Equine-Assisted Occupational Therapy: Increasing Engagement for Children With Autism Spectrum Disorder

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Engagement in meaningful activities is essential to development and is often reduced in children with autism spectrum disorder (ASD) who have limited engagement in activities or relationships. A multiple-baseline design was used with 7 children with ASD ages 4–8 yr to assess the effect of including a horse in occupational therapy intervention on task engagement. The children showed improvements in engagement. Including horses in occupational therapy sessions may be a valuable addition to conventional treatments to increase task engagement of children with ASD. Factors related to the environment, therapeutic strategies, and individual participation need to be considered in understanding why this intervention may be effective and developing a theoretical basis for implementation.


Children with autism spectrum disorder (ASD) have deficits in social interactions as well as restricted interests with stereotyped and repetitive patterns of behavior, core diagnostic features of ASD (American Psychiatric Association, 2013). These characteristics interfere with their ability to engage in activities beneficial for development. The duration and quality of engagement—the “intentional, persistent, active, and focused interaction with the environment, including people and objects” (Watling & Dietz, 2007, p. 576)—differ from that of children with typical or delayed development (Adamson, Bakeman, Deckner, & Romski, 2009). Children with ASD spend more time unengaged and, during their engaged periods, show a higher preference for objects and solitary play than for people. These behaviors are counterproductive to development because engagement is essential for learning (Patten & Watson, 2011). In equine-assisted occupational therapy, the variety and novelty of activities (e.g., saddling, grooming, riding) may engage children with ASD and increase their purposeful activities.

Identifying activities that engage children with ASD in interaction with others is essential. Research has reported an increase in social interactions related to animal-assisted intervention (including horses; Grandin, Fine, & Bowers, 2010; O’Haire, 2013). For centuries, people have interacted with animals to promote health and well-being (Jorgenson, 1997), laying a foundation for the management of life experiences. Developing relationships with animals may give children positive interactions and support and provide psychological and physical benefits (McCardle, McCune, Griffin, Esposito, & Freund, 2011). The natural attraction of animals may engage children in animal-related activities, providing the child with the opportunity for positive, engaged experiences that can generalize to other environments and persons. However, theory and research...
support for the underlying mechanisms of animal-assisted intervention are lacking.

Successful interactions with horses may provide important sensory and social stimuli with benefits for psychological, sensory, motor, communication, and social functioning (O’Haire, 2013). Research has identified benefits of therapeutic riding for children with ASD, such as increased social motivation and decreased sensation seeking and sensitivity (Bass, Duchowny, & Llabre, 2009), fewer stereotyped behaviors (Gabriels et al., 2012), and improvements in social communication and sensory processing during intervention (Ward, Whalon, Rusnak, Wendell, & Paschall, 2013). In contrast, Jenkins and DiGennaro Reed (2013) found no effects for on-task behavior and responding to others’ initiations for 4 children.

In equine-assisted occupational therapy, the variety and novelty of activities (e.g., saddling, grooming, riding) may engage children with ASD and increase their purposeful activities. Children with ASD have sensory integration or modulation deficits (Bundy & Murray, 2002). *Modulation* allows filtering of irrelevant stimuli and maintenance of an optimal level of arousal that facilitates attention to environmental demands (Lane, 2002) with longer engagement in tasks. Strategies to regulate arousal include activities to stimulate the vestibular and proprioceptive systems (Bundy & Koomar, 2002). The horse’s gait and speed may stimulate the vestibular system with either a calming effect by means of a quiet, unvarying gait or an alerting effect by means of a fast walk or trot (Lawton-Shirley, 2002). Equine-assisted occupational therapy may include on-horse activities that use movement to improve skills and off-horse activities that engender care and relationship building with the animal.

Research related to ASD and the use of riding in occupational therapy is limited to two studies and has not had a clear theoretical basis. Sams, Fortney, and Willenbring (2006) compared language use and social interaction in occupational therapy sessions with and without llamas for 22 children with ASD (ages 7–13 yr). Activities occurred both on and off the llamas. Significant differences were found that favored sessions including animals. Taylor et al. (2009) investigated the effects of 16 sessions of hippotherapy (use of a horse) on the volition of 3 children with ASD during video-recorded play sessions. They found positive effects for 2 children.

The current study extends the research with a rigorous single-case research design. It investigated the effects of equine-assisted occupational therapy on the engagement of young children with ASD. The hypothesis was that equine-assisted occupational therapy would increase engagement as earlier defined by Watling and Dietz (2007), including interactions with objects, the therapist, or the horse.

### Method

#### Participants

Nineteen children with ASD were recruited from a riding association’s waiting list or through a letter of invitation from the local autism society. To be included, children had to have been diagnosed with ASD by a multidisciplinary assessment team, be 3–8 yr old, understand English, and have had no riding experiences for ≥3 mo before the study. Children needed to show no aversion to horses (e.g., screaming, running away, refusal to approach) because it would make the intervention impossible. Exclusion criteria were repeated aggressive behavior (e.g., hitting, kicking; based on parent report) or comorbidities (e.g., deafness, blindness, epilepsy) that could interfere with the intervention.

Interested parents contacted the first author (Cecilia Llarguias). A phone interview was followed by two screening meetings. The first was a free-play session to determine the child’s ability to follow directions in English. A second screening meeting at the equine center ensured the child’s acceptance of riding a horse. Eleven children did not participate because they did not complete the screening process ($n = 8$) or were unwilling to ride ($n = 2$) or because of concerns about English skills ($n = 1$). Data from 1 boy were excluded because of consistently high levels of engagement during baseline, leaving little room for improvement. The study was approved by the university’s ethics board, and parents provided written consent.

Information on the 7 participants (3 girls, 4 boys) ages 4 to 8 yr old is provided in Table 1. All names are pseudonyms. The children’s spoken language level was classified using Tager-Flusberg et al.’s (2009) criteria: Phase 1, preverbal ($n = 2$); Phase 2, using single words ($n = 3$); Phase 3, using two- to three-word combinations ($n = 1$); and Phase 4, using sentences ($n = 1$). All children spoke English at home; 2 children also spoke a second language. Participants’ cognitive abilities varied. Three children had not had a cognitive assessment. Six children had motor delays. Assessment information was obtained from reports such as individualized education programs or specialized services (e.g., psychological, speech) reports completed within the past 2 yr but not concurrent with the study. Two children also had attention deficit hyperactivity disorder and were on medications for the disorder. Changes in medications were monitored. All children were in an education setting at least 12–16 hr/wk. Deb, Jen, and Larry attended elementary school 20 hr/wk, and Juan attended elementary school full time. In addition, all children had specialized services for 2–4 hr/wk with a speech language pathologist.
physical therapist, occupational therapist, or behavioral interventionist.

**Design**

A multiple-baseline design was selected (Kazdin, 2011) to test the effects of this novel intervention. It had three phases: baseline (activities in a play room), intervention (activities with or related to a horse), and follow-up (same activities as in baseline in a play room; see Figure 1). Children received a different number of baseline sessions (9–11). One feature of the design was the staggered introduction of intervention once data stability (a clear and stable pattern of the targeted behavior in the absence of intervention) was observed. Intervention sessions ranged from 9 to 12 because children whose data were stable first started intervention earlier, resulting in more intervention sessions. During intervention, 2 children missed one session because of medical issues, and sessions were cancelled 1 day for 4 children because of a blizzard. The study followed the standards of the single-case documentation developed by the What Works Clearinghouse (Kratochwill et al., 2010).

**Settings and Procedures**

All sessions (baseline, intervention, follow-up) were 45–60 min long. Children spent ≥20 min in gross motor (GM), or physical, activities and 20 min in fine motor (FM), or cognitive, activities in all sessions in all phases. To assess the specific contribution of including a horse in occupational therapy sessions, baseline and follow-up sessions mimicked the basic conditions and activities of the equine-assisted sessions. Children did activities off (considered FM) and on (considered GM) the horse during intervention. Therefore, baseline and follow-up sessions had both GM and FM activities. To mimic the novelty of the equine-assisted sessions, a new toy or activity was offered during baseline and follow-up for GM and FM sections. One difference between phases was that the vestibular stimulation provided by the horse during intervention was intentionally modified by the therapist to regulate the child’s arousal, whereas during baseline and follow-up, vestibular stimulation (e.g., trampoline, hammock, or swing) was initiated by the child.

The therapist used evidence-based strategies to promote engagement drawn from behavioral or developmental approaches during all phases. Strategies included offering choices (Lough, Rice, & Lough, 2012); gradual reinforcement
delay; following the child’s lead, using the child’s preferred activities and interests (Boyd, Conroy, Mancil, Nakao, & Alter, 2007); breaking activities into steps; verbal support and reinforcement; visual organizers; use of the Picture Exchange Communication System (Bondy & Frost, 1993); and grading the sensory stimulation, such as voice tone and touch to get the child’s attention.

Baseline and follow-up consisted of free play guided by the first author and took place in a room with mats, balls, and sport materials for GM activities and toys and school materials for FM activities. A swing, trampoline, or hammock was available. Specific activities depended on the child’s interests and age. GM activities included jumping, rolling, catching and throwing balls, and sports such as soccer and basketball. FM activities consisted of object-oriented play that included cognitive elements and often occurred at a table (e.g., matching activities, crafts, play with cars or dolls).

Intervention sessions occurred at the equine center once a week and were with the first author, an occupational therapy member of the American Hippotherapy Association (AHA) who is certified as a Professional Association of Therapeutic Horsemanship (PATH) International therapeutic riding instructor (PATH International, n.d.). When children were off the horse, she followed procedures for conventional occupational therapy sessions with inclusion of a horse as the main element of the planned activities. When children were on the horse, she followed AHA (2014) guidelines. Activities took place in an outdoor arena for 2 mo until cold weather forced a move to the indoor arena. Arenas were prepared with cones, poles, colored buckets, and letters and pictures on the fence or wall. The unshared outdoor arena provided a quiet environment. The indoor arena was shared with another program at the opposite end of the arena, which increased the noise level.

FM activities occurred at a table with chairs in a quiet area. Well-trained, calm horses were used. The horses were not consistent between sessions. Off-horse activities involved grooming or feeding the horse, saddling and leading the horse, art activities (e.g., drawing the horse), and games related to horses. On-horse activities included playing games, such as carrying an object from one part of the arena to the other or grabbing rings. Directed by the first author, one person led the horse, with two side walkers for safety. To make intervention similar to baseline, only the first author talked to the children. Initially, activities were controlled to promote safety, develop basic riding skills, and show the children what was and was not allowed (e.g., shouting, kicking or biting the horse). After these more directed sessions, all activities were planned to enhance engagement. There were opportunities to explore and show interest, make choices, solve problems, practice skills, and initiate. The environment promoted play, enjoyment, and learning and progressed according to each child’s needs. All children had the same goal of increasing engagement in activities, but strategies differed. Strategies related to sensory integration helped to regulate arousal by grading the vestibular stimulation from the horse’s movements: changes in gait (walk, trot), speed (slow, fast), and pattern (figures). For example, to increase attention, trotting was used (vestibular and proprioceptive stimulation).

Follow-up consisted of four free-play sessions for all children at the same location as baseline and using the same procedures. We observed whether any effects of equine-assisted occupational therapy sessions were sustained for at least a month after intervention. For all phases, the order within the sessions varied. Sessions sometimes began with GM or on-horse activities and sometimes with FM or off-horse activities.

**Outcome Measure**

Engagement was defined in keeping with Watling and Dietz (2007). When the therapist made a request, the child’s response was coded. If the child responded, interacted with the therapist or horse, or started the requested activity, this behavior was scored as “engaged.” A child was scored as “not engaged” if he or she ignored the request or attempts to capture attention, resisted guidance into the activity, looked away or avoided eye contact, played alone, had a tantrum or cried, wandered away from or left the activity or interaction partner (person or horse), showed stereotyped behaviors (e.g., flapping hands, flicking fingers, or spinning unrelated to the activity), or stopped or left the activity. The percentage of time engaged during a randomly selected segment was the outcome measure. GM activity–on-horse and FM activity–off-horse percentages were averaged to give a single value per session. Field notes were recorded and included notes about the setting (e.g., indoor or outdoor; unusual circumstances), children’s unusual behavior (positive or negative), conversations with parents or teachers, materials and activities used, and plans for the next session.

**Data Collection and Coding**

Digital video recordings captured interactions and verbalizations and were coded by raters (not the first author). A 5-min segment randomly selected (using random numbers functions) from the first 15 min of each section (GM activity–on-horse, FM activity–off-horse) of a session was coded. This resulted in two 5-min sections of video coded per session in all phases. Each 5-min video
was divided into 5-s intervals using Picture Motion Browser software (Sony Electronics Inc., Toronto, Ontario, Canada). This interval received a dichotomous code, engaged or not engaged. If the child was engaged for more than 5 s, each 5-s interval was coded as engaged. If the child lost interest, that interval was coded as not engaged. The percentage of intervals when the child was engaged was calculated. All segments were scored by the primary rater with a minimum of 25% scored by a second rater.

Raters were blind to the study purpose but not to condition (free play, horse) or phase (baseline or follow-up). To address this potential for bias, inter- and intrarater reliability were monitored carefully with an emphasis on adherence to the coding rules. Reliability checks occurred randomly during all phases. Inter- and intrarater calculations were based on the criteria from Richards, Taylor, Ramasamy, and Richards (1999). Interrater agreement was 96.7% (range = 88%–100%) for occurrence and nonoccurrence of the behavior. Discrepancies were discussed by the raters to reach consensus. If consensus was not reached, it was resolved by the first author. Discrepancies were due to rapid behavior changes or unusual behaviors. Intrarater reliability was assessed over 25% of the sessions and was 96.7% (range = 85%–100%).

Implementation Fidelity

The implementation fidelity checklist had 17 items and ensured that the intervention sessions were the same across children (e.g., type of prompts, positive feedback, intervention settings, length of GM and FM activities). It also ensured child safety (e.g., helmet use, side walkers). Sixteen sessions (2 per child) were selected using the random numbers function in Excel (2010 version; Microsoft, Redmond, WA). At least 15 min of each type of activity (GM and FM) per session were checked. Fidelity was 93%.

Data Analysis

Data were visually analyzed to interpret level, variability, and trend within phases (Kazdin, 2011). Analysis between phases consisted of changes in level, trend, variability, immediacy of effect, proportion of overlap, and consistency of the data from baseline to intervention phases (Kratochwill et al., 2010). Improved rate difference (IRD) was calculated to provide an effect size measure (Parker, Vannest, & Brown, 2009). When interpreting the IRD, Parker et al. (2009) suggested that small effects range from 0 to .49, moderate effects range from .50 to .69, and strong effects are .70 or more. They recommended that confidence intervals (CIs) be at 95%. CIs were calculated using WinPEPI software for epidemiologists (Version 11.32; Abramson, 2011).

Results

Figure 1 presents the percentage of time that children were engaged. Visual analysis suggests that equine-assisted occupational therapy had a strong effect compared with baseline. Average engagement during baseline was 77.8% (Juan), 76.1% (Cole), 69.9% (Anna), 58.1% (Jen), 56.1% (Deb), 54.7% (Qiang), and 51.8% (Larry). In the intervention phase, averages ranged from 99.3% (Juan) to 95.5% (Jen). The smallest increase was 21.0 percentage points (Juan), and the largest was 46.0 (Larry). It is noteworthy that engagement increased markedly early in the intervention and then remained at that level throughout. At follow-up, engagement for all children remained similar to that seen in intervention.

Differences in engagement level from baseline to intervention were clear for all participants. When intervention was compared with follow-up, Qiang was the only child with a large drop. He had difficulties with transitions, as is evident in his first follow-up session. However, he coped with the change much faster than during baseline, and his engagement returned to almost intervention levels for the remainder of follow-up. For the other children, engagement remained high, indicating that changes were maintained once intervention was removed.

Regarding baseline trends, there was a decreasing trend (−1.3 to −1.1). The intervention phase trends had a neutral slope for all children. With the increased engagement in the intervention phase, this stable level indicates that the children’s engagement was more consistently positive. Follow-up trends were also neutral for all children except Qiang, who showed an increasing trend with a return to his intervention level of engagement after the first follow-up session. There was a strong intervention effect with an IRD of 100% and 95% CIs [0.90 or 0.91, 1].

Positive effects of the equine-assisted occupational therapy sessions were reported by parents and in forwarded teacher’s notes as recorded by the first author. “It is a fact now: The day after the horse is his best day at school” and “After the horse session, once he is in the car, he doesn’t stop talking until he goes to bed” (Qiang’s mom). “I never saw him so engaged in an activity and so calm as when he is on the horse” (Larry’s mom). Teachers’ notes included, “Dear mom, Cole had another great day at school” and “The day after the horse is his best day at school” and “The day after the horse is his best day at school” (Larry’s mom). Mothers reported that Anna, Qiang, Deb, Jen, and Larry were talking more, with more initiation of communication, new words, or longer sentences. Three teachers came to observe the sessions once changes in behavior were observed at school.
According to the field notes, the children showed a strong preference for some of the hippotherapy activities and in particular trotting. Once they could balance on the horse (third session), all the children started to ask to trot from the time they were seated on the horse. All children showed signs of enjoyment such as smiles, laughing, or even singing while trotting. Saddling and feeding the horse were other preferred activities. These activities were included in the sessions as much as possible.

Discussion
This study continues the process of understanding the effects of including a horse in occupational therapy interventions (i.e., on-horse and off-horse activities) on the engagement of young children with ASD. All children made significant improvements, as indicated by an increased proportion of time engaged in activities during equine-assisted occupational therapy sessions compared with baseline. It is interesting that the increase happened early in the intervention, indicating a good fit of the activity with the child. There was little room for improvement after the initial response to intervention. Future research needs to consider what length of intervention is necessary to ensure ongoing effects on engagement in environments that do not include a horse and also theoretical explanations for why immediate effects persisted into the follow-up period.

Several possible explanations for the results need to be carefully considered to build a theoretical explanation for why equine-assisted therapy may be effective with children with ASD. Presence of a horse is one explanation. Our findings are consistent with the positive effects found in other studies of therapies incorporating horses for children with ASD (Bass et al., 2009; Gabriels et al., 2012) and with the first author’s clinical experience. As Endenburg and van Lith (2011) suggested, the consistency of positive effects suggests a real effect, particularly given that the studies differed in the animal used, therapy approach, or research method. However, consistent results do not help in understanding why the intervention worked.

Novelty must also be considered. None of the children had previously participated in riding or the associated activities. Although something new (new toy, game, activity, or task) was included in each baseline session, the level of novelty between baseline and intervention likely still varied. Many intervention elements were unfamiliar, such as the smell of the saddle leather, the texture of hay, and the warmth and movement of the horse’s body. Novelty in combination with an attraction to the horse may have increased the children’s engagement. If engagement was influenced only by novelty, it should have been reduced after habituation to riding. However, engagement remained high over the 2.5 mo of intervention.

Physical exercise may also positively influence engagement. After physical exercise, brain functions such as attention, memory, and perceptual and verbal skills improve (Chaddock, Pontifex, Hillman, & Kramer, 2011). Riding a horse provides physical demands. Although the children were having fun, they received the benefits of physical exercise in an outdoor environment. Such an environment has positive effects (Ryan et al., 2010) that promote wellness and are energizing, particularly when the activity involves social elements and physical exercise (Frederick & Ryan, 1995).

Another explanation is that the activities may have addressed the children’s sensory needs. Optimal arousal allows the child to produce appropriate responses to environmental demands and therefore more successfully engage (Bundy & Murray, 2002). Our strategies included stimulating the vestibular and proprioceptive systems through the horse’s gait. During baseline, the children received vestibular stimulation (e.g., on a trampoline) only if the child selected that activity. The stimulation came from self-initiated movement and was of short duration. During the intervention, all children had vestibular stimulation resulting from the tridimensional movements of the horse at walk. The child was moved up and down, forward and backward, and from side to side. The vestibular stimulation provided by the trot was likely stronger because it was combined with the sensation of speed and strong proprioceptive and deep touch input from bouncing on the horse’s back. Children often chose not to stop the bouncing by gripping the horse with their legs as they had been taught.

During follow-up, a swing was available and was often chosen. It may have provided vestibular activity similar to riding a horse (forward and backward, some up-and-down movement) but was self-driven with less side-to-side movement, less proprioceptive input, less deep touch, and shorter duration. When a child had decreased attention, we implemented a few minutes of trotting, which resulted in the child’s being more focused.

Study results suggest that activities in an individualized setting with the inclusion of an animal that provides vestibular and proprioceptive stimulation may improve engagement. The therapist’s responsibility to the child attempts to engage, physically challenging activities, a supportive environment, and matching strategies and stimulation to the child’s needs all seem important but were not directly measured. Future research needs to consider these aspects and evaluate these strategies in other environments such as a playground or school.
Generalization of Findings

Generalization of the intervention effect was measured in the playroom during follow-up. Changes in engagement were maintained during follow-up in the presence of a familiar adult. The intervention’s social validity was supported by the excellent attendance. During intervention, parents and teachers often reported changes in the children. After the study, 5 of the 7 parents registered their children in riding classes.

Limitations and Future Directions

The study had several limitations. Blinding the raters to phases was difficult. As with most single-case research designs, the small sample size limits generalization. The follow-up period was only 1 mo, which limited understanding of longer term effects. The first author delivered all sessions over all phases to ensure that changes were not due to differing adult characteristics. However, increased familiarity with her may have contributed to the results. Children could not run away or avoid the therapist when they were on the horse, making it more likely that they would be engaged. However, the children were also engaged in the off-horse activities when they could leave. Uniform standardized assessments of cognition and communication were not used across children.

Our findings support the benefits reported in other horse- and animal-based interventions (O’Haire, 2013). However, the current study needs replication with a larger and more heterogeneous sample and standardized assessments of the participants and the outcomes. Controlling for increased familiarity with the adult should be addressed. Specific aspects of the hippotherapy components need to be evaluated, such as the child’s response after different types or amounts of vestibular stimulation and proprioceptive input. Next steps for equine-assisted occupational therapy include the creation of specific standardized protocols and manualization of the intervention approach (Smith et al., 2007). These steps will help researchers and therapists to apply the same conditions and strategies across studies and allow replication. Work is needed to better understand the theoretical basis for the intervention.

Implications for Occupational Therapy Practice

The results of this study have the following applications for practice:

- To incorporate animals in intervention, occupational therapy practitioners need to understand the theoretical basis that links the animal (e.g., horse) with evidence-based therapy because this understanding may greatly enhance the effective use of the animal.
- The use of animals in therapeutic sessions can be a strong motivator for children with ASD. However, its greatest potential comes from combining the attraction of an animal with the strategic selection of techniques from within occupational therapy, such as those from sensory integration theory.

Conclusion

For young children with ASD, equine-assisted occupational therapy appears to increase engagement in adult-directed activities. Even though the mechanisms underlying the changes need further exploration, observations provide some clues to understanding how and why the changes were produced. It is important to understand which conditions make these therapies most effective. Interaction with an animal, novelty and variation, the strategies used, the vestibular stimulation, and the environment may all play an important role. This study emphasizes that it is not only the animal itself but also the selection of specific techniques and strategies in combination with the attraction and the features of the animal that may make equine-assisted occupational therapy a successful alternative intervention tool.

Acknowledgments

The Autism Society of Edmonton and the Autism Research Center provided funding. We thank the children and their families, the board and instructors of the equestrian center, and the volunteers whose presence and collaboration were invaluable. We thank Steve Mackenzie from the American Hippotherapy Association for his contribution. This study has been registered at ClinicalTrials.gov (Registration No. NCT02714101).

References


