A Transactional Analysis of Occupational Therapy in an Equine Environment for Youth with Autism Spectrum Disorder

B. Caitlin Peters[1], Christof Bentele[2], and Wendy Wood[3]

[1] Department of Animal Sciences, Colorado State University
[2] Department of Occupational Therapy, Colorado State University
[3] Departments of Animal Sciences and Occupational Therapy, Colorado State University

Existing empirical investigations of occupational therapy services that incorporate horses for youth with autism spectrum disorder (ASD) are limited by a lack of standardized protocols. The current study sought to support manualization of one approach to occupational therapy in an equine environment for youth with ASD (OT[ee] HORSPLAY), by vividly describing the intervention from a transactional perspective. Direct, real-time videos plus field notes of OT[ee] HORSPLAY were collected and then subjected to qualitative content analysis and descriptive statistical analysis. Analytical methods followed Ricoeur's hermeneutic arc of naïve interpretation, explanation through structural analyses, and comprehensive description. Following this arc, we found many architectural spaces, sequences of occupational opportunities, and actions of practitioners and youth that fluidly shifted in relationship to one another. The results of this study will inform the development of intervention protocols that will be tested for feasibility, acceptability, and preliminary efficacy in future investigations of OT[ee] HORSPLAY.

Keywords: occupational therapy, autism spectrum disorder, equine-assisted services, transactional perspective

Correspondence concerning this article should be addressed to B. Caitlin Peters, 1669 Campus Delivery, Fort Collins, CO 80523-1669. Email: Caiti.Peters@colostate.edu
        B. Caitlin Peters https://orcid.org/0000-0001-5145-2929
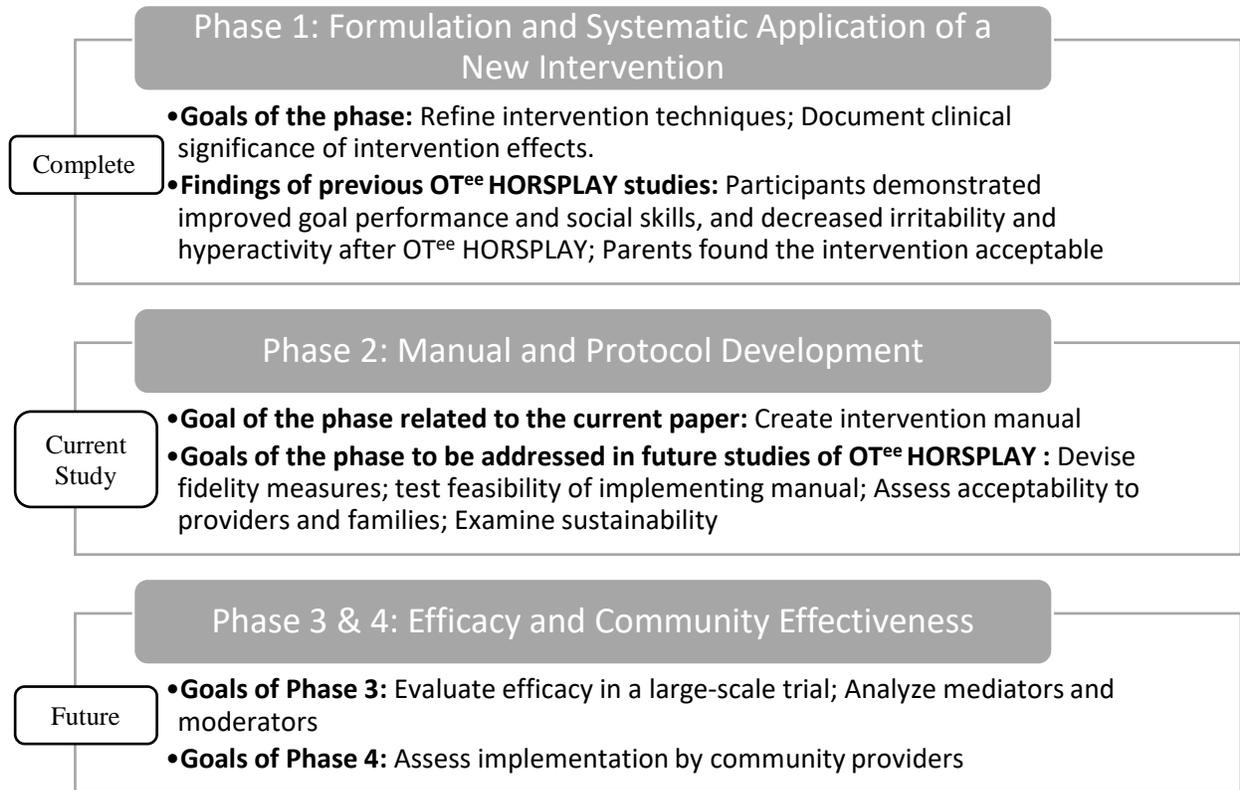   Wendy Wood https://orcid.org/0000-0001-9561-7721

Autism spectrum disorder (ASD) is a complex neurological disorder defined by limitations in social communication and restricted and repetitive behaviors (American Psychiatric Association, 2013). Youth with ASD often demonstrate decreased engagement in social situations, including during psychosocial interventions, therefore creating barriers to effective intervention. A growing body of evidence supports that including animals in interventions for youth with ASD may increase participants' social engagement, leading to a variety of benefits (O'Haire, 2017). In particular, recent reviews have found that various equine-assisted services demonstrate promise for improving social interaction, social communication, and behavior in youth with ASD (McDaniel-Peters & Wood, 2017; Srinivasan et al., 2018). One such review identified three studies where occupational therapists incorporated horses into their services for youth with ASD (McDaniel-Peters & Wood, 2017). Findings demonstrated that occupational therapy that incorporates horses may improve outcomes such as social engagement (Llambias et al., 2016), motor skills (Ajzenman et al., 2013; Liddiard, 2009), and performance and participation in related functional activities such as handwriting and self-care (Ajzenman et al., 2013; Liddiard, 2009). Despite these promising findings, studies remain in early stages of scientific development, limited by small sample sizes and a lack of standardized protocols, particularly intervention manuals (McDaniel-Peters & Wood, 2017).

To address the need for increasingly rigorous research to guide the inclusion of horses in occupational therapy services, our team has followed a phased approach developed by the National Institute of Mental Health to the scientific development and evaluation of psychosocial interventions for youth with ASD (Smith et al., 2007). Figure 1 illustrates the phases within Smith's recommended approach, and how our previous and current research is situated within those phases. We first conducted a phase one study, which included a single-case experimental trial of OT[ee] HORSPLAY with 7 participants, and interviews with providers and parents. This phase one study demonstrated that occupational therapy in an equine environment for youth with ASD was acceptable to parents (Kalmbach et al., 2020), improved participants' goal performance and social functioning, and decreased participants' irritability and hyperactivity (Peters et al., 2020). Given these promising results, we are now entering into Phase 2 of scientific development, focused on protocol development and manualization.

Creating a manual is an essential step in the development and evaluation of complex interventions, as it standardizes procedures to facilitate future research, and makes the intervention more widely available for clinical use once the manual is disseminated (Smith et al., 2007). During the process of manualization, our team named the intervention under investigation **O**ccupational **T**herapy in an **E**quine **E**nvironment: **H**arnessing **O**ccupation for Self-**R**egulation, **S**ocial Communication and **Pla**y in **Y**outh with Autism (OT[ee] HORSPLAY). To guide manualization, our research team is drawing on several sources of data, one of which is the focus of the present paper: videotapes of OT[ee] HORSPLAY sessions. The present paper reports on detailed analyses our team conducted of videotaped intervention sessions, in order to elucidate the content of the intervention and support manual development.

Figure 1

OT^ee HORSPLAY Research Situated within Smith et al.'s (2007) Framework of Intervention Development and Evaluation for Individuals with Autism

> **Phase 1: Formulation and Systematic Application of a New Intervention**
>
> **Complete**
>
> - **Goals of the phase:** Refine intervention techniques; Document clinical significance of intervention effects.
> - **Findings of previous OT^ee HORSPLAY studies:** Participants demonstrated improved goal performance and social skills, and decreased irritability and hyperactivity after OT^ee HORSPLAY; Parents found the intervention acceptable

> **Phase 2: Manual and Protocol Development**
>
> **Current Study**
>
> - **Goal of the phase related to the current paper:** Create intervention manual
> - **Goals of the phase to be addressed in future studies of OT^ee HORSPLAY :** Devise fidelity measures; test feasibility of implementing manual; Assess acceptability to providers and families; Examine sustainability

> **Phase 3 & 4: Efficacy and Community Effectiveness**
>
> **Future**
>
> - **Goals of Phase 3:** Evaluate efficacy in a large-scale trial; Analyze mediators and moderators
> - **Goals of Phase 4:** Assess implementation by community providers

Note. Depiction of how the ongoing program of research on OT^ee HORSPLAY is situated within Smith et al.'s (2007) recommended phases for intervention development and evaluation.

Applying a Transactional Perspective to the Detailed Description of OT^ee HORSPLAY

Occupational therapists recognize that their clients' occupations—the everyday things that they want to do, need to do, or are expected to do (Law et al., 2014)—are unique to each individual client and the contexts in which they live their lives. Therefore, in accordance with best practices in occupational therapy for youth with ASD, OT^ee HORSPLAY is tailored to participants' individualized occupational performance goals, collaboratively determined by an occupational therapist, parent, and child during an initial evaluation (See Table 1). In determining how to best analyze videotaped intervention sessions, we sought a method that could account for the individualized, occupation-centered nature of OT^ee HORSPLAY. In this pursuit, we identified transactional perspectives of occupation developed in occupational science as an appropriate theoretical framework to guide an analysis that explicates the inherent complexities and dynamic nature of OT^ee HORSPLAY.

Over the past decade, the concept of transactionalism has reached a level of prominence in the occupational science literature, often regarded for its potential utility and advantageous perspective in studying occupation (Aldrich, 2008; Cutchin & Dickie, 2013; Wood, 2019). In

defining transactionalism, John Dewey, an American pragmatist philosopher, described people as live creatures who live *through* the external environment in a constant codependent relationship, rather than understanding the environment as a container *in which* people live (Dewey & Bentley, 1949). When studying experience from a transactional perspective, all observable elements of situations are co-defining; to understand one element, one must understand how that element transacts with other elements. Thus, examining the content of OT[ee] HORSPLAY through a transactional lens reveals a perspective of the intervention whereby all elements of the intervention are understood as interdependent and co-defining.

Guided by this understanding, we determined that three broad constituent units comprise individual sessions of OT[ee] HORSPLAY. *Actors* are conscious beings that interact with their surroundings through actions. *Architectural spaces* refer to the physical environments designed by humans that are accessed during the intervention. Finally, *occupational opportunities* refer to how individual sessions of OT[ee] HORSPLAY avail, to the youth with ASD, opportunities to engage in various occupations, such as riding a horse or playing a game. These occupational opportunities are carefully selected and tailored by occupational therapists in order to address the participant's individualized goals. Hence, to grasp each session of the intervention in its entirety, we presumed that each constituent unit depended on its configuration with the other two.

Therefore, the aim of the present study was to illustrate and describe the constituent units of OT[ee] HORSPLAY and their dynamic transactions concretely and vividly, in order to support manualization of the intervention. To address this aim, we asked these four questions:

1. In what architectural spaces, and for how long, does OT[ee] HORSPLAY typically transpire?
2. What occupational opportunities comprise individual sessions of this intervention, and how are they sequenced throughout the sessions?
3. What do the youth with ASD and their occupational therapists do throughout the sessions of OT[ee] HORSPLAY?
4. How do the constituent units of the intervention, as analyzed in questions one through three, transact with one another?

Method

This paper stemmed from a larger pilot study of OT[ee] HORSPLAY, the design and methods of which are reported elsewhere (Peters et al., 2020). For the present paper, we comprehensively analyzed videotaped data of individual sessions of OT[ee] HORSPLAY, which had previously been collected during the pilot study. Colorado State University's Institutional Review Board approved all study procedures, and the Institutional Animal Care and Use Committee designated the study as exempt from review. Occupational therapists and caregivers provided informed consent; youth with ASD provided verbal assent if able.

Participants

For the pilot study (Peters et al., 2020), the first author distributed fliers to local organizations to recruit eight youth with ASD who met the following criteria: ages 6-13, diagnosed with ASD confirmed by meeting clinical cut-offs on the Social Communication Questionnaire and the Autism Diagnostic Observation Schedule, nonverbal IQ ≥55, and combined score ≥11 on the irritability and hyperactivity subscales of the Aberrant Behavior Checklist, Community. Participants were excluded if they had participated in equine-assisted services for 2+ hours in the previous six months, weighed more than 200 pounds, or did not meet physical, mental or emotional standards set forth by the Professional Association of Therapeutic Horsemanship, International

(PATH, Intl). Eight youth enrolled into the study, but one dropped due to anxiety about missing school. The remaining seven participants are described in Table 1.

Table 1
Participant Characteristics

Pseudonym	Gender	Age	Race	NVIQ	Occupational Performance Goal Area
Kayla	Female	9	Caucasian	123–137	Transitions
Ryan	Male	8	Caucasian	105–117	Reciprocal Conversation
Fisher	Male	6	Caucasian	99–112	Shoe Donning
Josh	Male	8	Native American	71–83	Transitions
Jorge	Male	11	Hispanic	43–55	Transitions
Maya	Female	13	Hispanic	103–116	Emotional Regulation
David	Male	13	Multi	71–83	Community Safety

Note. NVIQ=Nonverbal IQ as measured by the Leiter International Performance Scales, Third Edition (M=100, SD=15)

Two occupational therapists who worked at the riding center provided the intervention; both had completed Hippotherapy Treatment Principles 1 & 2 courses by the American Hippotherapy Association (AHA) and were certified by PATH Intl. During the intervention there was a 1:1 ratio between youth and an occupational therapist. Youth with similar social communication abilities were paired into dyads and received OT[ee] HORSPLAY simultaneously, to allow for peer interaction. Volunteers trained in safety procedures served as horse leaders and side-walkers. When possible, we paired youth with the same occupational therapist, peer, horse and volunteers throughout the 10 weeks, although these changed on occasion due to absences.

Intervention

As previously reported in Peters et al., (2020), the intervention occurred at a PATH Intl Premiere Accredited Center that met all required safety standards (equine selection and training, facility set-up, helmet use, etc.). Prior to the first session, youth and parents participated in an occupational therapy evaluation that included collaborative goal setting; goals were related to social participation and self-regulation. The intervention consisted of 10 weekly sessions that each lasted 45-60 minutes and followed a general structure: greetings, activities with horses, debriefings with parents, goodbyes. In accordance with best practice in occupational therapy for youth with ASD, OT[ee] HORSPLAY was highly individualized to participants' goals (Tomcheck & Koenig, 2016). Occupational therapists designed intervention activities based on these critical elements: a)

individualization of activities to address participant goals, b) facilitation of social interaction, c) positive reinforcement of communication, d) use of visual aids, and e) use of *hippotherapy* (AHA, 2021). The AHA defines hippotherapy as "the purposeful manipulation of equine movement as a therapy tool to engage sensory, neuromotor, and cognitive systems to promote functional outcomes" and encourages therapists to integrate hippotherapy "along with other therapy tools and/or strategies" (AHA, 2021). In the current study, equine movement was integrated into OT[ee] HORSPLAY for these reasons: 1) motivating youth to participate in mounted intervention activities, 2) providing proprioceptive, vestibular, and tactile stimulation to help youth achieve an optimal state of arousal, and 3) as a positive reinforcement for communication.

Data Collection

Because 8 participants were paired into dyads, and the intervention lasted 10 weeks, there were a total of 40 videotaped sessions, for a total of 38 hours of video data. As most sessions included two youth with ASD due to the design of the intervention, the focus of videotaping was on one participant for an entire session; the focus alternated between youth weekly. When a youth with ASD was not the direct subject of videotaping, the youth was referred to as the peer. Videotaping was conducted using a Sony Handycam and a tripod where possible, otherwise handheld filming was necessary to capture the dynamic changes and frequent movement across architectural spaces. Videotaping followed a predetermined schedule. We sampled 21 of the 40 sessions to be analyzed, choosing one videotaped session from each child's first, middle, and final sessions; overall, 19 hours and 15 minutes of video were sampled for analysis.

The second author also collected field notes during and following each day of data collection that included information not readily available from videotapes such as prevailing smells, textures, and sounds; nuances in temperature and weather; and direct quotes from actors. The field notes were also used to memo revelations inspired from witnessing the therapy in person.

Data Analysis

The hermeneutic arc in Ricoeur's (1976) theory of interpretation is congruent with inquiry grounded in a transactional perspective of occupation. According to Ricoeur, hermeneutic interpretation transpires within a hermeneutic arc (Figure 2). When following this arc, an observer successively moves back and forth among parts of a subject matter and its projected whole until comprehensive understanding of the subject matter is realized (Tan, Wilson, & Olver, 2009). Given its congruence with a transactional perspective, the hermeneutic arc guided our analysis.

The second author analyzed data following Ricoeur's hermeneutic arc. As next developed, entering the hermeneutic arc begins with a naïve interpretation, then an explanation, and finally moves into a comprehensive understanding.

Figure 2
Illustration of the Hermeneutic Arc
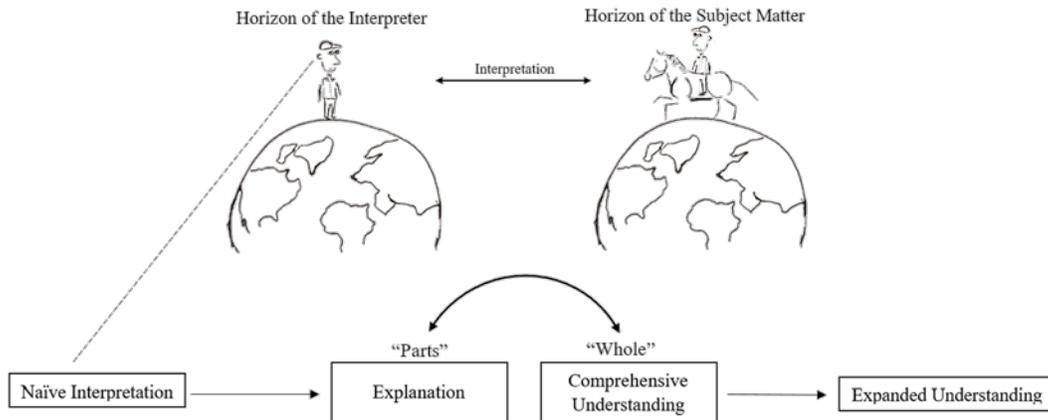
Note. The interpreter begins with a naïve understanding, then delves into the subject matter by moving back and forth successively between a part and the projected whole. This conversational process between the world of the interpreter and the world of the subject matter seeks to narrow the distance that exists between their two worlds.

Naïve Interpretation

The *naïve interpretation* is a basic and initial understanding of the subject matter removed from the author's intent, forging a new relationship between the interpreter and the subject matter (Ricoeur, 1976). This first interpretation is essentially a guess that may or may not be validated through the explanation of the subject matter. After videotaping initial sessions of the therapy, but before conducting any further analysis, the second author formed a naïve interpretation by writing a simple description of OT[ee] HORSPLAY. In doing so, he attempted to summarize field notes taken and the lived experience of being present in, but not a participant of the therapy. After reaching a naïve interpretation of the intervention as it was actually delivered, the research team (all three authors) sought to explain this initial understanding through structural analysis.

Explanation through Structural Analysis

Related to *explanation,* or the structural analytical phase of the hermeneutic arc, Ricoeur (1976) recommended extracting and examining constituent units out of context before putting them back together in a unified sequence and whole. Our structural analysis involved examining each constituent unit of the intervention before integrating findings pertaining to them within a comprehensive understanding of OT[ee] HORSPLAY.

This examination was conducted using qualitative content analysis (QCA) of collected videotaped data. Because QCA can generate precise descriptions and descriptive statistics of salient information entrenched in data (Schreier, 2012), it is well-suited for explanation in the

hermeneutic arc. In QCA, the coding scheme is deductively developed to answer research questions that were theoretically derived; our research questions formed the theoretical basis of the three broad constituent unit codes: architectural spaces, occupational opportunities, and actors and their actions (coding scheme available in Supplemental Table 1). QCA also permits inductive formation of codes from the data. For example, within the parent code architectural spaces, a child code "sensory trail" was discovered during data analysis. The coding scheme is created during early stages of QCA and to ensure that multiple investigators are reliably applying it, agreement coefficients can be calculated. Applying QCA in this study, investigators developed a coding scheme and completed all coding and analyses of video data using the qualitative software program, NVivo for Windows, version 11.4.1.1064 (QSR International, 2017).

To develop the coding scheme, videotaped sessions were uploaded into NVivo on a weekly basis. Weekly also, the team watched and re-watched uploaded videotapes to develop, deliberate, refine, and reach agreement on all codes and their definitions. The evolving coding scheme was applied to the sampled videos weekly, forming more comprehensive descriptive results with each pass. Before the sampled data were exhausted, a point was reached in which no new codes were found, thus obtaining theoretical saturation. Analysis then continued until all sampled sessions were examined. A research assistant independently trained in the coding scheme achieved 96.84% agreement with coding by the research team, suggesting strong interrater reliability.

The final coding scheme included several inductively derived child codes within each constituent unit. Specifically, the constituent unit of *actors and their actions* included 15 child codes describing the youth's actions; 14 child codes describing occupational therapists' actions; seven child codes describing volunteers' actions; and one child code denoting a family member's presence. Especially detailed child codes described actions of occupational therapists given their prominence in delivering the intervention. All codes describing actions of adults pertained to their interactions with the youth. Because multiple actions often occurred concurrently, action child codes were not mutually exclusive. The constituent unit of *architectural spaces* included six mutually exclusive and exhaustive child codes denoting the spaces that were occupied during the intervention. The constituent unit of *occupational opportunities* included 16 mutually exclusive and exhaustive child codes denoting specific occupations offered to the youth both when horses were and were not present.

In the constituent units of *occupational opportunities* and *actors and actions*, the final coding scheme also included inductively developed modifiers. Specifically, modifiers to *occupational opportunities* elaborated on the opportunities. For example, two modifiers of the opportunity, "riding horse—standing," indicated the youth was also being offered an opportunity to play "Simon Says" or "Red Light, Green Light." Hence modifiers denoted opportunities to participate in layered activities, which required more complex skills than the base opportunity alone, as in this example, simply to sit atop a standing horse. Modifiers of *actors and their actions* described actions more precisely. For example, the action code "riding horse—standing" denoted the youth had accepted an opportunity to ride and was mounted on a standing horse. If applied, modifier codes of "Simon Says" or "Red Light Green Light" denoted that the youth was simultaneously playing one of these games.

After the coding scheme was finalized, all 19 hours and 15 mins of sampled video data were continuously coded. For each included videotaped session, investigators numbered the order in which specific occupational opportunities were presented; for example, a session opened with opportunities for social interaction followed by opportunities to transition to different activities

and then to manage equipment. Lastly for the structural analysis, the investigators queried frequencies and durations of all codes, child codes, and modifiers in NVivo.

Comprehensive Understanding

To form a *comprehensive understanding*, investigators synthesized findings pertaining to individual constituent units of the intervention into a comprehensive understanding and coherent narrative. Specifically, the second author determined sequences of occupational opportunities and corresponding architectural spaces during videotaped sessions. The investigator then visually aggregated these sequences in three figures (Figures 2, 3, and 4 as introduced under findings), which reflected the three main time segments of the intervention identified during the phase of naïve interpretation. To further explore dynamic relationships, matrix queries were run in NVivo to determine durations of overlap between salient codes and modifiers that had been computed during structural analyses of the explanation phase. One of these matrix analyses showed, for instance, that when mounted activities were offered (an occupational opportunity), the youth's actions reflected positive social interactions (a youth action code). Another analysis showed that the youth displayed more disengaged behaviors (a youth action code) when occupational therapists were instructing them or talking with family members (therapist action codes). Thus, to generate a comprehensive understanding of OT[ee] HORSPLAY, investigators iteratively moved back and forth across the hermeneutic arc. This iterative process allowed investigators to create a sequential, whole, and coherent narrative of the intervention, which encompassed its dynamic unfolding across individual sessions as next reported.

Results

Naïve Interpretation

OT[ee] HORSPLAY as provided to youth with ASD was a highly social therapy program. This program involved a wide selection of occupational opportunities, physical spaces, and social environments that were ordered in a distinctive pattern. Broadly, this pattern took the shape of three distinct segments that occurred during every session: pre-mounted time, mounted time, and post-mounted time.

Explanation (Structural Analysis)

OT[ee] HORSPLAY consisted of ten sessions that averaged 55 minutes in duration. Detailed structural findings related to each constituent unit are next presented; these findings were informed by descriptive statistics (frequencies and durations) of all codes, child codes, and modifiers (Table 2 and Supplemental Tables 1-3).

Architectural Spaces

Six distinct architectural spaces were observed, as depicted in Supplemental Figure 1: the equine arena, the gear room, an outside "sensory" trail, the grooming and tack room, the therapy room, and the viewing room. All seven participants were observed in the equine arena, gear room, sensory trail and viewing room; four participants were observed in the therapy room; and three participants were observed in the grooming and tack room. The majority of the intervention was offered in the equine arena, representing 61% of session time on average (Supplemental Table 2). The equine arena (area≈950 m^2) had an enclosed dirt floor room, direct access to the sensory trail, the grooming and tack room, and the viewing room, and contained mounting blocks, a white board, and various obstacles. About one fifth (19% on average) of session time occurred on the sensory trail outside. This looping dirt trail (distance≈730m) contained a whiteboard, garden, bridge, glockenspiel, a "car wash" (a rectangle frame with hanging firehose), a gazebo, birdhouses, hills,

a "rubber tire dragon" (obstacle), a 30 m "race track" and a section of poles and platforms (obstacles). The temperature, wind, and ground precipitation of the sensory trail varied greatly across sessions. On average, 12% of session time took place in the gear room during pre- and post-mounted segments. The wood paneled gear room contained helmets, gait belts, and other safety equipment. To lesser extents, the intervention took place in the therapy, viewing, and grooming and tack rooms, or for 4%, 3%, and 1% of all session time on average respectively. The small therapy room had a fold-down therapy mat and whiteboard. The small viewing room had five chairs and three windows into the equine arena. The somewhat larger grooming and tack room contained saddles, reins, lead ropes, and six crossties for horses.

Occupational Opportunities

Seventeen different occupational opportunities were observed (Supplemental Table 3), many of which were modified by 14 different modifiers (Supplemental Table 1). Every session offered the following occupational opportunities at least once: mounting a horse, being mounted on a horse that was standing, being mounted on a horse that was walking, dismounting, transitions, managing equipment, and social interaction. Modifiers described more specific activities, such as playing basketball while mounted on a horse, and varied widely across sessions. Durations of opportunities to participate in mounted occupations extended over half of all sessions, or 53% on average. Durations of opportunities to participate in unmounted occupations with the horse present extended over nearly one quarter of all sessions, or 24% on average. Durations of opportunities to participate in unmounted occupations when horses were not present took up just under one fifth of all sessions, or 18% on average.

Actors and Their Actions

Average percentages of session time in which different actors were present were as follows: youth with ASD (participant who was the focus of the videotape; 99.79%), occupational therapist (97.16%), volunteers (85%), horses (80.15%), peer (participant who was not the focus of the videotape; 78.98%), and family members (15.64%). Table 2 presents the most common actions of youth with ASD and occupational therapists. The youth with ASD were observed to spend the largest proportion of sessions, 92% on average, engaged in various positive or neutral social interactions. The youth with ASD engaged in shared communication with other actors while mounted and unmounted, clearly demonstrating face and body orientation to a social partner, self-initiated and therapist-prompted verbal contributions, and directed listening with the other actors. The nature of each social interaction was characterized by the architectural spaces and the recent or upcoming occupational opportunities—often helping to process or prepare for past and future activities. For example, before transitioning into the equine space where the youth would meet the horse and volunteers, social interaction was focused on helping the youth understand the social or physical expectations of the coming activities such as making a wide arc when walking behind the horse. Frequencies of actions varied across segments. For example, about four times on average during pre-mounted segments, the youth action code, "disengaged behaviors," was recorded to represent refusals to participate or unsafe or disengaged behaviors; these behaviors were rarely observed during the mounted segments.

Table 2

Actions of Youth with ASD and Occupational Therapists: Average Proportion of Time per Session Spent Performing Actions

Actions	% Total Session (mm:ss)	% Total Session During Pre-mounted	% Total Session During Mounted	% Total Session During Post-mounted
Youth with ASD				
Social Interaction	92% (50:44)	30%	53%	10%
Riding Horse-Stand	28% (15:11)	0%	28%	0%
Riding Horse-Walk	25% (13:36)	0%	25%	0%
Verbalization	10% (05:42)	4%	5%	2%
Managing Equipment	5% (02:51)	3%	< 1%	2%
Disengaged Behaviors	5% (02:51)	2%	< 1%	2%
Transitioning	4% (02:06)	3%	< 1%	1%
Tacking	4% (01:59)	3%	< 1%	< 1%
Grooming	1% (00:42)	1%	0%	< 1%
Petting Horse	1% (00:38)	< 1%	< 1%	< 1%
Mounting	< 1% (00:13)	0%	< 1%	0%
Sensorimotor Regulation Tasks	< 1% (00:11)	< 1%	0%	< 1%
Dismounting	< 1% (00:10)	0%	< 1%	0%
Riding Horse-Trot	< 1% (00:08)	0%	< 1%	0%
Drawing or Writing	< 1% (00:05)	< 1%	0%	< 1%
Horse Leading	< 1% (00:02)	< 1%	0%	0%
Occupational Therapists				
Instructing the Child	15% (08:18)	6%	8%	1%
Physical Facilitation	4% (02:27)	2%	3%	< 1%
Instructing Parents	3% (01:38)	< 1%	0%	3%
Eliciting Communication	3% (01:36)	< 1%	2%	< 1%
Facilitating Social Interaction	2% (01:19)	1%	< 1%	< 1%
Positive Reinforcement	2% (00:59)	< 1%	< 1%	< 1%
Physical Support	2% (00:58)	0%	2%	< 1%
Individualizing equine equipment to child	2% (00:54)	< 1%	2%	< 1%
Instructing Volunteers	1% (00:34)	< 1%	< 1%	< 1%
Eliciting Choice-making	< 1% (00:22)	< 1%	< 1%	< 1%
Collaboration with other OT	< 1% (00:17)	< 1%	< 1%	< 1%
Singing	< 1% (00:16)	< 1%	< 1%	0%
Modeling	< 1% (00:15)	< 1%	< 1%	< 1%
Promoting sensorimotor regulation	< 1% (00:10)	< 1%	0%	< 1%

The occupational therapists were observed providing instruction to the youth with ASD over the largest proportion of sessions (15% of session time). Other notable actions were performed frequently yet over smaller proportions of sessions, such as eliciting communication (average of 36.14 times per session, but only 2.92% of session time), verbal positive reinforcement (23.5 and 1.8%), facilitating social interaction (13.6 and 2.39%), physical facilitation (9 and 4.45%), instructing volunteers (6.14 and 3%) and eliciting choices (5.3% and 0.65%). At least two volunteers were present for each youth during mounted times; one led the horse and the other walked by the horse's side. Volunteers physically supported the youth during 18% of all sessions on average, by providing arm-over-thigh holds or ankle-holds to increase stability. Volunteers also periodically instructed and elicited communication from the youth.

Comprehensive Understanding

A coherent storyline that provides a comprehensive understanding of OT^{ee} HORSPLAY is next presented. Figures 2, 3 and 4 partly illustrate this storyline by presenting sequences of utilized occupational spaces in relationship to sequences of offered occupational opportunities, as aggregated on average across all sessions. We next chronicle the progression of dynamic interactions among architectural spaces, actors and their actions, and occupational opportunities across the pre-mounted, mounted, and post-mounted time segments of the intervention. The following storyline integrates the visual data presented in Figures 2, 3, and 4 with further analyses of video data and fieldnotes.
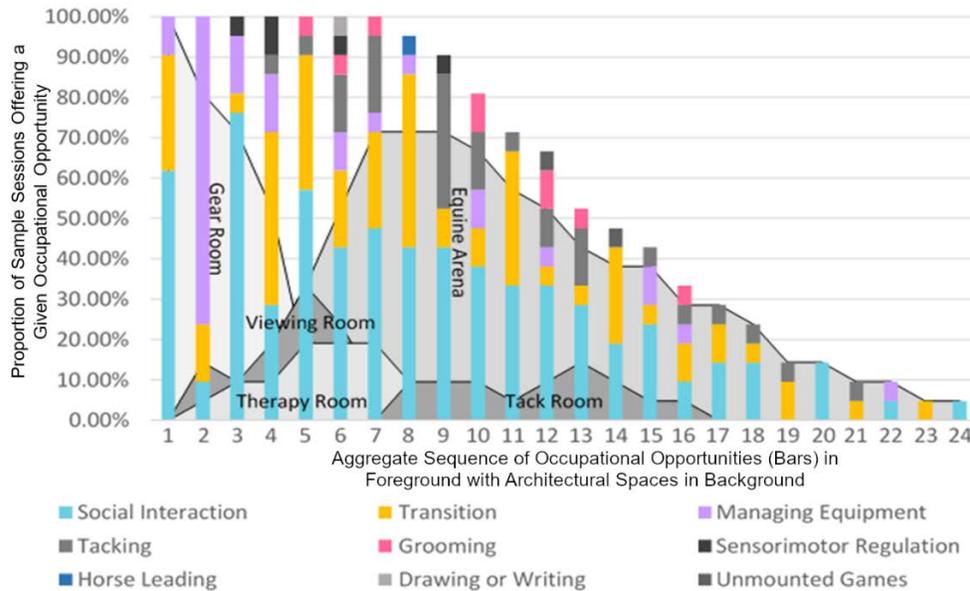
Pre-mounted Time

On average, pre-mounted time lasted 18:25 mm:ss and was primarily devoted to preparing the youth for mounting and riding the horse (Figure 3). Every session began in the gear room where occupational therapists greeted the youth with ASD, who would soon transition to donning safety equipment with some physical facilitation from the therapist or a volunteer. This transition from a family context into an unfamiliar social context often appeared to elicit, in some of the youth, disengaged behaviors. As a thoroughfare for the youth, therapists, and volunteers—with as many as 13 different people present at a given time—the gear room was potentially over-stimulating. Of the total duration that the youth were disengaged, about half occurred during pre-mounted time. Although challenging for the youth at times, this segment was also rich with preparatory therapeutic activities between the youth and the therapist such as social interaction related to goal behaviors and rapport building.

Following a period of social interaction where the occupational therapist instructed the youth about the contents of the day's session, most sessions transitioned by the fifth occupational opportunity into the viewing and therapy rooms or equine arena. Family members typically accompanied the youth from the gear room into the viewing room, but rarely joined them in the equine arena, therapy room, or grooming and tack room during pre-mounted time. The arrival of the peer was inconsistent across sessions; sometimes the youth prepared together and other times they did individualized introductory activities and met in the equine arena for shared mounted time. Sessions that utilized the therapy room prior to mounted time did so for two purposes: to facilitate sensorimotor self-regulation tasks or as an opportunity to collaboratively plan session activities with the youth. When utilized, the grooming and tack room primarily functioned as a social space for familiarizing the youth with their horse and volunteers and affording them opportunities to choose which equine equipment they needed for eventually tacking and grooming horses in the equine arena. Every pre-mounted time concluded by transitioning into the equine

arena, where the primary occupational opportunities included social interaction, tacking, grooming and managing equipment.

Figure 3
Pre-Mounted Sequence of Occupational Opportunities Within Architectural Spaces

Note. This figure depicts aggregated sequences across all sampled sessions of architectural spaces and occupational opportunities throughout the pre-mounted segment. The background depicts proportions of sessions making use of different architectural spaces across the ordered sequence of occupational opportunities. The horizontal axis is numbered to reflect the sequence of offered occupational opportunities aggregated across all sessions. The vertical axis shows proportions of sampled sessions that corresponded with each numbered order of offered occupational opportunities. Drops in the stacked bars below 100% indicate that a proportion of the sampled sessions have completed this segment and transitioned into mounted segment. For example, by bar #18, nearly 80% of sampled sessions had transitioned into the mounted segment of the intervention.

Thus, during pre-mounted time, the youth's relationship to architectural spaces and occupational opportunities evolved over the course of the intervention. The youth tacked horses in every session, but as they became more familiar with the space and its rules, the youth required less instruction and grooming time before mounting horses or playing unmounted games. During tacking or grooming, some youth talked about the equine environment (it has a cooler temperature…it makes me calmer"), how the horse made them feel ("her walk, [the horse's] it has a nice feel to it, side to side") and that they wished to continue working with horses in the future. Most sessions concluded pre-mounted time after 14 occupational opportunities.

Mounted Time

Mounted time averaged 29:06 mm:ss. This segment began by the youth's mounting of horses, which the occupational therapists always physically facilitated. Once mounted, the youth rode while horses alternated between walking, standing, or infrequently, trotting.

Compared to pre- and post-mounted time, the occupational therapists performed all actions at their highest frequencies and longer durations (except parental instruction and sensorimotor regulation promotion). Thus, mounted time elicited especially persistent and diverse skilled actions by the occupational therapists. Also compared to pre- and post-mounted time, the youth were rarely disengaged during mounted time.

Figure 4
Mounted Sequence of Occupational Opportunities Within Architectural Spaces
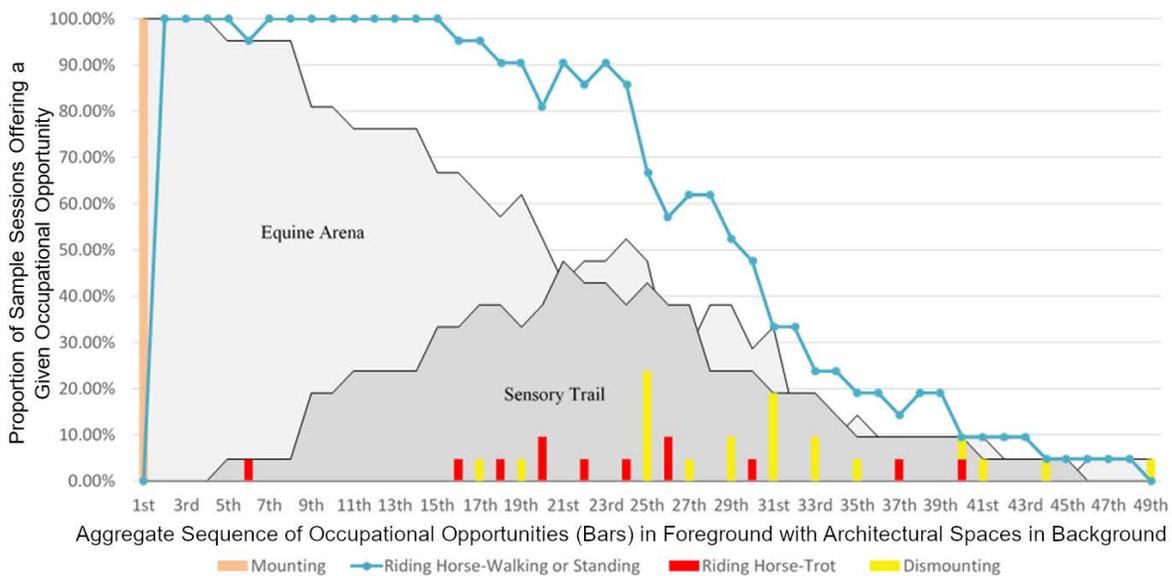
Note. This figure depicts aggregated sequences across all sampled sessions of architectural spaces and occupational opportunities throughout the mounted segment. The background depicts proportions of sessions making use of different architectural spaces across the ordered sequence of occupational opportunities, specifically the riding arena and the outdoor sensory trail. The horizontal axis is numbered to reflect the sequence of offered occupational opportunities aggregated across all sessions. Thus, mounting the horse is shown to have been the first offered opportunity in 100% of the sampled sessions. Because the prevailing opportunities involved being mounted on a standing horse or riding a walking horse, these opportunities are combined into a single blue line with dots that correspond with the order of presented opportunities. The large number of occupational opportunities, 49, reflect all of the possible modifiers of riding horse-standing, riding-horse-walking, and riding horse-trotting. When the dotted blue line shows 100%, it represents the occupational opportunities from all sampled sessions in the mounted segment. Drops in the dotted blue line below 100% indicate that a proportion of the sampled sessions have completed this segment and transitioned into the post-mounted segment.

Because mounted time superficially appeared repetitive given its same basic format across sessions, Figure 4 highlights moments of variation. Indeed, mounted time was especially rich with activities that modified the occupational opportunities of horse riding. On average, the youth spent 04:20 mm:ss participating in 12 activities that modified their actions while atop a horse, including mounted basketball, follow the leader, Simon says, red-light/green-light and obstacle navigation among others. Specific activities offered by the occupational therapists and chosen by the youth often related to youth's goals. For example, one youth participated in a question cards activity to develop his reciprocal conversation skills. On average, each session's mounted occupations were modified by six or more activities. Volunteers mostly physically supported the youth, thus acting as extensions of the occupational therapists and allowing them flexibility in their proximity to the youth. The youth always dismounted on the side of the occupational therapists, who provided physical facilitation with periodic support from volunteers. Most sessions concluded mounted time after 23 occupational opportunities.

Post-mounted Time

Post-mounted time averaged 07:21 mm:ss and was primarily devoted to transitioning socially and physically from mounted time and to debriefing with family members (Figure 5). Most sessions transitioned out of the equine arena by the fourth occupational opportunity and moved into the gear room by way of the viewing or grooming and tack rooms.

Figure 5
Post-mounted Sequence of Occupational Opportunities Within Architectural Spaces
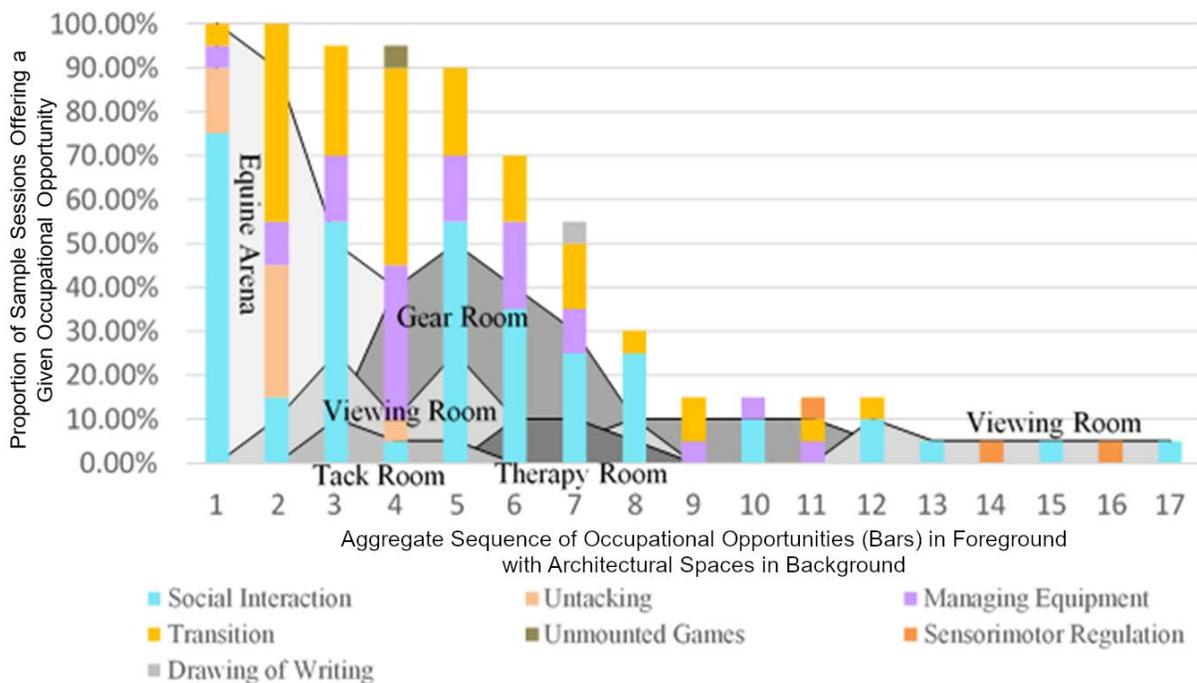
Note. This figure depicts aggregated sequences across all sampled sessions of architectural spaces and occupational opportunities throughout the post-mounted segment. The background depicts proportions of sessions making use of different architectural spaces across the ordered sequence

of occupational opportunities. The horizontal axis is numbered to reflect the sequence of offered occupational opportunities aggregated across all sessions. The vertical axis shows proportions of sampled sessions that corresponded with each numbered order of offered occupational opportunities. For example, bar #1 shows that the first occupational opportunity was always offered in the equine arena, with nearly 75% of all sessions starting the post-mounted segment with opportunities for social interaction. Drops in the stacked bars below 100% indicate that a proportion of the sampled sessions have completed this segment, marking the end of the session.

After dismounting, the occupational therapists facilitated the youth thanking horses and volunteers. The youth then typically untacked the horse and restored equipment to original locations. In the final session, this moment provoked frequent reflections by the youth. For instance, the youth expressed feelings of personal growth ("I accomplished a lot"), the bond they developed with their horse ("I love Gavin" [horse]), context-relevant reflections ("I feel like a cowboy") and sadness that the experience was ending ("I'll miss you" [speaking to the horse]). As therapists debriefed sessions with parents, absences of occupational opportunities that might have directly engaged the youth were common, as were disengaged behaviors by the youth. The majority of sessions concluded this segment after eight occupational opportunities.

Discussion

The present study aimed to vividly describe a novel approach to incorporating horses into occupational therapy for youth with ASD, OT^{ee} HORSPLAY. A transactional perspective of occupation helped to generate findings that illuminated the fast-moving and dynamically occupation-centered nature and complexity of the intervention.

To advance the science of novel interventions for people with ASD, investigators must first identify and fully elucidate active elements that comprise how an intervention is actually implemented (Craig et al., 2013; Smith et al., 2007). Systematic mapping reviews of equine-assisted services for diverse populations, including youth with ASD, suggest that investigators typically neglect or pay just scant attention to this crucial early research step (McDaniel-Peters & Wood, 2017; Wood & Fields, 2019). For example, Shurtleff and Engsberg (2012) offered one of the more comprehensive depictions of hippotherapy, a treatment strategy focused on equine movement; their description included a list of gaits, gait changes, sitting positions, mounted activities, walking patterns, and duration, frequency and location of sessions. Llambias et al. (2016) also provided brief descriptions of on- and off-horse activities in their descriptions of equine-assisted occupational therapy. Both studies identified occupational therapists as providers. However, sparse descriptions of their respective interventions did not foreground occupation and its dynamic manifestations and variations, thus leaving much to the imagination of other interested occupational therapists and researchers.

In contrast, the present study's specific and vivid elaborations of OT^{ee} HORSPLAY offer realistic examples of how occupational therapists and youth with ASD can fluidly engage in shared occupations with horses and other people throughout fast-moving, intensive therapy sessions. Findings clearly elucidated these key interworking parts of the intervention: utilized architectural spaces, the progression of opportunities to engage in different occupations when horses were and were not present, and associated actions of the youth with ASD and the practitioners, and, to lesser extents, other people and the horses. Findings further distinguished how these interworking parts successively arose, endured, and faded, eventually coalescing in complete 45 to 60 min sessions that broadly unfolded in three main segments of time. This concrete and vivid illumination of the rich and dynamic flows of sessions is one source of data that can inform development and revision

of the OT^{ee} HORSPLAY intervention manual, and can help other researchers and occupational therapists implement this intervention and tailor it to the needs of specific participants with ASD.

This thorough description highlighted the dynamic nature of the intervention, whereby occupational therapists intentionally created unique occupational opportunities tailored to the goals of each youth, and created in-the-moment adaptations in response to the various actors and their actions. Thus, OT^{ee} HORSPLAY cannot be reduced to a simple list of activities, but is a highly tailored intervention approach that must be customizable to particular facilities, therapists, and youth. Creating an intervention manual that standardizes the approach, while also allowing for intensive individualization will no doubt be challenging; yet, standardization that allows for individualization is a hallmark characteristic of high-quality intervention manuals for youth with ASD (Smith et al., 2007).

The results of this study also reveal potential mechanisms by which inclusion of horses in occupational therapy may affect outcomes. For example, the analysis revealed that youth were significantly less likely to disengage from activities while mounted on the horse. This finding lends support to the hypothesized mechanism that horses capture participants' attention and simultaneously support physiological regulation, therefore increasing participants' social engagement during therapy sessions (Peters et al., 2019). Yet, the descriptive nature of this study cannot infer causal relationships between mounted occupations and social engagement. Future research can use inferential designs and validated behavioral coding tools, such as the Observation of Human-Animal Interaction in Research (Guérin et al., 2018), to confirm differences in social engagement while mounted.

Furthermore, this study revealed areas of the intervention that merit special attention by providers, or that can be improved. For example, frequent disengaged behaviors in the gear room were likely related to the commotion, large number of people in the small room, and prevalence of verbal instruction with the absence of activities to engage the participant. It may be helpful to include direction in the intervention manual for providers to be aware of their clients' sensory needs, and arrange the environment to best support their learning, For example, at this particular facility, that may mean limiting the number of people in the gear room, limiting the participants' time in that room, or providing activities for youth to engage in during the caregiver debrief. The fine-grain detail of each constituent unit revealed by the structural analysis, combined with the comprehensive understanding highlighting the interdependence of all constituent units, resulted in these detailed findings that have implications for how OT^{ee} HORSPLAY can be manualized and improved.

Limitations and Future Research

This study is limited by reliance on two data sources (videotapes and fieldnotes) to characterize one approach to integrating horses into occupational therapy for youth with ASD, OT^{ee} HORSPLAY. To fully understand the intervention, it will be important to elucidate the professional reasoning that guided how occupational therapists designed occupational opportunities for particular youth. Therefore, analyses of videotapes cannot alone inform an intervention manual; several other data sources such as interviews and document review of session notes will be necessary to fully capture the critical elements. Thus, although this paper advances understandings of OT^{ee} HORSPLAY for youth with ASD, it does not tell the full story of this intervention.

The current study does, however, fully elucidate the architectural spaces, actors, and occupational opportunities that comprised the OTee HORSPLAY intervention, and reveals the

complex transactions among them. The process of manualization will require researchers to decide which elements of this description are critical and generalizable and therefore should be included in the manual, and which elements are necessarily specific to the particular facility, providers, and participants in this study. One challenge to manualization will be to standardize procedures in a manner that allows for individualization, which is critical to occupational therapy services for youth with ASD. Representing one small step forward in the rigorous development and evaluation of a novel intervention, the current study will inform the development and refinement of protocols that should be tested for feasibility, acceptability, and efficacy in future investigations of OT[ee] HORSPLAY (Smith et al., 2007).

Conclusion

This study produced a concrete and vivid description of a novel intervention incorporating horses into occupational therapy for youth with ASD, which can help to inform the development and refinement of an intervention manual. Such a thorough description that grapples with the complexity of an intervention is absent from the body of literature on equine-assisted services for youth with ASD, and therefore represents a pioneering step forward in the scientific advancement of this novel intervention. Our analytic method was effective in revealing the complex, dynamic, and fast-moving nature of OT[ee] HORSPLAY, and also reveals potential challenges in manualizing the intervention. Ultimately, this study makes clear that OT[ee] HORSPLAY cannot be reduced to a checklist of activities, but rather is a dynamically unfolding intervention responsive to emergent participant needs in the context of varied occupational opportunities.

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Supplemental Figure 1.

Scaled Illustration of the Architectural Spaces within the Equine Environment
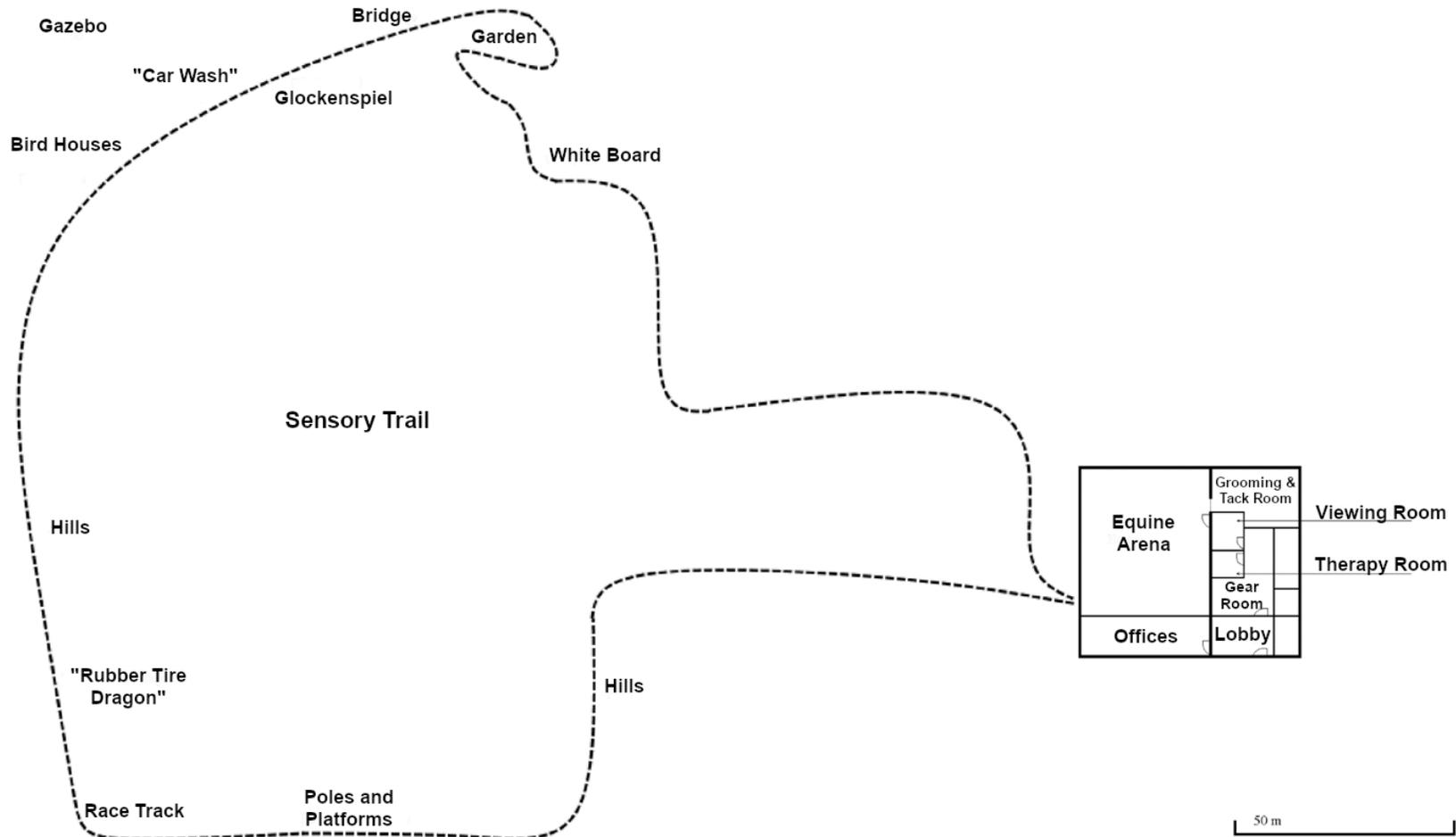
Supplemental Table 1
Coding Scheme

Code	Code Modifiers	Definitions
		Actors and Actions
Youth with ASD		The youth with ASD is present and:
1. Dismounting		Moves from a sitting position on the horse to standing on the ground
2. Drawing or Writing		Uses a pen, marker or pencil to write or draw
3. Unmounted Games		Participates in a game while dismounted
	Unmounted Obstacles	Participates in navigating obstacles while dismounted
	Unmounted Ring Game	Reaches for, holds onto, tosses, transports or manipulates a plastic ring while unmounted
	Unmounted Ye-Haw Game	Participates in the "ye-haw" social game (youth and peer say "ye-haw" back and forth)
4. Grooming		Combs, brushes, or towels the horse
5. Horse-leading		Grasps the lead rope of the horse and guides the horse
6. Managing Equipment		Collects, manipulates, or restores relevant equipment
	Cleaning Up	Restores items to their original state e.g. replacing tools, equipment, and gear
	Setting Up	Collects or manipulates items in preparation for the equine session: obtaining tools, equipment or gear
7. Mounting		Moves from standing on the ground to sitting on a horse
8. Petting Horse		Uses hand to directly interact with the horse
9. Disengaged Behaviors		Interacts with others through behaviors contrary to their established goals
	Disengaged	Does not participate in any occupation, activity or task AND is not self-stimulating
	Refusing Activity	Does not transition into the next parent/therapist directed activity or when he or she does not engage with non-preferred activities

	Self-stimulation	Engages in self-directed behavior for the purpose of self-stimulating sensory experiences while also disengaged from other occupational opportunities
	Unsafe Behaviors	Exhibits unsafe behaviors for self, other or the horse e.g. Running away, aggression, sudden movements on top of the horse
10. Riding Horse – Standing		Sits on the horse while the horse is stationary
	Mounted Basketball	Plays basketball while sitting on a stationary horse
	Emotional I.D. Activity	Participates in an activity where he or she is asked to recognize and name emotions while sitting on a stationary horse
	Hands in the Air	Raises their hands above head while sitting on a stationary horse
	Musical Pole Instrument	Uses the musical pole instrument (glockenspiel) on the sensory trail while sitting on a stationary horse
	Question Cards	Participates in a conversation prompted by question cards sitting on a stationary horse
	Ring Game	Reaches for, holds onto, tosses, transports or manipulates a plastic ring while sitting on a stationary horse
	Simon Says	Plays the game Simon Says (command following) while sitting on a stationary horse
	Standing in Stirrups	Stands up in the stirrups while stationary on the horse
	Red Light / Green Light	Participates in a game of red light green light (stop and go with visual or auditory cues) while sitting on a stationary horse
	Ye-Haw Game	Participates in a social game where participants take turns saying "ye-haw" while sitting on a stationary horse
11. Riding Horse – Trot		Sits on the horse while the horse trots (a gait in-between walk and canter/gallop)
	Red Light / Green Light	Participates in a game of red light green light (stop and go with visual or auditory cues) while riding a trotting horse
12. Riding Horse – Walk		Sits on the horse while the horse walks
	Mounted Basketball	Plays basketball while sitting on a walking horse

	Follow the Leader	Goes behind or leads a peer's direction while riding a walking horse
	Hands in the Air	Raises their hands above head while riding a walking horse
	Obstacles	Navigates around physical objects on a track while riding a walking horse
	Question Cards	Participates in a conversation prompted by question cards sitting on a walking horse
	Ring Game	Reaches for, holds onto, tosses, transports or manipulates a plastic ring while riding a walking horse
	Simon Says	Plays the game Simon Says (command following) while riding a walking horse
	Standing in Stirrups	Rides a walking horse while standing in the stirrups rather than sitting
	Red Light / Green Light	Participates in a game of red light green light (stop and go with visual or auditory cues) while riding a walking horse
13. Sensorimotor Regulation Tasks		Participates in activities that promote sensorimotor regulation while not in the presence of a horse e.g. Deep breathing, deep pressure, "push and pull game"
14. Transitions		Moves from one environment or task to another and does not continue to engage with other activities
15. Verbalization		Makes an audible vocal sound

Family Members   A member of the family is present during the intervention.

Occupational Therapists   An occupational therapist is present and:

1.	Eliciting choice-making	Prompts the youth to make a choice between 2 or more options
2.	Collaborating with other therapist	Discusses the course of treatment or intervention choices with the other therapist
3.	Eliciting communication	Directly elicits expressive communication for the sake of communication.
4.	Facilitating social interaction	Directly facilitates social interaction to improve social skills, often through the use of open-ended questions or direction of social cues
5.	Individualizing equine equipment to the youth	Adjusts the horse, equipment, activities, environment, sequence to tailor the treatment to the youth with ASD

6. Instructing volunteers — Provides feedback, education or directions to the volunteer

7. Instructing the youth — Provides feedback, education or directions to the youth with ASD

8. Instructing family members — Provides the parent(s) with information about their youth, the intervention, take home strategies etc.

9. Physical facilitation — Provides hands-on assistance with how the youth relates with their environment e.g. hand over hand, assisting manipulation of equipment and tactile cues while on the horse.

10. Physical support — Provides physical support such as bracing or holding.

11. Verbal positive reinforcement (praise) — Provides encouragement, praise, and/or support to the youth with ASD during a session.

12. Promoting sensorimotor regulation — Provides stimulation for the explicit purpose of promoting sensorimotor regulation. E.g. push and pull game, deep pressure, deep breathing

13. Singing — Communicates with the youth with ASD through song

14. Peer — Indicates presence of similarly aged youth with ASD, not the focus of the current videotape

Volunteers — A volunteer is present and:

1. Eliciting Choices — Prompts the youth with ASD to make a choice between 2 or more options

2. Eliciting Communication — Directly elicits expressive communication for the sake of communication

3. Facilitating Social Interaction — Directly facilitates social interaction to improve social skills, often through the use of open ended questions or direction of social cues e.g. recognizing peer's emotions and experiences as well as the consequences of one's own behavior on the experience of a peer

4. Instructing the Youth — Provides feedback, education or directions to the youth with ASD

5. Physical Facilitation — Provides hands-on assistance with how the youth relates with their environment e.g. hand over hand, assisting manipulation of equipment and tactile cues while on the horse.

6. Physical Support — Provides physical support such as bracing or holding

7. Verbal Positive Reinforcement (Praise)	Provides encouragement, praise, and/or support to the youth with ASD during a session.

Architectural Spaces

1. Equine Arena	Room where the primary equine occupational opportunities occur
2. Gear Room	Room where helmets and belts are stored
3. Sensory Trail	Area outside of the indoors rooms that forms a loop with a variety of sensory stimuli
4. Grooming and Tack Room	Staging room where some equine occupational opportunities may occur.
5. Therapy Room	Room where the occupational therapist educates, prepares, instructs or provides other therapeutic treatments without the assistance of a horse.
6. Viewing Room	Room used by an occupational therapist to review the day's treatment session with the youth and/or family members

Occupational Opportunities

An opportunity is presented:

1. Transitions		To move from one task, activity or architectural space to another

Mounted Occupations:

2. Mounting		To move from standing on the ground to sitting on a horse
3. Riding Horse-Standing		To sit on the horse while the horse is stationary
	Basketball	To play basketball while sitting on a stationary horse
	Emotional Identification Activity	To recognize and name emotions while sitting on a stationary horse
	Hands in the Air	To raise hands above head while sitting on a stationary horse
	Tube glockenspiel	To use the musical pole instrument (glockenspiel) on the sensory trail while sitting on a stationary horse
	Question Cards	To participate in a conversation starter card activity while sitting on a stationary horse

	Ring Game	The opportunity for the youth to reach for, hold onto, toss, transport or manipulate a plastic ring while sitting on a stationary horse
	Simon Says	To play the game Simon Says (command following) while sitting on a stationary horse
	Red Light, Green Light	To participate in a game of Red Light, Green Light (stop and go with visual or auditory cues) while sitting on a stationary horse
	Ye-haw game	To participate in a social game where participants take turns saying "ye-haw" while sitting on a stationary horse
4. Riding Horse-Walk		To sit on the horse while the horse walks (includes steering and commanding the horse)
	Mounted Basketball	To play basketball while sitting on a walking horse
	Follow the Leader	To go behind or lead a peer's direction while riding a walking horse
	Hands in the air	To raise hands above head while riding a walking horse
	Obstacles	To navigate around physical objects on a track while riding a walking horse
	Question Cards	To participate in a conversation starter card activity while riding a walking horse
	Ring Game	To reach for, hold onto, toss, transport or manipulate a plastic ring while riding a walking horse
	Simon Says	To play the game Simon Says (command following) while riding a walking horse
	Standing in the Stirrups	To ride a walking horse while standing in the stirrups rather than sitting
	Red Light, Green Light	To participate in a game of Red Light, Green Light (stop and go with visual or auditory cues) while riding a walking horse
5. Riding Horse-Trot		To sit on the horse while the horse trots (a gait in-between walk and canter/gallop)
6. Dismounting		To move from sitting on the horse to standing on the ground

Unmounted Occupations-
Horse Present:

7. Horse Leading		To guide the horse by physically moving the lead rope

8. Unmounted Games		To play organized games while in the presence of the horse, but not riding.
	Ring Game	To reach for, hold onto, toss, transport or manipulate a plastic ring while unmounted, but in the presence of a horse
	Ye-haw Game	To participate in a social game where participants take turns saying "ye-haw" while unmounted, but in the presence of a horse
9. Grooming		To comb, brush, towel the horse using tools
10. Managing Equipment		To collect, manipulate, and restore relevant equipment while in the presence of a horse, but unmounted
	Cleaning up	To restore items to their original state e.g. replacing tools, equipment, and gear while in the presence of a horse, but unmounted
	Setting up	To collect or manipulate items in preparation for the equine session: obtaining tools, equipment or gear while in the presence of a horse, but unmounted
11. Social Interaction		To engage in shared communication with other actors while unmounted and in the presence of a horse e.g. listening, talking, eye contact with people or relevant objects.
12. Tacking		To prepare a horse before or after riding. May include management of saddle pad, saddle, reins, belts etc.
Unmounted Occupations-
Horse Absent:		To participate in occupations while on the ground and the horse is absent.
13. Drawing and/or Writing		To use a writing utensil such as a marker or pen to make marks on a surface for the purpose of drawing or writing
14. Sensorimotor Regulation Tasks		To engage in activities that promote sensorimotor regulation while not in the presence of a horse e.g. deep breathing, deep pressure, "push and pull game"
15. Social Interaction		To engage in shared communication with other actors while unmounted and without the presence of a horse e.g. listening, talking, eye contact with people or relevant objects.
16. Managing Equipment		To collect, manipulate, and restore relevant equipment while unmounted, horse absent
	Cleaning up	To restore items to their original state e.g. replacing tools, equipment, and gear while unmounted, horse absent
	Setting Up	To collect or manipulate items in preparation for the equine session: obtaining tools, equipment or gear while unmounted, horse absent

Supplemental Table 2

Average Proportion of Total and Segment Session Time Spent in Architectural Spaces

Architectural Spaces	Percent of Total Session (mm:ss)	Percent of Total Session During Pre-mounted Time	Percent of Total Session During Mounted Time	Percent of Total Session During Post-mounted Time
Equine Arena	61% (33:27)	22%	34%	5%
Sensory Trail	19% (10:21)	0%	19%	0%
Gear Room	12% (06:33)	6%	0%	6%
Therapy Room	4% (02:23)	3%	0%	1%
Viewing Room	3% (01:31)	1%	0%	2%
Grooming and Tack Room	1% (00:47)	1%	0%	0%

Supplemental Table 3

Average Proportion of Total Session and Segment Time Devoted to Occupational Opportunities

	Percent of Total Session (mm:ss)	Percent of Total Session During Pre-mounted Time	Percent of Total Session During Mounted Time	Percent of Total Session During Post-mounted Time	Average Number of Opportunities Per Session
Transitions	4% (02:28)	3%	0%	2%	6
Mounted Occupations					
Riding Horse-Standing	28% (15:11)	0%	28%	0%	16
Riding Horse-Walk	25% (13:36)	0%	25%	0%	16
Mounting	< 1% (00:12)	0%	< 1%	0%	1
Dismounting	< 1% (00:10)	0%	< 1%	0%	1
Riding Horse-Trot	< 1% (00:08)	0%	< 1%	0%	< 1
Total Mounted Time	53% (29:17)	0%	53%	0%	
Unmounted Occupations – Horse Present					
Social Interaction	14% (07:39)	12%	0%	2%	6
Tacking	6% (03:15)	5%	0%	< 1%	2
Managing Equipment	3% (01:24)	2%	0%	1%	< 1
Grooming	2% (00:53)	2%	0%	0%	< 1
Unmounted Games	< 1% (00:10)	< 1%	0%	< 1%	< 1
Horse Leading	< 1% (00:02)	< 1%	0%	0%	< 1
Total Unmounted Time - Horse Present	24% (13:23)	21%	0%	4%	
Unmounted Occupations – Horse Absent					
Social Interaction	14% (07:31)	6%	0%	7%	5
Managing Equipment	4% (02:04)	3%	0%	< 1%	2
Sensorimotor Regulation Tasks	< 1% (00:13)	< 1%	0%	< 1%	< 1
Drawing and/or Writing	< 1% (00:04)	< 1%	0%	< 1%	< 1
Total Unmounted Time - Horse Absent	18% (09:52)	10%	0%	8%	