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## Brief Report

# The Feasibility and Acceptability of Occupational Therapy in an Equine Environment for Youth with Autism Spectrum Disorder

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## ABSTRACT

**Background:** Equine-assisted services are promising, yet supporting research is limited. This Phase 2 study sought to assess the feasibility and acceptability of the newly manualized intervention and assessment protocol for occupational therapy in an equine environment for youth with autism spectrum disorder (ASD).

**Method:** A multi-site randomized controlled design was implemented. Twenty-four youth with ASD, age 6–13, were randomized to receive occupational therapy in an equine environment or in a garden environment. Feasibility indicators included rates of recruitment, treatment delivery, attendance, attrition, fidelity, and assessment completion. Acceptability was assessed with satisfaction surveys (parents and therapists) and focus groups (therapists).

**Results:** Twenty-three participants completed the study, attending 89% of occupational therapy sessions in the equine environment, and 88% in the garden environment. Providers achieved 93.7% fidelity to the experimental intervention, and 94.0% fidelity to the control condition. Parents and study staff completed 100% of outcome assessments, however only 54% and 80% of blinded raters in the experimental and control conditions completed all assessments. Parental satisfaction was highest for the experimental intervention (89.7%). Occupational therapists expressed satisfaction with the evaluation (90.7%) and intervention (93.3%), and provided recommendations for future studies.

**Conclusions:** The manualized intervention and assessment protocol is feasible to implement and acceptable to parents and therapists. Future studies can schedule make-up sessions, improve blinded rater assessment completion, and make minor modifications to the study protocol.

## 1. Introduction

About 10% of youth with autism spectrum disorder (ASD) have participated in equine-assisted services (Lindly, Thorburn, Heisler, Reyes, & Zuckerman, 2018). Although some such services have demonstrated promise for this population, they remain in early scientific development (McDaniel-Peters & Wood, 2017; Srinivasan et al., 2018). This study accordingly sought to advance the scientific basis of one equine-assisted service, *occupational therapy in an equine environment*, in accord with the National Institutes of Mental

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Health's recommended phased scientific approach to developing novel psychosocial interventions for individuals with ASD (Smith et al., 2007).

Namely, our research team first completed a Phase 1 pilot study of the intervention, finding improved goal attainment, behavioral regulation, and social functioning for some participants with ASD (Peters et al., 2020a). The present study addresses the recommended Phase 2 of scientific development, manualization and protocol development (Smith et al., 2007). We therefore developed an evaluation and intervention manual based on a) results of the Phase 1 study; b) interviews and focus groups with occupational therapists; c) evidence supporting direct instruction and practice of targeted social skills in context of motivating activities with natural social-communication partners (see Ke et al., 2018 for a review); d) best-practice guidelines in occupational therapy for children with ASD including family-centered evaluation, goal-directed and activity-based interventions, incorporation of behavioral techniques, and use of physical and multi-sensory activities (Tomchek & Koenig, 2016); e) evidence supporting how purposeful incorporation of animals, particularly horses, can increase social engagement by youth with ASD (Llambias et al., 2016; O'Haire, McKenzie, Beck, & Slaughter, 2013); and f) evidence that multisensory environments may improve physiological arousal and behavioral regulation of youth with ASD (Shapiro et al., 1997; Woo et al., 2015).

The authors named the resulting intervention protocol "Occupational Therapy in an Equine Environment: Harnessing Occupation to promote Self-Regulation, Social Communication, and Play in Youth with Autism" (OT<sup>ee</sup> HORSPLAY). The assessment and intervention protocols were designed to be activity-based and highly individualized to the needs of families and to participant's goals. The therapeutic use of equine movement, referred to as *hippotherapy*, is one of many treatment techniques incorporated into OT<sup>ee</sup> HORSPLAY; the purposeful incorporation of equine movement within the intervention offers proprioceptive and vestibular input plus frequent natural and concrete positive reinforcements of communication, such as when the horse starts walking after the youth says "go." The purpose of this Phase 2 study was thus to assess the feasibility and acceptability of the newly manualized assessment and intervention protocol.

## 2. Methods

### 2.1. Design

A multi-site randomized controlled design was implemented. Colorado State University's IRB approved study procedures.

### 2.2. Participants

The study team decided on a total sample size of 24 participants to ensure variability across indicators of feasibility and acceptability. Investigators screened potential participants as they contacted the study team until 24 participants met inclusion criteria. Participants not included in the study were provided with referrals to community-based services.

Youth with ASD and their caregivers were recruited via electronic fliers distributed to community organizations in one large and one mid-size city. Parents signed informed consent and youth gave verbal assent if able. Participants were eligible if they met criteria in Table 1.

To obtain blinded raters, parents provided contact information of an adult who had consistent contact with and knew their child for at least 6 weeks, and could likely remain blinded to treatment allocation. Raters were asked to participate, provide informed consent, and complete surveys via email; they were compensated \$20 for each completed survey, up to \$60.

Fig. 1 provides participant flow through the study. During screening, parents completed an online survey that included demographic information, the Social Communication Questionnaire to ensure present ASD symptoms, and the Aberrant Behavior Checklist-Community (ABC-C) to establish behavioral regulation difficulties. Next, participants attended a visit during which the first

**Table 1**  
Inclusion and Exclusion Criteria for Youth with ASD.

Inclusion Criteria	Exclusion Criteria
1. Age 6–13 years old	1. Participated in equine-assisted activities or therapies for two hours or more in the last 6 months
2. Score $\geq 15$ on the SCQ	2. Weigh more than 200 pounds.
3. Diagnosed with ASD by a community provider	
4. Meet clinical cut-offs for ASD on the ADOS, ADOS-2, or SRS-2	
5. Score $\geq 55$ on the Leiter-3	
6. Combined score $\geq 25$ on the irritability and hyperactivity subscales of the ABC-C	
7. Can participate in 10-minutes of riding while following safety rules	
8. Meets PATH Intl physical, mental, and emotional standards	

Note. SCQ = Social Communication Questionnaire; ASD = Autism Spectrum Disorder; ADOS = Autism Diagnostic Observation Schedule; ADOS-2 = Autism Diagnostic Observation Schedule, Second Edition; SRS-2 = Social Responsiveness Scale, Second Edition; Leiter-3 = Leiter International Performance Scale, Third Edition; ABC-C = Aberrant Behavior Checklist, Second Edition; PATH Intl = Professional Association of Therapeutic Horsemanship, International.

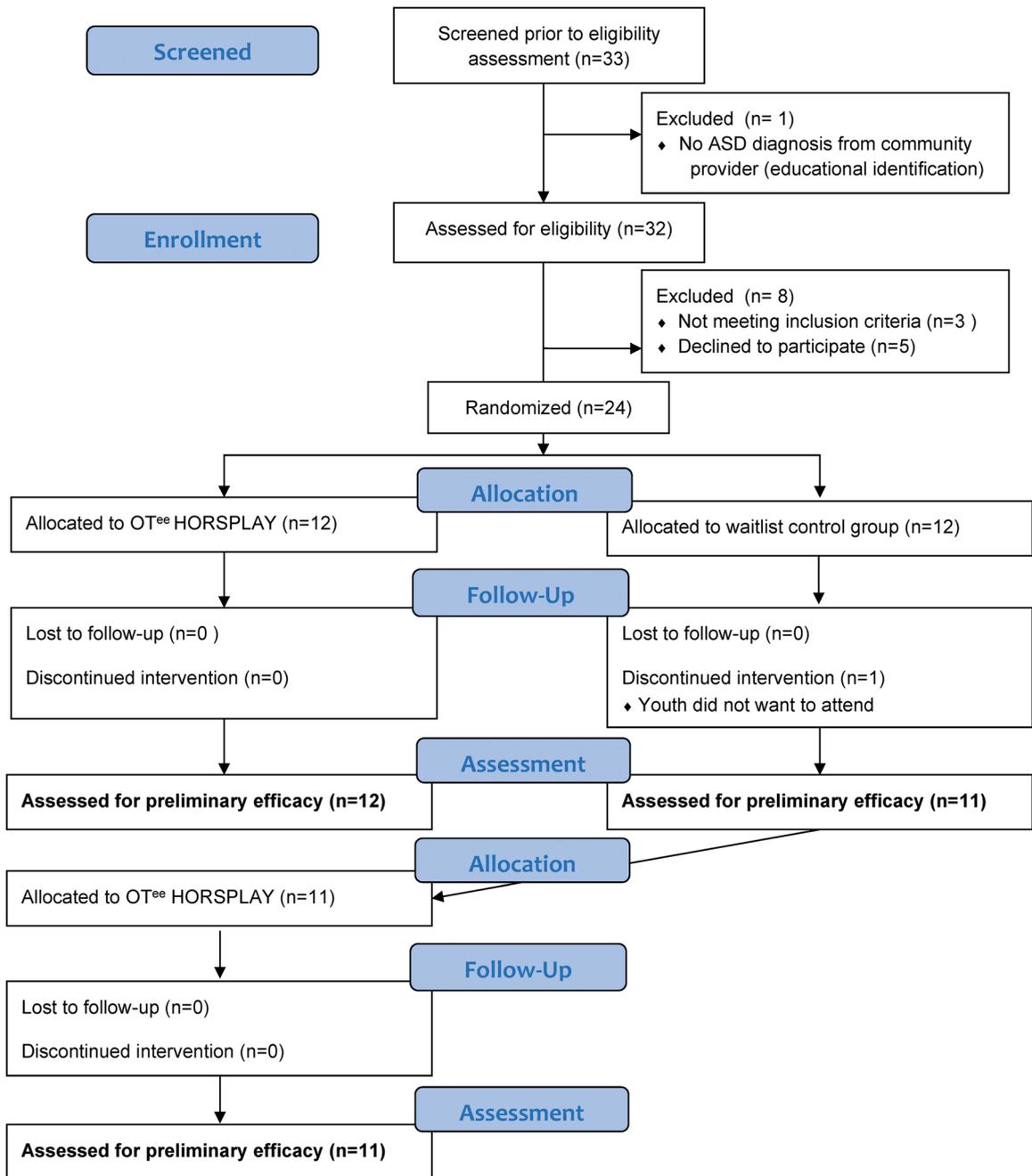


Fig. 1. Participant Flow through the Study. Adapted from “CONSORT 2010 Statement: Extension to Randomized Pilot and Feasibility Trials” by S. Eldridge, C. Chan, M. Campbell, C. Bond, S. Hopewell, L. Thabane, and G. Lancaster, 2016, *BMJ*, 355, p. 20.

author administered the Leiter International Performance Scales, Third Edition and Autism Diagnostic Observation Schedule, Second Edition, and the Adaptive Behavior Assessment System, Third Edition (ABAS-3). Participants attended a final screening visit to ensure they met all Professional Association of Therapeutic Horsemanship International (PATH Intl) standards and could ride a horse for 10 minutes.

### 2.3. Occupational Therapy Evaluation

Occupational therapists a) conducted an evaluation with each included parent and youth, which included clinical observation, an occupational profile, and social skills checklist; b) collaborated with parents to determine three goals related to self-regulation, social

communication, and social play; and c) scaled each goal using goal attainment scaling (GAS) methods described in [McDougall and King \(2007\)](#). The goal designated by the parent as most important became the child's primary goal.

#### 2.4. Randomization

Participants were paired into dyads based on similar social communication abilities. Dyads were randomized to treatment or waitlist control groups using a random coin toss and yoking procedure. After 10 weeks of the control condition, waitlist-control group participants received 10 weeks of the experimental intervention.

#### 2.5. Experimental Condition: OT<sup>ee</sup> HORSPLAY

**Setting.** Two PATH Intl riding facilities, located outside a mid-size city or in a large city.

**Interventionists.** Five licensed occupational therapists implemented the intervention who a) were also PATH Intl instructors (n = 3), or accompanied by one (n = 2), to ensure adherence to safety and equine welfare standards, and b) had completed Hippotherapy Treatment Principles 1 and 2 training from the American Hippotherapy Association, and 2 hours of training provided by the first author. A one-to-one ratio of youth to occupational therapist was maintained; when possible, two individual sessions of youth with similar communication abilities occurred simultaneously. Due to unforeseen unavailability of enough horses at one facility, 6 children did not participate in these paired sessions. The fourth author collaborated with occupational therapists to pair participants with horses, taking into consideration participants' motor, sensory, and social needs, and horses' temperament and movement patterns. Trained volunteers were matched with participants based on participants' physical and social needs, and served as horse leaders and side-walkers. When possible, the horse and volunteer team was consistent for each participant throughout the 10 weeks.

**Intervention.** Occupational therapists designed sessions to incorporate all critical intervention elements ([Table 2](#)), and to follow a general structure of greeting, activities with horses, goodbyes, and parent debriefings.

#### 2.6. Control Condition: Occupational Therapy in a Garden Environment

**Setting.** The control intervention occurred at a botanic garden in a large city, or at a University garden in a mid-size city.

**Interventionists.** The lead author trained six occupational therapy graduate students to implement the intervention, including 2 hours of didactic training, 3 weeks of modeling, followed by intermittent direct supervision and feedback. A one-to-one ratio of youth to occupational therapy student was maintained; barring absences, sessions of two youth with similar communication abilities occurred simultaneously.

**Intervention.** This intervention followed a similar structure (greetings, activities in nature, goodbye, and parent debriefings) as OT<sup>ee</sup> HORSPLAY and mirrored its critical elements ([Table 2](#)), except activities were designed with nature instead of horses.

#### 2.7. Assessment Protocol

Outcome measures were completed at baseline, after occupational therapy in a garden environment (waitlist control participants only), and after OT<sup>ee</sup> HORSPLAY. Parents and blinded raters provided reports of social functioning using the Social Responsiveness Scale, Second Edition (SRS-2) and irritability and hyperactivity using the ABC-C. An occupational therapist blinded to study purpose conducted semi-structured interviews with parents to determine GAS ratings. The first author collected hair samples by cutting approximately 50 strands from the posterior vertex of the scalp to be analyzed for hair cortisol content. This manuscript reports on assessment completion as an indicator of protocol feasibility; the results of these measures as indicators of efficacy are reported

**Table 2**  
Critical Intervention Elements.

Occupational Therapy: Equine Environment	Occupational Therapy: Garden Environment
1. Use horses to optimize attention and engagement in therapy session (Integrate strengths, interests, and motivators, including the horse; Use equine movement to facilitate optimal arousal)	1. Optimize attention and engagement in therapy session (Integrate strengths, interests, and motivators, including nature; Use gross motor activities to facilitate optimal arousal)
2. Design therapeutic activities with horses that elicit child's goal behavior (Minimum 20 minutes mounted; Minimum 3 opportunities to practice primary goal; Collaborative activities that promote interaction)	2. Design therapeutic activities in nature that elicit child's goal behavior (Minimum 3 opportunities to practice primary goal; Collaborative activities that promote interaction)
3. Provide positive reinforcement for goal behaviors (Natural reinforcement; Equine activities as reinforcement; Premack's principle)	3. Provide positive reinforcement for goal behaviors (Natural reinforcement; Activities in nature as reinforcement; Premack's principle)
4. Scaffold goal performance using behavioral techniques (Prompting, fading, shaping, chaining, labeled praise)	4. Scaffold goal performance using behavioral techniques (Prompting, fading, shaping, chaining, labeled praise)
5. Arrange environment to best support goal performance (Horse selection base on movement and temperament; Tack selection; Physical, social, sensory characteristics of environment)	5. Arrange environment to best support goal performance (physical, social, sensory characteristics of environment)

elsewhere (Peters, Wood, Hepburn, and Moody In Review).

## 2.8. Feasibility Measures

**Fidelity Measure.** Fidelity instruments measured the extent to which sessions of the intervention and control conditions abided by critical elements (Table 2), on a 22-point scale. The first and second authors obtained 94% agreement on use of the OT<sup>ec</sup> HORSPLAY checklist by rating 16% of rated sessions, and 92% agreement on use of the control condition checklist by rating 10% of rated sessions. The first author rated fidelity of 22% of OT<sup>ec</sup> HORSPLAY sessions and 21% of control sessions by observing sessions in-person. Providers were informed of the pre-determined fidelity observation schedule at the beginning of the study

**Acceptability Surveys.** Parents and therapists completed online acceptability surveys including Likert scales and open-ended questions after completing the control condition (waitlist control parents only) and OT<sup>ec</sup> HORSPLAY.

**Therapist Focus Groups.** The first author conducted a focus group with the five occupational therapists, guided by a semi-structured discussion guide focused on satisfaction, perceived appropriateness, and suggested improvements.

## 2.9. Analysis

Mann-Whitney *U*, Fisher's exact tests, and Chi-square tests were used to test for differences in demographic and clinical variables between treatment groups and between sites. To assess feasibility, we calculated descriptive statistics for recruitment, attendance, attrition, fidelity, and assessment completion. The small amount of missing data was handled using pairwise deletion. To assess acceptability, we calculated parent and therapist satisfaction ratings. We also conducted thematic analysis on focus group transcripts using qualitative content analysis, deriving main categories from focus group questions and inductively generating sub-categories from the data (Schreier, 2012).

## 3. Results

### 3.1. Participants

Overall, 122 parents contacted the study within 3-months. Thirty-three participants were screened before the study capacity of 24 participants was achieved. Table 3 provides baseline demographic and clinical information for all participants. Participants in the waitlist group had significantly lower nonverbal IQ, and participants at the large-city site were more likely to be Hispanic; there were no other significant differences between groups.

**Table 3**  
Participant Characteristics.

	Group Differences			Site Differences		<i>p</i> -Value*
	Waitlist (n = 11)	OT <sup>ec</sup> HORSPLAY only (n = 12)		Large City (n = 12)	Mid-size City (n = 11)	
Age, y, mean (range, SD)	9.64 (6-11,1.52)	8.94 (6-13, 2.46)	0.29	9.26 (6-13, 2.51)	9.30 (6-11,1.52)	0.74
Gender, n, M/F	7/4	10/2	0.37	10/2	7/4	0.37
<b>NVIQ, mean (range, SD)</b>	<b>83.45</b> <b>(65-123, 16.95)</b>	<b>101.17</b> <b>(78-126, 13.92)</b>	<b>0.01</b>	86.17 (71-111, 12.99)	99.82 (65-126, 19.70)	0.09
ABAS-GAC, mean (range, SD)	70.73 (54-85, 10.44)	72.33 (58-89, 10.17)	0.83	69.92 (54-82, 9.70)	73.36 (55-89, 10.68)	0.45
SCQ Total, mean (range, SD)	21.36 (15-30, 5.26)	19.5 (15-31, 6.27)	0.38	20.40 (15-30, 6.33)	19.70 (15-31, 5.85)	0.93
Psychiatric conditions, n	5	8	0.41	7	6	0.86
ADD / ADHD	4	7		6	5	
Anxiety	2	4		5	1	
OCD	0	1		0	1	
Latino / Hispanic, n (n = 22)	3	2	0.62	5	0	0.04
Race			0.57			0.57
Asian	0	1		1	0	
Black	0	1		1	0	
White	9	8		8	9	
Multi-racial	2	2		2	2	
Household Income, mdn (range)	\$80,000 (\$18,000 - \$180,000)	\$99,500 (\$14,400 - \$200,000)	0.58	80,000 (\$18,000 - \$180,000)	107,000 (\$14,400 - \$200,000)	0.32

Note: NVIQ = Nonverbal IQ as measured by the Leiter International Performance Scale, Third Edition, ABAS-GAC = Adaptive Behavior Assessment System, Third Edition General Adaptive Composite, SCQ = Social Communication Questionnaire, ADD = Attention Deficit Disorder, ADHD = Attention Deficit Hyperactivity Disorder, OCD = Obsessive Compulsive Disorder.

\* *p*-values represent Mann-Whitney *U* tests for continuous variables, and Fisher's Exact test or Chi Square test for categorical variables.

### 3.2. Treatment Delivery

For OT<sup>ee</sup> HORSPLAY, riding centers cancelled some sessions due to therapist illness ( $n = 3$ , mid-size city), equine illness, ( $n = 5$ , mid-size city) or weather ( $n = 6$ , large city); therefore, 14 participants were offered nine sessions and nine participants were offered all 10 sessions.

For the control condition, occupational therapy in a garden environment, sessions were cancelled due to therapist illness ( $n = 5$ ) or weather ( $n = 10$ ); five participants in the mid-size city site were offered 7 regularly scheduled sessions and 1 make-up session, while six participants in the large city site were offered 10 sessions. Most youth in the experimental condition were offered optional participation in the control condition after the study conclusion; two were excluded due to safety concerns concerning elopement behaviors in the gardens.

### 3.3. Attrition

One participant at the site in a mid-size city withdrew from the study after attending three weeks of the control condition. The participant had among the highest developmental levels of all participants (13 years old, NVIQ = 98, ABAS-3 = 78), and was not interested in garden-related activities.

### 3.4. Attendance

Participants attended 89% of OT<sup>ee</sup> HORSPLAY sessions. Of the 23 participants who completed the study, 13 attended 100% of offered sessions, four missed 1 session, two missed 2 sessions, and three missed 3 sessions. After completing the control condition, one parent indicated that the experimental condition's schedule interfered with summer school; this participant missed 6 sessions.

Waitlist control group participants attended 88% of the control condition's sessions. Of the 11 control participants, two completed 100% of offered sessions, six missed 1 session, and three missed 2 sessions. Control condition and OT<sup>ee</sup> HORSPLAY attendance did not significantly differ by site ( $U = 13.00, p = 0.79; U = 44.50, p = 0.19$ ).

### 3.5. Assessment Completion

One hundred percent of parents completed parent outcome measures (SRS-2, ABC-C). Ninety-one percent of parents (21/23) identified a blinded rater for the study; 62% (13/21) of invited blinded raters completed the ABC-C and 57% (12/21) completed the SRS-2 before and after OT<sup>ee</sup> HORSPLAY. Of the subset of 10 blinded raters in the waitlist control group, 80% (8/10) completed the ABC-C and SRS-2. Nineteen percent (4/21) of blinded raters did not complete outcome assessments because they lost consistent contact with the participant; others did not respond to the email invitation. Blinded rater assessment completion did not significantly differ across treatment sites,  $X^2(1, 34) = 0.97, p = 0.32$ .

The occupational therapist obtained 100% of GAS ratings and remained blinded to 22 of 23 participants' treatment allocation. One hundred percent of hair samples were collected; five did not contain adequate hair weight to assess hair cortisol content.

### 3.6. Fidelity

Providers achieved 93.7% fidelity to OT<sup>ee</sup> HORSPLAY, and 94.0% fidelity to the control condition. There were no significant differences in fidelity to OT<sup>ee</sup> HORSPLAY across sites ( $U = 195.50, p = 0.38$ ). However, fidelity to the control intervention was significantly higher in the mid-size city site ( $Mdn=21$ ) compared to the large-city site ( $Mdn=20, U = 72.00, p = 0.02$ ).

### 3.7. Parent Satisfaction

For OT<sup>ee</sup> HORSPLAY, mean satisfaction score was 89.7%; parents were most satisfied with therapist-child rapport (94.6%,  $n = 23$ ) and occupational performance goals (93.5%,  $n = 23$ ). Parents indicated the intervention was a good "fit" for their child (91.3%,  $n = 23$ ) and they would recommend it to a friend (91.3%,  $n = 23$ ). Lowest satisfaction score (78.3%,  $n = 23$ ) pertained to logistical feasibility (transportation, timing).

For the control condition, mean satisfaction score was 79.7%; parents were most satisfied with occupational performance goals (88.6%,  $n = 11$ ) and indicated their child was agreeable to attend (86.8%,  $n = 11$ ). Fewer parents indicated the intervention was a good "fit" (72.7%,  $n = 11$ ), or that they would recommend it (75%,  $n = 10$ ). There were no significant differences in OT<sup>ee</sup> HORSPLAY or control condition mean satisfaction scores across sites ( $U = 60.5, p = 0.74; U = 8.5, p = 0.25$ ).

### 3.8. Therapist Satisfaction

For OT<sup>ee</sup> HORSPLAY the occupational therapists' mean satisfaction score was 90.7% for evaluation and 93.3% for the intervention. Thematic analysis of focus group data resulted in three main themes: satisfaction, perceived appropriateness, and recommended changes. Therapists expressed *satisfaction* with the evaluation, particularly the family-focused structure, social skills checklist, and GAS. The occupational therapists also expressed satisfaction with the intervention's critical elements, particularly collaborating with another occupational therapist, paired interventions allowing natural opportunities to practice social skills, and structure and focus on

social skills. For example, one therapist said “I loved having the kids together”, referring to the paired nature of the intervention, “I think it’s so much easier for most [youth with ASD] to interact with an adult versus the peer so it’s just a good challenge.” Identified difficulties of paired interventions included addressing both participants’ needs, time management, environmental management (e.g. arena space, horses), and needs for flexibility; however, therapists viewed benefits of paired interventions as outweighing challenges. Finally, therapists also expressed satisfaction with the research process, including training, intervention manuals, mentorship, and fidelity.

Therapists also expressed that the evaluation and intervention were *appropriate*. In particular, they considered OT<sup>ee</sup> HORSPLAY appropriate, 1) to be delivered by occupational therapists, 2) to address the needs of youth with ASD, and 3) to be delivered in the context of an equine environment. For example, when discussing the appropriateness of the equine environment, one therapist commented, “In the clinic, you would have to do some of the social communication stuff while they’re on a swing or while they’re on a trampoline which is what we did a lot in the clinic. I would manage the regulation state so that we could access cognitive ability to communicate, and here [in the equine environment] I feel like we can do that with the horse so much faster and easier.”

Finally, therapists *recommended changes* for future studies. Recommended changes to the evaluation included additional practice with GAS (1 therapist), assessment of sensory functioning (2 therapists), a form for horse recommendations (2 therapists), and following participants from evaluation to intervention (4 therapists). For example, one therapist said, “It really is best if you can do the eval and the intervention with the same participant,” which had not been possible because randomization occurred post-evaluation. Recommended changes to the research process included additional training in the equine environment (as opposed to classroom), pairing participant dyads based on arousal level, and additional feedback regarding fidelity.

#### 4. Discussion

High fidelity and attendance ratings supported feasibility of implementing OT<sup>ee</sup> HORSPLAY. It is possible that high fidelity was influenced by providers’ knowledge of the in-person fidelity observation; future studies can consider minimizing these possible provider effects by rating fidelity of videotaped sessions. Future research can also minimize cancelled sessions by scheduling make-up weeks or not scheduling in the summer when attendance was lower. In addition, high recruitment, low attrition, and 100% assessment completion by parents and study staff indicated that most of the assessment protocol was feasible to implement. Future research needs to increase blinded rater assessment completion, possibly by collaborating with schools or not scheduling during the summer when some youth lost contact with blinded raters. In addition, future protocols will necessitate collection of larger hair samples to allow for accurate analysis in children with thin hair, and stratified randomization strategies to eliminate group differences at baseline. Finally, modifications to the control condition, occupational therapy in a garden environment, to ensure inclusion of participants with elopement behaviors will increase feasibility of future studies.

High satisfaction ratings by parents and occupational therapists suggest that OT<sup>ee</sup> HORSPLAY was acceptable to them. Ultimately, the occupational therapists found both the evaluation and intervention appropriate for other occupational therapists to deliver to youth with ASD in equine environments. Parents were most satisfied with the experimental condition, suggesting that horses and the equine environment were particularly appealing. The evaluation can be improved by collecting additional information (e.g. sensory profiles, horse recommendations), and using this information to better match participants. In addition, more hands-on training and additional feedback (e.g. case conferences) may enhance therapist confidence in intervention implementation.

#### Implications

This study established the feasibility and acceptability of a manualized intervention and assessment protocol of OT<sup>ee</sup> HORSPLAY for youth with ASD. Given promising results and modifications for future research, this study lays the foundation for large-scale efficacy trials that can assess the effect of this novel intervention on goal attainment, behavioral regulation, and social functioning of youth with ASD.

#### Declaration of Competing Interest

The authors report no declarations of competing interest.

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