AN EXPERIMENTAL ANALYSIS OF THE EFFECTS OF THERAPEUTIC HORSEBACK RIDING ON THE BEHAVIOR OF CHILDREN WITH AUTISM

By

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Submitted to the graduate degree program in the Department of Applied Behavioral Science and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Master of Arts.

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Date approved: July 25, 2012

Abstract

The current study experimentally evaluated the effects of therapeutic horseback riding on the behavior of children with autism using a multiple baseline across participants design and a waitlist control group for comparison purposes. Participants were observed weekly in an after school program during four center-based activities and during therapeutic horseback riding lessons. They were also observed during home visit probes throughout the study. Self-report data as well as parent surveys were used to corroborate direct observation methods. Time-series results indicate that despite anecdotal parent reports of improvements, therapeutic horseback riding did not have an effect on affect, language, off-task behavior, compliance, or problem behavior; however, participants' posture did improve. The current study supports the claims that therapeutic horseback riding does not meet the criteria for evidence-based practices. Implications for this study within evidence-based practices, single-case design, and therapeutic horseback riding literature are provided, as well as directions for future research.

Keywords: therapeutic horseback riding, single-case design, alternative treatments

Acknowledgements

What's a project without people to thank? Just a research idea, so without further ado, it's thank you time!

First, I would like to thank the undergraduate research assistants that helped collect data, run sessions, and who were always very sweet, professional, and kind to every participant. This project could not have been run if it were not for you guys, thank you!

Next, I would like to thank Shel Silverstein for creating the best analogy for this project and to the person who furtively left the picture and biological description of the zebra on my office door, it meant a great deal to me.

Moreover, thank you to Sesame Street for providing levity to the project with a little bit of nostalgia. Ironically enough, it is one of my favorite songs from this series that relates most to this project: *The Alligator King and his Seven Sons*. Which bring me to my next acknowledgment, thank you to #7 for standing strong during the entire project. You never faltered or reduced yourself to #6, for that, I am grateful.

Also, a big thank you goes to Drs. Jan Sheldon and Derek Reed. Thank you for agreeing to be a part of this committee. Derek, I appreciate your interest and your perspective on the scope of this project and thank you Jan for being so sweet during each e-mail exchange.

Thank you to my family who provided encouragement to press on and reassurance that "I've got this." Heaps full of thank you's go to Andrew, who kept Captain Fuzzy Boots occupied while I wrote the document for this project. Holy moly, you are patient! I appreciate your emotional support, frequent prompts to take a deep breath, and trips to Sonic for much needed milkshakes and Blasts.

A large debt of gratitude goes to Dr. Mike Strouse, Colleen Baker, and CLO who provided scholarships for each participant to ride in the program as well as provided a research space and taught the THR lessons. Without your generosity and help, this project would not have come to fruition.

Finally, no amount of thanks seems enough to give to Dr. Florence DiGennaro Reed, O.M. (Outstanding Mentor), who patiently, persistently, and promptly provided any assistance, feedback, and encouragement that I needed throughout the project. Thank you for sponsoring a large portion of the research. I learned that some projects do not always go according to plan, or even plan B, but in the end they are just projects that you work hard toward completing and then you take the lessons you learn and apply them to the other projects that you will inevitably complete as well. For that lesson alone, among soooo many others, thank you!

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An Experimental Analysis of the Effects of Therapeutic Horseback Riding on the Behavior **of Children with Autism**

Autistic disorder (commonly referred to as Autism Spectrum Disorder or ASD) is one of five disorders categorized under the umbrella of Pervasive Developmental Disorders in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR. American Psychiatric Association, 2000). ASD may be diagnosed in early childhood and is characterized by deficits in communication, social skills, and stereotyped behaviors. According to the DSM-IV-TR (2000) diagnostic criteria, communication deficits may include delayed or absent speech, deficits in initiating conversations with others, or responding inappropriately to initiations made by others. Social deficits may include a failure to establish relationships with peers of a similar age, a lack of eye contact with others, and/or preference for solitary activities in lieu of shared interests and playing with others. Stereotyped behaviors include repetitive vocal or gross or fine motor movements and/or perseverative or ritualistic behaviors with objects or components of objects. Deficits must occur in each of these core areas of development with abnormal functioning taking place in at least one area prior to the age of three. These impairments fall along a continuum of severity such that some individuals may only have moderate impairments, while others may show significant behavioral excesses or deficits in all three domains.

The prevalence of ASD has risen nearly 600% in the past two decades with current estimates suggesting that 1 in 88 children have a diagnosis (Centers for Disease Control and Prevention, 2011). Reports project that the number of children with ASD will exceed the number of children with cancer, juvenile diabetes, and pediatric AIDS combined (Autism Speaks, n.d.c; Centers for Disease Control and Prevention, 2011; National Standards Project, 2009). Moreover, the nation spends $137 billion per year on costs associated with ASD (Autism Speaks, n.d.b).

Families spend a staggering $1.2 million caring for an individual with ASD across their lifetime (Autism Speaks, n.d.a). The collective individual and societal costs for treatment indicate a need to select and adopt interventions that have been shown to be effective in high-quality, experimental research (National Standards Project, 2009). However, a myriad of treatment options makes it challenging to select an appropriate course of treatment. Fortunately, researchers have synthesized the larger body of experimental evidence for particular ASD treatments to help guide families and practitioners. For example, the National Autism Center conducted a multi-year project to evaluate and categorize ASD interventions according to the amount of evidence indicating positive outcomes. Their report, coined the *National Standards Project* (2009), identified 38 different categories of interventions consisting of three to 99 studies each. In another review of the literature, Romanczyk, Gillis, White and DiGennaro (2008) identified 414 different interventions for children with ASD. The wide array of treatment options can make it difficult to determine the appropriate empirically-supported course of treatment. Fortunately, standards for evaluating the efficacy of interventions have been developed to help guide treatment decisions.

Evidence-Based Practice

Within clinical practices, evidence-based practice (EBP) refers to treatment strategies and clinical techniques supported by high-quality experimental research, expertise from clinicians, and client preferences (Kazdin, 2008). EBP can be a helpful aid to consumers, caregivers, and clinicians by informing them of clinical practices that have been shown to be effective for particular populations to target various behaviors including both maladaptive and appropriate behaviors. This information can be used to help guide the selection of an effective treatment among a myriad of available options, some of which may be harmful (American Psychological

Association (APA), 2008). As such, EBP can protect consumers from potentially harmful or ineffective treatments (Detrich, 2008).

A necessary—though not sufficient—component of EBP is reliance on empirically-validated interventions (Kazdin, 2008). The criteria used for empirical validation differs as a function of the research methodology adopted by single-subject researchers (i.e., behavior analysts) and more traditional psychological researchers who use large sample sizes. "Well-established" empirically-validated interventions using group designs must demonstrate statistically and clinically significant differences between the treatment and other treatments or a control group (e.g., placebo) and/or demonstrate evidence of equally effective outcomes compared to other established interventions with adequate sample sizes, across at least two between-group studies. In addition, the criteria require the creation of treatment manuals, evidence of procedural fidelity, and sufficient description of participant characteristics (Chambless, et al., 1998). Although the criteria for EBP differ slightly for single-subject research, its purpose is similar to that of group researchers. EBP is demonstrated when (a) the measures and procedures are defined and described in a way that permits replication by other researchers; (b) the intervention is implemented as it was prescribed; (c) a functional relationship is demonstrated by controlling for extraneous variables; (d) the results are replicated in at least five similar single-subject designs with experimental control; (e) these five studies are conducted by at least three different research teams in different geographical settings with at least 20 total participants; (f) the studies are published in peer-reviewed journals; and (g) operational definitions are included that describe the conditions under which the intervention is most appropriate, the individuals qualified to deliver the intervention, and the participants for whom

the intervention is most appropriate. Additionally, the dependent variables must be well defined (related to outcomes) (Horner et al., 2005).

Different fields have attempted to provide information about and set forth guidelines for EBP. For example, in 1984 the US Public Health Service launched the first task force to develop guidelines regarding EBP within preventative care (Sox & Woolf, 1993). The Division 12 Task Force of the APA (Society of Clinical Psychology) was developed in order to provide clinicians and the public with information regarding available evidence-based therapy options. This information is also made available to, and is relevant for, third parties who may be responsible for financing a portion of the treatment or who may influence the degree to which the public has access to the treatment option (e.g., insurance companies or government agencies; Chambless, 1993). Other APA divisions have also developed task forces with similar missions of promoting and disseminating EBP. In addition, the fields of medicine, nursing, speech and language, and education have made similar efforts (Kazdin, 2006). The increased interest in EBP has many putative benefits; however, there is a lack of consensus across disciplines about the criteria that constitute EBP. Additionally, there is variability among the terminology used (e.g., empirically validated therapy, scientifically-validated.) which may be confusing to consumers, caregivers, and clinicians (DiGennaro Reed & Reed, 2008). Adding to this confusion, particularly for caregivers, is that descriptions of various treatment options may suggest empirical support where none exists (e.g., complementary and alternative medicines).

Complementary and Alternative Medicines (CAM)

CAM includes procedures, interventions, and/or treatments that are not considered conventional for a particular treatment need (Umbarger, 2007). These interventions can be used in conjunction with conventional medicine (complementary), or they can be used in lieu of

common practices (alternative). Types of CAM include therapies targeting the body and mind, biological approaches, manipulation of the body, approaches addressing energy, and a whole system approach, which integrate all of the approaches described (Atkins, Angkustsiri, & Hansen, 2010).

The use of CAM has increased, in part, due to greater accessibility through media outlets, personal contacts, and practitioners using alternative medicines (Nickel & King Gerlach, 2001). Recent estimates suggest that, among families with children with disabilities, CAM use is highest for families with children with ASD (Atkins et al., 2010). Families adopting these practices are generally from higher socio-economic backgrounds and fund the majority of the treatments themselves (Atkins et al., 2010; Umbarger, 2007). CAM may be adopted within a multidisciplinary treatment approach and incorporate elements from various fields to enhance treatment outcomes. Animal-assisted therapy (AAT) is a commonly used CAM that incorporates the use of animals into occupational, physical, or other therapeutic procedures.

Animal-assisted therapy. AAT is a goal-based approach that uses the bond between humans and animals as a way to target and improve various measures of quality of life (Geist, 2011; Pavlides, 2008). It is generally not used in isolation as the only treatment approach and is often combined with another intervention strategy (Nimer & Lundahl, 2007). The animal handler or therapist targets therapeutic goals using numerous animals including dogs, horses, dolphins, or others (Barker & Dawson, 1998; Martin & Farnum, 2002; Miller Adams, 2010). AAT can take many forms and is delivered in a variety of settings including (a) programs in which animals visit a client for a short period of time, (b) residential programs, in which the animal lives in the facility where the therapy is delivered and clients are involved with taking care of the animal, (c) programs that train dogs to work as service animals for individuals who need assistance with

day-to-day activities, and (d) programs that use non-domesticated animals, such as horses or dolphins that are used during the delivery of therapy (Martin & Farnum, 2002; Miller Adams, 2010).

Nimer and Lundahl (2007) found moderate effect sizes in a meta-analysis examining 49 studies evaluating AAT. Of those reviewed, seven studies included horses within therapy, which was the third most used animal (behind dogs (28 studies) and an "other" category, which included 11 studies with rabbits and/or birds). Positive effects included improvements in deficits commonly associated with ASD (e.g., communication, social skills, and stereotyped behaviors) as well as improvements in mental and/or medical problems (e.g., stress, gross motor skills, and coordination). These findings, as well as benefits reported in other AAT studies and meta-analyses, may have contributed to the increase in interest in the use of horses during AAT. In a survey of families with children with ASD, 11% of respondents indicated use of AAT with horses to target social goals (Thomas, Morrissey, & McLaurin, 2007). Interestingly, AAT with horses (i.e., hippotherapy, therapeutic horseback riding) is one of the more popular therapies targeting social skills and goals, second to social skills training. Hippotherapy and therapeutic horseback riding and their research support are described below.

Hippotherapy. Hippotherapy is taken from the Greek word Hippos, which means horse, and is delivered by an occupational or a licensed therapist as a means of therapy that fosters posture and motor control skills (Drnach, O'Brien, & Kreger, 2010; Macauley & Gutierrez, 2004). This type of therapy can be classified into two forms: classic hippotherapy and hippotherapy. In *classic hippotherapy* the focus is strictly on the movement of the horse and the rider's posture and responses to those movements (Heine, 1997). The rider sits facing forward or backward or may lie down on the horse while the horse is directed by the therapist to change

directions, stride, and perform other skills (Debuse, Chandler, & Gibb, 2005). The participant is completely passive during classic hippotherapy sessions (i.e., they do not control or guide the horse with reins, vocal commands, or any other type of movement). In contrast to classic hippotherapy, the focus of *hippotherapy* is different although it uses the movement of the horse to target goals. Hippotherapy is delivered by a licensed therapist to address specific goals (e.g., speech, psychological, cognitive) and is multidisciplinary (Granados & Fernandez Agis, 2011). Moreover, the therapist uses the movement of the horse to target particular physical (e.g., posture, muscle control) and speech goals. Within both *classic hippotherapy* and *hippotherapy*, neither daily functioning skills nor riding skills are directly targeted during sessions (Heine, 1997: Macauley & Gutierrez, 2004). Past studies have evaluated the effects of hippotherapy on various dependent variables for children with disabilities. Improvements in targeted skills were reported (e.g., Macauley & Gutierrez, 2004; Taylor et al., 2009).

Taylor et al., (2009) assessed the effects of a 16-week hippotherapy program on the motivation of three children with ASD using the Pediatric Volitional Questionnaire (Basu, Kafkes, Geist, & Kielhofner, & 2002). The 45-min weekly hippotherapy sessions included mounting procedures, 20 to 30 min of riding, and dismounting procedures. An increase in motivation was observed for two of three participants during treatment compared to a pre-treatment assessment. The third participant showed an increase in motivation after the program ended, but changes in scores on the Pediatric Volitional Questionnaire were not observed during treatment compared to pre-treatment. While these data suggest some positive effects of hippotherapy, they are preliminary at best. This study did not rely on direct measurement of behavior nor did it show replication of effects in a way that demonstrates experimental control.

Moreover, the study did not target behaviors symptomatic of ASD (e.g., socialization, communication, ritualistic behavior).

Macauley and Gutierrez (2004) compared the effects of hippotherapy to traditional therapy for three boys with a language-learning disability. Both types of therapy were designed to address individualized speech and language goals for each participant. Hippotherapy occurred 60 min twice weekly for six weeks and included the speech and language pathologist walking or standing next to the participants as they performed various activities with the horses. For example, one activity included writing a sentence on a small white board after listening to words presented out loud or using expressive language to say the sentence aloud while riding around the arena. Each participant had individualized language (expressive and receptive) goals, as well as reading and writing goals during therapy. Traditional therapy included clinic-based and school-based speech and language therapy. Parents and participants completed a 21-item satisfaction questionnaire containing a 10-point Likert-type scale. Items assessed therapy effectiveness, clinician readiness, and enjoyment. Both parents and participants reported improvements in participants' daily speech and language skills, motivation to attend therapy, and self-concept following hippotherapy. However, participants indicated that their daily speech and language skills improved more after the traditional therapy. While these data are interesting, they rely on a self-report assessment one time after the completion of each type of therapy, which may be unreliable due to demand characteristics. Moreover, this study does not include objective measures of behavior.

Less than five studies have evaluated hippotherapy with individuals with ASD, only one of which has been published in a peer-reviewed journal. None of these studies are cited or referenced by the American Hippotherapy Association. Collectively, the findings indicate some

improvements in motivation (Taylor et al., 2009) sensory processing (Treuthart, 2011), social behavior (Citterio, 1997), interactions with family members (Citterio, 1997), and communication (observed with adults with ASD only) (Garrique, Moutiez, & Galland, 1994). Many of these studies relied on retrospective data, self-reports, and/or observations without descriptions of operational definitions or procedures. None of these studies relied on sound experimental methodology and many lack sufficient detail of the procedures to allow for replication. The poor methodological rigor may explain why so few are published in peer-refereed journals.

Therapeutic horseback riding (THR). THR is a type of AAT that teaches horsemanship skills such as holding a horse's reins appropriately, controlling the horse with voice commands, and other basic riding skills (Bracher, 2000; Drnach et al., 2010). In addition, goals of therapy include improving balance, posture, gross and fine motor skills, and communication (Bertoti, 1998; Snider, Korner-Bitensky, Kammann, Warner, & Saleh, 2007).

A common misconception is that hippotherapy and THR are synonymous; however, there are important differences between these AATs. For example, the qualifications of the change agent, or individual responsible for delivering the service, are different. Hippotherapy requires a licensed professional (e.g., physical therapist, occupational therapist, or speech and language pathologist) with highly specialized training to address the goals of therapy. In order for speech pathologists to deliver hippotherapy, they must also have a certification in clinical competence (PATH International, n.d. a). THR that is provided to individuals with disabilities requires a certified instructor who must demonstrate knowledge and competencies in equine management, horsemanship riding instruction, teaching methodology, and disabilities. Although THR is considered an AAT in the literature, some individuals consider it to be an *activity* for individuals to learn specific riding skills whereas classic hippotherapy and hippotherapy are classified as an

animal-assisted *therapy*, which specifically targets therapeutic outcomes and goals related to the movement of the horse and how the rider responds to these movements (Gabriels, et al., 2012; Shurtleff, Standeven, & Engsberg, 2009). This distinction is not made by all researchers or practitioners.

Past research indicates benefits in varying domains of development when THR is used as an intervention for children with ASD (Bass, Duchowny, & Llabre 2009; Gabriels et al., 2012; Kern et al., 2011; Nelson et al., 2011). For example, Bass et al. (2009) evaluated the effects of a 12-week hourly THR program on the social functioning of children with autism using the Social Responsiveness Scale (Constantino, 2002) and indicators on the Sensory Profile (Dunn, 1999). The assessments were administered to both parents and teachers before and after the THR program. Each 60-min THR session included a warm-up, games, and opportunities to practice horsemanship skills. Results indicated improvements in attention and sensory sensitivity and decreases in distractibility in the riding group, compared to a waitlist control group. While these assessments have been validated for the population targeted in the study, direct measurement of behaviors throughout the study was not conducted. This limitation suggests the need for repeated measurement of the dependent variables using direct observation.

In another study, Kern et al. (2011) examined the effects of THR on the severity of symptoms related to ASD. The researchers used a group design, in which each participant participated in the waitlist period prior to starting the riding program. Data were collected during the waitlist period, just prior to beginning the riding program, three months into the riding program, and after six months of riding. The program consisted of weekly 60 min riding sessions for six months, in which the participants learned horse management as well as responsibilities related to caring for a horse (e.g., brushing and putting on the bridle and saddle). Parent-child

interactions were also part of each lesson, during which the parents acted as their child's side-walker and were engaged in the activities of the program. The researchers used parent-rating measures as well as clinical assessments to evaluate the effects of the equine-assisted activities. Parent-rating measures included (a) The Sensory Profile (Dunn, 1999), which measured sensory processing, modulation, and behavioral and emotional responses, (b) Quality of Life Enjoyment and Satisfaction Questionnaire (QLES-Q: Endicott, Nee, Harrison, & Blumenthal, 1993), using the General Activities Subscale, and (c) a treatment satisfaction survey (TSS), which was completed after the program was finished. The clinical measures included the Childhood Autism Rating Scale (CARS; Schopler, Reichler, Renner, 1994) which was used to describe the severity of symptoms participants exhibited, and the Timberlawn Parent-Child Interaction Scale (Kern et al., 2011), which was used to measure parent-child interactions through observations. The clinical measures were scored by a research assistant who was blind to the purpose and outcomes of the study. Results indicate a decreasing trend for scores on the CARS as well as statistically significant changes on scores on a subscale of the Sensory Profile (High-Threshold Auditory Processing). However, overall changes in the eight subscales of the Sensory Profile were not statistically significant. Overall increases in the QLES-Q were reported; however, changes were observed from the first point of measurement (three months prior to participating) to the second point of measurement (just prior to starting the program) only. There were no significant changes three months or six months after the program began. Parents indicated that they were satisfied with the treatment, perceived some benefits of the treatment, would continue with this the program, and would recommend the treatment to others. While these overall results suggest benefits of this equine-assisted program, a limitation of this study includes a lack of direct measurement and reliance on self-report. Moreover, the data for the assessments were aggregated

across the entire participant sample, which does not allow for examination of individual variability and/or improvements in the dependent variables.

Gabriels et al. (2012) used a 10-week THR program to evaluate its effects on three areas of development including self-regulation, adaptive skills, and problem behavior for 41 children with ASD, 16 of whom served as a wait-list control group. The researchers measured various dependent variables using pre-post testing. The Vineland Adaptive Behavioral Scales, Interview Edition (VABS-II; Sparrow, Cicchetti, & Balla, 2005) was administered to measure changes in adaptive skills (e.g., communication, daily living skills, socialization skills). Two tests of motor skills were also included in the study. The Bruininks-Oserestsky Test of Motor Proficiency (Bruininks & Bruininks, 2005) was used to measure changes in fine motor skills, dexterity, balance, running speed, agility, coordination, and strength, and the Sensory Integration and Praxis Test (SIPT; Ayres, 1989) was used to measure motor skills including sensory processes and planning and performing motor movements. The researchers also included weekly measurement. They asked parents to complete the Aberrant Behavior Checklist-community (Aman, Singh, Stewart, & Field, 1985) each week to measure self-regulation (e.g., irritability, lethargy, stereotypy, hyperactivity, inappropriate speech). Results suggest significant improvements in self-regulatory behaviors, expressive language on the subscale for adaptive skills, and motor skills on the SIPT and BOT-2 using raw scores for the riding group, compared to the waitlist control group. Although Gabriels et al. (2012) relied on instructors with accreditation from PATH International, developed operationally defined procedures, and worked with trained volunteers; these results are preliminary since the research was a pilot study. Although the goals for each participant were individualized, the data do not represent individual improvements in the dependent variables and the aggregated data do not permit an evaluation of

individual changes in performance. Repeated measurement of behavior was not a part of this study except for the Aberrant Behavior Checklist-community, which is not based on direct observation and relied on parent reports. Unfortunately, because the parents were not blind to their child's participation in the treatment or control group, parent responding may be a function of demand characteristics.

Only one study to date incorporates research design elements that address the limitations identified above. Nelson et al. (2011) used a single-case reversal design to evaluate the effects of THR on the social behavior of three children with ASD. Baseline consisted of noncontingent access to activities and other THR materials; however, the horses were positioned on the opposite end of the arena (i.e., participants did not ride the horse). Praise was provided when the participants engaged in social, vocal, or gestural interactions. The treatment phase consisted of the same activities as baseline while the participants rode the horse and practiced various skills such as stopping or starting the horse, turning left and right around the arena, and activities with a ball. During this phase, the participants were responsible for making the horse move using commands. Total exposure to THR during the study was approximately 2.5 hr per participant. The authors report that participants' social behavior increased as a result of THR. However, changes in performance may be due to other confounding variables. For example, programmed reinforcement was provided for social behavior during the baseline and THR sessions. Increases in socialization may be a function of reinforcement, rather than intervention. The researchers did not evaluate these separately in a component analysis. In addition, vocal prompts and models were provided for language. The degree to which increases in social behaviors were due to THR or to the prompt and models is unknown. Measurement of social behaviors aggregated both independent and prompted responses and it is unclear which form of social behaviors increased.

These limitations make it difficult to state with certainty that improvements in social behaviors are a function of THR exclusively; therefore, a functional relationship was not demonstrated. Another limitation of this study was the lack of methodological detail, which does not support replication by other researchers. For example, only the topographies of problem behaviors each participant displayed were described. Operational definitions were not provided. These results, in light of this limitation as well as the relatively little exposure participants had to THR (150 min total for the present study versus 45 to 60 min sessions for 6 to 16 weeks in other studies), are highly optimistic.

Reviews conducted by several entities (e.g., Association for Science in Autism Treatment, n.d.; National Standards Project, 2009; Umbarger, 2007) indicate that THR does not meet the criteria for an EBP. As already described, numerous studies have evaluated the effects of THR on the skills of individuals with various disabilities including ASD (e.g., Bass et al., 2009; Gabriels et al., 2012; Kern et al., 2011; Nelson et al., 2011) cerebral palsy (e.g., Bertoti, 1988; Drnach et al., 2010; Snider, et al., 2007), and psychiatric disabilities (e.g., Bizub, Joy, & Davidson, 2003). Across these studies, a number of intervention components varied substantially including the dependent measures, experimental design, participants' disability, length of exposure to therapy, and activities conducted during the therapy. Despite the limitations of these studies and general lack of empirical support, parents of children with ASD may be inclined to select THR as a treatment. Parents may select a particular treatment, such as THR, because descriptions of its effect can be readily found on the internet when searching for therapies for children with ASD (Wong & Smith, 2006). Online resources, such as parent blogs, might suggest positive benefits of THR without a methodologically rigorous evaluation with other evidence-based interventions. However, parents may not have the scientific background and training to

evaluate among methodological rigorous studies and poorly designed studies (Kay & Vyse, 2008). Additionally, parents may erroneously believe that trying several treatment options simultaneously is more beneficial than pursuing evidence-based treatment. For example, when asked to specify the number of treatments they would seek with their current financial resources, parents indicate they would use, on average, 9.7 different treatments with their child with ASD (Call, 2012). When presented with the same question, but with unconstrained resources, parents report that they would select an average of 48.6 different treatments for their child with ASD. Although parents in this study indicated that empirical support for a treatment was important, many continued to choose treatments that lacked this support. In addition, parents indicated that they would use treatments lacking empirical support if they were affordable and available. The reason parents may make these decisions was not a focus of Call (2012) and remains unknown; however, these findings provide some insight into the decision-making practices of parents. This approach, however, undermines the importance of providing the right amount of exposure to an intervention to ensure its effectiveness (Romanzcyk et al., 2008). Finally, parents may also choose THR because they believe their child will enjoy the activity and it could be become an important leisure skill for the child. The latter example emphasizes the importance parents place on increasing their child's quality of life through leisure activities.

Rationale

Barlow, Nock, and Hersen (2009) recommend the use of single-case research designs as a way to evaluate the effectiveness of interventions, especially when these interventions are in a pilot stage. This research design approach may be particularly helpful when evaluating the effects of alternative interventions that do not have research to support their use. In keeping with the aims and scope of Chok, Reed, Bird, and Kennedy (2010), Kay and Vyse (2005), and

Lerman et al. (2008), this study used single case experimental design to evaluate the effects of THR on the behavior and skills of children with ASD. Chok et al. (2010) used a multielement design to document that ambient lenses did not produce improvements in balance and coordination when compared to control and placebo conditions. Changes in performance that were observed were only due to practice effects. In a similar study, Kay and Vyse (2005) used an alternating treatments design to demonstrate that ambient lenses did not decrease toe walking and even produced decreased performance in appropriate walking. Lerman et al. (2008) used a multiple baseline across participants design to evaluate the effects of hyperbaric oxygen therapy on spontaneous communication and engagement in tasks and documented that it was not superior to, or more effective than, a behavioral intervention. These studies provide a framework for evaluating controversial or untested therapies using single-case design elements.

While THR is gaining popularity among the autism community, there is scant methodologically rigorous research documenting its effectiveness. Although previous research suggests favorable outcomes, these studies lack repeated measurement of behaviors and include pre-post assessment of subjective measures (e.g., Bass et al., 2009; Macauley & Gutierrez, 2004; Miller & Alston, 2004; Taylor et al., 2009). The only study that used direct measurement of behavior (i.e., Nelson et al., 2011) contained flaws that compromise the inferences one can make about the benefits of THR. In a field that supports and "demands" the use of evidence-based interventions it would be beneficial to scientifically document the effects of this type of treatment option. The purpose of the present study, then, is to adopt single-case experimental design to evaluate the effects of THR on numerous behaviors of children with ASD using repeated measurement of operationally defined behaviors.

Method

Participants

Seven children (six boys, one girl) with a diagnosis of autistic disorder (299.00 of DSM-IV-TR. American Psychiatric Association, 2000) between six to 14 years of age (M = 9.5 years) participated in the study. Participants were diagnosed before the start of the study by an independent, licensed professional. In order to be included in the study, participants were required to live within 30 miles of the research site, a horse arena located in the Midwest. In addition, participants were included if they did not have prior experience with hippotherapy or THR. All participants received a scholarship for THR, such that families did not incur any costs for their child's participation.

Ivan was a 14-year-old boy with a diagnosis of ASD secondary to Tuberous Sclerosis. He attended an autism program within a public school and received one-to-one individualized instruction. He received speech and language therapy as well as occupational therapy services. According to parental report, he received special education services starting at a young age. Ivan was nonvocal, but occasionally used gestures and minimal sign language to communicate as well as a Picture Exchange Communication System (PECS) at school. He was able to match identical stimuli, such as colors; however, he could not tact colors and needed hand-over-hand assistance when writing. Additionally, Ivan engaged in motor and verbal stereotypy. During the study he participated in a toilet training program across environments. Ivan took medications to reduce the occurrence of seizures and inappropriate behaviors as well as to help him sleep at night. His adaptive behavior composite standard score on the Vineland Adaptive Behavior Scales, Second Edition (Vineland-II; Sparrow, Cicchetti, & Balla, 2005) was 40, which indicated severe deficits. Additionally, Ivan's maladaptive behavior index was within clinically significant levels (v-scale score = 22). Numerous maladaptive behaviors were endorsed on the Vineland-II including

avoidance of social interactions, temper tantrums, strange habits, and preferring objects to people. His identical twin also participated in the study.

Selina, a 13-year-old girl with ASD and verbal and motor apraxia, attended public school and received education in both small group and individualized (1:1) instructional arrangements. At the start of the study, Selina received speech therapy services at home and school. She also received occupational, physical, and sensory integrative therapies in the past; however, she did not receive these services during the study. Selina had vocal communication ability and spoke in simple sentences. She could tact colors, shapes, and the alphabet and read sight words. She often used repetitive greetings in order to initiate conversations with others. According to parent and teacher reports, she lacked social skills and did not have friends. Selina took medications to reduce the likelihood of seizures, behavior problems, and nasal allergies. Her adaptive behavior composite score on the Vineland-II was 57, which indicated mild deficits. She scored a 16 on the maladaptive behavior index, which was within the average range.

Milo was a 14-year-old boy with Tuberous Sclerosis and ASD. Milo was Ivan's identical twin and educated in a similar instructional format (individualized instruction within a public school autism program). He received special education services starting from a young age. Milo lacked vocal communication skills but would occasionally use gestures with minimal sign language. In addition, on occasion he would make single-word requests and used PECS at school. Milo was able to match stimuli, but needed help with writing. Milo took medications for seizures, inappropriate behavior, and to help him sleep at night. His adaptive behavior composite on the Vineland-II was 42, which indicates he experienced moderate deficits in adaptive functioning. He obtained a v-scale score of 19 on the maladaptive behavior index, which was

within elevated levels. A sample of endorsed items included overly dependent, acted overly familiar with strangers, used bizarre speech, and had a hard time paying attention.

Seth, a 6-year-old boy with ASD, attended public school with a paraprofessional aide in a mainstreamed first grade classroom with occasional pull-out services. He received speech and occupational therapy services in both one-to-one and small group instructional arrangements. Seth spoke in simple sentences, but needed some prompting to respond to questions. He could tact colors and shapes, read sight words, and count to 100. Seth engaged in vocal stereotypy and sometimes displayed noncompliance. His parent and teacher reported that,he had a few friends noting that his communication deficits impacted his social and academic progress. He did not take medication at the time of the study. Seth obtained a 58 (mild deficits) on the adaptive behavior composite and a v-scale score of 17 (within average levels) on the maladaptive behavior index.

Frank, a 6-year-old boy with ASD, attended an autism program in a public school where he also received speech, music, and occupational therapy. Frank could not communicate using vocal speech and used very little sign language, but used PECS at school. He engaged in frequent motor and verbal stereotypy and displayed oppositional behavior. According to parent and teacher reports, he did not have friends, respond to initiations, nor display consistent skills at school. During the study he participated in a toilet training program across environments. Frank could match stimuli and could receptively identify numbers, letters, shapes, and colors. He took medication to help him sleep at night and to reduce symptoms associated with attention deficit hyperactivity disorder and ASD. He obtained a score of 36 on the adaptive behavior composite of the Vineland-II, which indicated severe deficits. He also obtained a v-scale score of 19 on the

maladaptive behavior index (e.g., often had sleep difficulties, defied authority, had strange habits, used bizarre speech), which was within elevated levels.

Denis, a 6-year-old boy with ASD, attended public school in a special education classroom full time, 30 hours a week. Before and during the study, Denis received music and speech therapy services at school. He had vocal communication ability, but did not respond to questions in a socially appropriate manner. He was able to expressively and receptively identify some colors, shapes, and letters, and count to 50 independently. Denis engaged in repetitive and echolalic behavior, such as repeating and reenacting scenes from movies. According to teacher reports, his constant detachment and preoccupation with scenes from movies made it difficult for him to remember and learn new academic topics. On occasion, he engaged in aggressive outbursts. Denis did not take any medication during the study. He scored 58 (mild deficits) on the Vineland-II's adaptive behavior composite and 19 (elevated levels) on the maladaptive behavior index. A sample of endorsed items included acted overly familiar with strangers, remembered odd information for an extended period of time, was more restless than others his age, and grinded his teeth.

Edmund was an 8-year-old boy with ASD who was educated in a public school, general education third grade classroom full time with additional 1:1 paraprofessional support, as needed. He also received music and speech therapy services during school hours and periodically received in-home speech therapy services. Edmund was able to tact colors, subtract and add numbers, spell various words, and read. According to parent and teacher reports, he had a few friends, showed evidence of communication deficits, and tended to fixate on particular things throughout the day. Edmund did not take medication during the course of the study. His Vineland-II adaptive behavior composite score was 64, which indicated mild deficits, and his

maladaptive behavior index was 20, which was within elevated levels (e.g., often preferred to be alone, was impulsive, fearful of ordinary situations/sounds, had strange habits).

Setting

All participants were observed in their home during typical routines on three occasions (i.e., single session probes across conditions) to evaluate generalization of skills and behaviors. Homes were located within 30 miles of the horse facility and included single family homes and townhomes. The presence of other individuals (e.g., caregivers, siblings, and friends) varied across families and observations. Participants were also observed during an after-school program held in a reserved area at the riding facility where THR was provided. The after-school program observations were conducted weekly during four center-based activities including an academic task, art, games; and snack. With the exception of games, which were played on the floor, activities took place on a table top containing relevant materials. Two participants were assigned to each center and led by a research assistant. Two activities, games and snack, were located in individual rooms measuring 3.66 m x 3.54 m and 3.96 m x 4.75 m, respectively. Art and the academic centers were located in the same room with tables placed 0.61 m apart. Treatment group participants were also observed during THR sessions held in an arena measuring 24.38 m x 30.48 m. THR sessions were held immediately following the after-school program observations. One to four participants were present during THR atop horses. In addition, the certified instructor, two side walkers, and one horse leader were also present for each participant.

Dependent Variables and Response Measurement

Data collection lasted 10 min during weekly THR sessions and intermittent home probe observations. Data collection also occurred one time weekly for 10 min for each of four center-based activities (40 min total). Several dimensions of behavior were recorded including rate,

percentage of intervals, and percentage of opportunity. Numerous behaviors were recorded as well. In addition, the Child Behavior Checklist (CBCL/6-18: Achenbach & Rescorla, 2001) and an experimenter-designed parent survey of perceptions of THR were administered before and after the study. Each of these variables are described in more detail below.

Experimenters recorded data on a hand-held device (iPod touch) using a downloaded ABC\Data Pro software application (Romanczyk, Gillis, & Callahan, 2010) during THR sessions as well as when scoring home observation videos. The digital device allowed for multiple behaviors to be recorded simultaneously by pressing a button associated with each dependent variable. Additionally, a digital voice recording device, approximately 0.12 m in length, was mounted on the helmets worn during THR. The device was turned on before the observation period began and was used to capture any vocal language or vocal stereotypy emitted by participants during the observation session while in the arena. Dependent variables (e.g., spontaneous initiations, vocal commands given to the horse, responses to initiations, and non-contextual vocalizations) were scored from a 10-min time sample of each riding session, for each participant. Data collection during the after-school program center activities was accomplished using paper and pencil. See Appendices A and B for examples of the datasheets. Video footage of home visits was scored using the iPod touch.

Affect. Data were collected for affect (happiness and unhappiness) using a 10 s momentary time sampling procedure during two weekly 10-min observation sessions at an after-school program and during three 10-min observation sessions at the participants' homes. Happiness was defined as "any facial expression or vocalization typically considered an indicator of happiness among people without disabilities" (Green & Reid, 1999, p. 284) and included smiling, laughing, and yelling while smiling. Unhappiness was defined as "any facial expression

or vocalization typically considered an indicator of unhappiness among people without disabilities" (Green & Reid, 1999, p. 284) and included frowning, grimacing, crying, scowling, or yelling without smiling. The percentage of intervals participants exhibited happiness and unhappiness was calculated by dividing the number of intervals during which examples of happiness or unhappiness occurred by the total number of intervals, multiplied by 100.

Responses to initiations. Responses to initiations were defined as any contextually appropriate vocalization, picture exchange, use of augmentative device, sign language, or other form of communication within 3 s of another's initiation (adapted from Shafer, Egel, & Neef, 1984). Non-examples included repeating the question and/or a non-contextual response given the initiation. The percentage of opportunities was calculated by dividing the number of responses by the total number of opportunities, multiplied by 100. Each presentation of a question (even if repeated multiple times) was counted as an opportunity to respond. Responses during the after-school program were recorded in vivo, while responses made during therapy sessions or during home observations were captured using an RCA digital voice recording device or on video, respectively, and were analyzed after each session.

Spontaneous initiations. Data were collected on the rate of spontaneous initiations during each observation session in all settings. Initiations recorded during the after-school program were recorded via video for each center-based activity; likewise, video footage was used to capture this behavior during home observations. A RCA digital recorder placed atop the participants' helmets was used to capture spontaneous initiations during therapy sessions. Spontaneous initiations were recorded as any language used before a prompt or model was provided (Matson, Sevin, Fridley, & Love, 1990). A new initiation was scored when a pause occurred for 10 s during which the child did not use any type of language. Non-examples of

spontaneous initiations included echolalic language, answering a question, or vocal stereotypy. Rate was calculated by dividing the total number of initiations by the duration (in min) of the observation session.

Off-task behavior. Data were collected for off-task behavior using a 10 s momentary time sampling procedure during two center activities (art and academic task) during the after-school program only. Off-task behavior was defined as "motor behaviors or verbalizations that are not permitted or are unrelated to the current task (e.g., not seated at the center, manipulating materials in a way that is not appropriate for the task) (adapted from DiGennaro, Martens, & Kleinmann, 2007, p. 449). The percentage of intervals participants were off-task was calculated by dividing the number of intervals in which off-task behavior occurred by the total number of intervals, multiplied by 100.

Compliance. Compliance was recorded during the after-school program and home observations and was defined as following a direction within 10 s of its presentation (adapted from Wilder, Atwell, & Wine, 2006). Independent compliance (i.e., unprompted) was recorded during the center activities in the after-school program and during home visit probes. Compliance was recorded during THR sessions at the start and end of sessions (i.e., when the participants put on their helmets, while mounting the horse, while dismounting the horse, and when removing their helmet). Experimenters were cued to begin recording compliance when the instructor indicated it was time for the participants to put on the riding helmet. Data were analyzed based on the percentage of opportunities to comply by dividing the frequency of compliance by the total number of opportunities, multiplied by 100. Compliance trials for therapy included (a) putting the helmet on when told to do so without resistance, the first time the direction is presented (b) putting the helmet on after subsequent directions (if applicable), (c)

mounting the horse without resistance, (c) dismounting the horse without resistance, and (d) taking the helmet off without resistance.

Problem behavior. The percentage of intervals in which problem behavior occurred was assessed in all settings using a 10 s momentary time sampling procedure. The following behaviors were recorded as problem behavior: aggression (e.g., hitting, slapping, kicking, biting, pushing) directed toward another individual; pica (eating non-food items); stereotypy (e.g., hand flapping, body rocking, finger posturing, non-contextual vocalizations); self-injurious behavior (e.g., self-biting, head banging, hitting head with hands or objects); screaming or other vocalizations not appropriate for the setting; property destruction (e.g., inappropriate tearing, throwing, ripping materials); and any other disruptions not appropriate for the setting (e.g., jumping on furniture). The percentage of intervals was calculated by dividing the number of intervals in which problem behavior occurred, by the total number of intervals, multiplied by 100.

The Child Behavior Checklist (CBCL/6-18: Achenbach & Rescorla, 2001) was also used to assess behavior problems and competencies using rating scales given to teachers (teacher rating form; TRF) and parents and was administered before and after the 9-week therapy program. The CBCL and TRF are comprised of profiles and scales which measure competence, adaptive functioning, internalizing and externalizing problems, and syndromes (e.g., somatic complaints, thought problems). For this study, only externalizing, internalizing, and total problems scores were reported. T-scores were used to determine the range of behaviors displayed within each behavior category. For the internalizing, externalizing, and total problems categories, T-scores above 63 indicate clinical ranges and T-scores between 60 to 63 indicate borderline ranges, while T-scores below 60 are considered to be within normal ranges. Internal consistency

coefficients range from .63 to .79 for competence scales, .78 to .97 for problem scales, and .72 to .91 for the DSM-oriented scales; these coefficients overall range from moderately high to high internal consistency.

Commands to direct the horse. Data were collected on commands to direct the horse during each 10-min observation session in the arena. Commands were defined as tapping the horse on the neck or vocalizations (e.g., "walk-on," "whoa," or "trot") delivered by the participant in order to get the horse to walk, turn, or stop. A digital voice recorder was placed on each of the participant's helmet to capture the vocal commands during each therapy session. For nonvocal participants, gestural commands such as tapping the horse's neck were scored as commands in vivo. Rate was calculated by dividing the total number of commands by the duration (in min) of the observation session.

Posture. Data were collected on appropriate posture while participants rode a horse during therapy using a 10 s momentary time sample procedure during a 10-min observation period for each session. Appropriate posture was defined as sitting upright with the back parallel to the wall and buttocks in the saddle. Deviations from sitting upright by more than 45 degrees were considered examples of inappropriate posture. The percentage of intervals participants exhibited appropriate posture was calculated by dividing the number of intervals during which appropriate posture occurred by the total number of intervals, multiplied by 100.

Pre-post parent surveys. Parents of participants completed a survey regarding their perceptions of THR prior to the study and then following the completion of the therapy program. The pre-THR survey consisted of seven items in which parents used a 4-point Likert type scale (1 = *strongly disagree*, 4 = *strongly agree)* to indicate the degree to which they agreed with each statement. Parents were also able to include open-ended comments regarding their perceptions of

THR. The post-THR survey consisted of eight items using the same rating scale as the pre-THR survey. Parents were also able to provide open-ended comments regarding their perceptions of THR after their child finished the program. See Appendices C and D for examples of the pre- and post- parent surveys.

Experimental Design and Procedures

A multiple baseline design across participants was used to evaluate the effects of THR on participant behavior. The analysis consisted of two phases: (a) baseline; and (b) THR. Data were collected across settings to assess the extent to which changes in the dependent variables were generalized across settings (i.e., THR sessions, after-school program, and home).

Baseline. The purpose of this phase was to establish levels of the target behaviors prior to the intervention. These data were used to compare the changes that occurred during and after the intervention (Baer, Wolf, & Risley, 1968). During baseline, participants were observed at a weekly after-school program and at home before receiving THR. The next phase was introduced when behavior across all dependent variables was stable and/or displaying a trend in the direction opposite to that anticipated during intervention.

THR. The purpose of this phase was to evaluate the effects of THR on participant behavior and performance. Four participants received THR; the remaining participants were assigned to the control group. Weekly 60-min therapy sessions were conducted during an established 9-week THR program. The experimenter was positioned outside of the arena and did not interact with instructors or participants during the sessions. The riding program was accredited by the Professional Association of Therapeutic Horsemanship International (PATH International), a nonprofit organization, established in 1969 (PATH International, n.d.b). The same instructor taught all but one lesson for all participants throughout the study. Preparation for

THR involved creating lesson plans (See Table 1 for examples of weekly THR objectives) based on each rider's skill level and acquisition of target horsemanship skills. At the time of the study, the instructor had five years of experience with THR, four of which she practiced with the PATH International certified credential. Each participant had two volunteers (side-walkers) walking alongside them during THR who ensured the participants were seated safely in the saddle during the session. The side-walkers also provided verbal prompts or physical guidance when riders were instructed to deliver a command to the horse or comply with the activities. A third volunteer, a horse leader, also provided assistance during the session by guiding the horse around the arena if the rider was not able to deliver commands to control the horse. The number of volunteers required to walk with participants was determined by the instructor who administered a pre-screening horse evaluation before THR. All four participants who received THR required two side-walkers and one horse leader.

Interobserver Agreement and Procedural Fidelity

Interobserver Agreement (IOA). Observers independently collected data on all dependent variables during at least 30% of sessions during the after-school program and home program and at least 27% of THR sessions for all participants. IOA for interval recording (i.e., affect, off-task behavior, and problem behavior) was calculated using the interval-by-interval method, by dividing the number of intervals with agreement on the occurrence or nonoccurrence of the dependent variables by the total number of intervals, multiplied by 100. IOA for rate-based behaviors (i.e., spontaneous initiations and commands given to the horse) was calculated using the total count approach, in which the smaller rate was divided by the larger rate, multiplied by 100. IOA for behaviors recorded per opportunity (i.e., compliance and responses to initiations) was calculated using an adaptation of the trial-by-trial approach in which the number

of opportunities with agreement on occurrence or nonoccurrence of behavior was divided by the total number of opportunities, multiplied by 100. During 60% of sessions in baseline, IOA averaged 96% across all dependent variables, participants, and settings (range, 92% to 100%). Agreement across all dependent variables for 51% of the home and center activity observations under the THR condition averaged 97% (range, 86.8% to 100%). During 36% of sessions of THR, agreement averaged 98.4% (range, 89% to 100%) across all dependent variables. See Tables 2 and 3 for detailed information about the IOA statistics for the treatment and control groups.

Procedural fidelity. Undergraduate research assistants completed a protocol checklist during the games and snack centers See Appendices E, F, G, and H for examples of the checklists. These sessions were also video-recorded and scored by an independent observer during 92% of sessions to confirm accuracy of implementation. Procedural fidelity was calculated by viewing the video, comparing marks on the checklist, and summing the number of steps followed correctly (e.g., delivering the correct trials and circling the appropriate answer choice) divided by the total number of steps, multiplied by 100. Procedural fidelity averaged 96.6% (range, 89% to 100%). Procedural fidelity was also recorded for 30% of therapy sessions for Seth, Selina, and Frank and 43% of therapy sessions for Milo. The THR instructor provided a lesson plan for the session and an independent observer recorded whether each step was implemented as indicated in the correct order. To calculate procedural fidelity, the sum of the correct steps implemented by the instructor was divided by the total number of steps, multiplied by 100. Procedural fidelity averaged 86.7% (range, 60% to 100%).

Results

Center Activities and Home Visits

Affect. The percentage of intervals in which happiness and unhappiness occurred was recorded during two 10-min center activities (art and academic) and during 10-min home visit probes. Data for the treatment and control group are depicted in Figures 1 and 2, respectively.

Treatment group. Seth's happiness (*M* = 0%) and unhappiness (*M* = 0%) during baseline in the center activities were low and stable. He displayed similar levels of happiness and unhappiness during the home visit probe (0% for both). When THR was introduced, happiness and unhappiness were also low and stable and remained unchanged though there was increased variability for unhappiness (happiness, *M* = 0%; unhappiness, *M* = .79%; range, 0% to 6%). During the two home visit probes during the THR condition, happiness (M = 0%) and unhappiness (*M* = 0%) remained unchanged and were low and stable. Selina's happiness (*M* = 12.57%; range, 0% to 37%) and unhappiness (*M* .71%; range, 0% to 5%) were also low in baseline during center activities. Her percentage of happiness shows a decreasing trend during baseline and was somewhat variable; unhappiness was stable. During the baseline home visit probe, happiness and unhappiness was observed during 3% and 0% of intervals, respectively. There was no change in happiness and unhappiness once THR was introduced for center activities (happiness, *M* = 1.88%; range 0% to 12%; unhappiness, *M* = 0%) or home visit probes (happiness *M* = 6%; range 2% to 10%; unhappiness *M* = 0%). Frank's baseline percentage of happiness and unhappiness during center activities were at zero levels. During the home visit probe in baseline, happiness and unhappiness occurred during .67% of intervals and 0% of intervals, respectively. During the THR phase, happiness and unhappiness remained at 0% of intervals for both center activities and home visit probes. Milo's baseline happiness (*M* = 11.33%; range, 0% to 33%) during center activities was low and somewhat variable with a sharp decreasing trend, while unhappiness was low and stable (*M* = 0%). He displayed 15% and 0% of

intervals of happiness and unhappiness, respectively, during the home visit probe. Happiness was somewhat variable in the center activities during the THR phase (*M* = 9.23%; range, 0% to 25%); unhappiness continued to occur at zero levels during center activities. Milo's level of happiness (*M* = 19.5%; range, 17% to 22%) was also somewhat variable during the home visit probes, while unhappiness (*M* = 0%) was similar to baseline levels. In sum, the treatment group data indicate that THR did not produce changes in affect during center activities or home visit probes.

Control group. During center activities Ivan's level of happiness was somewhat variable (*M* = 6.5%; range, 0% to 18%). Unhappiness was low and stable with a brief increase for one session (*M* = 1.79%; range, 0% to 32%). Happiness observed during home visit probes was variable (*M* = 14.7%; range, 0% to 42%), while unhappiness was at zero levels for all home visit probes. Baseline happiness for Denis during center activities was low and stable with a one-session increase (*M* = 2.1%; range, 0% to 18%). Unhappiness was at zero levels. During the home visit probes, happiness (*M* = 2.67%; range, 0% to 8%) and unhappiness (*M* = 1%; range, 0% to 3%) were both low and stable. Happiness for Edmund was somewhat variable and low during center activities (*M* = 4.45%; range, 0% to 18%). This pattern was also observed during home visit probes (*M* = 10%; range, 0% to 25%). Unhappiness, however, was displayed at zero levels during the center activities and home visit probes.

Responses to initiations. The percentage of responses to initiations was recorded during two 10-min center activities (games and snack) as well as 10-min home visit probes. Data for the treatment and control group are depicted in Figures 3 and 4, respectively.

Treatment group. Seth's percentage of responses to initiations during center activities was low and at zero levels except for one session during baseline (*M* = 12.5%; range, 0% to

50%). The percentage of responses made during the baseline home visit probe was 100% with two opportunities to respond. In the THR phase, responses to initiations during center activities was low and at zero levels except for two sessions during which the percentage of responses increased (*M* = 4.15; range, 0% to 50%). During the home visit probes, the percentage of responses was 33%; however, this percentage only represents responses made during one of the home visits; there were no opportunities to respond during the last home visit probe during the THR phase. Selina's percentage of responses to initiations during baseline in center activities was high, variable, and increasing (*M* = 84%; range, 50% to 100%). The percentage of responses during the baseline home visit probe was 70% with 10 opportunities to respond. After the introduction of THR, responses to initiations during center activities decreased initially and then became high and slightly variable during centers activities (*M* = 88.33%; range, 25% to 100%). Performance in the home visit probes during THR was variable (*M* = 50%; range, 0% to 100%). During the first probe, her performance was 100% out of six opportunities, but decreased to 0% in the final observation during which there was one opportunity to respond. The percentage of responses to initiations for Frank during baseline in center activities was low and stable (*M* = 0%). This was also the case during the baseline home visit probe, despite the presentation of 15 opportunities to respond. During the THR phase, Frank's performance remained low and stable during the center activities (*M* = 0%) and the home visit probes (*M* = 3%; range, 0% to 6%). Twenty-one opportunities were presented during the first home observation in this phase, while five opportunities were presented during the second home observation. Milo did not make any responses in baseline during center activities. During the baseline home visit probe, responses occurred in 7% of the 29 presented opportunities. During the THR phase, responses did not occur during center activities. An average of 5.1% responses (range, 3.2% to 7%) occurred

during the home visit probes. Thirty-two opportunities were presented during the first home visit probe and 14 opportunities were presented during the second home visit probe. In sum, these data indicate that THR had no effect on participants' responses to initiations.

Control group. Ivan's baseline percentage of responses to initiations was low and somewhat stable during center activities (*M* = 3.95%; range, 0% to 25%) and low during the home visit probes (*M* = 1.5% range, 0% to 4.5%). The number of opportunities to respond during home visit probes ranged from 15 to 22. The baseline percentage of responses to initiations for Denis had an increasing trend initially, but became variable during center activities (*M* = 40.1%; range, 0% to 75%) and the home visit probes (*M* = 61.7%; range 40% to 81%). The number of opportunities to respond during the home visit probes ranged from 11 to 21. Edmund's percentages had high variability during center activities in baseline (*M* = 65%; range, 0% to 100%). During the home visit probes, his percentages of responses to initiations were high (*M* =96.5%; range, 93% to 100%) and stable. The opportunities presented to respond during these visits ranged from 0 to 14 for two of the home visits. No opportunities were presented during one of the home visit probes; therefore, those data are not represented in Figure 4.

Spontaneous initiations. The rate of spontaneous initiations was recorded during all four 10-min center activities as well as during 10-min home visit probes. Data for the treatment and control group are depicted in Figures 3 and 4, respectively.

Treatment group. Spontaneous initiations in baseline during center activities for Seth was stable early in the phase, but increased in variability over time (*M* = 0.38; range, 0.1 to 0.5). During the baseline home visit probe, the rate of spontaneous initiations was 0.6. In the THR phase during center activities, the rate of spontaneous initiations increased initially and then became highly variable (*M* = 0.41; range, 0.1 to 1). During the home visit probes, spontaneous

initiations were stable (*M* = 0.55; range, 0.5 to 0.6). Selina's rate of spontaneous initiations in baseline during center activities had a decreasing trend with variability (M = 0.46; range, 0 to 0.9). During the baseline home visit probe, the rate was 0.8. In the THR phase, rates were variable with a general decreasing trend across the phase (*M* = 0.25; range, 0 to 1). During the THR home visit probes, the rate of spontaneous initiations was stable and averaged 0.8. During baseline, Frank's rate of spontaneous initiations in center activities was low and stable; spontaneous initiations did not occur during center activities or the home visit probe. This was also the case in the THR phase during center activities and the subsequent home visit probes. During baseline, Milo's rate of spontaneous initiations during center activities was low and somewhat stable (*M* = 0.02; range, 0 to .1). Spontaneous initiations did not occur during the baseline home visit probe. During the THR phase, the rate remained low and somewhat stable during center activities (*M* = 0.02; range, 0 to 0.2). During the home visit probes, spontaneous initiations were stable (*M* = 0.35; range, of 0.3 to 0.4). Overall data for the treatment group indicate that THR did not produce changes in the rate of spontaneous initiations during center activities or home visit probes.

Control group. Ivan's rate of spontaneous initiations in baseline was low and somewhat variable during center activities (*M* = 0.04; range, 0 to 0.3). During the home visit probes, spontaneous initiations were low with an increasing trend (*M* = 0.1; range, 0 to 0.2). Denis had highly variable spontaneous initiations in baseline during center activities (*M* = 0.54; range, 0.1 to 1.2), while the rate during home visit probes was stable (*M* = 0.63; range, 0.5 to 0.7). The rate of spontaneous initiations for Edmund were also variable during center activities (*M* = 0.66; range, 0.2 to 1). Spontaneous initiations during the home visit probes were variable (*M* = 0.7, range, 0.4 to 1.1).

Off-task. The percentage of intervals in which off-task behavior occurred was recorded during two center activities (art and academic). Data for the treatment and control group are depicted in Figures 5 and 6, respectively.

Treatment group. Seth's off-task behavior showed an increasing trend during baseline but stabilized at 100% of intervals at the end of the phase (*M* = 67%; range, 18% to 100%). During the THR phase, the percentages were generally high with variability noted (*M* = 74.95%; range, 30% to 100%). Selina's off-task behavior in baseline was variable with an increasing trend toward the end of the phase (*M* = 44%; range, 15% to 73%). Off-task behavior remained unchanged during the THR phase and showed similar variability (*M* = 39.3%; range, 3% to 71%). Frank's percentages in baseline were high and stable (*M* = 100%). This pattern continued in the THR phase; Frank engaged in off-task behavior during 100% of intervals. Milo's off-task behavior in baseline was variable (*M* = 19.62%; range, 0% to 52%). After the introduction of THR, Milo's off-task behavior increased and remained stable for about seven sessions with a steep increase in off-task behavior during the eighth session (*M* = 33.62%; range, 7% to 75%). The last five sessions within this phase, however, showed a decreasing trend. In sum, data for this group indicate that THR did not produce clinically significant changes in off-task behavior.

Control group. Ivan's (*M* = 47.79%; range, 3% to 98%) and Denis' (*M* = 62.1%; range, 23% to 92%) percentage of off-task behavior in baseline during center activities was highly variable. Edmund's off-task behavior was low and variable (*M* = 11.6%; range, 0% to 33%).

Compliance. The percentage of compliance (unprompted) to an adult direction was recorded during two 10-min center activities (games and snack) as well as 10-min home visit probes. Data for the treatment and control group are depicted in Figures 5 and 6, respectively.

Treatment group. Compliance in baseline for Seth was generally low, but variable during the center activities (*M* = 18.75%; range, 0% to 50%). Seth complied one time out of five opportunities during the baseline home visit probe. During the THR phase, compliance was in the same range as baseline and showed similar variability (*M* = 13.3%; range, 0% to 50%). For the home visit probes, Seth complied with 71% of the seven directions that were presented during the first probe and he complied with 60% of the five directions presented in the second probe. Selina's percentages in baseline were variable (*M* = 59.38%; range, 25% to 100%). Compliance during the baseline home visit probe was 86% (seven directions were presented). Her range of compliance in the THR phase remained unchanged and was variable (*M* = 71.67%; range, of 25% to 100%). However, stability was observed by the end of this phase. During the first home visit probe in the THR phase, Selina complied with both directions presented to her. During the second probe, she complied with 86% of the seven directions that were presented. Frank's percentages during both baseline and treatment were low and stable; he did not comply with any directions during center activities. During the home visit probe in baseline, Frank complied with 11% of nine directions presented. For the first home visit probe in the THR phase, Frank complied with 33% of six directions He did not independently comply with any of the 10 directions presented during the second home visit probe in this phase. Milo's baseline compliance was low and stable with one session during which compliance increased during center activities (*M* = 4.17%; range, 0% to 25%). During the home visit probe, he complied with 67% of the nine directions presented. In the THR phase, compliance during center activities was generally low with variability (*M* = 10.71%; range, 0% to 50%). During the home visit probes, Milo independently complied with 29% of the 14 directions presented during the first home visit probe in this phase and 14% of the 14 directions presented in the second home visit probe. In

sum, these findings suggest that THR does not impact levels of compliance during center activities or home visit probes.

Control group. Ivan's compliance was stable and low during baseline in the center activities (*M* = 3.95%; range, 0% to 25%). During the home visit probes he complied with directions an average of 31.67% (range, 20% to 50%) without a prompt. The number of directions presented during these probes ranged from 5 to 22. Denis' baseline percentages during center activities were somewhat variable (*M* = 15.45%; range, 0% to 50%). Compliance during the home visit probes averaged 64.67% (range, 57% to 73%), with 7 to 17 opportunities to comply. The baseline percentages during center activities for Edmund show an increasing trend, with increased stability over time (*M* = 85%; range, 25% to 100%). During the home visit probes, compliance averaged 96% (range, 88% to 100%). Three to 16 directions were presented.

Problem behavior. The percentage of intervals in which problem behavior occurred was recorded during all four 10-min center activities as well as during 10-min home visit probes. Data for the treatment and control group are depicted in Figures 7 and 8, respectively.

Treatment group. Seth's baseline percentage of intervals with problem behavior during center activities was somewhat variable and low (*M* = 7%; range, 0% to 22%). Problem behavior during the baseline home visit probe occurred during 10% of intervals. During the THR phase, the low and somewhat variable trend continued during center activities (*M* = 3.68%; range, 0% to 25%). During the home visit probes, problem behavior was low and stable (*M* = 2%). The percentage of intervals with problem behavior during both center activities and the home visit probe in baseline was zero for Selina. During the THR phase, problem behavior averaged .06% during center activities and 0% during the home visit probes. Frank's baseline percentage of intervals during which problem behavior occurred during center activities was variable with an

increasing trend (*M* = 64.29%; range, 32% to 97%). During the home visit probe, problem behavior occurred during 18% of intervals. In the THR phase, problem behavior during center activities was in the similar range as baseline and showed similar variability (*M* = 58.44%; range, 23% to 92%). During the home visit probes, problem behavior occurred less, on average, than during center activities in this phase (*M* = 42.5%; range, 15% to 70%). Milo's baseline percentages were low and stable during center activities (*M* = 2.33%; range, 0% to 10%). For the home visit probe, problem behavior occurred during 23% of intervals. In the THR phase, his problem behavior was low and somewhat variable during center activities (*M* = 4%; range, 0% to 25%). Problem behavior during the home visit probes was lower, on average, compared to the baseline home visit probe (*M* = 10%; range, of 2% to 18%). Overall, data for the treatment group indicate that THR did not have an effect on the occurrence of problem behavior during center activities or home visit probes.

Control group. Ivan's baseline percentage of intervals with problem behavior during center activities was variable (*M* = 14.82%; range, of 0% to 62%). Problem behavior during home visit probes was low (*M* = 3.33%; range, 0% to 10%). Denis' percentages in baseline during center activities were low and somewhat stable (*M* = 2.24%; range, 0% to 12%). During the home visit probes, problem behavior was low and stable (*M* =.67%; range, of 0% to 2%). Edmund did not engage in problem behavior in the center activities or home visit probes.

THR

Posture. The percentage of intervals in which participants displayed appropriate posture while mounted on the horse was recorded for 10 min during each weekly lesson. These data are depicted in Figure 9. Seth's percentage of intervals with appropriate posture was variable with stability observed during the final three lessons (*M* = 60.5%; range, 35% to 77%). Selina's

percentages were high and stable (*M* = 94.25%; range, 90% to 98%). Frank's appropriate posture showed an increasing trend during THR (*M* = 64.5%; range, 0% to 92%). Milo's percentages were generally high and stable with a slight increase at the end of the study (*M* =71.86%; range, 64% to 82%). These data suggest that participants' posture improved during THR.

Responses to initiations. The percentage of responses to another's initiation was captured using a voice recorder, in which a 10-min time sample of each THR session was scored for each participant. These data are depicted in Figure 10. The percentage of Seth's (*M* = 13.89%; range, 0% to 50%) and Selina's (*M* = 70.83%; range, 0% to 100%) responses to initiations were variable Frank and Milo did not respond to any initiations made by others across all sessions. In sum, these data suggest that responses to initiations remain unchanged throughout THR.

Spontaneous initiations. The rate of spontaneous initiations was captured each week via a voice recorder, in which a 10 min time sample of each THR session was scored for each participant. These data are depicted in Figure 10.Seth's rate had a decreasing trend (*M* =0.58; range, 0.2 to 1). Selina's rate of spontaneous initiations was variable (*M* = 0.55; range, 0.1 to 1.1). Frank did not make any spontaneous initiations during THR. Milo had a low and stable rate (*M* = 0.01; range, 0 to 0.1). In sum, there were no changes in the rate of spontaneous initiations for three of four participants. One participant demonstrated decreases in the rate of spontaneous initiations during THR.

Vocal commands. The rate of vocal commands used to direct the horse was captured via a voice recorder, in which a 10 min time sample of each THR session was scored for each participant. These data are depicted in Figure 10. Seth's rate of vocal commands was variable with a one-session increase in the rate of vocal commands (*M* = 0.4; range, 0.2 to 1.1). Selina's

rate was also variable and showed no clear trend (*M* = 0.49; range, 0 to 1.1). Neither Frank nor Milo used vocal commands during THR. These data suggest that the rate of vocal commands remained unchanged throughout THR.

Gestural commands. The rate of gestural commands was recorded in vivo during each THR session for 10-min per participant. These data are depicted in Figure 10. Neither Seth nor Selina used gestural commands during therapy. Frank's rate of gestural commands was low and somewhat stable (*M* = 0.04; range, 0 to 0.2). Milo's rate of gestural commands was variable (*M* = 0.23; range, 0 to 0.9). Overall, these data indicate little changes in the rate of gestural commands during THR.

Compliance. The percentage of compliance was recorded prior to participants stepping in the arena (e.g., putting on the helmet, mounting the horse) with their horses as well as when they dismounted (e.g., dismounting the horse without resistance, removing their helmet). These data are depicted in Figure 11. The percentage of compliance for Seth was stable initially and increased in variability thereafter (*M* = 81.5%; range, 25% to 100%). Selina complied with all directions (*M* = 100%) during THR. Frank's percentage showed an increasing trend with stability observed at 80% by the end of the study (*M* = 72.5%; range, 25% to 100%). Milo had a high and stable percentage of compliance (*M* = 94.29%; range, 80% to 100%). In sum, increases in compliance were observed for two of four participants during THR while no changes were demonstrated for the remaining participants (though compliance, on average, was high).

Problem Behavior. The percentage of intervals in which participants engaged in problem behavior was recorded for 10-min in vivo (e.g., motor stereotypy) as well as from voice recorders (e.g., vocal stereotypy). These data are depicted in Figure 11. Seth's percentage of problem behavior was low and stable (*M* = 4.6%; range, 0% to 11%). Selina did not engage in

problem behavior during THR. Frank's percentages were variable (*M* = 48.82%; range, 3% to 85%). Milo's problem behavior was low and stable (*M* = 5.4%; range, of 2% to 12%). In sum, three of four participants displayed low levels of problem behavior during THR.

Survey Data

Pre-THR parent survey. Prior to the start of the study, the parents of the participants completed surveys to assess their impressions of the benefits of THR using a Likert-type scale (1 = strongly disagree to 4 = strongly agree). Parents generally agreed that THR would increase their child's use of language (*M* = 3.25; range, 3 to 4) (e.g., sign language, speech, or use of a language device), motivation (*M* = 3.25; range, 3 to 4), and that their child would be excited to participate (*M* = 3.25; range, 2 to 4). Parents also agreed that THR would take an important role in their child's therapy and services (*M* = 3.5; range, 3 to 4). The highest rated item was one in which parents agreed that THR would be a fun activity for their child to experience (*M* = 3.75; range, 3 to 4). Parents slightly disagreed that THR would decrease the frequency of problem behavior (*M* = 2.75; range, 2 to 3) that their child displayed. Additionally, parents indicated that THR would not increase their child's level of independence (*M* = 2.5; range, 2 to 3). Open-ended comments indicated that parents hoped that THR would improve communication skills, expressed excitement for the opportunity for their child to participate, and indicated an interest in THR. They also expressed uncertainty that THR would be effective. These data are depicted in Table 4.

Post-THR parent survey. Parents completed a survey after the conclusion of THR to assess their impressions of the effects of THR for their child. Parents disagreed that THR helped to increase their child's use of language (*M* = 2.25; range, 1 to 3). Parents also disagreed that THR was an effective intervention to decrease problem behavior (*M* = 2; range, 1 to 3). Parents

still disagreed that THR would improve their child's level of independence (*M* = 2.5; range, 1 to 4). Parents agreed that THR improved their child's motivation (*M* = 3.33; range, 2.5 to 4), which is a slight increase from the pre-THR survey. Parents also expressed agreement that their child appeared excited to participate (*M* = 3.75; range, 3 to 4) and that THR was a fun activity for their child to experience (*M* = 4). Parents slightly agreed that THR was beneficial to their child's overall skill and behavior acquisition (*M* = 3.33; range, 2.5 to 4); however, when asked if their child would continue to participate in THR sessions, the average rating did not reflect this perceived benefit (*M* = 2.7; range, 2 to 3). Open-ended comments indicated that some parents would look into other opportunities for their child to continue THR as well as noting that their child loved going each week. Other comments indicated that the parents noticed an increase in language expression; however most of the other behaviors that the child displayed did not change significantly. These data are depicted in Table 5.

CBCL and Teacher Rating Form (TRF)

CBCL. Parents completed rating forms regarding behavior problems and competencies their child displayed before the study started and after its completion. Data for internalizing problems, externalizing problems, and total problems for the treatment and control group are reported below and can also be found in Table 6.

Treatment Group. Scores are described using three classifications of behavior ranges (e.g., normal, clinical, and borderline). T-scores below 60 are considered to be within normal ranges, while 64 and above indicate clinical ranges, and 60 to 63 indicate borderline ranges. Seth's pre-study CBCL scores for internalizing (T = 45), externalizing (T = 58), and total problems (T = 55) fell within the normal range. These T-scores decreased for externalizing (T = 54) and total problems (T = 53) for the post-study assessment and remained the same for

internalizing problems (T = 45). Pre-study scores for Selina also fell within the normal ranges for all three categories of behaviors. Post-study scores indicate a decrease in all three categories; however, these decreases in internalizing (T = 39 to T = 33), externalizing (T = 56 to T = 52), and total problems (T = 51 to T = 47) were small. Frank's pre-study assessment scores were within borderline ranges for externalizing (T = 60) and total problems (T = 62), while internalizing problems (T = 48) were rated within normal ranges. The post-study scores indicate increases in internalizing (T = 66), externalizing (T = 68), and total problems (T = 73) categories, which all fell within clinical ranges. On the pre-study assessment, Milo's parent rated his internalizing problems (T = 52) as falling within the normal ranges. Externalizing (T = 63) and total problems (T = 64); however, fell within borderline and clinical ranges, respectively. On the post-study assessment, all of the behavior categories decreased, such that internalizing (T = 50), externalizing (T = 54), and total problems (T = 57) all fell within normal ranges. According to the findings of the CBCL, improvements in scores for Seth, Selina, and Milo were reported by parents at the end of THR.

Control Group. Before the study Ivan scored within the borderline range for internalizing problems (T = 62) and within clinical ranges for externalizing (T = 64) and total problems (T = 70). For the post-study assessment, internalizing problems (T = 59) and externalizing problems (T = 59) decreased and were within normal ranges, and while still within clinical levels, items scored for the total problems (T = 64) category decreased as well. Denis' pre-study CBCL scores indicate that his behaviors were within normal levels for internalizing (T = 50), externalizing (T = 53), and total problems (T = 54). Denis' post-study CBCL scores indicate that internalizing problems (T = 48) decreased, while externalizing problems (T = 63) increased and were within borderline ranges and total problems (T = 66) also increased and fell within clinical ranges.

Edmund's pre-study assessment scores indicated that internalizing (T = 72), externalizing (T = 67) and total problems (T = 73) all fell within clinical ranges. Post-study assessment scores decreased for all three categories of behaviors, such that, internalizing problems (T = 60) fell within borderline ranges, while externalizing problems (T = 50) and total problems (T = 53) were within normal levels.

TRF. Participants' teachers completed the TRF of the CBCL prior to the start of the study and after its completion. Behavior categories reported within the CBCL are also reported below and use the same T-score classification of ranges of behaviors. Data for the treatment and control group can be found in Table 7.

Treatment group. On the pre-study assessment, Seth's teacher rated his behavior as generally falling within normal ranges. T-scores for internalizing (T = 58) and externalizing problems (T = 55) were within normal ranges. T-scores for total problems (T = 61), however, fell just within borderline ranges. Post-study assessment scores suggest that all three categories of behaviors fell within normal ranges (internalizing problems, T = 45; externalizing problems, T = 58; total problems, T = 56). Pre-study TRF scores for Selina fell within borderline levels for externalizing problems (T = 63) and total problems (T = 63), while internalizing problems (T = 57) fell within normal ranges. On the post-study assessment, T-scores for two categories of behavior increased to clinical levels (internalizing problems, T = 64; total problems, T = 66). These changes were not observed for externalizing problems (T = 62), which decreased slightly, but still fell within borderline levels. Frank's teacher rated his pre-study behavior as falling within normal ranges for internalizing problems (T = 59) and within clinical ranges for externalizing (T = 69) and total problems (T = 70). After the study, T-scores for internalizing (T = 62) and externalizing problems (T = 66) increased to borderline and clinical ranges,

respectively. The total problems (T = 67) T-score decreased slightly; however, this was still within clinical ranges. On the pre-study assessment, Milo's teacher rated his behavior as falling within normal ranges for internalizing problems (T = 50), externalizing problems (T = 42), and total problems (T = 53). During the post-study assessment, internalizing problems (T = 50) were rated similarly to baseline levels; however, T-scores for externalizing problems (T = 54) and total problems (T = 56) increased slightly, but were still within normal ranges. In sum, these data suggest that THR did not have an overall effect on these behavior categories.

Control group. On the pre-study assessment, Ivan's T-scores for internalizing (T = 52), externalizing (T = 54), and total problems (T = 54) fell within normal ranges. With the exception of internalizing problems, which remained the same after the completion of the study, T-scores for externalizing (T = 56) and total problems (T = 56) increased, but were still within normal ranges. Pre-study TRF scores for Denis indicate clinical ranges for externalizing (T = 71) and total problems (T = 72), while internalizing problems (T = 53) fell within normal ranges. Post-study scores show very little change for externalizing problems (T = 70) and total problems (T = 73); however, there was a small change for internalizing problems (T = 59), which still fell within normal range. On the pre-study assessment, Edmund's teacher rated his internalizing problems (T = 60) as falling within borderline levels, while T-scores for externalizing (T= 53) and total problems (T = 52) were within normal ranges. On the post-study assessment, the internalizing problems (T = 64) score, which was within clinical levels, while scores for externalizing problems (T = 55) and total problems (T = 56) were still within normal ranges.

Discussion

The purpose of the present study was to use a single-case experimental design to evaluate the effects of THR on numerous behaviors of children with ASD using repeated measurement of

operationally defined behaviors. In addition, this study included a waitlist control group for comparison purposes. The results suggest that THR did not produce clinically significant effects on participant affect, off-task behavior, problem behavior, compliance, or language (i.e., spontaneous initiations and responses to initiations) from baseline to treatment during center-based activities and home observations. Data for participants who received THR are similar to participants assigned to the waitlist control group; data showed similar variability (or stability) across many, if not most, of the dependent variables for these settings. Improvements were noted for posture during THR sessions. The findings from the time series analysis suggest that THR is not an effective intervention to improve performance on the dependent variables—with the exception of posture—included in the present study.

Overall CBCL scores for both the treatment and control group indicate reductions in problem behavior at the end of the study (as reported by parents); however, a follow-up interview with parents suggested that these findings were a product of the flaws in self-reports. Two parents, in particular, indicated that they did not believe their child engaged in less problem behavior after participating in THR and were surprised about the discrepancy when asked about it during the interview. Both also indicated that the way in which they rated the items was more a function of their most recent experiences (e.g., less screaming and tantrums during the week that the assessment was completed) with their child and may not be due to THR. Perhaps improvements observed by parents were due to other interventions implemented during the course of the study. Because reductions were observed in both the treatment and control group, THR is not responsible for this change. Changes in CBCL scores were not reflected in the data collected in other settings. That is, results of direct measurement do not support the self-report questionnaire. Interestingly, the TRF scores differ from the CBCL scores. TRF scores, in

general, do not indicate an overall effect for THR. While some participants' post-study data revealed lower scores in internalizing problems, externalizing problems, and/or total problems, these changes were not observed in other settings and may be explained by limitations in self-report questionnaires.

Post-THR parent surveys appear to support the main findings. Although pre-THR surveys suggested that parents believed THR would increase their child's language, they reported a lack of noticeable improvements in language at the end of the study. Interestingly, anecdotal verbal reports from some parents indicated changes in their child's language both at home and at school; however, these changes were not captured during data collection over time and across settings. Parent ratings of the effectiveness of THR to reduce problem behavior decreased from the beginning to the end of the study. Although parents indicated appreciation for the opportunity for their child to participate in THR, it was not perceived as an effective therapy for addressing problem behaviors or language deficits. In summary, parents appear to indicate that THR may be best conceptualized as a leisure activity, rather than a treatment option for symptoms of ASD.

These findings also support the use of single-case experimental design to evaluate claims of effectiveness of alternative or controversial treatments. Like Chok et al. (2010), Lerman et al. (2008), and Kay and Vyse (2005), the present study failed to replicate previous research. Moreover, the approach adopted in the present study is in keeping with the recommendations of Barlow et al. (2009) to use behavior analytic research in this manner.

Past research has evaluated the effects of THR on various dependent variables using pre-post assessments, surveys, waitlist control groups, and in one case, a reversal design. The collective results of these studies suggest that THR improved social skills, motivation, fine motor perception (Bass et al., 2009; Nelson et al., 2011), motor skills, and self-regulation (Gabriels et

al., 2012) across participants. While these past results suggest promising effects of THR, the results of the current study not only fail to replicate the magnitude of effects across dependent variables, but also fail to demonstrate any meaningful improvements across participants. Posture was the only dependent variable to increase across most participants in the treatment group, which supports claims that THR is effective in improving dimensions of motor functioning (Gabriels et al., 2012). Perhaps this failure to replicate may be due to the way in which data were collected. While past studies relied on self-report forms and poorly defined constructs, the current study used direct observation of operationally defined dependent variables as well as repeated measurement. Although the current study relied on some self-report forms, they were used as a *supplement to,* not in lieu of, direct observation techniques, which are the hallmark of behavior analytic research. It may also be the case that participants in this study differed in a meaningful way from participants in previously published research (e.g., skill and functioning level, experiences outside of THR sessions). Additionally, the number of sessions of THR offered to the participants differs across studies and may be responsible for the differences in treatment effects. It is important to note, however, that participants were exposed to 1 hr sessions for nine weeks, which is still within the range of exposure of other studies (6 to 12 weeks). The content of each lesson may be a contributing factor for the failure to replicate. The various procedures used and opportunities to practice different skills may influence skill acquisition and/or behavior change; however, there is no research thus far to suggest that a specific set of lesson plans for THR is superior to, or more effective, than another.

Contributions to the THR Literature

The current study adds to the existing body of literature by using a single-case experimental design to evaluate the effectiveness of THR for children with ASD. This study

contradicts previous research and failed to show benefits across the dependent variables. As the number of ASD treatments continue to increase, more experimental research is needed to evaluate these treatment options. This will not only help parents and practitioners select the most appropriate intervention, but will hopefully preserve valuable instructional or treatment time. In addition, this study will help to inform EBP, which provide some guidance about which interventions are most appropriate for a particular clinical issue. Identifying interventions that *are not* effective, or even harmful, is as important as documenting interventions that *are* effective (Romanczyk et al., 2008).

Behavior analysts have the ethical obligation to recommend evidence-based interventions that have been shown to be effective, both in the short- and long-term, within the literature (Bailey & Burch, 2011; BACB: Behavior Analyst Certification Board, 1998-2010). If a parent solicited help regarding the selection of an alternative treatment option for their child with ASD, behavior analysts are responsible for reviewing the effects of the alternative treatment, based on evidence in the literature, to try to prevent harm to their client. It is important that behavior analysts provide information regarding the risks of treatment or lack of experimental research to support a particular treatment. Failure to do so may leave families with the misconception that proceeding with treatment is appropriate or not harmful to their child (Greenspan, 2008). Sharing this information may save the family money and valuable treatment time (Kay & Vyse, 2008). If outcome data for a treatment are lacking and simply do not exist, a behavior analyst is expected to evaluate the effects of treatment with the specific client by collecting data, which bolsters the client's right to an effective treatment (Bailey & Burch, 2011; BACB, 1998-2010).

Results of this study also suggest that participants enjoyed participating in THR, as indicated by parent reports, despite the intervention failing to produce robust changes in overall

behavior. Anecdotal data suggest that parents found value in THR even though it was not effective as a therapy. This finding suggests that THR could be incorporated into another evidenced-based treatment approach for children with ASD; THR would not be used therapeutically in this case, but might serve as a valued reinforcer.

Limitations and Future Research

Although this study has strengths and addresses a gap in the literature, it also has several limitations. First, the research team relied on video cameras to capture center activities that were not scored in vivo. For a few sessions, the cameras lost battery power and did not record sessions for some participants. These sets of data were unable to be recovered and were not scored or included in the analysis of the effects of THR. However, because dependent variables were measured two to four times weekly during center activities, this data loss was minimal and may have only marginally impacted data analysis. Additionally, IOA for two of the participants (i.e., Selina and Frank) was low for one session, which decreased the average. Due to loss of video footage for these sessions, the data could not be rescored for accuracy. Overall, IOA for all dependent variables across participants was generally high and it is unlikely that the study's results were negatively impacted.

Next, dependent variables were measured for one participant at a time during therapy. Those participants most likely to dismount before the end of the session due to problem behavior were observed first. Consequently, Selina, who was the most likely to remain on the horse during the entire session, was not always observed for a full 10 min (despite riding for the whole session). This was the case even if the lesson began late because lessons had to end at a specific time due to volunteer availability. Since some dependent variables were recorded in vivo during these sessions, those data were not captured; however, data for a vast majority of Selina's

therapy sessions were recorded. Given the lack of change in behavior throughout THR sessions, it is unlikely that this loss of data greatly impacted data analysis. Furthermore, Seth and Frank were dismounted before the conclusion of a lesson on two separate occasions due to unsafe behavior and/or non-assent, which may have impacted their horsemanship skill acquisition. To mitigate this limitation, both participants were given the opportunity to ride a horse during two additional sessions, which equated to a total of nine full sessions of therapy. Additionally, because of missed sessions, time, and resource constraints during the study, Milo did not complete nine full sessions of THR. The therapy facility and research team were unable to offer additional sessions. This may have impacted skill acquisition during therapy and in other settings; however, given the data from other participants, it is less unlikely that these absences greatly impacted Milo's behavior.

Lesson plans and therapy sessions were developed by the certified instructor at the research site. The research team did not have input or control over the objectives and procedures. A replication of this study could examine the effects of a THR program developed by researchers to control for extraneous variables and further assess the utility and effects of this type of therapy on the behavior of children with ASD. Furthermore, THR was offered for nine weeks, which is a shorter amount of exposure time than other studies. Perhaps this is a limiting factor which may have impacted skill acquisition. Future studies may be able to capitalize on the single-case design methodology by measuring dependent variables for an extended period of time, such as 12 to16 weeks. This extended time would allow for an examination of trends in behavior over a longer period of time as well as reduce the likelihood that behavior changes occur due to extraneous variables, while also evaluating the importance of "dose" with regard to THR exposure. Future researchers could also collect data using direct observations with larger

treatment and waitlist control groups. A larger sample size would help to evaluate the generalization of effects of THR across the targeted population. Moreover, future studies could evaluate more dependent variables commonly cited in both hippotherapy and THR literature, such as motivation or social skills. These dependent variables should be defined behaviorally, which will allow for objective and direct measurement. Another area for future research includes evaluating the use of THR as a reinforcer for performance during teaching sessions. For example, after completing a token board during discrete trial instruction, a student could be allowed to participate in a session of THR. Instructors or teachers could capitalize on the Premack principle, in which performance during work sessions may improve because it is followed by a highly preferred activity. Future research could also evaluate the effects of incorporating behavioral teaching techniques during THR on the behaviors measured in the present study. For example, incidental teaching and contingent reinforcement could be used during THR sessions, an enriched environment, more formally.

Conclusions

This study used a single-case experimental design to evaluate the effects of THR on the behavior of children with ASD. Overall, results indicate that THR was not effective in improving language, compliance, off-task behavior, problem behavior, or affect across settings and time. Although previous research suggests that THR is an effective intervention for children with ASD, this outcome was not replicated in the present study. While THR may not improve various topographies or dimensions of behavior, it could be used in conjunction with other evidence-based interventions shown to be effective. THR could be used as a reinforcer within a treatment package, but should not be used as the primary treatment option to change behavior (given the results of the present study). The results of this study are important because they demonstrate

that THR may be an enjoyable activity for children with ASD (as indicated by parent reports), but it does not represent an EBP.

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Table 1

Therapeutic Horseback Riding Lesson Plans

Week	Objectives
1	1. Riders will become comfortable in arena (this is the first ride for both riders) 2. Rider will identify reins by touching or picking them up 3 out of 6 times during lesson 3. Rider will correctly perform 4 out of the 8 skills once during the lessons
2	1. Riders will become comfortable in arena (this is the second ride for both riders) 2. Rider will identify reins by touching or picking them up 3 out of 6 times during lesson 3. Rider will correctly perform 4 out of the 8 skills once during the lessons 4. Rider Frank will mount with less resistance and ride thru ¼ of the lesson
3	1. Riders will become comfortable in arena 2. Rider will identify reins by touching or picking them up 3 out of 6 times during lesson 3. Rider will correctly perform 4 out of the 8 skills once during the lessons 4. Rider Frank will mount with less resistance and ride thru ¼ of the lesson 5. Riders Selina and Milo New Skill – Correct Way to Hold Reins 6. Rider Seth New Skill – Right Turn
4	1. Rider will identify reins by touching or picking them up 3 out of 6 times during lesson (review) 2. Riders will ask their horses to move off by saying "Walk On" or tapping their horse on the neck. 3. Riders will ask their horse to stop by saying " whoa" or lowering reins to neck 4. Rider Frank will mount with less resistance and ride thru 1/2 of the lesson 5. Riders Selina and Milo New Skill – Right Turn 6. Rider Seth Review Skill – Right Turn
5	1. Riders Milo and Frank will become comfortable in arena 2. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 3. Rider Frank will mount with less resistance and ride thru 100% of the lesson 4. Rider Milo will ask horse to move off by tapping his neck 5. Riders Selina and Seth will continue to correctly hold reins. 6. Rider Seth and Selina will review and practice the verbal commands "walk on" and "Whoa". 7. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.
6	1. Riders Milo and Frank will become comfortable in arena 2. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 3. Rider Frank will mount with less resistance and ride thru 100% of the lesson 4. Rider Milo will ask horse to move off by tapping his neck 5. Rider Milo and Frank will ask horse to stop by pulling reins back. 6. Riders Selina and Seth will continue to correctly hold reins. 7. Rider Seth and Selina will review and practice the verbal commands "walk on" and "Whoa". 8. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.
7	1. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 2. Rider Frank will mount with less resistance and ride thru 100% of the lesson 3. Rider Milo will ask horse to move off by tapping his neck 4. Rider Milo and Frank will ask horse to stop by pulling reins back. 5. Riders Selina and Seth will continue to correctly hold reins. 6. Rider Seth and Selina will review and practice the verbal commands "walk on" and "Whoa". 7. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.
8	1. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 2. Rider Frank will mount with less resistance and ride thru 100% of the lesson 3. Rider Milo will ask horse to move off by tapping his neck 4. Rider Milo and Frank will ask horse to stop by pulling reins back. 5. Riders Selina and Seth will continue to correctly hold reins. 6. Rider Seth and Selina will review and practice the verbal commands "walk on" and "Whoa". 7. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.

9	1. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 2. Rider Milo will ask horse to move off by tapping his neck 3. Rider Milo and Frank will ask horse to stop by pulling reins back. 4. Riders Selina and Seth will continue to correctly hold reins. 5. Rider Seth and Selina will review and practice the verbal commands “walk on” and “Whoa” with little or no prompting 6. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.
10	1. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 2. Rider Milo will ask horse to move off by tapping his neck 3. Rider Frank will ask horse to move off by tapping his neck. 4. Rider Milo and Frank will ask horse to stop by pulling reins back. 5. Riders Selina and Seth will continue to correctly hold reins. 6. Rider Seth and Selina will review and practice the verbal commands “walk on” and “Whoa” with little or no prompting 7. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.
11	1. Rider Milo and Frank will identify reins by touching or picking them up 3 out of 6 times during lesson 2. Rider Milo and Frank will ask horse to move off by tapping his neck 3. Rider Milo and Frank will ask horse to stop by pulling reins back. 4. Riders Selina and Seth will continue to correctly hold reins. 5. Rider Seth and Selina will review and practice the verbal commands “walk on” and “Whoa” with little or no prompting 6. Rider Seth and Selina will review and practice Right and Left Turn using reins to guide horse.

Table 2

Interobserver Agreement for Home Visit Probes, Center Activities, and THR for Treatment Group

	Seth	Selina	Frank	Milo
Home Visit Probe: BL	33% of sessions	33% of sessions	33% of sessions	33% of sessions
Affect	100%	97%	98%	95%
Problem Behavior	97%	100%	97%	97%
Compliance	97%	85%	98%	88%
RTI	100%	95%	98%	92%
SI	86%	90%	100%	100%
Center Activities: BL				
Affect				
Average	100%	90.60%	98%	92.70%
% of sessions	75%	71%	50%	43%
Range	100%	85% to 100%	98% to 100%	88% to 100%
Off-task				
Average	96.3%	86.40%	94%	92%
% of sessions	75%	100%	50%	43%
Range	89% to 100%	50% to 97%	94% to 100%	88% to 97%
Problem Behavior				
Average	95.40%	99.80%	82.40%	97.40%
% of sessions	63%	67%	57%	67%
Range	85% to 100%	98% to 100%	42% to 97%	92% to 100%
Compliance				
Average	100%	100%	100%	100%
% of sessions	100%	63%	50%	83%
Range	-	-	-	-
RTI				
Average	100%	100%	100%	100%
% of sessions	70%	60%	50%	83%
Range	-	-	-	-
SI	96.7%	95.60%	93.30%	100%
Average	75%	64%	50%	67%
% of sessions	80% to 100%	80% to 100%	80% to 100%	-
Range				
Home Visit: THR	33% of sessions	33% of sessions	33% of sessions	33% of sessions
Affect	100%	98%	100%	98%
Problem Behavior	98%	100%	100%	97%
Compliance	100%	86%	100%	90%
RTI	100%	94%	100%	90%
SI	100%	80%	100%	100%

Center Activities: THR				
Affect				
Average	97.75%	97%	99.40%	93%
% of sessions	42%	56%	70%	42%
Range	94% to 100%	92% to 100%	98% to 100%	83% to 100%
Off-task				
Average	94.10%	86.80%	99.60%	90.60%
% of sessions	42%	56%	50%	42%
Range	90% to 100%	83% to 90%	98% to 100%	88% to 90%
Problem Behavior				
Average	97.1%	99.70%	90.20%	98%
% of sessions	42.50%	42%	38%	39%
Range	89% to 100%	98% to 100%	86% to 95%	93% to 100%
Compliance				
Average	100%	100%	100%	100%
% of sessions	70%	60%	65%	64%
Range	-	-	-	-
RTI				
Average	100%	100%	100%	100%
% of sessions	70%	60%	65%	64%
Range	-	-	-	-
SI				
Average	100%	100%	100%	100%
% of sessions	42.50%	39%	38%	36%
Range	-	-	-	-
THR				
Posture				
Average	94.30%	89%	91%	90.70%
% of sessions	30%	44.40%	30%	42.80%
Range	38% to 77%	90% to 98%	0% to 92%	64% to 82%
Verbal Commands				
Average	100%	100%	100%	100%
% of sessions	30%	33%	30%	42.80%
Range	-	-	-	-
Gestural Commands				
Average	100%	100%	100%	100%
% of sessions	30%	44.40%	40%	42.80%
Range	-	-	-	-
RTI				
Average	100%	100%	100%	100%
% of sessions	30%	33%	30%	42.80%
Range	-	-	-	-
Compliance				
Average	100%	100%	100%	100%
% of sessions	36.60%	33%	40%	42.80%
Range	-	-	-	-

Problem Behavior				
Average	97.70%	100%	95.70%	100%
% of sessions	30%	33%	30%	42.80%
Range	95% to 100%	-	90% to 100%	-
SI				
Average	100%	100%	100%	100%
% of sessions	42.50%	39%	38%	36%
Range	-	-	-	-

Note: BL= Baseline, RTI = Responses to Initiations, SI = Spontaneous Initiations, THR = Therapeutic horseback riding. Double lines indicate phase change

Table 3

Interobserver Agreement for Home Visit Probes and Center Activities for Control Group

	Ivan	Denis	Edmund
Home Visit Probes	33% of sessions	33% of sessions	33% of sessions
Affect	98%	100%	100%
Problem Behavior	100%	98%	100%
Compliance	100%	90%	98%
RTI	100%	90%	98%
SI	100%	100%	80%
Center Activities			
Affect			
Average	94.1%	95.5%	95%
% of sessions	47.0%	40.0%	70%
Range	89% to 98%	92% to 100%	87% to 100%
Off-task			
Average	92.0%	94.3%	92.4%
% of sessions	47.0%	40.0%	70%
Range	88% to 97%	88% to 97%	88% to 100%
Problem Behavior			
Average	93.80%	96.9%	98.8%
% of sessions	37.0%	43.0%	57%
Range	88% to 100%	92% to 100%	90% to 100%
Compliance			
Average	100%	100.0%	100%
% of sessions	58.0%	70.0%	80%
Range	-	-	-
RTI			
Average	100%	100.0%	100%
% of sessions	58.0%	55.0%	60%
Range	100%	100.0%	100%
SI			
Average	100%	97.6%	96.9%
% of sessions	42.0%	37.0%	47%
Range	-	83% to 100%	86% to 100%

Note: RTI = Responses to Initiations, SI = Spontaneous Initiations

Table 4

Pre-Therapeutic Horseback Riding Parent Survey

Question	*M*	*SD*
Therapeutic horseback riding will increase my child's use of language (sign language, speech, or use of a language device).	3.25	0.5
Therapeutic horseback riding will decrease the frequency of problem behavior (elopement, aggression, pica, etc.) that my child displays.	2.75	0.5
I think therapeutic horseback riding is a fun activity for my child to experience.	3.75	0.5
Therapeutic horseback riding will increase my child's motivation	3.25	0.5
I think my child will be excited to participate in the therapeutic horseback riding.	3.25	0.96
Therapeutic horseback riding will improve my child's level of independence.	2.5	0.58
Therapeutic horseback riding will be an important part of my child's therapy and services.	3.5	0.58
Other comments: 1) We hope therapeutic horseback riding will improve our child's communication skills. 2) I am really excited for the boys to be able to participate in the program. 3) Sounds interesting, open to the idea. Not 100% sure it will work, but it couldn't hurt.		

Table 5

Post-Therapeutic Horseback Riding Parent Survey

Question	*M*	*SD*
Therapeutic horseback riding helped to increase my child's use of langauage (sign language, speech, or use of a language device.)	2.25	0.96
Therapeutic horseback riding helped decrease the frequency of problem behavior (elopement, aggression, pica, etc.) that my child displays.	2	0.82
I think therapeutic horseback riding was a fun activity for my child to experience.	4	0
My child's motivation increased.	3.33	0.58
My child appeared to be excited to participate in therapeutic horseback riding.	3.75	0.5
Therapeutic horseback riding helped to improve my child's level of	2.5	1.29
Therapeutic horseback riding was very beneficial to my child's overall skill and behavior acquisition.	3.33	0.58
My child will continue to participate in therapeutic horseback riding sessions.	2.67	0.58
Other comments: 1) I would really like for him to continue in therapeutic horseback riding. I will be checking into any kind of scholarships available. 2) I am certain that he enjoyed the experience. We have noticed an increase in language expression; however most of his behaviors have not change very much. 3) Not sure if we will continue therapeutic horseback riding. Looking into opportunities. Our child loved coming.		

Table 6

Treatment and Control Group Pre- and Post-Study CBCL Scores

	Pre-study CBCL T-score	Behavior Range	Post-study CBCL T-Score	Behavior Range
Treatment Group				
Seth				
Internalizing Problems	45	Normal	45	Normal
Externalizing Problems	58	Normal	54	Normal
Total Problems	55	Normal	53	Normal
Selina				
Internalizing Problems	39	Normal	33	Normal
Externalizing Problems	56	Normal	52	Normal
Total Problems	51	Normal	47	Normal
Frank				
Internalizing Problems	48	Normal	66	Clinical
Externalizing Problems	60	Borderline	68	Clinical
Total Problems	62	Borderline	73	Clinical
Milo				
Internalizing Problems	52	Normal	50	Normal
Externalizing Problems	63	Borderline	54	Normal
Total Problems	64	Clinical	57	Normal
Control Group				
Ivan				
Internalizing Problems	62	Clinical	59	Normal
Externalizing Problems	64	Clinical	59	Normal
Total Problems	70	Clinical	64	Clinical
Denis				
Internalizing Problems	50	Normal	48	Normal
Externalizing Problems	53	Normal	63	Borderline
Total Problems	54	Normal	66	Clinical
Edmund				
Internalizing Problems	72	Clinical	60	Borderline
Externalizing Problems	67	Clinical	50	Normal
Total Problems	73	Clinical	53	Normal

Table 7

Treatment and Control Group Pre- and Post-Study TRF Scores

	Pre-study TRF T-score	Behavior Range	Post-study TRF T-Score	Behavior Range
Treatment Group				
Seth				
Internalizing Problems	58	Normal	45	Normal
Externalizing Problems	55	Normal	58	Normal
Total Problems	61	Borderline	56	Normal
Selina				
Internalizing Problems	57	Normal	64	Clinical
Externalizing Problems	63	Borderline	66	Clinical
Total Problems	63	Borderline	62	Borderline
Frank				
Internalizing Problems	59	Normal	62	Borderline
Externalizing Problems	69	Clinical	66	Clinical
Total Problems	70	Clinical	67	Clinical
Milo				
Internalizing Problems	50	Normal	50	Normal
Externalizing Problems	42	Normal	54	Normal
Total Problems	53	Normal	56	Normal
Control Group				
Ivan				
Internalizing Problems	52	Normal	52	Normal
Externalizing Problems	54	Normal	56	Normal
Total Problems	54	Normal	56	Normal
Denis				
Internalizing Problems	53	Normal	59	Normal
Externalizing Problems	71	Clinical	70	Clinical
Total Problems	72	Clinical	73	Clinical
Edmund				
Internalizing Problems	60	Borderline	64	Clinical
Externalizing Problems	53	Normal	55	Normal
Total Problems	52	Normal	56	Normal

Figure Captions

Figure 1. Percentage of Intervals in which Happiness and Unhappiness Occurred for Treatment Activities Group during Center and Home Visit Probes.

Figure 2. Percentage of Intervals in which Happiness and Unhappiness Occurred for Control Group during Center Activities and Home Visit Probes.

Figure 3. Percentage of Response to Initiations to Initiations and Rate of Spontaneous Initiations for Treatment Group during Center Activities and Home Visit Probes.

Figure 4. Percentage of Intervals in which Off-Task Behavior Occurred and Percentage of Compliance for Treatment Group during Center Activities and Home Visit Probes.

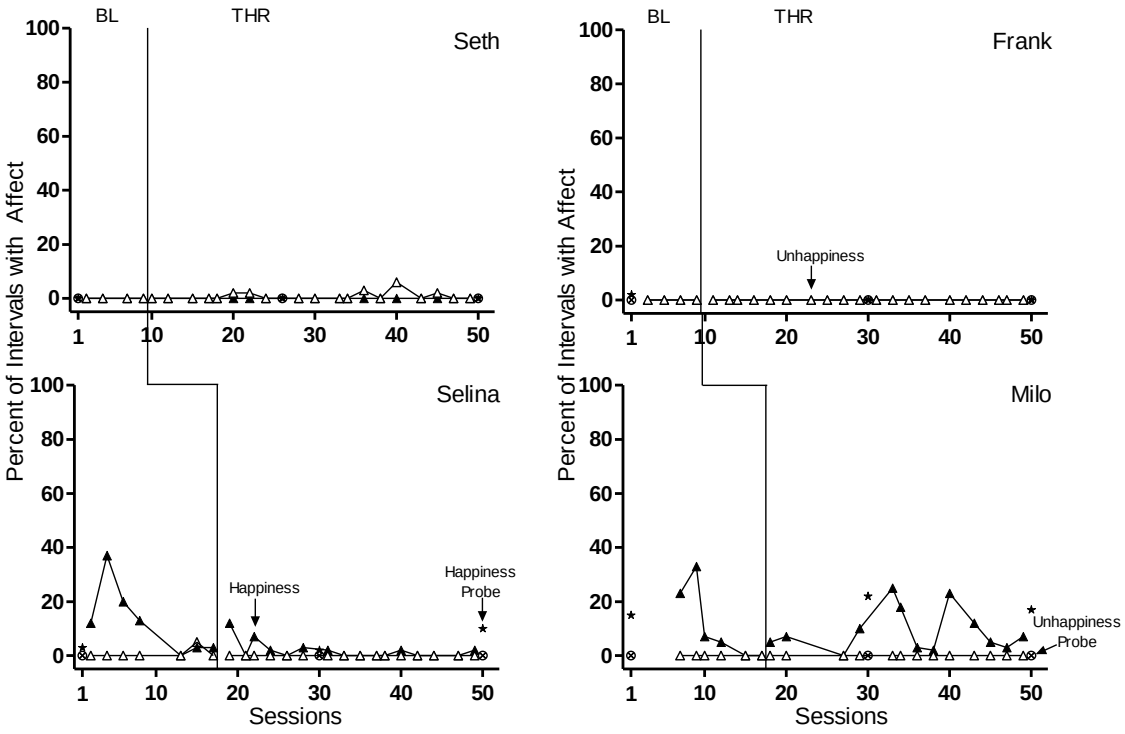
Figure 5. Percentage of Intervals in which Off-Task Behavior Occurred and Percentage of Compliance for Control Group during Center Activities and Home Visit Probes.

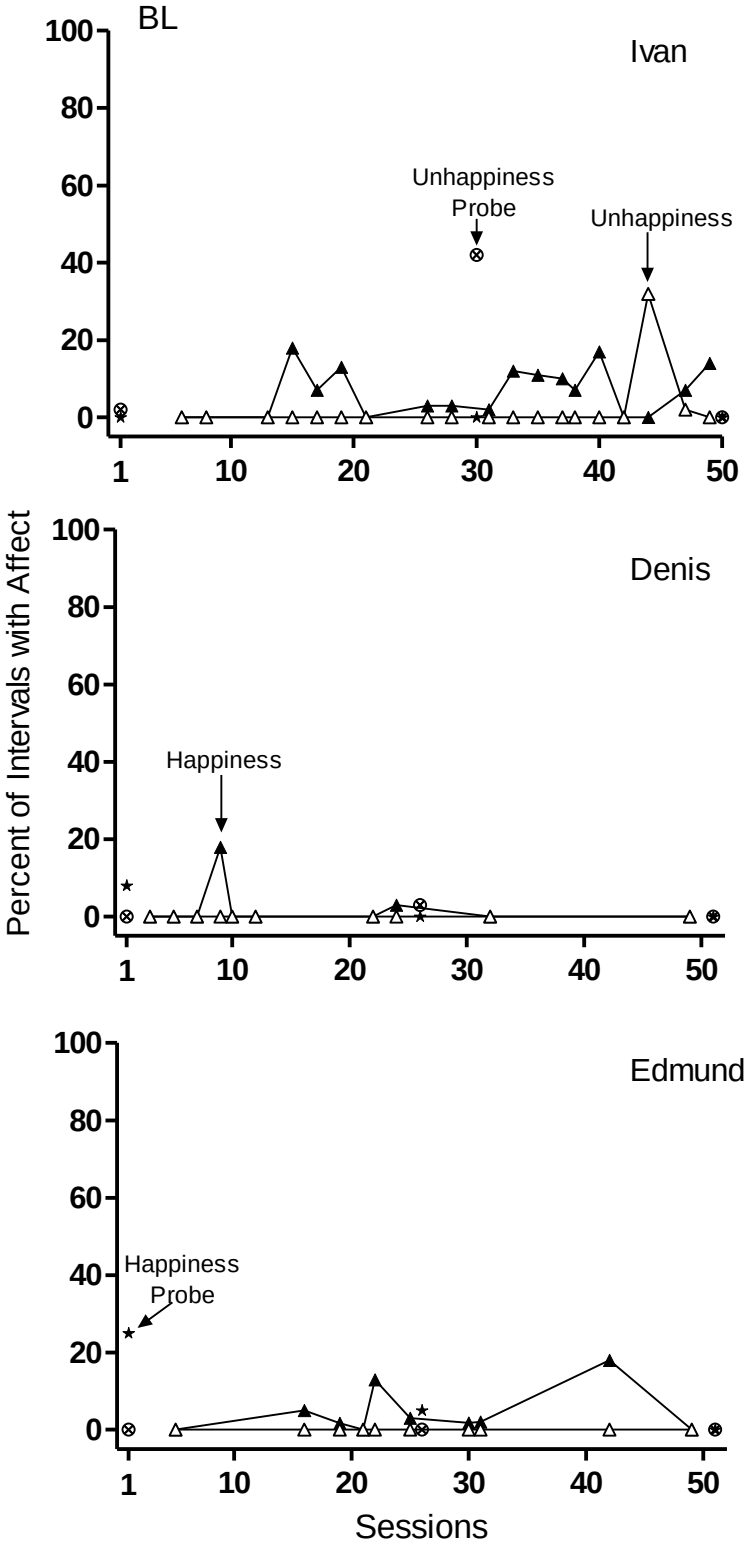
Figure 6. Percentage of Intervals in which Problem Behavior Occurred for Treatment Group during Center Activities and Home Visit Probes.

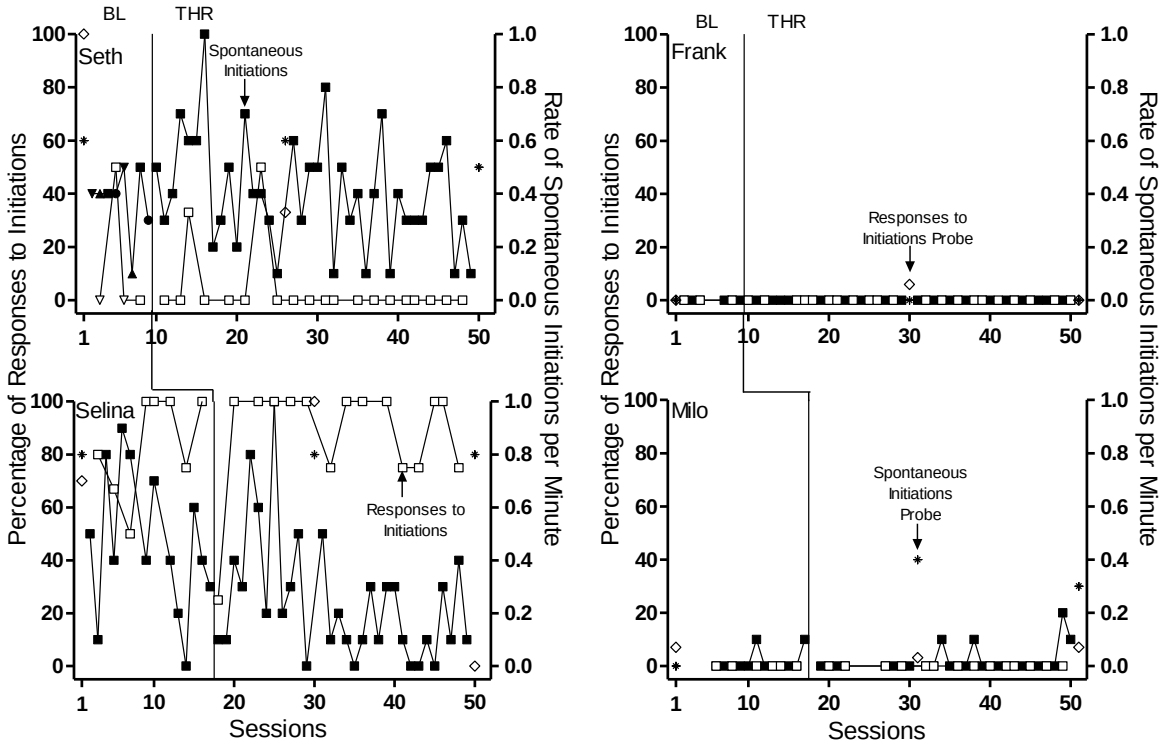
Figure 7. Percentage of Intervals in which Appropriate Posture Occurred for Treatment Group during THR.

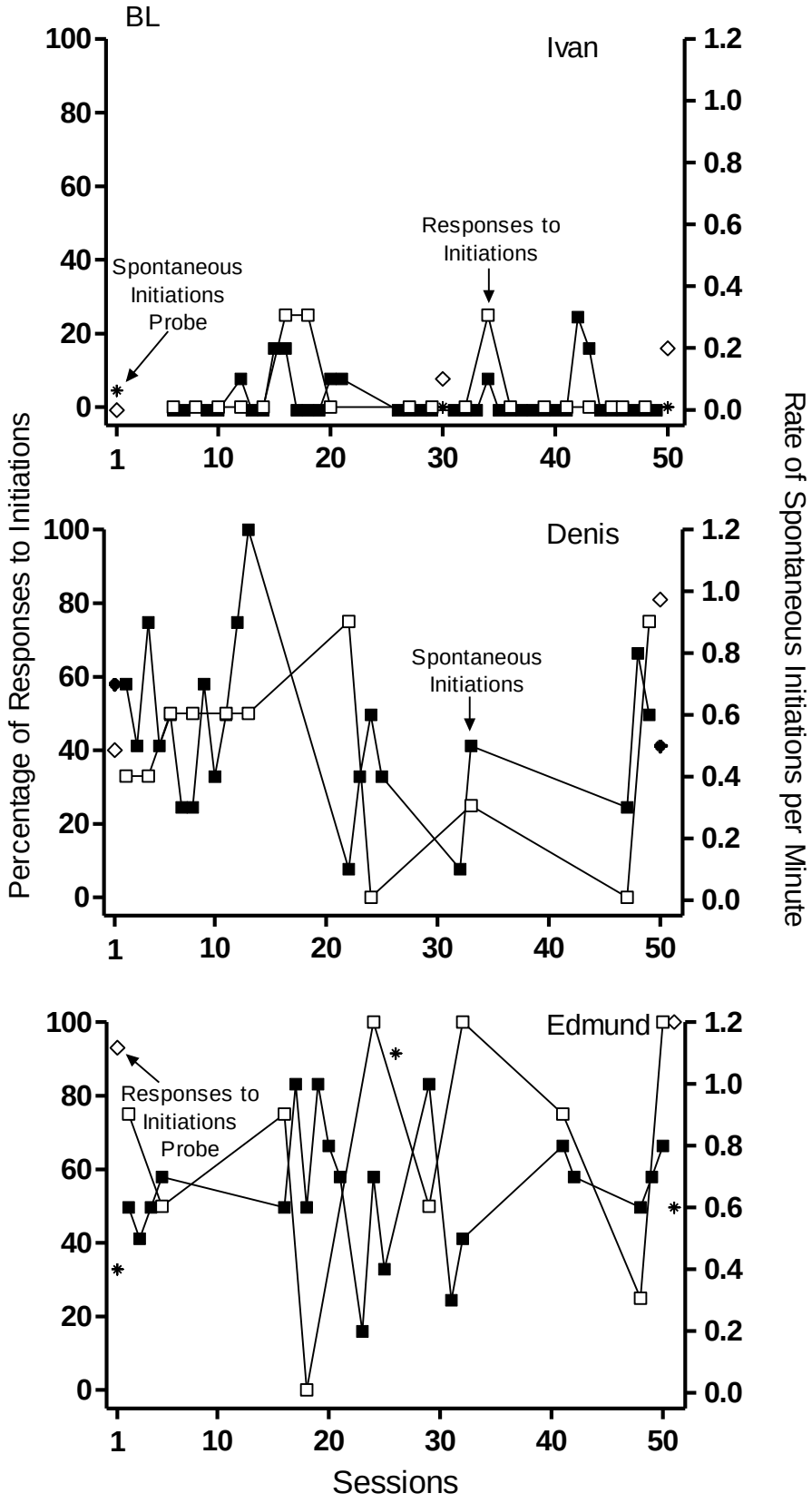
Figure 8. Percentage of Responses to Initiations, Rate of Spontaneous Initiations, Vocal Commands, and Gestural Commands for Treatment Group during THR.

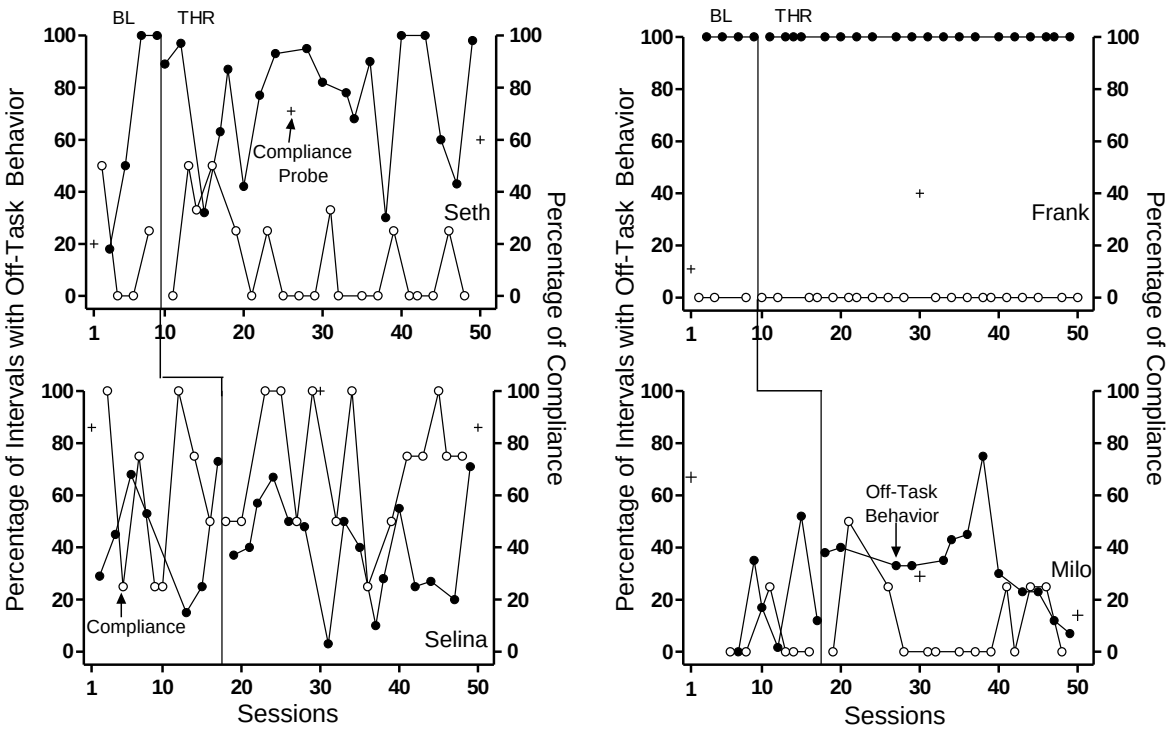
Figure 9. Percentage of Compliance and Percentage of Intervals in which Problem Behavior Occurred for Treatment Group during THR.

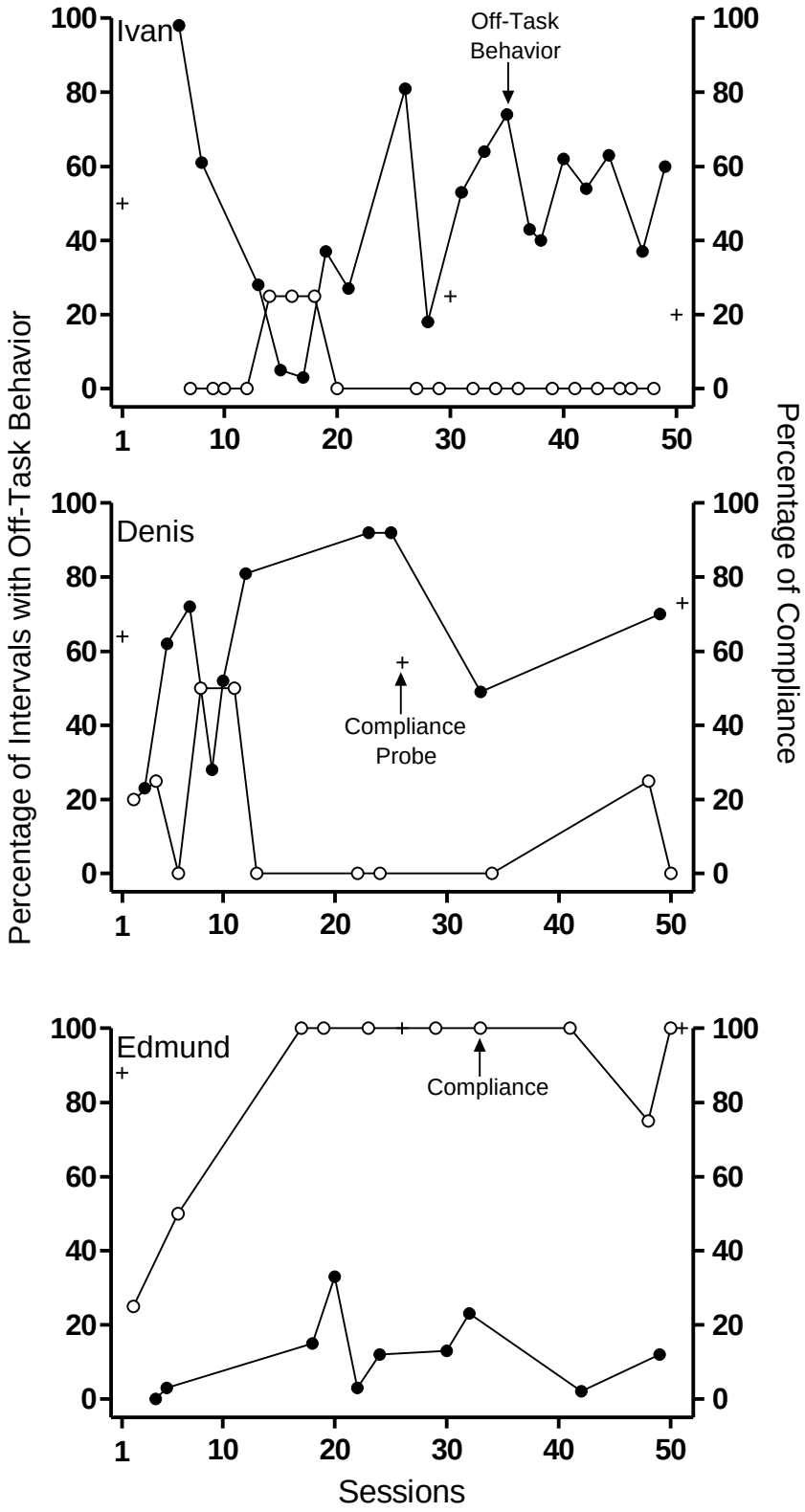

BL
THR
Seth
Frank
Selina
Milo
Percent of Intervals with Affect
Sessions
Happiness
Happiness Probe
Unhappiness
Unhappiness Probe
0
20
40
60
80
100
1
10
20
30
40
50

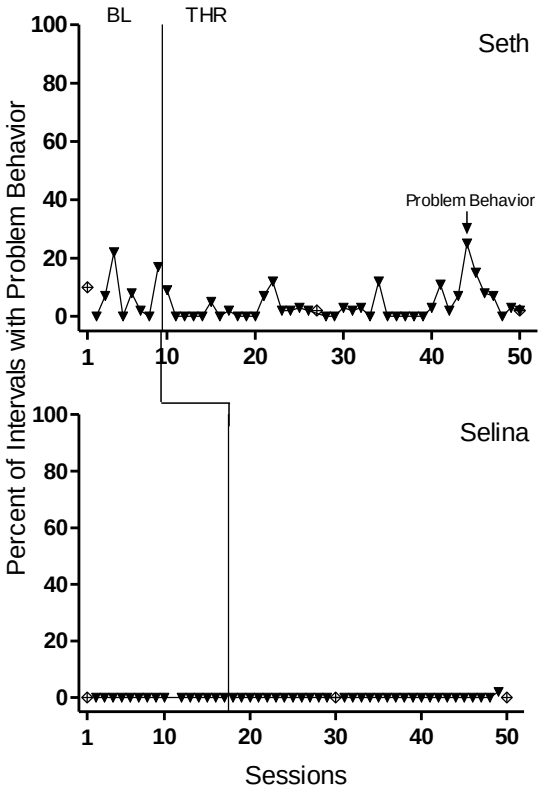

BL
Ivan
Unhappiness
Probe
Unhappiness
Denis
Happiness
Edmund
Happiness
Probe
Percent of Intervals with Affect
Sessions
100
80
60
40
20
0
1
10
20
30
40
50

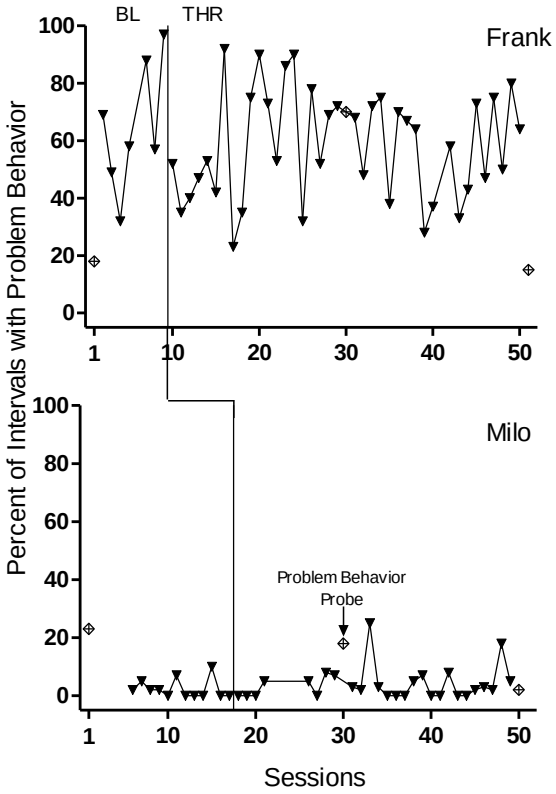

BL
THR
Seth
Spontaneous Initiations
Selina
Responses to Initiations
Frank
Responses to Initiations Probe
Milo
Spontaneous Initiations Probe
Percentage of Responses to Initiations
Rate of Spontaneous Initiations per Minute
Sessions

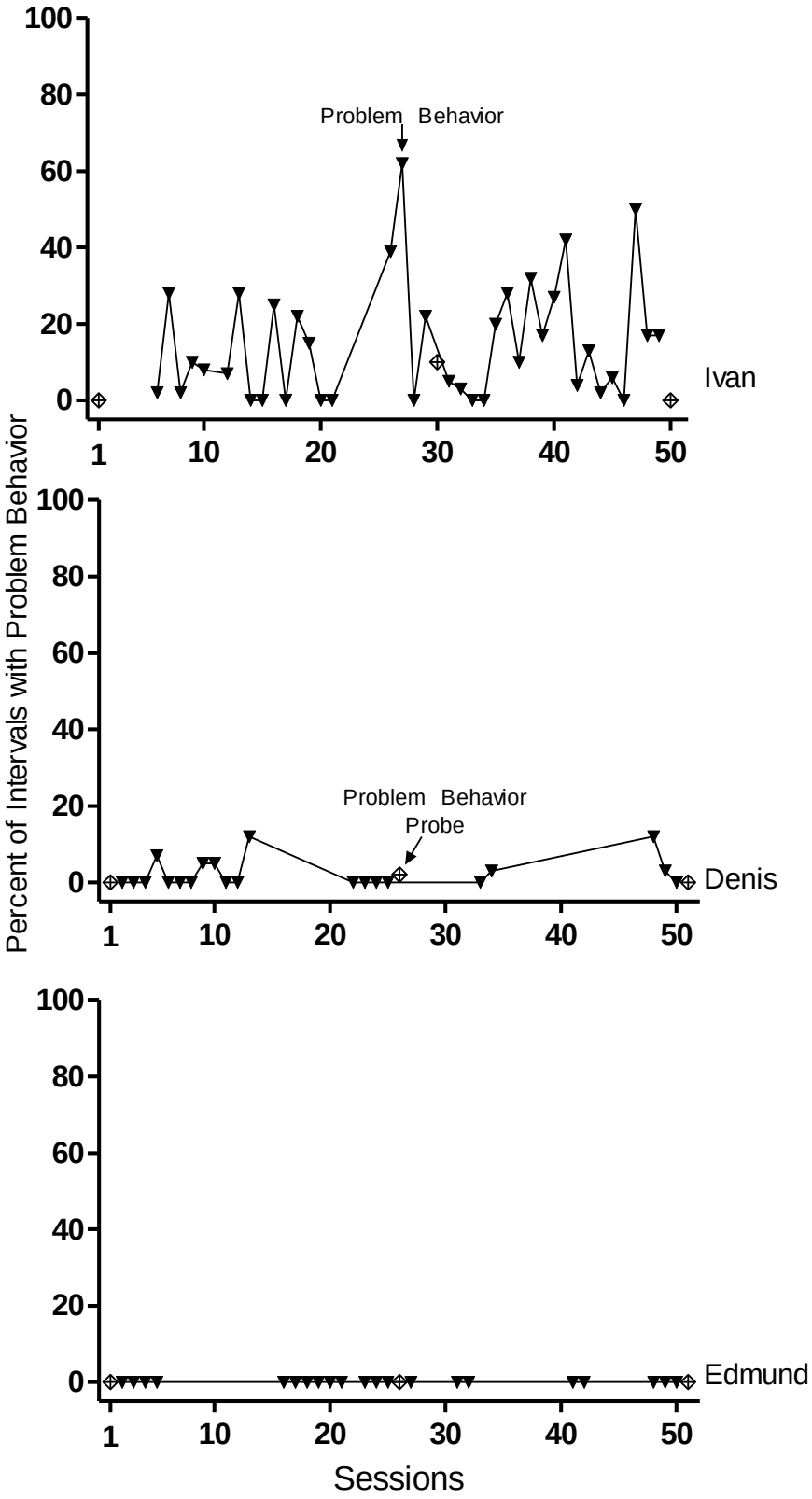

BL
Ivan
Responses to Initiations
Spontaneous Initiations Probe
Denis
Spontaneous Initiations
Edmund
Responses to Initiations Probe
Percentage of Responses to Initiations
Rate of Spontaneous Initiations per Minute
Sessions
100
80
60
40
20
0
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
10
20
30
40
50

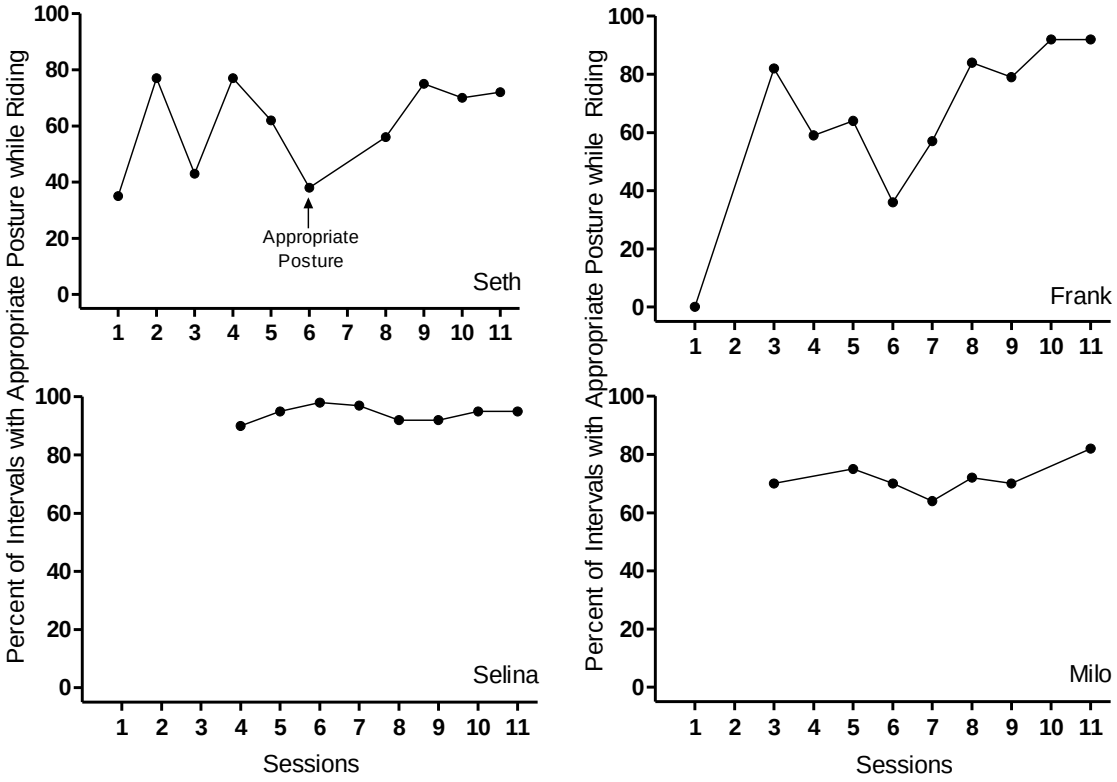

BL
THR
Compliance
Probe
Seth
Compliance
Selina
Frank
Off-Task
Behavior
Milo
Percentage of Intervals with Off-Task Behavior
Percentage of Compliance
Sessions

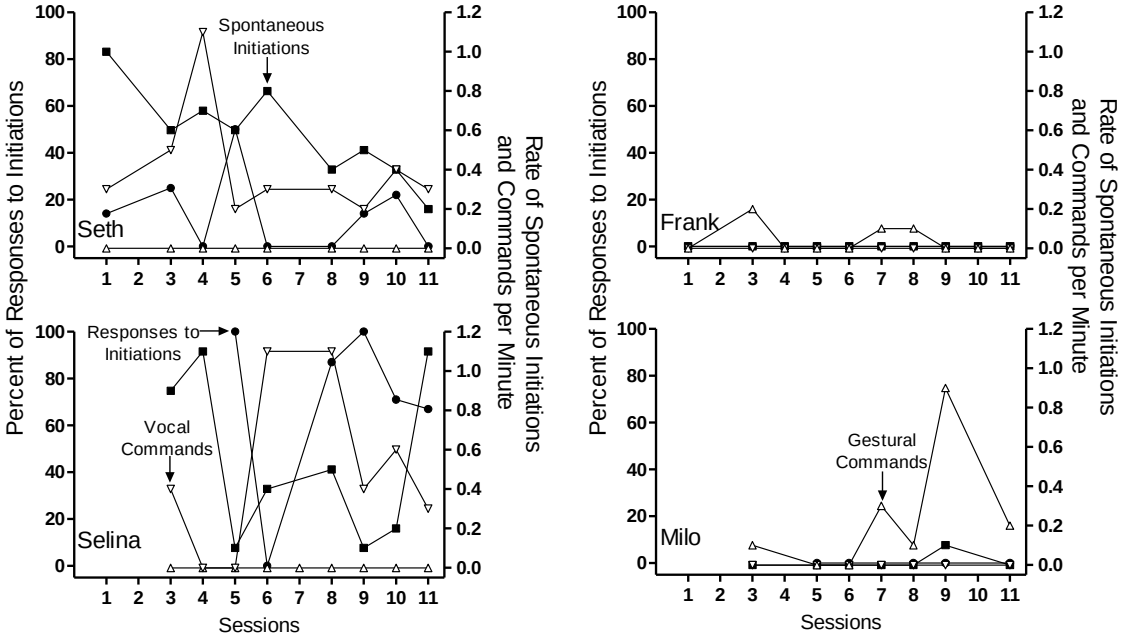

Ivan
Off-Task
Behavior
Denis
Compliance
Probe
Edmund
Compliance
Percentage of Intervals with Off-Task Behavior
Percentage of Compliance
Sessions
100
80
60
40
20
0
1
10
20
30
40
50

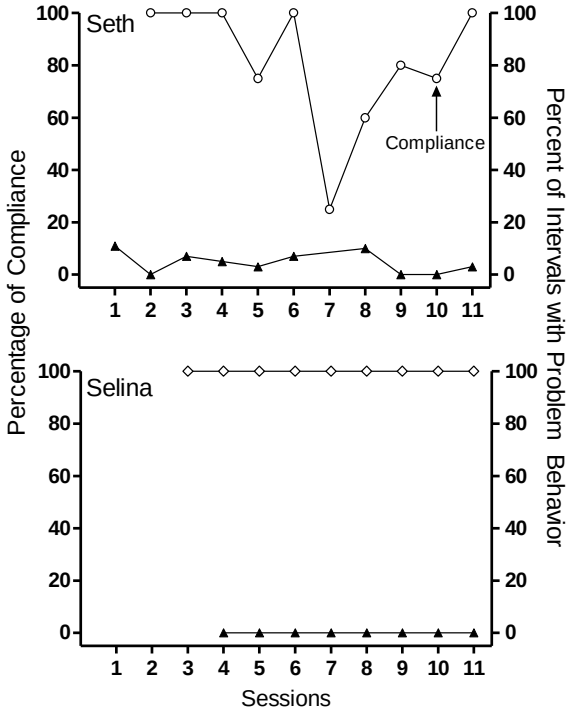

BL
THR
Seth
Problem Behavior
Selina
Percent of Intervals with Problem Behavior
Sessions

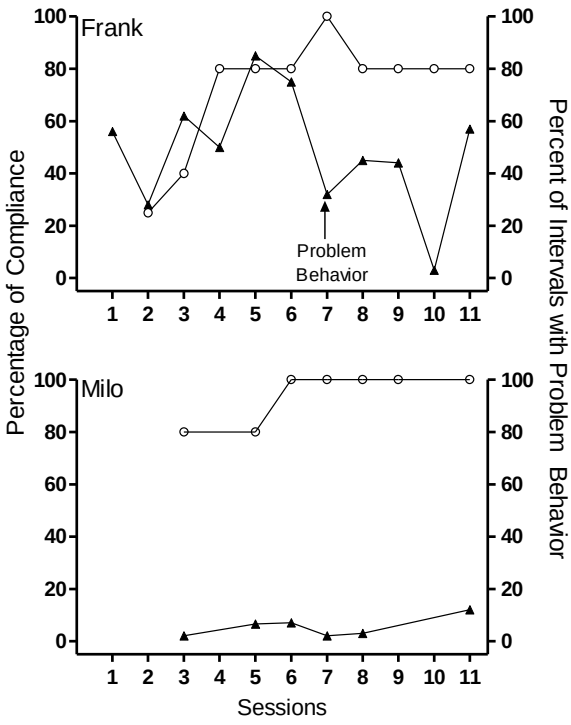

BL
THR
Frank
Milo
Problem Behavior
Probe
Percent of Intervals with Problem Behavior
Sessions


Percent of Intervals with Problem Behavior
Problem Behavior
Ivan
Problem Behavior
Probe
Denis
Edmund
Sessions
100
80
60
40
20
0
1
10
20
30
40
50


Percent of Intervals with Appropriate Posture while Riding
Appropriate Posture
Seth
Frank
Selina
Milo
Sessions
Sessions


Seth
Spontaneous Initiations
Selina
Responses to Initiations
Vocal Commands
Frank
Milo
Gestural Commands
Percent of Responses to Initiations
Rate of Spontaneous Initiations and Commands per Minute
Sessions


Seth
Compliance
Selina
Percentage of Compliance
Percent of Intervals with Problem Behavior
Sessions


Frank
Problem Behavior
Milo
Percentage of Compliance
Percent of Intervals with Problem Behavior
Sessions

Appendix A

Date:_____ Observer:_____

ART/ACADEMIC

MOMENTARY TIME SAMPLING

Directions: Fill-in ☺ when happiness is observed. Fill-in 😐 when neither happiness or unhappiness are observed. Fill-in ☹ when unhappiness is observed. Circle Y when off-task behavior is observed; circle N when off-task behavior is *not* observed. Circle Y if instances of problem behavior are observed; circle N when problem behavior is *not* observed. Tally each occurrence of spontanous initiations in the blank boxes.

Happiness: Any facial expression or vocalization typically considered an indicator of happiness
Examples:smiling, laughing, and yelling while smiling.

Unhappiness: Any facial expression or vocalization typically considered an indicator of unhappiness
Examples: frowning, grimacing, crying, scowling, or yelling without smiling

Off-task: Motor behaviors or verbalizations that are not permitted or are unrelated to the current task (e.g., non-contextual vocalizations, speaking without permission during an academic task, etc)

Spontaneous initiations: Are defined as any language (vocal, picture exchange, use of language technology, and/or sign language) used before a prompt or model is provided. A pause of 10 s or more in between initiations is recorded as a new initiation.

Problem Bx: Aggression (hitting, slapping, kicking, biting, pushing etc.) directed toward another individual; pica (eating non-food items); stereotypy (hand flapping, body rocking, finger posturing, non-contextual vocalizations, etc.); self-injurious behavior (self-biting, head banging, hitting head with hands or objects, etc); screaming or other vocalizations not appropriate for the setting; property destruction (tearing, throwing, ripping, etc. materials that is inappropriate for the activity); any other disruptions not appropriate for the setting.

Participant: G

	Hap. & Unhap.	OFF-T	P Bx	S-I
Interval 1	☺ 😐 ☹	Y N	Y N	
Interval 2	☺ 😐 ☹	Y N	Y N	
Interval 3	☺ 😐 ☹	Y N	Y N	
Interval 4	☺ 😐 ☹	Y N	Y N	
Interval 5	☺ 😐 ☹	Y N	Y N	
Interval 6	☺ 😐 ☹	Y N	Y N	
Interval 7	☺ 😐 ☹	Y N	Y N	
Interval 8	☺ 😐 ☹	Y N	Y N	
Interval 9	☺ 😐 ☹	Y N	Y N	
Interval 10	☺ 😐 ☹	Y N	Y N	
Interval 11	☺ 😐 ☹	Y N	Y N	
Interval 12	☺ 😐 ☹	Y N	Y N	
Interval 13	☺ 😐 ☹	Y N	Y N	
Interval 14	☺ 😐 ☹	Y N	Y N	
Interval 15	☺ 😐 ☹	Y N	Y N	
Interval 16	☺ 😐 ☹	Y N	Y N	
Interval 17	☺ 😐 ☹	Y N	Y N	
Interval 18	☺ 😐 ☹	Y N	Y N	
Interval 19	☺ 😐 ☹	Y N	Y N	
Interval 20	☺ 😐 ☹	Y N	Y N	

Participant: H

	Hap. & Unhap.	OFF-T	P Bx	S-I
Interval 1	☺ 😐 ☹	Y N	Y N	
Interval 2	☺ 😐 ☹	Y N	Y N	
Interval 3	☺ 😐 ☹	Y N	Y N	
Interval 4	☺ 😐 ☹	Y N	Y N	
Interval 5	☺ 😐 ☹	Y N	Y N	
Interval 6	☺ 😐 ☹	Y N	Y N	
Interval 7	☺ 😐 ☹	Y N	Y N	
Interval 8	☺ 😐 ☹	Y N	Y N	
Interval 9	☺ 😐 ☹	Y N	Y N	
Interval 10	☺ 😐 ☹	Y N	Y N	
Interval 11	☺ 😐 ☹	Y N	Y N	
Interval 12	☺ 😐 ☹	Y N	Y N	
Interval 13	☺ 😐 ☹	Y N	Y N	
Interval 14	☺ 😐 ☹	Y N	Y N	
Interval 15	☺ 😐 ☹	Y N	Y N	
Interval 16	☺ 😐 ☹	Y N	Y N	
Interval 17	☺ 😐 ☹	Y N	Y N	
Interval 18	☺ 😐 ☹	Y N	Y N	
Interval 19	☺ 😐 ☹	Y N	Y N	
Interval 20	☺ 😐 ☹	Y N	Y N	

				OFF-T		P Bx		S-I
Interval 21	☺	😐	☹	Y	N	Y	N	
Interval 22	☺	😐	☹	Y	N	Y	N	
Interval 23	☺	😐	☹	Y	N	Y	N	
Interval 24	☺	😐	☹	Y	N	Y	N	
Interval 25	☺	😐	☹	Y	N	Y	N	
Interval 26	☺	😐	☹	Y	N	Y	N	
Interval 27	☺	😐	☹	Y	N	Y	N	
Interval 28	☺	😐	☹	Y	N	Y	N	
Interval 29	☺	😐	☹	Y	N	Y	N	
Interval 30	☺	😐	☹	Y	N	Y	N	
Interval 31	☺	😐	☹	Y	N	Y	N	
Interval 32	☺	😐	☹	Y	N	Y	N	
Interval 33	☺	😐	☹	Y	N	Y	N	
Interval 34	☺	😐	☹	Y	N	Y	N	
Interval 35	☺	😐	☹	Y	N	Y	N	
Interval 36	☺	😐	☹	Y	N	Y	N	
Interval 37	☺	😐	☹	Y	N	Y	N	
Interval 38	☺	😐	☹	Y	N	Y	N	
Interval 39	☺	😐	☹	Y	N	Y	N	
Interval 40	☺	😐	☹	Y	N	Y	N	
Interval 41	☺	😐	☹	Y	N	Y	N	
Interval 42	☺	😐	☹	Y	N	Y	N	
Interval 43	☺	😐	☹	Y	N	Y	N	
Interval 44	☺	😐	☹	Y	N	Y	N	
Interval 45	☺	😐	☹	Y	N	Y	N	
Interval 46	☺	😐	☹	Y	N	Y	N	
Interval 47	☺	😐	☹	Y	N	Y	N	
Interval 48	☺	😐	☹	Y	N	Y	N	
Interval 49	☺	😐	☹	Y	N	Y	N	
Interval 50	☺	😐	☹	Y	N	Y	N	
Interval 51	☺	😐	☹	Y	N	Y	N	
Interval 52	☺	😐	☹	Y	N	Y	N	
Interval 53	☺	😐	☹	Y	N	Y	N	
Interval 54	☺	😐	☹	Y	N	Y	N	
Interval 55	☺	😐	☹	Y	N	Y	N	
Interval 56	☺	😐	☹	Y	N	Y	N	
Interval 57	☺	😐	☹	Y	N	Y	N	
Interval 58	☺	😐	☹	Y	N	Y	N	
Interval 59	☺	😐	☹	Y	N	Y	N	
Interval 60	☺	😐	☹	Y	N	Y	N	

				OFF-T		P Bx		S-I
Interval 21	☺	😐	☹	Y	N	Y	N	
Interval 22	☺	😐	☹	Y	N	Y	N	
Interval 23	☺	😐	☹	Y	N	Y	N	
Interval 24	☺	😐	☹	Y	N	Y	N	
Interval 25	☺	😐	☹	Y	N	Y	N	
Interval 26	☺	😐	☹	Y	N	Y	N	
Interval 27	☺	😐	☹	Y	N	Y	N	
Interval 28	☺	😐	☹	Y	N	Y	N	
Interval 29	☺	😐	☹	Y	N	Y	N	
Interval 30	☺	😐	☹	Y	N	Y	N	
Interval 31	☺	😐	☹	Y	N	Y	N	
Interval 32	☺	😐	☹	Y	N	Y	N	
Interval 33	☺	😐	☹	Y	N	Y	N	
Interval 34	☺	😐	☹	Y	N	Y	N	
Interval 35	☺	😐	☹	Y	N	Y	N	
Interval 36	☺	😐	☹	Y	N	Y	N	
Interval 37	☺	😐	☹	Y	N	Y	N	
Interval 38	☺	😐	☹	Y	N	Y	N	
Interval 39	☺	😐	☹	Y	N	Y	N	
Interval 40	☺	😐	☹	Y	N	Y	N	
Interval 41	☺	😐	☹	Y	N	Y	N	
Interval 42	☺	😐	☹	Y	N	Y	N	
Interval 43	☺	😐	☹	Y	N	Y	N	
Interval 44	☺	😐	☹	Y	N	Y	N	
Interval 45	☺	😐	☹	Y	N	Y	N	
Interval 46	☺	😐	☹	Y	N	Y	N	
Interval 47	☺	😐	☹	Y	N	Y	N	
Interval 48	☺	😐	☹	Y	N	Y	N	
Interval 49	☺	😐	☹	Y	N	Y	N	
Interval 50	☺	😐	☹	Y	N	Y	N	
Interval 51	☺	😐	☹	Y	N	Y	N	
Interval 52	☺	😐	☹	Y	N	Y	N	
Interval 53	☺	😐	☹	Y	N	Y	N	
Interval 54	☺	😐	☹	Y	N	Y	N	
Interval 55	☺	😐	☹	Y	N	Y	N	
Interval 56	☺	😐	☹	Y	N	Y	N	
Interval 57	☺	😐	☹	Y	N	Y	N	
Interval 58	☺	😐	☹	Y	N	Y	N	
Interval 59	☺	😐	☹	Y	N	Y	N	
Interval 60	☺	😐	☹	Y	N	Y	N	

Appendix B

Date:_____ Observer_____

GAMES/SNACK

% of Opportunity & MTS

Directions: Circle **+** when a response is made when an opportunity (initiation from another person) is presented. Circle **-** when a response does not occur when an opportunity is presented. Circle **+** when compliance is observed. Circle **-** if the behavior does not occur after a direction is presented. Circle Y if instances of problem behavior are observed; circle N when problem behavior is *not* observed. Tally each occurrence of spontanous initiations in the blank boxes.

Responses to initiations: any contextually appropriate vocalization, picture exchange, use of augmentative device, sign language, or other form of communication within **3** s of another's initiation.

Compliance: following a direction within **10** s of its presentation without a prompt.

Spontaneous initiations: are defined as any language (vocal, picture exchange, use of language technology, and/or sign language) used before a prompt or model is provided. A pause of **10 s** or more between initiations is recorded as a new initiation.

Problem Bx: Aggression (hitting, slapping, kicking, biting, pushing etc.) directed toward another individual; pica (eating non-food items); stereotypy (hand flapping, body rocking, finger posturing, non-contextual vocalizations, etc.); self-injurious behavior (self-biting, head banging, hitting head with hands or objects, etc); screaming or other vocalizations not appropriate for the setting; property destruction (tearing, throwing, ripping, etc. materials that is inappropriate for the activity); any other disruptions not appropriate for the setting.

Participant: G

		3s	10s
	P Bx	RTI	Comp
Interval 1	Y N	+ -	+ -
Interval 2	Y N	+ -	+ -
Interval 3	Y N	+ -	+ -
Interval 4	Y N	+ -	+ -
Interval 5	Y N		
Interval 6	Y N		
Interval 7	Y N	SI	
Interval 8	Y N		
Interval 9	Y N		
Interval 10	Y N		
Interval 11	Y N		
Interval 12	Y N		
Interval 13	Y N		
Interval 14	Y N		
Interval 15	Y N		
Interval 16	Y N		
Interval 17	Y N		
Interval 18	Y N		
Interval 19	Y N		
Interval 20	Y N		
Interval 21	Y N		

Participant: H

		3 s	10s
	P Bx	RTI	Comp
Interval 1	Y N	+ -	+ -
Interval 2	Y N	+ -	+ -
Interval 3	Y N	+ -	+ -
Interval 4	Y N	+ -	+ -
Interval 5	Y N		
Interval 6	Y N		
Interval 7	Y N	SI	
Interval 8	Y N		
Interval 9	Y N		
Interval 10	Y N		
Interval 11	Y N		
Interval 12	Y N		
Interval 13	Y N		
Interval 14	Y N		
Interval 15	Y N		
Interval 16	Y N		
Interval 17	Y N		
Interval 18	Y N		
Interval 19	Y N		
Interval 20	Y N		
Interval 21	Y N		

Interval 22	Y N			
Interval 23	Y N	**3s**		**10s**
Interval 24	Y N	**RTI**		**Comp**
Interval 25	Y N	+	-	+ -
Interval 26	Y N	+	-	+ -
Interval 27	Y N	+	-	+ -
Interval 28	Y N	+	-	+ -
Interval 29	Y N			
Interval 30	Y N	SI		
Interval 31	Y N			
Interval 32	Y N			
Interval 33	Y N			
Interval 34	Y N			
Interval 35	Y N			
Interval 36	Y N			
Interval 37	Y N			
Interval 38	Y N			
Interval 39	Y N			
Interval 40	Y N			
Interval 41	Y N			
Interval 42	Y N			
Interval 43	Y N			
Interval 44	Y N			
Interval 45	Y N			
Interval 46	Y N			
Interval 47	Y N			
Interval 48	Y N			
Interval 49	Y N			
Interval 50	Y N			
Interval 51	Y N			
Interval 52	Y N			
Interval 53	Y N			
Interval 54	Y N			
Interval 55	Y N			
Interval 56	Y N			
Interval 57	Y N			
Interval 58	Y N			
Interval 59	Y N			
Interval 60	Y N			

Interval 22	Y N			
Interval 23	Y N	**3s**		**10s**
Interval 24	Y N	**RTI**		**Comp**
Interval 25	Y N	+	-	+ -
Interval 26	Y N	+	-	+ -
Interval 27	Y N	+	-	+ -
Interval 28	Y N	+	-	+ -
Interval 29	Y N			
Interval 30	Y N	SI		
Interval 31	Y N			
Interval 32	Y N			
Interval 33	Y N			
Interval 34	Y N			
Interval 35	Y N			
Interval 36	Y N			
Interval 37	Y N			
Interval 38	Y N			
Interval 39	Y N			
Interval 40	Y N			
Interval 41	Y N			
Interval 42	Y N			
Interval 43	Y N			
Interval 44	Y N			
Interval 45	Y N			
Interval 46	Y N			
Interval 47	Y N			
Interval 48	Y N			
Interval 49	Y N			
Interval 50	Y N			
Interval 51	Y N			
Interval 52	Y N			
Interval 53	Y N			
Interval 54	Y N			
Interval 55	Y N			
Interval 56	Y N			
Interval 57	Y N			
Interval 58	Y N			
Interval 59	Y N			
Interval 60	Y N			

Appendix C

Pre-Therapeutic Horseback Riding Parent Survey

Please indicate the extent to which you agree or disagree with the following statements.

1=strongly disagree, 4=strongly agree

1. Therapeutic horseback riding will increase my child's use of language (sign language, speech, or use of a language device).

   1 2 3 4

2. Therapeutic horseback riding will decrease the frequency of problem behavior (elopement, aggression, pica, etc.) that my child displays.

   1 2 3 4

3. I think therapeutic horseback riding is a fun activity for my child to experience.

   1 2 3 4

4. Therapeutic horseback riding will increase my child's motivation.

   1 2 3 4

5. I think my child will be excited to participate in the therapeutic horseback riding.

   1 2 3 4

6. Therapeutic horseback riding will improve my child's level of independence.

   1 2 3 4

7. Therapeutic horseback riding will be an important part of my child's therapy and services.

   1 2 3 4

Comments regarding therapeutic horseback riding:

Appendix D

Post-Therapeutic Horseback Riding Parent Survey

Please indicate the extent to which you agree or disagree with the following statements.
1=strongly disagree, 4=strongly agree

1. Therapeutic horseback riding helped to increase my child's use of language (sign language, speech, or use of a language device.

   1 2 3 4

2. Therapeutic horseback riding helped decrease the frequency of problem behavior (elopement, aggression, pica, etc.) that my child displays.

   1 2 3 4

3. I think therapeutic horseback riding was a fun activity for my child to experience.

   1 2 3 4

4. My child's motivation increased.

   1 2 3 4

5. My child appeared to be excited to participate in therapeutic horseback riding.

   1 2 3 4

6. Therapeutic horseback riding helped to improve my child's level of independence.

   1 2 3 4

7. Therapeutic horseback riding was very beneficial to my child's overall skill and behavior acquisition.

   1 2 3 4

8. My child will continue to participate in therapeutic horseback riding sessions.

   1 2 3 4

Comments regarding the therapeutic horseback riding experience:

Appendix E

Game Protocol: Uno

Directions: Provide statements/questions in the order indicated below for each child.
For questions: wait 3 seconds for response.
For compliance: wait 10 seconds for response.
= Indicates statements made to both participants.

TURN CAMERA ON

Time	Statements for:_____	Statements for:_____
Start	Hi _____ and _____ my name is _____. Lets play Uno	
0:15	If you have the same color/number that's on the table you can put your card down.	
0:30	Here are cards for each of us.	
0:45	We will go in a circle. I will put _____ down.	
1:00	_____ Is it your turn? Y N Y N Y N Y N	_____Are you having fun? Y N Y N Y N
1:15	You can say Uno when you have one card left.	
1:30	When I see the skip card, it means that the next person will have a turn the next time around.	
1:45	The wild card means you can pick any color you want	
2:00	_____Give me five. Y N Y N Y N Y N	_____Take a card from the deck. Y N Y N Y N
2:15	I like playing Uno.	
2:30	We are all taking turns.	
2:45	_____ put down a _____.	
3:00	_____ Do you have a lot of cards left? Y N Y N Y N Y N	_____ Is it your turn? Y N Y N Y N
3:15	__color____ is my favorite color.	
3:30	_____ is smiling.	
3:45	I need to pick a new card.	
4:00	_____Take a card from the deck. Y N Y N Y N Y N	_____Give me five. Y N Y N Y N
4:15	We sure have a lot of __color___ cards in the pile.	
4:30	The deck is getting smaller.	
4:45	The color of the cards reminds me of a rainbow.	
5:00	_____Are you having fun? Y N Y N Y N Y N	_____ Do you have a lot of cards left? Y N Y N Y N
5:15	I like seeing rainbows after it stops raining.	
5:30	I like rain as long as I have an umbrella with me.	
5:45	I wonder who will win.	
6:00	_____Show me a red number. Y N Y N Y N Y N	_____Give a card to me. Y N Y N Y N
6:15	The number _____ is at the top of the pile.	
6:30	I'm going to put down the number/color _____.	
6:45	I have __#__ cards left.	
7:00	_____Who has the least cards left? Y N Y N Y N Y N	_____Show me a red number. Y N Y N Y N

7:15	_____ put down the _____ card.	
7:30	_____ put down a _____.	
7:45	I'm waiting for my turn.	
8:00	_____Give a card to me. Y N Y N Y N Y N	_____Who has the least cards left? Y N Y N Y N
8.15	The deck is getting smaller.	
8:30	I wonder who will win.	
8:45	I like when I can match the color and number.	
9:00	We are taking turns putting one card down at a time.	
9.15	The back of the cards is the color _____.	
9:30	Lets finish up the game.	
9:45	_____ put down a _____.	
10:00	Alright, we are done with Uno.	

TURN CAMERA OFF (CLOSE SCREEN)

Appendix F

Game Protocol: Puzzles

Directions: Provide statements/questions in the order indicated below for each child.
For questions: wait 3 seconds for response.
For compliance: wait 10 seconds for response.
= Indicates statements made to both participants.

Time	Statements for:_____	Statements for:_____
Start	Hi _____ and _____ my name is _____.	
0:15	We are going to play with puzzles.	
0:30	You can pick your favorite puzzle to work on.	
0:45	My puzzle is a _____.	
1:00	_____ Do you like puzzles? Y N Y N Y N Y N	_____ What does your puzzle look like? Y N Y N Y N
1:15	My puzzle has ___a little/a lot___ of pieces.	
1:30	I'm putting together one piece at a time	
1:45	I'm looking for a ___color___ piece to fit in my puzzle.	
2:00	_____Give me five. Y N Y N Y N Y N	_____Give me a puzzle piece. Y N Y N Y N
2:15	_____ is wearing a __color____ shirt.	
2:30	_____ found a piece that fit into his/her puzzle.	
2:45	My shirt is the color _____.	
3:00	_____Is your puzzle easy or hard? Y N Y N Y N Y N	_____ Do you like puzzles? Y N Y N Y N
3:15	I have __#__ pieces left.	
3:30	It is warm/chilly outside.	
3:45	I hope it snows soon--I like to make snowmen.	
4:00	_____Give me a puzzle piece. Y N Y N Y N Y N	_____Have you seen one of my puzzle pieces? Y N Y N Y N
4:15	My favorite season in winter.	
4:30	I like puzzles with animals on them.	
4:45	_____ is putting the puzzle together fast.	
5:00	_____ What does your puzzle look like? Y N Y N Y N Y N	_____Is your puzzle easy or hard? Y N Y N Y N
5:15	It looks like _____ is having fun.	
5:30	We are all working hard to finish our puzzles.	
5:45	_____ has __#___ pieces left.	
6:00	_____Show me a smile. Y N Y N Y N Y N	_____Give me five. Y N Y N Y N
6:15	When I'm having fun, I like to smile.	
6:30	I like working on puzzles.	
6:45	When I finish puzzles I sometimes like to frame them like a picture.	
7:00	_____Have you seen one of my puzzle pieces? Y N Y N Y N Y N	_____Find a puzzle piece with blue on it. Y N Y N Y N

7:15	I'm looking for a ___color___ piece to fit in my puzzle.	
7:30	I can start to see the picture in my puzzle.	
7:45	I have __#__ pieces left.	
8:00	_____Find a puzzle piece with blue on it. Y N Y N Y N Y N	_____Show me a smile. Y N Y N Y N
8.15	_____ is sitting on a __color___ chair.	
8:30	_____ looks like he/she is having fun.	
8:45	I like taking my time when I put puzzles together.	
9:00	This is going to look so cool when I finish it.	
9.15	These pieces are small/big.	
9:30	It's almost time to go to the next center.	
9:45	These pieces fit gether so nicely.	
10:00	Alright guys we are all done with the puzzles	

Appendix G

Game Protocol: Play-Doh

Directions: Provide statements/questions in the order indicated below for each child.
For questions: wait 3 seconds for response.
For compliance: wait 10 seconds for response.
= Indicates statements made to both participants.

Minute	Statements for:_____	Statements for:_____
Start	Hi _____ and _____.	
0:15	We are going to play with play-doh.	
0:30	We can pick our favorite color.	
0:45	I choose the __color____ play-doh.	
1:00	_____ What are you making? Y N Y N Y N Y N	_____ Share some play-doh with _____. Y N Y N Y N
1:15	I'm rolling the play-doh.	
1:30	I'm making a _____.	
1:45	The play-doh is smooth.	
2:00	_____ Squish the play-doh with your hands. Y N Y N Y N Y N	_____ Do you want a different color? Y N Y N Y N
2:15	I want the _____color_____ play-doh.	
2:30	Now my play-doh is flat.	
2:45	_____ is playing with the __color___ play-doh	
3:00	_____ Do you want a different color? Y N Y N Y N Y N	_____ What are you making? Y N Y N Y N
3:15	_____ is ___rolling, squishing, etc._____ the play-doh.	
3:30	My play-doh looks like a happy face.	
3:45	_____ is smiling.	
4:00	_____Share some play-doh with _____ Y N Y N Y N Y N	_____ Squish the play-doh with your hands. Y N Y N Y N
4:15	The _____color_____ play-doh is my favorite.	
4:30	I like they way the play-doh feels	
4:45	_____ you can use the __color___ and _____ and use the _color_____.	
5:00	_____ What are you making? Y N Y N Y N Y N	_____ Share some play-doh with _____ Y N Y N Y N
5:15	I'm making _____	
5:30	My play-doh is the color of _____.	
5:45	I'm using two different colors.	
6:00	_____ Squish the play-doh with your hands. Y N Y N Y N Y N	_____ Do you want a different color? Y N Y N Y N

6:15	I like playing with play-doh.	
6:30	I'm sharing the ___color___ with _____.	
6:45	I am squishing the play-doh on the table.	
7:00	_____ Do you want a different color? Y N Y N Y N Y N	_____ What are you making? Y N Y N Y N
7:15	_____ is __rolling, squishing, etc____ the play-doh.	
7:30	My play-doh looks like a _____.	
7:45	I'm making a round ball.	
8:00	_____Share some play-doh with _____ Y N Y N Y N Y N	_____ Squish the play-doh with your hands. Y N Y N Y N
8:15	I like to share play-doh	
8:30	I'm making a snake.	
8:45	The snake is going to slither to _____.	
9:00	Now my snake looks like a snail.	
9:15	_____ is making a _____.	
9:30	_____ is __rolling, squishing, etc____ the play-doh.	
9:45	I had fun playing with play-doh.	
10:00	We can put the play-doh in the containers now.	

Appendix H

Snack Protocol

Directions: Provide statements/questions in the order indicated below for each child.
For questions: wait 3 seconds for response.
For compliance: wait 10 seconds for response.
= Indicates statements made to both participants.

TURN CAMERA ON

Time	Statement for:_____	Statement for:_____
Start	Hi _____ and _____.	
0:15	Lets eat some snack.	
0:30	We have _____ to drink.	
0:45	Everyone has a napkin.	
1:00	_____ Take a drink. Y N Y N Y N Y N	_____ What do you have for snack? Y N Y N Y N
1:15	_____ is taking ___small/big____ bites	
1:30	_____is sitting on a _color___ chair and _____ is sitting on a __color___ chair	
1:45	_____ is eating one at a time.	
2:00	_____ What do you have for snack? Y N Y N Y N Y N	_____ Hold up your napkin. Y N Y N Y N
2:15	_____ has _____#___ _____ left	
2:30	_____ napkin is __color____	
2:45	You guys have the __same/different___ color cups.	
3:00	_____Hold up your napkin. Y N Y N Y N Y N	_____ Do you like the _____? Y N Y N Y N
3:15	_____ has ____#_____ left	
3:30	The _____ are the color _____.	
3:45	_____ looks like he/she is hungry	
4:00	_____ Do you like the _____? Y N Y N Y N Y N	_____ Take a drink. Y N Y N Y N
4:15	_____ _____ look good.	
4:30	_____ napkin is __full/empty____.	
4:45	When I eat snack I take big bits.	
5:00	_____ Hold up your cup. Y N Y N Y N Y N	_____What is your favorite snack? Y N Y N Y N
5:15	_____ is eating ____some/a lot of__ _____.	
5:30	There are 3 people sitting at the table	
5:45	I don't like eating messy snacks.	
6:00	_____ Is your cup empty or full? Y N Y N Y N Y N	_____Wipe your mouth. Y N Y N Y N
6:15	Drinking water keeps you hydrated.	
6:30	Eating snack gives us lots of energy.	
6:45	_____ is eating with his/her hands.	

7:00	_____Wipe your mouth. Y N Y N Y N Y N	_____ Is your cup empty or full? Y N Y N Y N
7:15	_____ is taking ___small/big____ bites	
7:30	_____ cup is __full/empty___.	
7:45	_____ is eating one at a time.	
8:00	_____What is your favorite snack? Y N Y N Y N Y N	_____ Hold up your cup. Y N Y N Y N
8:15	_____ are my favorite snack	
8:30	The _____ look good.	
8:45	_____ ate ___a lot/some___ of his/her snack	
9:00	This has been a nice snack time.	
9:15	_____ has __#___ _____ left.	
9:30	Snack time is almost over.	
9:45	Lets finish up.	
10:00	Lets throw our trash away.	

TURN CAMERA OFF (CLOSE SCREEN)

Appendix I

Effects of
Therapeutic Horseback Riding
on Behavior of Children with Autism

Purpose:
Researchers at the University of Kansas are collaborating with Community Living Opportunities (CLO) to evaluate the effects of its therapeutic horseback riding program at CLO's Midnight Farm on various skills and behaviors of children with autism.

Scholarships:
CLO's Midnight Farm will provide full riding and after-school camp scholarships for 8 to 10 children with autism. A two hour lesson/camp experience will be provided once a week for 9 to 12 weeks after school each Monday (starting in early November).

To be Eligible:

- Children must be 6 to 15 years old and have no previous therapeutic riding experience.
- Researchers will observe children in riding and in the after school camp each week and in their home 2-3 times across the duration of the study.

For details, please contact Sarah Hyman at shyman@ku.edu or at (785) 864-0521.

Midnight Farm
2084-B N. 600 Road
Baldwin City, KS 66006

CLO's
MIDNIGHT FARM

Appendix J

Therapeutic Horseback Riding Research Study
Collaboration between CLO and KU's Performance Management Laboratory

Purpose

The importance of this study is underscored by recent calls for delivery of evidence-based practice by numerous professional groups and funding agencies. While early research shows promising benefits, we were unable to locate a published study that *systematically* evaluated the effects of therapeutic horse back riding on behaviors and skills of children with autism using direct measures of behavior. Much of the research relies on self-report and rating scales. Thus, the purpose of the present study is to conduct a pilot evaluation to better understand the impact the therapy may have on a variety of behaviors and skills across settings.

Potential Participants

Eight children with autism ages 5-16 with no experience with therapeutic horseback riding will be recruited. Four of the children with receive therapy after an initial assessment. The other four children will serve as a waitlist control group and will receive therapy after the first group is done. Our goal is to recruit children from the same school district who are receiving similar educational services.

Ongoing Schedule

Afterschool program: Four 10 min observations during center-based activities
Home: 10 min observations 2-3 times during the course of the study for each child
Therapy: Nine 60-min lessons held weekly

Behaviors/Skills Measured

Pre- and post-assessment:
- Problem behavior (Child Behavior Checklist, Second Edition)
- Adaptive skills (pre- only; Vineland Adaptive Behavior Scales, Second Edition)

After School Program
- Problem behavior
- Compliance
- Language (spontaneous initiations & responses to others' initiations)
- Off-task behavior
- Happiness & negative affect

Home:
- Problem behavior
- Compliance
- Language (spontaneous initiations & responses to others' initiations)
- Happiness & negative affect

Therapy:
- Posture
- Problem behavior
- Compliance

Language (spontaneous initiations, responses to others' initiations, commands to direct horse)
Happiness & negative affect

Eligibility, Pre-Screening, Safety Protocols, and Assent Procedures

Rider eligibility will be determined from established guidelines, CLO's safety guidelines, and a pre-screening process (takes 30-45 minutes). Rider eligibility is an ongoing process throughout intervention as well. That is, if a rider is deemed unsafe, therapy will cease for that session and termination criterion will be considered.

Established Guidelines and Eligibility:
Midnight Farm considers guidelines presented by the Professional Association of Therapeutic Horsemanship (PATH) International, a global resource and authority on equine-related activities. Contraindications from these guidelines relevant to this research include: dwarfism, amputation, allergies, participant under 2 years of age, and/or a seizure disorder not controlled by medication.

In addition, physical conditions that would make a participant ineligible include:

- Inability to close hands (to hold reins)
- Inability to sit for longer than 20 minutes
- Inability to hold one's torso erect (keeping trunk straight while mounted on the horse)

Safety Guidelines
In order to select an appropriate horse for the pre-screening process, the staff uses information gathered after speaking with parents and information from the participant's application. These tools help staff choose which horse will be able to tolerate the demands that will be put on it during the pre-screening process. For example, if the participant is very loud and active, a horse will be selected that can tolerate these demands. Likewise, if a participant shows apprehension, a horse will be selected that rides slower and smoother. In addition, the participant's height, weight, and age are also taken into account.

All evaluations include a team of 4 people (evaluator, certified instructor, and 2 trained volunteers). The horse is kept on the lead line at all times and lead by a trained volunteer. Two side-walkers, one on each side of the rider, assist all new riders. The side-walkers remain no more than half an arm's length from the horse and rider, and are positioned at the rider's hips to ensure they can support the rider as necessary. If needed, all volunteers have been taught special holds to provide greater security for a rider. All new riders start with two side walkers and a leader. As riders progress, one side walker may be gradually removed and then the second for riders who show more advanced skills. The lead may be removed from the horse (in rare circumstances for advanced riders), but the leader will remain in position to assist as needed. CLO's goal is to progress riders while maintaining the safest riding situation for the particular rider at all times.

Pre-Screening (on ground) Procedures:

Prior to mounting the horse, the PATH International certified staff conduct pre-screening on the ground in order to assess the needs of the rider (physical as well as how many assistants are appropriate). While on the ground, the participant's cooperation and apprehension levels, reactions to new people, and receptive and expressive language are assessed. This is accomplished by playing games to assess how the participant follows directions (e.g., putting a ring in a bucket when told to do so). In addition, instructors will practice putting on the participant's helmet to assess cooperation and apprehension levels. The staff also uses the portion of the assessment that parents complete in order to further assess basic cognitive ability (see the "Pre-Screening Evaluation Form" at the end this description).

Pre-Screening (while mounted on the horse) Procedures:
After the initial pre-screening on the ground, participants mount the horse, at which time the staff assess balance, anxiety, and cognition (as it relates to riding). These procedures directly inform specific decisions about type of saddle required, mounting protocols, and other safety equipment that may be necessary. Prior to mounting the horse, the instructors encourage the rider to pet the horse, which helps them establish the rider's comfort level. Participants are also required to wear a helmet both during pre-screening and during the intervention. Riders mount the horse from a ramp positioned just outside of the arena, which allows the child to observe/mount the horse from a higher vantage point, which is less intimidating for the rider. Anytime the participant is mounted on the horse, the side-walkers and lead walker ensure that the participant is safe (see safety guidelines above).

After the rider has mounted the horse, the horse leader leads the horse into the arena directing the horse to move in straight lines and circles. This movement helps the instructor evaluate the balance ability of the rider, which helps them determine the type of equipment, particular horse, and number of volunteers appropriate for the rider during the intervention. Cognitive ability and language are also assessed as riders are asked to perform simple tasks, such has holding the reins, petting the horse, vocalizing "walk on," etc. For nonverbal riders, the instructor teaches the child how to tap the horse on the neck to indicate "walk on." Once the assessment is complete (which takes roughly 15 minutes), the rider will dismount the horse in the arena with the help of the volunteers and the horse leader.

Appendix K

Dear Parent/Guardian,

My name is Sarah Hyman and I am a graduate student at the University of Kansas. I am interested in studying the benefits of therapeutic horseback riding for children with autism.

If you agree for your child to be in the study, your child will participate in a nine week therapeutic horseback riding program located at Midnight Farm, an equestrian facility in Baldwin City operated by Community Living Opportunities (CLO). CLO is a non-profit organization that has provided services to individuals with disabilities for over two decades. A nine week therapeutic horseback riding scholarship will be provided for participation in the study.

According to the website of the Professional Association of Horsemanship International (PATH Intl.), "therapeutic riding uses equine-assisted activities for the purpose of contributing positively to cognitive, physical, emotional and social well-being of people with disabilities. Therapeutic riding provides benefits in the areas of therapy, education sport and recreation & leisure. Throughout the world, there are thousands of individuals with special needs who experience the rewarding benefits of horseback riding. A disability does not have to limit a person from riding horses. In fact, experiencing the motion of a horse can be very therapeutic. Because horseback riding rhythmically moves the rider's body in a manner similar to a human gait, riders with physical disabilities often show improvement in flexibility, balance and muscle strength. In addition to the therapeutic benefits, horseback riding also provides recreational opportunities for individuals with disabilities to enjoy the outdoors." The purpose of this study is to evaluate some of these claims.

This study will involve observations at three locations: an after school program, your home, and therapeutic riding sessions at Midnight Farm. Your child will be observed once a week within an after school program. Additionally, we will observe regular routines in your home 2-3 times across the entire study for 15 minutes during each visit. Our goal is to not disturb any family time and will record targeted behaviors when it is most convenient for your family. Finally, we will observe your child weekly during the 60 minute therapeutic riding sessions, following the after school program. Midnight Farm's trainers are certified by PATH Intl. They will be coordinating and delivering the therapy as part of their normal work responsibilities. Agents of the University of Kansas will not be delivering the therapy; our role is to evaluate the impact of the therapy on behaviors and skills of children with autism or other pervasive developmental disorder.

Observation sessions will be video-taped in the home and at Midnight Farm. The confidentiality of you and your child will be protected to the fullest extent of the law. You and your child will be assigned code names at the start of the study. All information containing any personal information will be kept in a locked room only accessible by the research team. Information we collect will be destroyed after 7 years. No identifying information will be used or revealed in any publications or presentations that might result from this study.

Should you agree to participate, you and your child have the right to withdraw consent at any time, without penalty. The benefits of the study are that we may gather information that helps us understand the benefits of therapeutic horseback riding.

There is some, but minimal risk for participating in this study. The trained and PATH Intl. certified staff and horse handlers at Midnight Farm will follow safety protocols and will dismount riders due to any safety concerns.

If you have any questions about this study or would like your child to participate, please contact Sarah Hyman shyman@ku.edu. You may also contact my faculty advisor, Dr. Florence DiGennaro Reed, at (785) 864-0521 or fdreed@ku.edu.

Thank you for your time,

Sarah R. Hyman, B.S.
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Appendix L

Approved by the Human Subjects Committee University of Kansas, Lawrence Campus (HSCL). Approval expires one year from

Dear Educators,

Enclosed please find a questionnaire (Teacher Report Form of the Child Behavior Checklist). I ask that you complete this questionnaire for _____, who is participating in a study I am conducting for my master's thesis. The parents of this student have provided consent for participation and have granted me permission to obtain this information from you.

The Child Behavior Checklist aides in the evaluation of adaptive functioning, as well as overall behavior, for children ages 6-18 years. The form should take approximately 15-20 minutes to complete and consists of fill-in-the-blank and rating scale questions. Please be sure to complete all items to the best of your ability.

Once the form has been completed, please mail the completed form using the addressed envelope.

If you have any questions, please feel free to contact me by e-mail shyman@ku.edu or my adviser, Dr. DiGennaro Reed fdreed@ku.edu.

Thank you for your time.

Sarah R. Hyman, B.S.
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VITA

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