippotherapy sessions. Since hippotherapy includes a variety of on the horse and off the horse activities,

sessions in baseline were divided on gross motor and physical activities (GM) and fine motor and cognitive activities (FM). Each type of activity (GM and FM) lasted between 20 to 30 minutes. For all phases, the order within the sessions varied sometimes starting the session with gross motor or on horse activities and other times starting fine motor or off horse activities. To mimic the novelty of the hippotherapy sessions, a new toy and/or activity was offered in the baseline sessions for both GM and FM sections.

The main purpose of the hippotherapy was to increase the children's participation and engagement in activities which was also expected to increase communication. Thus, strategies used in hippotherapy sought to promote focus, understanding and participation such as breaking activities into steps (Grindle et al., 2009), offering novelty and variation (Ryan & Deci, 2000), following the child's lead, and using the child's preferred activities, objects and interests (Boyd, Conroy, Mancil, Nakao, & Alter, 2007; Dunst, Trivette, & Masiello, 2011). In addition, other strategies were making eye contact and ensuring that the child understood the request, modeling, grading the sensory stimulation such as changing the voice tone, using touch to gain the child's attention, verbal support and reinforcement, and giving time for responses. Some strategies to motivate spontaneous communication were also provided such as offering opportunities to choose (Lough, Rice, & Lough, 2012), using gradual reinforcement delay (Reichle, Johnson, Monn, & Harris, 2010), and visual organizers.

Baseline sessions were 45 to 60 minutes long. The activities were appropriate for the child's age and interests. Physical or gross motor activities

included jumping, play with balls, and sports such as soccer and basketball while fine motor/cognitive activities were usually carried out on a table and included memory games, puzzles or play with cars and dolls.

Hippotherapy sessions were held at an equine center once a week for 45 to 60 minutes. The one-on-one sessions followed the guidelines of the Canadian Therapeutic Riding Association (CANTRA, n.d.) and American Hippotherapy Association (2006). There were both on and off horse activities (e.g., grooming, feeding, and saddling the horse; horse related art activities). On horse activities included learning riding skills such as rein control, understanding the horse's movement patterns, and carrying and placing objects while riding. To meet safety requirements, there were two side walkers and one person leading the horse. The therapist directed the flow of the session indicating when to change gait, speed and direction of the horse's movements. Initially, sessions were quite directive to ensure child and horse safety and that the children knew what was allowed and not allowed (e.g., kicking or biting the horse). In later sessions, activities addressed targeted behaviors with opportunities to explore, make choices, solve problems, and initiate activities. Efforts were made to ensure that all children experienced age and developmentally appropriate but similar types of activities. In this study, all children had the same goals but the strategies used were different according to each child's needs. The goals for all of the children were to increase participation, responsivity and communication. The strategies used promoted the children's participation and responses to the adult requests. Strategies during intervention were similar to those used in baseline with the addition of some

strategies to promote focus and attention using vestibular stimulation and physical challenges. For example, during the hippotherapy session if a child responded to the adult's request, the activities continued and new requests were offered. However, if the child did not respond to the adult requests even with strategies such as attempts to capture his/her attention by repetitions, calling or touching, the therapist implemented either one to two minutes of trotting or activities that involved greater physical challenge such as walking the horse in circles and serpentines or changing the speed of the horse's walk. To make intervention similar to baseline, leader and side walkers were asked to do not talk to the children during the sessions.

The follow-up phase was very similar to the baseline. There were 4 free play sessions at the university.

Data collection, coding and reliability

The child and therapist interactions and verbalizations were video recorded. In addition, the children wore the digital language processor for all hippotherapy sessions and most of the baseline sessions. Some baseline sessions occurred before acquisition of the digital language processor.

Raters who scored the video recordings were blinded to the study hypotheses. A randomly selected 5-minute segment was divided into 5-second intervals using the Picture Motion Browser software from Sony and analyzed. The segments were from the first 15 minutes of each section (gross motor/on horse and fine motor/off-horse). This resulted in two 5-minute videos per session

through all phases. A principal rater coded all segments and a minimum of 25% per phase were coded by a second rater.

Blinding the coder to baseline or intervention phase was not possible. Baseline scores were needed to assess score stability prior to the staggered intervention start required for a multiple baseline design. Therefore, inter and intra rater reliability were assessed randomly and frequently with calculations based on Richards, Taylor, Ramasamy and Richards (1999). Inter-rater agreement was 92.15% (85-100) for Response to requests and 96.30% (86-100) for Spontaneous communication. Discrepancies were mostly due to unintelligibility or lack of clarity in the response to request and were discussed among the two raters. The final decision was decided by the author (secondary rater). Intra- rater agreement was 92.33 % (85-100) for Response to requests and 97.53% (87-100) for spontaneous communication.

LENA data differed from child to child according to the duration of each session. Since LENA data is reported in 5-minute segments, the mean of all 5-minute segments per day were used to make LENA data comparable with the video recorders' data.

Implementation Fidelity

The implementation fidelity check list included 17 items considered essential for hippotherapy interventions and for the outcomes of the study (Appendix A). Implementation fidelity was measured for 18.6 % of the sessions (two sessions per child). The sessions were randomly selected using the random

numbers function in Excel software (2010 version). Checks were completed observing at least 15 minutes of each type of activity (GM/FM) per session and scoring yes if the item was accomplished. Fidelity was calculated by dividing the number of items completed by the total number of items in the checklist. Overall treatment fidelity was 93%. The primary variation from the planned protocol was for the item minimum of 15 minutes duration and no more than 30 minutes. For fine motor/off horse activities, there were instances where the children completed 10 to 14 minutes instead. In one instance which was due to weather conditions, Deb spent most of the 1 hour session in fine motor/off horse activities. Since following the child's lead was one of the therapeutic strategies, less time spent in fine motor/off horse activities may reflect the children's preference for being on the horse. In general, the intervention sessions followed the planned protocol.

Analysis

Data obtained from the video recordings (Responses to Requests and Spontaneous Communications) and data obtained from the LENA (vocalizations, conversational turns, and adult words) were graphed and analyzed both visually and statistically following the guidelines of Kazdin (2011) and Kratochwill et al. (2010; 2013). Changes in level, variability and trend within phases were observed. Between phases analysis involved differences in levels, trends, variability, immediacy of effects, proportion of overlap and consistency of the data from baseline to intervention phases (Kratochwill et al., 2010; 2013). Effect size calculations were carried out with the Improved Rate Difference (IRD) statistics method which supported the findings of the visual analysis (Parker, Vannest, & Brown, 2009; Parker, Vannest, & Davis, 2011). The IRD is calculated

as the difference of two proportions, improvement rate in intervention phase minus improvement rate in baseline phase. The main distinction of IRD and other SCRD effect size calculation methods is that IRD accounts for trends within the phases and is also able to detect negative effects (Waddell, Nassar & Gustafson, 2011). This stringent feature of IRD is recommended if the investigator is interested in causal relationship statements. The maximum IRD score is 100% or 1.00. For comparing with visual analysis and interpreting the IRD, Parker et al. (2009) suggest the following benchmarks: small and questionable effect is a score about .49 and below; IRDs of .50 to .70 are considered moderate effect sizes and IRD scores of .70 or .75 and higher are considered large or very large effect sizes. Further and refined interpretation of IRD is provided by the confidence intervals (CIs) that should accompany each IRD score. As Parker et al. (2009) indicated, effect size alone may give an erroneous sense of precision. While a narrow confidence interval indicates greater precision and confidence in the IRD value, wide CIs indicate less certainty. The 95% confidence intervals used in this study were calculated using WinPEPI software (Abramson, 2011).

Questionnaire data for the parents was analyzed using paired t-tests (Gravetter & Wallnau, 2009) in SPSS (Version 20). Infostat (2009) was used to conduct a one-tailed test. The t-test is robust enough to withstand violations of assumptions. However, since sample size was small, caution is recommended when interpreting the study results. Alpha level for the t-test calculations was set at p= .017 to adjust for multiple comparisons. Questionnaire data from the teachers were not analyzed statistically but reported descriptively.

Results

Hippotherapy and Responses to requests

Figure 3.1 reports the percentage of positive responses to requests over the total number of requests per session per child. Visual inspection of the data suggests that hippotherapy did have an effect for seven of the eight children. The mean of the participants' percentages of responses to requests in baseline was 69.2% (Anna), 65.2% (Qiang), 81.3% (Cole), 61.7% (Deb), 78.4% (Juan), 89.4% (Fred), 58% (Jen) and 56.6% (Larry). In the intervention phase, the mean was 94.7% (Anna), 91.7% (Qiang), 93.8% (Cole), 85.5% (Deb), 99.5% (Juan), 96.8% (Fred), 85.5% (Jen) and 93.5% (Larry). With the exception of Fred, the smallest increase in responses to requests was 12.5 percentage points (Cole) and the largest was 37 percentage points (Larry). At follow-up, results indicate that for five of the eight children, the percentage of responses to requests remained similar to that seen in intervention. Exceptions were Qiang (81%) and Fred (90.1%), whose responses to requests decreased 10.7 and 6.7 percentage points respectively, and Jen (92%), who increased 6.5 percentage points. Regarding trend, Anna, Qiang, Cole, Deb, Juan, Jen and Larry showed a decreasing trend during baseline (−1.5 to -1.1) while Fred showed a very slightly increasing trend (1.01). The intervention phase trends showed a neutral slope for all children except Qiang, Deb and Jen, whose trends were slightly increasing, showing more gradual intervention effects. Thus, with the increased level of responses to requests in the intervention phase, these increasing and neutral trends indicate that the children's percentage of responses to requests were more consistently positive in the

intervention phase for all children except Fred. Fred's pattern is due to his continued ceiling effects during baseline. Follow up trends were also neutral for all children except Jen, who had a slightly increasing trend and Qiang, who showed an increasing trend. Qiang's trend indicates that he was returning to his intervention level of engagement after the first session.

Statistical analysis showed intervention effects for seven of the eight children. Effect sizes were large for Anna, Juan, Jen and Larry with effect sizes as follows: Anna IRD of 71.7% CI [0.33-1], Juan IRD of 100% CI [.91- 1], Jen IRD of 100% CI [.90-1] and Larry IRD of 100% CI [.89 -1]. Moderate effect size was found for Qiang with an IRD of 52.8% CI [0.07-0.99] and a small effect size was found for Cole and Deb, with an IRD of 48.3% CI [0.08- 0.89] and 48.5% CI [0.01- 0.97] respectively. For Fred, hippotherapy had a negative effect. The mean percentage of intervals in which he was engaged increased from 94.5% in baseline to 97% in intervention with an IRD of 16.2 % CI [-1 - -0.49].

Hippotherapy and Spontaneous Communications

Figure 3.2 reports the number of spontaneous communications. Visual analysis suggests none to negative intervention effects for four children. The range of the data pattern reached levels below baseline range (Anna, Qiang, Fred and Larry). These children's amount of spontaneous communications decreased from 0.8 to 2 mean points during intervention. Small mean differences were found for the other four children (Cole, Deb, Juan and Jen). The amount of spontaneous communications increased from baseline to intervention by 2.9 points for Deb while for the rest of the children their increase ranged from 0.6 to 1.7 points.

Immediacy of effects was not observable for any of the children and the amount of non-overlapped data points was almost non-existent with the exception of Deb who had 4 non-overlapped from 11 data points. Thus, with no immediacy of effects, no differences in level and insufficient non-overlapping data points for all children the intervention did not have effect. As the guidelines for interpreting intervention effects suggest, if intervention effects were not replicated three times, researchers should conclude that there was no effect and therefore effects size calculations are not needed (Kratochwill et al., 2010).

Compared to intervention, during follow-up the amount of spontaneous communication increased for all children. Anna went back to baseline values. For the rest of the children, a small increase was observed in two children, 1.2 mean points for Jen (M=1.8) and 0.5 points for Larry (M=5.4). The rest of the children showed a large increase from 3.5 to 9 mean points, with mean values of 7.1 for Qiang, 9.3 for Cole, 9.4 for Deb, 15.8 for Juan and 9.9 for Fred. These values revealed that, even though the spontaneous communications decreased during intervention, five children showed a large increase during the follow-up phase. From baseline to follow-up, the amount of spontaneous communications' mean points that these children increased was: Qiang 5.3, Cole 4.4, Deb 8.4, Juan 9.8 and Fred 3.5. For four children, spontaneous communications increased more than double (Qiang, Cole, Deb, and Juan).

Hippotherapy and Child Vocalizations, Conversational Turns and Adult Words

Figure 3.3 contains the results of data analyzed with the LENA. Qiang had insufficient data from the LENA during baseline to be analyzed using IRD but

visual analysis shows a decreasing trend in vocalizations and turns. Table 3.2 contains 5-minutes average of the LENA variables per phase.

For child vocalizations, there were no intervention effects. Visual analysis shows no immediacy of effects and none or a negative difference in level. There is a large amount of overlapping data in the intervention phase compared to baseline in most of the children. In addition, there were several cases in which the intervention range went below baseline indicating negative intervention effects (all children except Cole and Juan). Juan was the only child with a possible intervention effect as observed by the seven non-overlapping intervention data points over a total of eleven .

For conversational turns intervention no effects were found. There were no clear intervention effects in at least three children. There were some indications of intervention effects in three children (Cole Juan and Larry) as shown by the immediacy of effects at the beginning of the intervention phase. However, effects were variable with the data showing a clear decreasing trend toward the end of the intervention phase.

Parents' and teachers' responses

Parents' scores on the first baseline measurement for the ATEC were significantly different than scores on the questionnaire completed at the end of intervention as shown in Table 3.5. Differences were most apparent for the total score and the Social subscale. The five teachers' scores followed a similar pattern

although no statistical comparisons were made because of the small sample size. Decreasing values on the ATEC mean fewer problem behaviours.

Mothers reported an increase in the use of new words, use of more words, increased length of sentences and more initiation of communication at home (Anna, Deb, Jen and Larry). Qiang's mother told us that, following hippotherapy, he did not stop talking from the moment that they got into the car until the time that he went to bed. Larry's mother reported that she never saw him so calm and focused as he was on the horse. The teachers of 3 children came to a session to observe what the children were doing because of changes at school (for Cole- improvements in behaviors; for Deb and Jen- increase in the amount of words). During hippotherapy, one activity was to complete 2-3 word sentences about aspects of the horses such as "Horses eat grass". In later sessions, sentences were longer such as "horses eat grass and carrots." The child had to give ideas or choose among options to complete the sentences. Observing Anna doing this activity accurately, her mother realized that Anna could read and began to utilize sentences to communicate with her and to help her make requests. When coloring a horse's picture, Anna looked at the horse several times. After this activity, Anna made many drawings about everyday life at home and showed them to her mother with increased verbalizations as she explained each picture.

Discussion

The purpose of this study was to examine the effects of hippotherapy on the social communication of 8 children with ASD during and after intervention. During hippotherapy, visual and statistical analysis of the data showed that

intervention effects varied by variable. Moderate intervention effects were found for responses to requests, an indicator of their child's responsiveness but small to negative intervention effects were found for the variables that involved spoken language: spontaneous communications, child vocalizations and adult-child conversational turns.

Regarding responses to requests, strong intervention effects (IRD above 75%) were found for 4 of the 8 children, moderate effects for one child and small effects for two children based on the increase in responses to the requests during hippotherapy compared to baseline. The strategies described in the introduction of this chapter to facilitate the children's comprehension and attention were effective. As described in Chapter 2, during hippotherapy the children rode and played games on the horse and participated in horse related activities interacting with the horse and the therapist. The attraction of the animal is fundamental for the children's predisposition and motivation to accept the therapeutic interventions. In addition, clear enjoyment of some activities was observed during the sessions such as in trotting. Activities that are fun capture most children's interest and provide satisfaction. Offering physical challenges also was used effectively to increase the children's responsiveness. In addition, it is possible that the vestibular stimulation provided by the horse may have positively affected the children's behavior modulating their arousal levels. This resulted in an increase of focus and active participation as indicated by their increased responses to requests (Bundy & Murray, 2002). This increase in the children's responsiveness suggests that, when the activities are attractive, the responsiveness of children with ASD

increases. However, this is likely not the only reason for the children's improvement. The adult's responsiveness also played an important role. Children will participate and interact more if they find an adult who responds and facilitates their responses, as mentioned in the introduction of this paper. The therapeutic strategies used by the adult during hippotherapy, facilitated by the presence of the animal, likely played a role.

For this group of children, Fred was the only one that did not show intervention effects. However, his responses to requests were usually high and stable, with ceiling effects from baseline onwards. Results of this study differ from those of Jenkins and DiGenaro Reed (2013) who provided THR and measured variables such as off task behaviours and compliance. The individual sessions that characterize hippotherapy and the focus on specific therapeutic goals may explain the differences. Individual sessions facilitate adult responsiveness and contingency, resulting in the increase of children's responses to requests due to the continued social interaction between the child and adult.

Child-adult conversational turns, child vocalizations and spontaneous communications showed small or negative intervention effects for most of the children. Regarding spontaneous communication, other studies have also noted the difficulty of children with ASD spontaneously initiating communication (Duffy & Healy, 2010; Meadan et al, 2012). In our study the children with less spontaneous communications were the children with less verbal skills which is not surprising. However, it was unexpected that the children would have a negative intervention effect, indicating that the intervention resulted in

suppression of spoken communications during therapy. While positive effects of THR for children with ASD have been reported (Bass et al., 2009; Gabriels et al., 2012; Ward et al., 2013), the results of these studies were from data collected after the session and not during the session. These studies using THR did not control for the effect of the social group (instructor/leader/side walkers/other rider). The positive effects may be related to the stimulation received from others in the groups as well as the horse and the therapist. Our study was the first to measure what happens with the children's communication not only after but also during the therapy sessions, and we also controlled for the effect of interactions with others by asking the leader and side walkers to not talk to the children.

The relatively small effects for spontaneous communications and child vocalizations during the hippotherapy sessions may be related to the physical and cognitive demands that young children face related to being on a horse. Learning new physical skills on a mobile surface is challenging. The novel and varied physical demands may have kept the children focused on the sensations they were experiencing and ensuring their own safety thus limiting their ability to communicate. On the horse, they were responsive to the therapist, as shown by the strong intervention effects for responses to requests. It seems logical that having your body constantly moved might not make it easy to talk or vocalize at the same time. It is also possible that other factors such as the novelty of the activities, the physical challenges of the requested activities (e.g., trotting, standing up on stirrups or sitting backwards while the horse was walking) and the varied environmental stimuli during the hippotherapy sessions (sun, trees, wind,

noise, other horses) may have captured the children's attention to such a degree that spontaneous communications or verbalizations were not elicited. This may explain why parents noted effects of the intervention on expressive communication after the therapy.

Environmental features and intervention duration need to be considered as well. Duffy and Healy (2011) highlight the importance of the time required to develop social communication skills in children with ASD. In this regard, our study had two negative aspects, its relatively short duration of two and half months for the intervention phase and the need to change arenas midway through intervention due to weather conditions inadvertently resulting in two intervention settings. Changing arenas may have had an impact for some children. Other studies report the influence of the environment on children's behavior and communication, highlighting the role of natural and green environments (Frederic & Ryan, 1995; Kaplan, 1995; Ryan et al., 2010). Field notes and environmental information provided by the LENA indicated that the indoor arena was much noisier than the outdoors. It may be important to analyze the data separately for hippotherapy settings and taking into account features of the environment when promoting communication in children with ASD. As Bagatell (2012) and Ruble and Robson (2007) suggest, the quality of the environment is an essential consideration when working with children ASD. Considering the amount of adult words in each arena would also be important. In conclusion, changes in arenas may have had effects on the children and the therapist. The results may have been

different if the children had received longer exposure in one setting or the other. This needs further exploration.

Visual observation of the spontaneous communication data shows two main types of patterns among the children. A set of children showed a stable pattern of very few spontaneous communications (0 to 2) with slightly increasing tendency towards the end of the study (Anna, Qiang, Deb and Jen). These children were the children with lower spoken language level. The upward trend during the intervention phase could indicate that for these children, intervention should be longer to be able to show results. For Deb, improvements in the indoor arena were much higher than for the other three children, indicating greater gains towards the end of the intervention. A second set showed a variable pattern during outdoor sessions with a more stable but decreasing trend indoors (Juan, Fred and Larry). This group was made up of children with better spoken language skills. Cole had a unique pattern of response to the intervention. He showed an almost constant variable pattern, fluctuating between 3 to 10 spontaneous communications during the entire intervention phase with a slight tendency upwards.

Results of this study suggest that a therapeutic session that includes an animal and designed to increase communication for children with ASD needs to control several aspects. Riding a horse may have positive effect in the children, helping them to organize their responses, possible due to the vestibular stimulation (Bundy and Koomar, 2002). This improvement in organization may have been the reason for the increased responsiveness as the first step in

improving communication skills such as prompted or spontaneous verbal responses (spontaneous communications, child vocalizations and conversational turns). The setting, the duration and the therapeutic strategies may play an important role. Results of this study suggest that children's responsiveness may improve with the presence of the animal and the use of carefully selected therapeutic strategies, including a highly responsive adult. Improving verbal communication seems to need a longer intervention period and a more controlled environment.

Generalization of findings

Generalization of the intervention effect was measured in three social contexts: play room (during follow-up), home, and school environments. Changes in the children's responses to the requests during intervention were maintained during the follow-up sessions in the presence of a familiar adult. In addition, spontaneous communication and child vocalization results during follow up sessions increased even higher than baseline levels. This might demonstrate that intervention effects were not seen during therapy but they were seen when children were off the horse. However, maturation or familiarity with the adult may be also the reason of this increase. Statistically significant changes were observed by parents' responses of the ATEC questionnaires. These results revealed that changes in the children's communication (speech and social subscales) were observed at home. Changes in these two areas were also observed at school. Our findings corroborate the findings of post intervention effects in other studies regarding social interaction and communication outcomes after

therapy with horses (Bass et al., 2009; Gabriels et al. 2011; O'Haire, 2013; Ward et al., 2011).

Social validity of hippotherapy was observed from: a) parents' excellent attendance; b) the parents' and teachers' observations during the intervention phase about changes in the children at home and school; c) the enrollment of 5 of the 8 children, once the study concluded, in hippotherapy programs or therapeutic riding due to the lack of hippotherapy.

Limitations

Limitations of this study included a lack of blinding of the raters to phases. To address this issue, inter-rater was kept very high. The sample size was small limiting generalization of the results. The follow up period was only one month long limiting the understanding of the longer term effects. To ensure that changes were not due to characteristics of the adult, the adult who delivered the sessions was kept constant over all phases. This resulted in increased familiarity with the adult and difficulty sorting out the effects of the adult's increasing interaction skills versus hippotherapy. The ability of the children to run away or avoid the therapist was restricted in the hippotherapy sessions by being on the horse, increasing the chances that the children responded to the requests. However, data indicated that the children responded to the requests not only in ON horse activities but also in the OFF horse activities when there were opportunities to leave the therapy area, reducing this as a likely explanation. The lack of current standardized assessments of children's cognitive levels and language abilities at baseline in order to better understand the children's abilities is another limitation.

Finally, social desirability and Hawthorne effect may have been present in the parents' questionnaire responses. For this reason, each time questionnaires were given to the parents, the rules for responding to the questionnaires were reinforced. Teachers' questionnaires mean values were close to the parents values. This seems to indicate that the possibility of response bias by the parents was partially controlled by having teacher responses. When teachers were given the questionnaires, they were not told the study phase. Finally, teachers answered the questionnaires two and a half months after the first response making it difficult for them to remember what they had answered in the first measurement.

Future directions

An unanswered question is about the delayed effects of hippotherapy and the reasons why the children reduced their expressive communication during hippotherapy sessions. This information can be collected by measuring intervention effects after the sessions, such as having a free play session in a quiet room once the hippotherapy session concludes, instead of measuring during intervention. Parent questionnaire responses indicated intervention effects at the children's home and field notes revealed that some children increased talking once they got into the car and at home. This finding calls for more objective data collection tools (unbiased by the knowledge of the children being in the study). This can be addressed by collecting data using the LENA about vocalizations once the children get off the horse until they go to bed, and also the number of vocalizations during the following day after hippotherapy. Second, we wanted to control for the effect of having different adults during baseline and intervention as

a confounding factor for the study results. However, this led to another confounding factor, the possibility that increased familiarity with the adult might explain positive results. This aspect should be addressed in future studies. Third, an important step might be to analyze data collected in the current study to contrast the amount of children's vocalizations during off horse activities that occurred prior to on horse activities with the amount in off horse activities after on horse activities. Forth, strategies that directly foster friendship between the children and the animal might increase the children's wish for communication attempts. Fifth, future studies could include a consistent hippotherapy setting or explore differences associated with settings for hippotherapy and child vocalizations or spontaneous communications. Sixth, some strategies seem to have favored the children's responsivity; for example, grading the vestibular stimulation provided by the horse according to the needs of each child to modulate arousal levels, providing clear instructions, and promoting eye contact among others. Future investigations could study the use of these strategies. Seventh, controlling quality of the environment and longer intervention duration with a more explicit focus on promoting spontaneous communication could be another area of future studies. Future steps for hippotherapy as well as for THR include the creation of specific standardized protocols and manualization of each one of these two intervention types, a necessary step for the growing of the field (Smith, Scahill, Dawson, Guthrie, Lord, & Odom, 2007). This will help researchers and therapists to apply same conditions and strategies to be able to

find the reported studies, which will increase replication of results and therefore the validation and growing of this innovative therapy.

Conclusions

Findings from this study support the use of hippotherapy to increase the responsivity of young children with ASD. Hippotherapy effects were moderate for responses to requests during therapy with maintenance of the changes during follow-up. However, hippotherapy effects were small to negative for child vocalizations, spontaneous communications and conversational turns during therapy. Parents and teachers questionnaire responses indicated statistically significant changes. Follow-up and parents' and teachers' reported changes suggest that hippotherapy effects may be more observable after the therapy rather than during it. Our findings suggest that child responsivity may increase due to hippotherapy; however, spoken communication skills were not improved during hippotherapy sessions but they may have improved after therapy. It is possible that the attraction of the animal and the features of the possible activities on and around a horse may have increased the children's motivation to participate resulting in an increase in responsivity, but the physical challenge of riding may have kept the children from talking during the sessions. In addition, the environment seemed to have played an important role that needs further exploration. In interventions with animals for children with ASD, it is important to evaluate which conditions make these therapies most effective. The interaction with an animal and the vestibular stimulation combined with therapeutic strategies seem to have a positive effect on the children's responsivity. However, activities

on or around a horse alone may not explain the positive changes. The combination of the horse with trained responsive adult and environmental features that facilitate communication may all be needed to result in changes.

References

Abramson, J.H. (2011). WINPEPI updated: computer programs for epidemiologists, and their teaching potential. Epidemiologic Perspectives & Innovations 2011, 8, 1.

American Hippotherapy Association (2006). *American Hippotherapy Association, Treatment Principles Manual-Level I, 2011, 3rd ed*. Fort Collins, Colorado: Education Curriculum Committee of the American Hippotherapy Association.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM 5th ed.).Washington, DC: Author.

Bagatell, N. (2012). Engaged moments: Mediated action and children with autism in the classroom setting. *OTJR Occupation, Participation and Health, 32 (1),* 258-265.

Bass, M. M., Duchowny, C. A., &Llabre, M. M. (2009). The effect of therapeutic horseback riding on social functioning in children with autism. *Journal of Autism and Developmental Disorders, 39(9),* 1261–1267.

Boyd, B.A., Conroy, M.A., Mancil, G.R., Nakao, T., & Alter, P.J. (2007). Effects of circumscribed interests on the social behaviors of children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37 (8),* 1550-1561.

Bundy, A. & Koomar, J, (2002). Orchestrating intervention: the art of practice. In A. Bundy, S. Lane, & E. Murray (Eds.), *Sensory integration, theory and practice (2nd ed.*,pp. 242-259). Philadelphia, PA: F.A. Davis.

Bundy, A. & Murray, E. (2002). Sensory integration: A. Jean Ayres' theory revisited. In A. Bundy, S. Lane & E. Murray (Eds.). *Sensory Integration, theory and practice* (2nd ed., pp. 3-33) Philadelphia , PA: F.A. Davis.

CANTRA (n.d.). Canadian Therapeutic Riding Association, Guelph, Ontario. Available at http://www.cantra.ca/home.shtml. Access date: August, 2013.

Cappadocia, M.C., & Weiss, J.A. (2011). Review of social skills training groups for youth with Asperger Syndrome and High Functioning Autism. *Research in Autism Spectrum Disorders 5 (1),* 70-78.

Chiang, H.M. (2009). Differences between spontaneous and elicited expressive communication in children with autism. *Research in Autism Spectrum Disorders 3 (1),* 214-222.

Corbett, B.A., Schupp, C.W., Levine, S., Mendoza, S. (2009). Comparing Cortisol, stress, and sensory sensitivity in children with autism. *Autism Research 2 (1),* 39-49.

Dawson, G., Toth, K., Abbott, R., Osterling, J., Munson, J. Estes, A., & Liaw, J. (2004). Early social attention impairments in autism: Social orienting, joint attention, and attention to distress. Developmental Psychology, 40, 271–283.

Duffy, C., & Healy, O. (2011). Spontaneous communication in autism spectrum disorder: A review of topographies and interventions. *Research in Autism Spectrum Disorders 5 (3)*, 977-983.

Dykstra, J., Sabatos-Devito, M.G., Irvin, D.W., Boyd, B.A., Hume, K.A., & Odom, S.L. (2012). Using the Language Environment Analysis (LENA) system in preschool classrooms with children with autism spectrum disorders. *Autism 0(0)*, 1-13.

Dunst, C.J., Trivette, C.M., & Masiello, T. (2011). Exploratory investigation of the effects of interest-based learning on the development of young children with autism. *Autism, 15 (3),* 295-305.

Emde, R. (1983). The pre-representational self and its affective core. Psychoanalytic Study of the Child, 38, 165–192.

Endenburg, N., & van Lith, H.A. (2011). The influence of animals on the development of children. *Veterinary Journal, 190 (2),* 208-214.

Fine, A. H. (2010). Incorporating animal-assisted therapy into psychotherapy: guidelines and suggestions for therapists In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)* (pp. 169–191). San Diego, CA: Elsevier.

Flynn, L., Healy, O. (2012). A review of treatments for deficits in social skills and self-help skills in autism spectrum disorder. *Research in Autism Spectrum Disorders 6 (1)* , 431-441.

Frederick, C.M. & Ryan, R.M. (1995). Self-determination in sport: a review using cognitive evaluation theory. *International Journal of Sport Psychology, 26*, 5-23.

Gabriels, R. L., Agnew, J. A., Holt, K. D., Shoffner, A., Zhaoxing, P., & Ruzzano, S. (2012). Pilot study measuring the effects of therapeutic horseback riding on school-age children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6(2),* 578–588.

Goldberg, S., Corter, C., Lojkasek, M., & Minde, K. (1991). Prediction of behavior problems in four-year-olds born prematurely. *Annual Progress in Child Psychiatry and Child Development,* 91–113.

Goldstein, H. (2002). Communication Intervention for Children with Autism: A Review of Treatment Efficacy. *Journal of Autism and Developmental Disorders, 32 (5),* 373-396

Grandin, T. Fine, A. H. & Bowers, C.M. (2010). The use of therapy animals with individuals with autism spectrum disorders. In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)*(pp. 247-264). San Diego, CA: Elsevier.

Gravetter, F.J. & Wallnau, L.B. (2009*). Statistics for the Behavioral Science (8th ed.).* Belmont, CA: Wadsworth.

Grindle, C.F., Hastings, R.P., Saville, M., Hughes, J.C., Huxley, K., Kovshoff, H., Griffith, G.M., (...), Remington, B. (2012). Outcomes of a behavioral

education model for children with autism in a mainstream school setting. *Behavior Modification, 36 (3),* 298-319.

Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single subject research to identify evidence-based practice in special education. *Exceptional Children, 71(2),* 165–179.

InfoStat (2009). InfoStatversión 2009. GrupoInfoStat, FCA, Universidad Nacional de Córdoba, Argentina.

Irvin, D.W., Hume, K., Boyd, B.A., McBee, M.T., & Odom, S.L. (2013). Child and classroom characteristics associated with the adult language provided to preschoolers with autism spectrum disorder. *Research in Autism Spectrum Disorders 7 (8),* 947-955.

Jenkins, S.R., & Digennaro Reed, F.D. (2013). An experimental analysis of the effects of therapeutic horseback riding on the behavior of children with autism. *Research in Autism Spectrum Disorders 7 (6),* 721-740

Jorgenson, J. (1997). Therapeutic use of companion animals in health care. *Journal of Nursing Scholarship, 29 (3),* 249-254.

Joseph, R. M., & Tager-Flusberg, H. (1997). An investigation of attention and affect in children with autism and down syndrome. Journal of Autism and Developmental Disorders, 27, 385–396.

Kantner, R.M., Kantner, B., Clark, D.L. (1982). Vestibular stimulation effect on language development in mentally retarded children (semicircular canals, therapy, PICAC). *American Journal of Occupational Therapy, 36* (1), 36-41.

Kaplan, S. (1995). The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology, 15 (3),* 169-182.

Katcher, A.H. &Walkins, G.G (2000). The centaur's lessons: therapeutic education through care of animals and nature study. In A. Fine (Ed.), *Handbook on Animal Assisted Therapy (3rd ed.)* (pp. 153-178). San Diego, CA: Elsevier.

Kazdin, A. E. (2011). *Single-case research designs: methods for clinical and applied settings (2nd ed.).* New York, NY: Oxford University Press.

Kratochwill, T.R., Hitchcock, J.H., Horner, R.H., Levin, J.R., Odom, S.L., Rindskopf, D.M., & Shadish, W. R. (2013). Single-case intervention research design standards. *Remedial and Special Education, 34 (1),* 26-38.

Kratochwill, T.R., Hitchcock, J., Horner, R.H., Levin, J.R., Odom, S.L., Rindskopf, D.M., & Shadish, W. R. (2010). Single-case designs technical documentation. Resource document. What Works Clearinghouse. http://ies.ed.gov.login.ezproxy.library.ualberta.ca/ncee/wwc/pdf/wwc_scd.pdf. Accessed 7June 2013.

Kruger, K.A., & Serpell, J.A. (2006). Animal-Assisted interventions in mental health: definitions and theoretical foundations. In A.H. Fine (Ed.), *Handbook on Animal-assisted Therapy: Theoretical Foundations and Guidelines for Practice (2nd Ed.),* (pp. 21–38). San Diego, CA: Academic Press.

Landry, S. H. Smith, K. E., & Swank, P. R. (2006). Responsive parenting: Establishing early foundations for social, communication, and independent problem-solving skills. Developmental Psychology, 42, 627–642.

Lane, S.J. (2002). Sensory modulation. In A.C. Bundy (Ed.), *Sensory integration, theory and practice* (2nded.) (pp. 101-120). Philadelphia, PA: Davis.

Lough, C.L., Rice, M.S., & Lough, L.G. (2012). Choice as a Strategy to Enhance Engagement in a Coloring Task in Children with Autism Spectrum Disorders. *Occupational Therapy International, 19 (4),* 204-211.

Magrun, W.M., Ottenbacher, K., McCue, S., Keefe, R. (1981). Effects of vestibular stimulation on spontaneous use of verbal language in developmentally delayed children (sensory integration, speech, mental retardation, language acquisition). *American Journal of Occupational Therapy, 35* (2), 101-104.

Martin, F., & Farnum, J. (2002). Animal-assisted therapy for children with pervasive developmental disorders. *Western Journal of Nursing Research, 24(6),* 657–670.

McCauley, A., Esposito, M., & Cook, M. (2011). Language environment of preschoolers with autism: Validity and applications. LENA Users Conference, Denver, CO. More details at: http://www.lenafoundation.org/Research/Conference/Default.aspx

Meadan, H., Halle, J.W., Kelly, S.M. (2012). Intentional Communication of Young Children with Autism Spectrum Disorder: Judgments of Different Communication Partners. *Journal of Developmental and Physical Disabilities 24 (5),* 437-450.

Memari, A.H., Shayestehfar, M., Mirfazeli, F.-S., Rashidi, T., Ghanouni, P., & Hafizi, S.(2013). Cross-cultural adaptation, reliability, and validity of the autism treatment evaluation checklist in Persian. *Iranian Journal of Pediatrics 23 (3),* pp. 269-275.

O'Haire, M.E. (2013). Animal-assisted intervention for Autism Spectrum Disorder: A systematic literature review. *Journal of Autism and Developmental Disorders, 43 (7), 1606-1622.*

O'Haire, M.E., McKenzie, S.J., Beck, A.M., & Slaughter, V. (2013). Social behaviors increase in children with autism in the presence of animals compared to toys. *PLoS ONE 8 (2),* e57010.

Parker, R.I., Vannest, K.J., & Brown, L. (2009). The improvement rate difference for single-case research. *Exceptional Children, 75 (2),* 135-150.

Parker, R.I.,Vannest, K.J., & Davis, J.L.(2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification, 35 (4),* 303-322.

Prelock, P.J., Nelson, N.W. (2012).Language and communication in autism: An integrated view. *Pediatric Clinics of North America 59 (1),* 129-145

Prizant, B.M., Wetherby, A.M. (1998). Understanding the continuum of discrete-trial traditional behavioral to social-pragmatic developmental approaches in communication enhancement for young children with autism/PDD. *Seminars in speech and language 19 (4),* 329-352; quiz 353; 424.

Ray, T.C., King, L.J., & Grandin, T. (1988). The effectiveness of self-initiated vestibular stimulation in producing speech sounds. *Journal of Occupational Therapy Research, 8* (3), 186–190.

Redefer, L. A., & Goodman, J. F. (1989). Brief report: Pet-facilitated therapy with autistic children. *Journal of Autism and Developmental Disorders, 19(3),* 461–467.

Reichle, J., Johnson, L., Monn, E., & Harris, M. (2010). Task engagement and escape maintained challenging behavior: Differential effects of general and explicit cues when implementing a signaled delay in the delivery of reinforcement. *Journal of Autism and Developmental Disorders, 40 (6),* 709-720.

Richards, S. B., Taylor, R.L, Ramasamy, R., & Richards, R.Y. (1999). *Single subject research*. London. UK: Singular Publishing Group.

Rimland, B., Edelson, M. (n.d.). The Autism Treatment Evaluation Checklist (ATEC). Autism Research Institute, San Diego, CA. Available at http://www.autism.com/ind_atec_report.asp. Access date: August, 2013.

Ruble, L.A., & Robson, D. M. (2007). Individual and environmental determinants of engagement in autism. *Journal of Autism and Developmental Disorder, 37(8),* 1457-1468.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55,* 68–78.

Ryan, R.M., Weinstein, N., Bernstein, J., Brown, K.W., Mistretta, L., & Gagné, M. (2010). Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology*, *30* (2), 159-168, 2010.

Sams, M. J., Fortney, E. V., & Willenbring, S. (2006). Occupational therapy incorporating animals for children with autism: A pilot investigation. *American Journal of Occupational Therapy, 60(3),* 268–274.

Scambler, D.J., Hepburn, S., Rutherford, M.D., Wehner, E.A., Rogers, S.J. (2007). Emotional responsivity in children with autism, children with other developmental disabilities, and children with typical development. Journal of Autism and Developmental Disorders 37 (3), pp. 553-563.

Siller, M., & Sigman, M. (2008). Modeling longitudinal change in the language abilities of children with autism: Parent behaviors and child characteristics as predictors of change. Developmental Psychology, 44, 1691–1704.

Siller, M., Hutman, T., & Sigman, M. (2013). A parent-mediated intervention to increase responsive parental behaviors and child communication in children with ASD: A randomized clinical trial. *Journal of Autism and Developmental Disorders 43 (3),* 540-555.

Smith, T., Scahill, L., Dawson, G., Guthrie, D., Lord, C., & Odom, S. (2007). Designing research studies on psychosocial interventions in autism. *Journal of Autism and Developmental Disorders, 37(2),* 354–366.

Tager-Flusberg, H., Rogers, S., Cooper, J., Landa, R., Lord, C., Paul, R., Rice, M., (...), Yoder, P. (2009). Defining spoken language benchmarks and selecting measures of expressive language development for young children with autism spectrum disorders. Journal of Speech, Language, and Hearing Research 52 (3), pp. 643-652.

Tamis-LeMonda, C. S., Bornstein, M. H., & Baumwell, L. (2001). Maternal responsiveness and children's achievement of language milestones. *Child Development, 72,* 748–767.

Waddell, D.E., Nassar, S.L., Gustafson, S.A. (2011). Single-case design in psychophysiological research: Part II: Statistical analytic approaches. *Journal of Neurotherapy 15 (2),* 160-169

Ward, S.C., Whalon, K., Rusnak, K., Wendell, K., & Paschall, N. (2013). The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. *Journal of Autism and Developmental Disorders*, 1-9. In Press.

Warren, S. F., & Brady, N. C. (2007). The role of maternal responsivity in the development of children with intellectual disabilities. *Mental Retardation and Developmental Disabilities Research Reviews, 13*, 330–338.

Warren, S.F., Brady, N., Sterling, A., Fleming, K., Marquis, J. (2010). Maternal responsivity predicts language development in young children with fragile X syndrome. American *Journal on Intellectual and Developmental Disabilities 115 (1)*, 54-75.

Warren, S.F., Gilkerson, J., Richards, J.A., Oller, D.K., Xu, D., Yapanel, U., & Gray, S. (2010). What automated vocal analysis reveals about the vocal production and language learning environment of young children with autism. *Journal of Autism and Developmental Disorders 40 (5),* 555-569.

Xu, D., Yapanel, U., & Gray, S. (2009). Reliability of the LENATM language environment analysis system in young children's natural language home environment. (Infoture Technical Report LTR-05-2). Available at: http://www.lenafoundation.org/ TechReport.aspx/Reliability/LTR-05-2.

Yirmiya, N., Kasari, C., Sigman, M., & Mundy, P. (1989). Facial expressions of affect in autistic, mentally retarded and normal children. Journal of Child Psychology and Psychiatry, 30, 725–735.

Yoder, P. J., & Warren, S. F. (2001). Intentional communication elicits language: Facilitating maternal responses in dyads with children who have developmental disabilities. American Journal on Mental Retardation, 106, 327– 335.

Table 3.1. Participant information

Child	Age	Diagnosis	Cognitive	Communication
Anna	4-10	ASD	Low average	Phase 2, seldom 2-3 words comb. Echolalia
Qiang	5-3	ASD, Anxiety, Dyspraxia	Severe delay.	Phase 2, seldom 2-3 words comb. Echolalia
Cole	5-8	ASD	None reported. Possible moderate-severe delay	Phase 2, often 2-3 words comb. Echolalia
Deb	5-1	ASD	Unable to complete due to behavioral challenges.	Phase 1, seldom single words
Juan	7-8	ASD, ADHD	None reported. Possible moderate-severe delay	Phase 4
Fred	6-1	ASD	Low average	Phase 4. Echolalia
Jen	5-1	ASD	Delay of 15 months	Phase 1
Larry	5-5	ASD, ADHD	Extremely low range	Phase 3. Echolalia

Communication levels: Level 1- preverbal; level 2- one word utterances; level 3- 2 to3 words combinations; level 4- sentences (Tager-Flusberg et al, 2009).

Table 3.2. LENA data per 5 minutes. Means per phase.

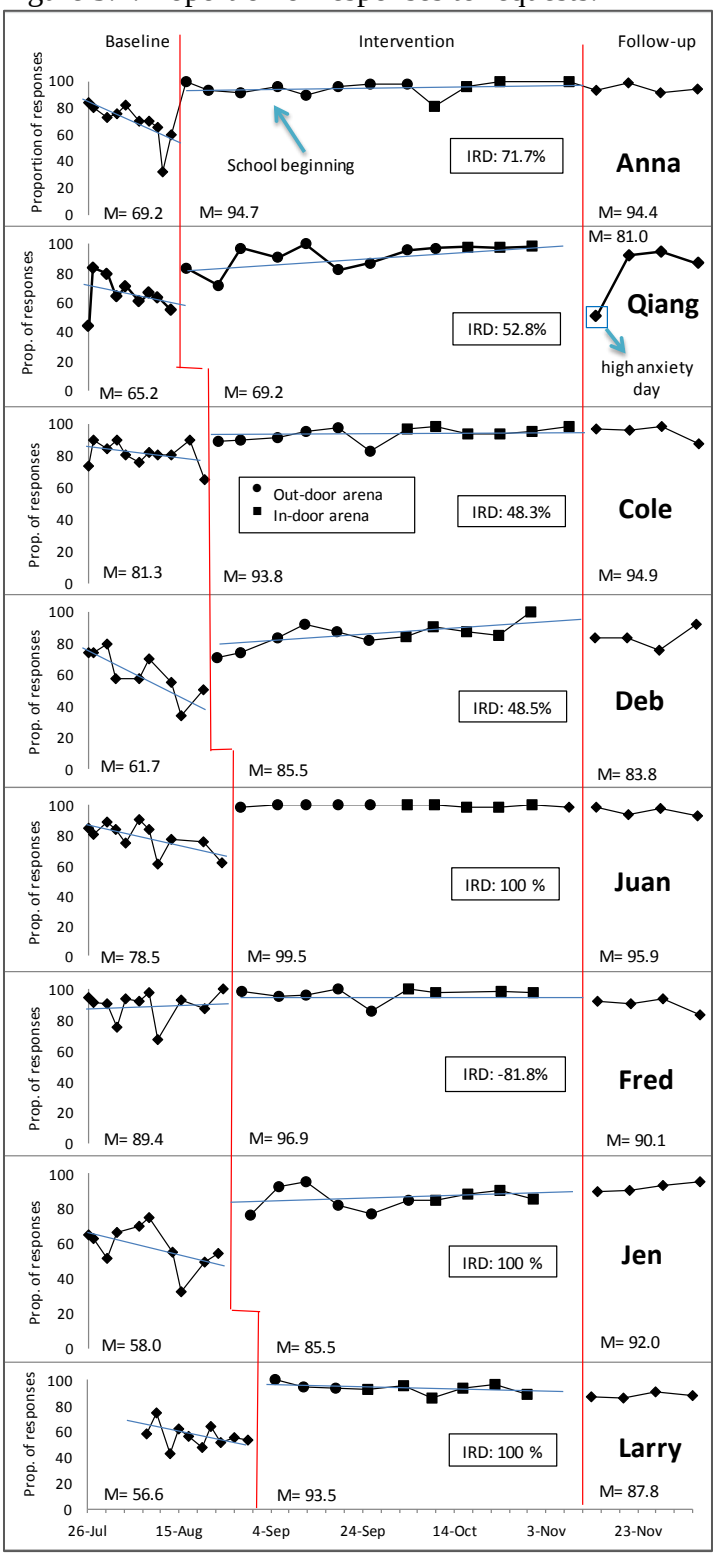
	Conversational Turns			Child Vocalizations			Adult Words		
Child	**Baseline**	**Intervention**	**F-U**	**Baseline**	**Intervention**	**F-U**	**Baseline**	**Intervention**	**F-U**
Anna	6.5	7.2	5.9	12.2	10.8	12.2	201.5	356.9	204.1
Qiang	10.0	10.1	7.0	24.93	20.4	14.9	214.77	301.9	170.6
Cole	11.6	16.1	12.2	29.5	32.5	30.3	183.7	314.3	211
Deb	11.2	11.1	16.3	29.9	27.4	47.8	186.7	200	225.5
Juan	8.4	14.2	12.4	20.7	29.0	35.8	153.1	309.1	232.5
Fred	10.3	9.9	12.9	25.0	17.2	37.1	204.5	328.4	214.9
Jen	10.0	10.4	8.1	30.3	27.3	20.3	174.7	219.9	167.3
Larry	8.3	10.5	7.5	20.5	20.7	14.9	196.3	302.4	260.7

Table 3.3 Parents' (n=8) and teachers' (n= 5) Autism Treatment Evaluation Checklist (ATEC) responses

ATEC scores[a]	Mean (SD)		T-test value	P value (one tail)
	Pre	Post		
Parents: Global [b]	57.13 (23.53)	44.50 (20.61)	t (7) = 2.61	p = .0174
Parents: Speech subscale [c]	12.63 (5.85)	10.50 (6.23)	t (7) = 2.15	p = .045
Parents: Social subscale [d]	12.13 (6.47)	10.50 (7.89)	t (7) = 1.52	p = .0172
Teachers: Global	52.20 (24.48)	36.90 (20.31)		
Teachers: Speech subscale	7.80 (2.32)	6.60 (3.20)		
Teachers: Social subscale	12.80 (6.52)	8.20 (7.19)		

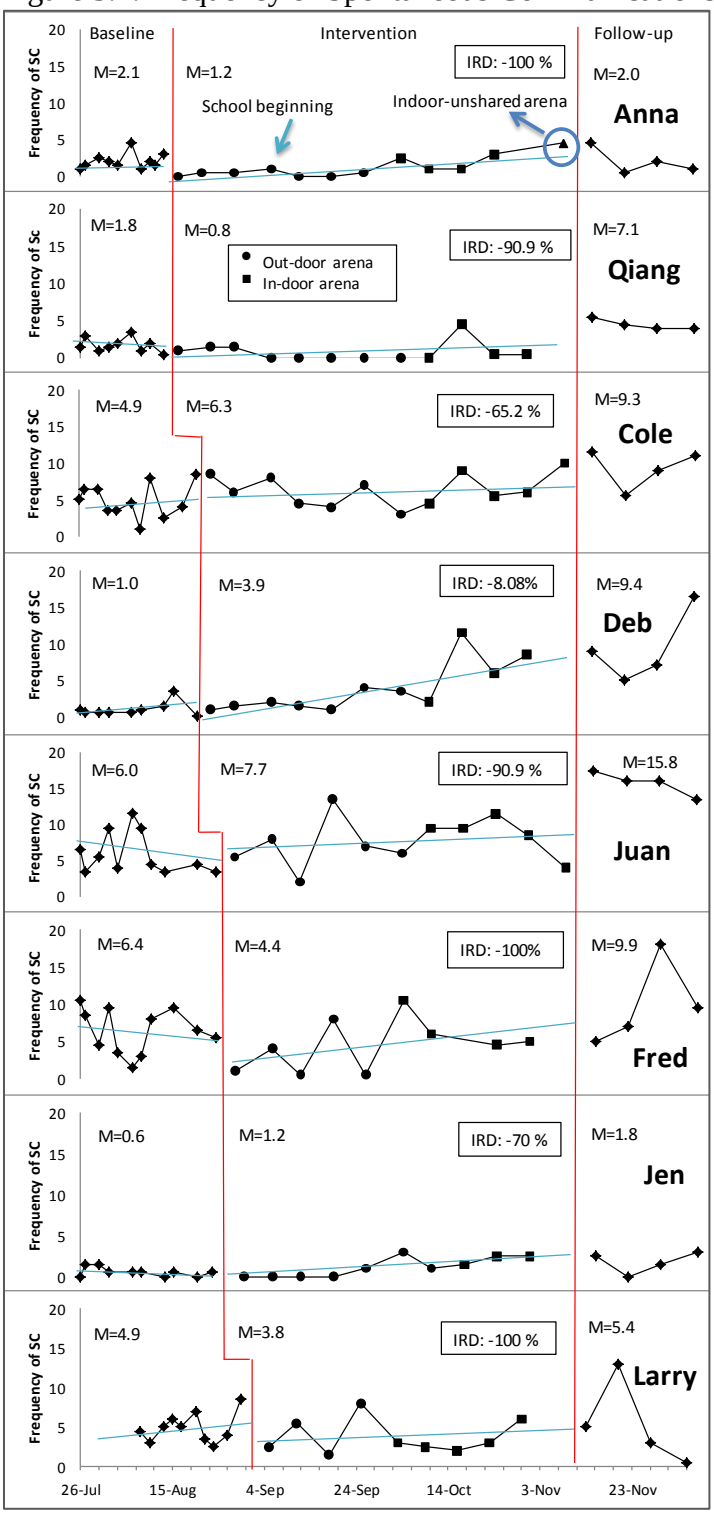
[a]Lower scores indicate improvements.
[b] Maximum score is 179 (=highest impairment- with all answers indicating the worst within the options. 0= all answers indicating parents found no problem in any of the items)?
[c] Maximum score is 28 (0= none problem).
[d] Maximum score is 40.

Figure 3.1.Proportion of responses to requests.



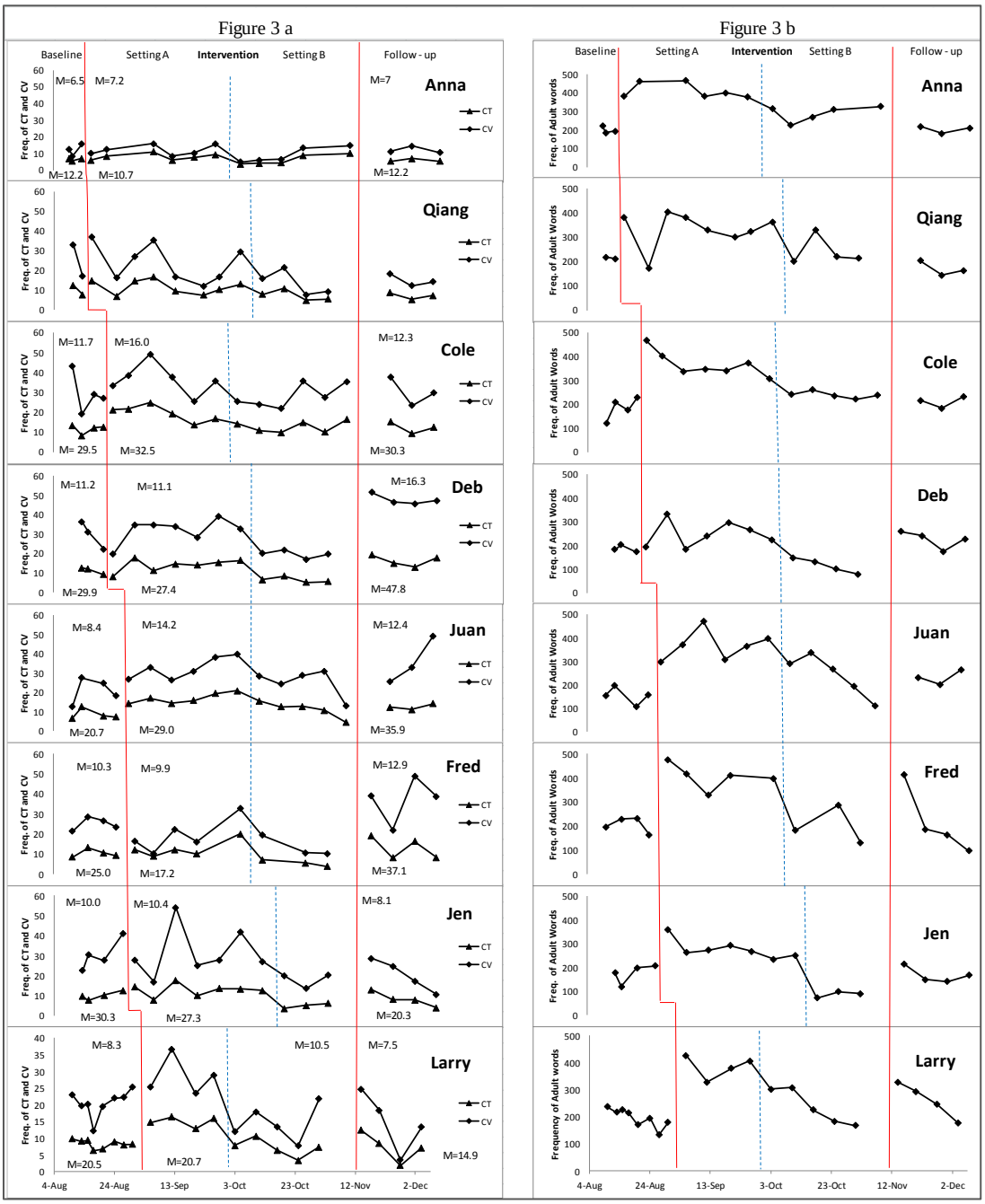
Legend: Left down corner: Mean values per phase. Upper right box: effect size values.

Figure 3.2. Frequency of Spontaneous Communications (SC)



Legend: Left upper corner: Mean values per phase. Upper right box: effect size values.

Figure 3.3 Five-minutes mean of LENA variables. 3.a) child vocalizations and conversational turns and b) amount of adult words.



3.a) Amount of Conversational Turns (CT) and Child Vocalizations (CV), and b) Amount of Adult Words (AW) per phase. Continuous lines shows division among phases. Dashed lines show the division among the two settings: outdoors (A) and indoors (B). Each data point represents the mean of everyday LENA 5-minutes segments. Mean values of CT are in the upper part of each panel. CV mean values per phase are in the lower part of each panel.

APPENDIX A. Implementation Fidelity checklist

1	Did the session involve a horse or elements of horses' life and environment?
2	Was the session one-on-one?
3	Did each type of session (GM-FM) last at least 15-20 minutes?
4	Did the activities provide opportunities for fun, enjoyment or the rider's active participation?
5	Were the activities explained in a clear and understandable way according to each child's cognitive and developmental level making sure that the child could understand the requested activity or task (this includes asking volunteers if the question was understandable due to English pronunciation or construction of the question when a child seemed to do not understand)?
6	If necessary, did the therapist provide prompts to the rider to complete the activities?
7	Did the therapist provide feedback and positive reinforcement to the rider?
8	When on horse, did the session include different gaits or speeds, opportunities to promote children's balance and /or steering (steering was taught only in the last sessions)?
9	When off horse, did the session include the horse or horse environment materials and promote activities such as working with textures, cognitive tasks, fine motor skills, or purposeful activities such as feeding, grooming or saddling the horse or playing games about aspects or materials of the horses' world?
10	Did the sessions offer variability in activities or toys used (this means the therapist offered different types of activities during a session instead of asking the child only to ride or be on the horse?
11	Did the group (therapist and helpers) around the children foster a positive learning or joyful environment?
12	Were the side walkers not talking to the child unless the therapist requested it?
13	Did the riders use a helmet during the on horse activities?
14	Were the sessions on the horse provided with safety procedures? This means a leader close to the head of the horse at all times and one or two side walkers at the side of the horse and child?
15	Were the sessions off the horse provided with safety procedures? This means someone was always with the child when the child was on the ground and the child was never left alone close to the horse if the horse was present.
16	Did the horse demonstrate good temperament and docility?
17	Were the horses treated in a good manner by the therapist and helpers?

CHAPTER 4

DISCUSSION AND OVERALL CONCLUSIONS

The primary purpose of this study was to examine the effects of hippotherapy on the motivation and social interaction/social communication of children with ASD. Specifically, I measured the effects of hippotherapy on one indicator of motivation, engagement in purposeful activities. I also measured the effects of hippotherapy on responses to requests or children's receptiveness and in spontaneous communications, child vocalizations and conversational turns.

Summary of Overall Results

Effects of hippotherapy during the sessions

The first main finding was that hippotherapy resulted in increased engagement in purposeful activities for seven of the eight children who showed strong intervention effects. Thus, the introduction of a horse in therapeutic sessions can have a significant impact, improving engagement and participation in purposeful activities.

However, the effects of hippotherapy on the children's responsivity and communication were mixed. Intervention effects were moderate for responses to requests, a measure of responsivity with four replications of strong intervention effects, but effects were small to negative for spontaneous communications, child vocalizations and conversational turns.

Possible explanations of the effects of hippotherapy for the areas investigated in this study (engagement, responsivity and communication) were explored separately in Chapter 2 and 3, but they were not explored in combination. As a whole, intervention had strong effects for two variables (engagement and responses to requests), and small to negative for the variables that involved spoken language; spontaneous communications, child vocalizations and conversational turns. Some ideas come from these findings.

It is possible that the variable response to requests is more linked to engagement and motivation rather than to communication. The rule for coding engagement was that the child was scores as engaged as long as the child responded to what was requested. Thus, high scores in engagement indicate that the child was compliant with the therapist, and responding to requests. Strategies to promote engagement included following the child's lead/ideas. When coding, if the child did not do the activity suggested by the therapist but instead did another thing, it was coded as not engaged. However, as soon as this happened, the therapist often followed the child's idea to promote his/her participation in an activity with her instead of playing alone. As soon as the therapist did this, a new set of requests were offered to the child about his/ her own idea. Therefore the child had a new set of possibilities to respond to the new requests. The point behind doing this was to promote the children's participation in activities together with the therapist instead of leaving the child playing or doing activities alone, which was what the children often wanted. Thus, response to request was closely linked to engagement.

Another potential explanation is related to the developmental link of response to requests with the variables that involved spoken language. As mentioned in Chapter 3, responses to requests or children's responsiveness are a fundamental skill for the development of spoken language and social interaction. Thus, it is not surprising that children shower higher scores for responsiveness, a basic level skill, than for any of the other variables that require more cognitive skills. Visual observation of the data suggests that intervention may have been not long enough to result in observable effects during the sessions although there were upward trends for some children. The physical demands of the riding activity may have meant the children spoke less, focusing on the more immediate challenges. Changing arenas may not have been beneficial for some of the children. The literature indicates that the time that children with ASD need to develop communication skills is often underestimated (Duffy & Healy, 2010) and also that one of the most difficult skills to teach children with ASD is related to initiating communication or social interactions (Frith, 2003; Quill, 2000). They can be trained in skills regarding communication and can respond but it is difficult for them to initiate. This was reflected in the results of this study. It seems that they needed the clue or a prompt to know what to do. In other words, if someone starts a conversation or asks for something, they can respond, and also they can do it better if the request is for an action rather than a verbal response. However, when it comes to initiating a communication, especially verbally, they struggle. However, the area of communication in children with ASD is much

more complex than what is discussed here. There are still many unanswered questions.

It is possible that the strategies used to promote communication were not enough. As the theories underlying this study highlight, the importance of choosing activities that are purposeful to the individual and the combination of elements that foster intrinsic motivation and successful participation may have a positive effect on engagement in purposeful activities. However, to effectively promote communication, the strategies may not have been enough. Possibly, to improve their communication skills, children with ASD need a quieter environment and therapeutic strategies focused directly on this area. Thus, from this work, new questions came up. For instance, what would be the results for communication if the therapist focused explicitly on promoting communication instead of mainly promoting engagement?

Regarding engagement, some of the primary concepts of the theories discussed in the introduction were observed in the results of the study. In the MOHO, the idea suggested by Kielhofner (2008) of motivation as a cycle that grows as the person was moved by internal wishes and likes, seemed to be observed in the children's behavior during the study. At first, during baseline, they usually preferred to play alone and their play was pretty repetitive. During hippotherapy, they discovered that hippotherapy was amusing and that riding a horse was fun, but not only that. They discovered that they could learn a new activity that was challenging at first. In addition, once this happened, they showed much more creativity, wishes for more, and more initiations than in baseline. It

was as if hippotherapy had awakened them. They took initiative, chose and decided much more often than in baseline. Thus, it is not difficult to observe how Self Determination theory explains the results, since most of the children were intrinsically motivated. The results of the study support some of the underlying tenets of MOHO as discussed in the introduction.

Guidelines taken from Sensory Integration theory were followed in this study. Even though what was done in the sessions was not pure sensory integration, the strategies used also corroborate this theory. This theory suggests vestibular stimulation regulates arousal levels and that when regulated, they have improved focus (Bundy & Murray, 2002). This was observable in the children's responses after trotting. In addition, the theory says that they also need intense and large quantities of stimuli. It seems that what children with ASD need to regulate their arousal is not simply a small amount of vestibular stimulation, but great doses of it. This is likely the reason why some of the children that were sensory seekers and liked to jump from high surfaces during baseline (an aspect that was sometimes scary because safety had to be constantly monitored), they were so content on the horse. It is possible that the horse provided them with the large amount of sensation that they needed. However, more research is needed in this area. It could be interesting to see the differences in focus during table top activities soon after the children had large quantities of trotting. In this way, it would be possible to know if the elements usually offered in schools to improve their sensory modulation (such as sitting on a ball or jumping on a trampoline) provide the strong sensory input that these children, at least some of them, seem

to need. It is also possible that the reason trotting was so liked and so effective in providing an increase of focus was that trotting involves a combination of sensations. It provides vestibular stimulation up and down, strong proprioception and tactile stimuli and also speed, together with the challenge of muscle work and balance reactions in order to not be propelled off the horse.

Parents and teacher perception of changes

Three questionnaires were used to measure changes in the children's behavior at their home and school. All of them showed significant differences in the parents' responses. Teachers' responses also showed improvement.

Several challenges came up from the use of these questionnaires. In the first place, the questionnaires were tiring to the parents. Parents completed the questionnaires twice a month during most of the study. The idea for these repeated measures was to replicate the method used by Gabriels, Agnew, Holt, Shoffner, Zhaoxing and Ruzzano (2012). Even though authors of this study reported no problems with the repeated completion of the questionnaires over xx months, there were concerns that repeated administration might influence the reliability of the parents' responses. To address this concern, parents were asked to observe their children during the week the questionnaire was delivered. This rule was reinforced every time the questionnaires were delivered to control for possible bias. Indeed, some parents indicated that they did carefully observe their child's progress, especially with the PVQ completion in which the requirement was to observe their child playing during one hour, keeping constant the social and physical environment for the observations. However, the benefits of the

repeated administration of the same questionnaires need to be weighed against parent burden and loss of interest in careful completion over time. Lack of motivation is one of the known risks of repeated assessments resulting in less accurate responses (Portney & Watkins, 2000). Given these concerns, our plan to analyze the questionnaires at only two time points was appropriate.

Clinical Implications

Findings of this study provide preliminary evidence of the positive effect of incorporating horses into therapeutic sessions under the modality of hippotherapy for improving engagement for purposeful activities and responsivity of young children with. Results of this study may help clinicians and rehabilitation professionals to make better evidence based recommendations about hippotherapy for children with ASD. In addition, rehabilitation providers interested in delivering hippotherapy for children with ASD may find in this study some preliminary and fundamental lines of work.

Implications for Occupational Therapists (OTs)

The number of OTs interested in non-conventional therapies is increasing. This study contributes to the profession of Occupational Therapy in several ways: 1) it illustrates the application of the philosophy and theories of the profession within a novel intervention approach; 2) it provides examples of the selection and use of strategies based on principles of sensory integration in novel environments; and 3) it may encourage OTs to be creative and to believe that it is possible to deliver effective professional services using non-conventional approaches, combining intervention strategies, client needs and natural elements together with

professional preferences, as several OTs working in therapies with animals do, and many others wish to do. Therefore, it is important to carefully evaluate if outcomes are changing as expected for clients during the hippotherapy, to be open to changing aspects of the hippotherapy intervention or selecting another approach as needed.

Dissemination of Results

Chapter 2 and 3 will be submitted to peer-reviewed journals. Results have been presented in several ways. A poster was presented at the Woman and Children Health Research Institute's 5th Annual Research Day in November, 2012 in Edmonton, and a paper was presented at the Canadian Occupational Therapists Conference May 30, 2013 in Victoria, BC. Results were also disseminated in two newsletters, one to the database of the Little Bits Therapeutic Riding Association and the other for members of the Autism Society of Edmonton. In addition, a presentation will be made at the Glenrose Rehabilitation Hospital, Edmonton, Alberta in October 2013.

Implications for future research

Implications for future research have been stated at the end of Chapter 2 and Chapter 3. The findings of this study build the body of evidence of hippotherapy for children with ASD. However, as mentioned in the introduction of this thesis, there is still much to do in order to promote the delivery of hippotherapy in an efficient, evidence based, and responsible manner. Replication of this study is necessary. In addition, while hippotherapy seems to be effective to

improve engagement and responsiveness in young children with ASD, its utility with other ages needs to be addressed. The only prior study using hippotherapy for children with ASD (Taylor et al, 2009) included children of similar ages to this study.

Because hippotherapy is still in its beginnings, more research is needed to replicate the findings of this study and to investigate its effect on other outcomes, or with other populations. However, it would be not beneficial for the field to have studies with weak methodology. What is necessary now are replications of the studies already conducted, with the same methodology and same procedures, for example, carrying out studies with the same procedures as the large sample studies done with therapeutic horseback riding. Replication of the stronger methodology studies using hippotherapy could make another very good contribution to the field. In this way, studies are not disconnected or, as noted by O'Haire (2013), researchers study new things each time. Using well designed studies to build up evidence will strengthen the field. In addition, the need of standardized protocols and manualization is imperative, as Smith, Scahill, Dawson, Guthrie, Lord, and Odom (2007) and O'Haire (2013) suggest. This will organize future studies, replicate evidence and also help the audience since this could help researchers to talk a common and unified language within the field.

Other lines of research could be done to compare different types of Animal Assisted Therapy such as dogs or dolphins, delivered by OTs who implements strategies based in same theories and observing differences in results, together with comparing other aspects such as cost and environment.

Final conclusions

The findings of this study indicate that for young children with ASD, hippotherapy appears to be beneficial in specific areas. In the first place, hippotherapy may increase the children's engagement to participate in purposeful activities. Secondly, hippotherapy appears to be beneficial in promoting child's responsiveness or responses to requests. In addition, positive effects were found in other environments such as home and school based on the parents' and teachers' questionnaire responses. However, hippotherapy did not produce benefits for communication such as spontaneous communications, child vocalizations or conversational turns during therapy, even though changes were observed after therapy. Observations in the discussion of Chapter 2 and 3 provide some clues for understanding how or why the changes were produced. However, more research is needed in this area with strategies that directly address communication impairments. Possibly, changes in the protocol used for this study may result in benefits for children's communication outcomes. Possible changes include more communication strategies, maintaining a quiet environment without changing settings, and carrying out the study for a longer time.

It is important to highlight that when working in therapies with animals, the therapists should understand which conditions make these therapies most effective. Interaction with an animal, novelty and variation, the use of child centered strategies, the vestibular stimulation, the responsiveness and contingent support and feedback from the therapist and the environment all appear to play an important role. However, the most important finding of this study emphasizes

that, as Kielhofner (2008) suggested, the positive feedback of successful experiences in one environment facilitates and increases the children's engagement and participation in other environments. It discloses the children's potential, optimizing growth and learning. Finally, it is not only the animal itself, but the selection of specific techniques and strategies in combination with the attraction and the features of the animal that may make hippotherapy a successful intervention tool (Prelok & Nelson, 2012). It is the responsibility and ability of the therapist to orchestrate all these elements to get the most benefits from this unique intervention approach (Szatmari, 2004).

References

Bundy, A. & Murray, E. (2002). Sensory integration: A. Jean Ayres' theory revisited. In A. Bundy, S. Lane & E. Murray (Eds.). *Sensory Integration, theory and practice* (2nd ed., pp. 3-33) Philadelphia , PA: F.A. Davis.

Duffy, C., & Healy, O. (2011). Spontaneous communication in autism spectrum disorder: A review of topographies and interventions. *Research in Autism Spectrum Disorders 5 (3),* 977-983.

Frith, U. (2003). *Autism, explaining the enigma (2nd ed.).* Oxford, UK: Blackwell Publishing.

Gabriels, R. L., Agnew, J. A., Holt, K. D., Shoffner, A., Zhaoxing, P., & Ruzzano, S. (2012). Pilot study measuring the effects of therapeutic horseback riding on school-age children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 6(2),* 578–588.

Kielhofner, G. (2008). *Model of Human Occupation: Theory and Application (4th Ed.).* Baltimore, MD: Lippincott Williams & Wilkins.

O'Haire, M.E. (2013). Animal-assisted intervention for Autism Spectrum Disorder: A systematic literature review. *Journal of Autism and Developmental Disorders, 43 (7), 1606-1622.*

Portney L.G., & Watkings, M.P. (2000). *Foundations of clinical research: Applications to practice (2nd ed.).* New Jersey, NJ: Prentice Hall.

Prelock, P.J., & Nelson, N.W. (2012). Language and communication in autism: An integrated view. *Pediatric Clinics of North America 59 (1),* pp. 129-145.

Quill, K. A. (2000). *Do-watch-listen-say: social and communication intervention for children with autism*. Baltimore, MD: Paul H. Brookes Publisher.

Smith, T., Scahill, L., Dawson, G., Guthrie, D., Lord, C., & Odom, S. (2007). Designing research studies on psychosocial interventions in autism. *Journal of Autism and Developmental Disorders, 37(2),* 354–366.

Szatmari, P. (2004). *A mind apart: Understanding children with autism and Asperger Syndrome*. New York, NY: Guilford Press.

Taylor, R.R., Kielhofner, G., Smith, C., Butler, S., Cahill, S.M., Ciukaj, M.D., Gehman, M. (2009). Volitional change in children with autism: A single-case design study of the impact of hippotherapy on motivation. *Occupational Therapy in Mental Health, 25,* 192-200.