

DISSERTATION

EQUINE-ASSISTED ACTIVITIES AND THERAPIES FOR
CHILDREN WITH AUTISM SPECTRUM DISORDERS

Submitted by

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ABSTRACT

EQUINE-ASSISTED ACTIVITIES AND THERAPIES FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS

Objective: The purpose of this dissertation is to systematically map, and then advance, the state of scientific and theoretical development of equine-assisted activities and therapies (EAATs) for children with autism spectrum disorders (ASD).

Method: This dissertation is composed of two studies. The first study was a systematic mapping review of peer-reviewed literature relevant to EAATs for children with ASD. In conjunction with my research team, I gathered peer-reviewed literature pertaining to EAATs for children with ASD, and extracted information from each paper about scientific methods, participants, interventions, theory, and outcomes. Guided by the results of the first study, the second study was a mixed-method investigation of occupational therapy in an equine environment (OT^{ee}). The quantitative strand consisted of a multiple-baseline single-case experimental design, investigating the efficacy of OT^{ee} on occupational performance, behavior, and social functioning of eight children with ASD. The qualitative strand adopted a generic qualitative research approach; I conducted interviews with two occupational therapists, aimed at elucidating the theoretical rationale guiding OT^{ee} for children with ASD.

Results: In the systematic mapping review, five types of equine-assisted activities were identified across 25 studies, with reported improvements in behavior, social interaction, and communication. Four types of equine-assisted therapies were identified across eight studies, with reported improvements in motor control and self-care. Different approaches to therapeutic

riding and hippotherapy, the most studied interventions, were evident. Theoretical linkages among change mechanisms, intervention designs incorporating horses, and outcomes were rare. Explanatory formal theories and possible change mechanisms were more prevalent. Guided by findings, we propose that a) equine movement, manipulated by a therapist, challenges and improves postural control, and that an equine-assisted activity or therapy can, b) promote engagement, a platform for social development, and c) provide structured support for social interaction and positively reinforce communication. While promising, these three nascent theoretical frameworks merit further critique, testing and refinement.

In study 2, children with ASD who received 10 weeks of OT^{ee} demonstrated improvements in individualized occupational performance goals, social communication, and social motivation. Some, but not all, participants also demonstrated a decrease in hyperactive and irritable behaviors. Children did not demonstrate significant changes in social cognition, social awareness, or restricted and repetitive behaviors. Occupational therapists portrayed OT^{ee} as a holistic intervention that provides children with opportunities to learn and practice a variety of skills within a motivating context where children are purposefully engaged in equine-related occupations. Derived from interview data, a concept map of therapists' clinical reasoning delineates hypothesized mechanisms of change, including the role of the horse, that lead to improvements in the following outcomes: a) cognitive skills, b) motor skills, c) attention and engagement during therapy, d) social interaction, e) communication, f) behavior, and g) safety. Qualitative results elucidated specific mechanisms and intervention components that may have led to improved occupational performance, behavior, and social functioning in the quantitative strand.

Conclusion: Peer-reviewed literature pertaining to EAATs for children with ASD is in early stages of scientific and theoretical development. Promising outcomes support continued investigation focused on conceptual development and testing of theoretical frameworks, standardization, appropriateness, and efficacy. One type of EAAT, OT^{ee}, is a highly individualized intervention that requires clinical reasoning to incorporate the unique affordances of the equine environment into individualized occupational therapy; when tailored to the individual needs of children with ASD, OT^{ee} may improve occupational performance, hyperactivity, irritability, social communication, and social motivation.

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DEDICATION

I dedicate this dissertation to my loving husband, Cole Peters.

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DEFINITION OF KEY TERMS

1. Autism spectrum disorder (ASD): A developmental disability marked by restricted and repetitive behaviors and deficits in social interaction and social communication (American Psychiatric Association, 2013).
2. ASD community: The ASD community includes all people affected by autism, such as individuals diagnosed with ASD, as well as their families, caregivers, advocates, and service providers.
3. Equine-assisted intervention: Interventions that incorporate horses and the equine environment in order to promote the health and well-being of individuals with a variety of health conditions. Equine-assisted interventions are often categorized into equine-assisted activities and equine-assisted therapies.
4. Equine-assisted activities and therapies (EAATs): This term is used to describe the industry as a whole.
 - a. Equine-assisted activity (EAA): “Equine-assisted activities are any specific center activity, e.g. therapeutic riding, mounted or ground activities, grooming and stable management, shows, parades, demonstrations, etc., in which the center’s clients, participants, volunteers, instructors and equines are involved” (Professional Association of Therapeutic Horsemanship International, 2017b).
 - b. Equine-assisted therapy: “Equine-assisted therapy is treatment that incorporates equine activities and/or the equine environment. Rehabilitative goals are related to the patient’s needs and the medical professional’s standards of practice” (Professional Association of Therapeutic Horsemanship International, 2017b).

The most common distinction between EAA and EAT is that the latter must be provided by a credentialed health professional.

5. Therapeutic riding (TR): “Therapeutic riding is an equine-assisted activity for the purpose of contributing positively to the cognitive, physical, emotional and social well-being of individuals with special needs” (Professional Association of Therapeutic Horsemanship International, 2017b). Therapeutic riding is typically provided by a certified riding instructor, and focuses on teaching riding and horsemanship skills to individuals with a variety of health conditions.
6. Hippotherapy (HPOT): “The term hippotherapy refers to how occupational therapy, physical therapy, and speech-language pathology professionals use evidence-based practice and clinical reasoning in the purposeful manipulation of equine movement to engage sensory, neuromotor, and cognitive systems to achieve functional outcomes. In conjunction with the affordances of the equine environment and other treatment strategies, hippotherapy is part of a patient's integrated plan of care” (American Hippotherapy Association, 2017).

Hippotherapy is a single treatment strategy, integrated into a more comprehensive professional service, such as occupational therapy in an equine environment.
7. Occupational Therapy in an Equine Environment (OT^{ee}): The integration of horses and the equine environment into occupational therapy practice. OT^{ee} often incorporates the treatment strategy of hippotherapy—the manipulation of equine movement to affect functional outcomes. However, OT^{ee} is broader in that it includes all therapeutic activities occurring with the use of the horse and the equine environment. This term has not yet been published in peer-reviewed literature, and was coined by my adviser Dr. Wendy Wood. I chose to use the term OT^{ee} in order to re-affirm that the intervention is first and foremost occupational

therapy, and horses are incorporated in order to help achieve the client's occupation-focused goals.

CHAPTER ONE: INTRODUCTION

Statement of the Problem

Autism spectrum disorder (ASD) is a developmental disability marked by restricted and repetitive behaviors and impairments in social communication. It is estimated that one in 68 children under the age of eight in the United States has ASD (Centers for Disease Control and Prevention, 2014). In 2013, the American Psychological Association established new criteria for the diagnosis of ASD (American Psychiatric Association, 2013). First, ASD is characterized by deficits in social interaction and social communication, specifically, deficits in the domains of social-emotional reciprocity, nonverbal communicative behaviors, and relationships. The second diagnostic criterion is the existence of restricted or repetitive behaviors, specifically, stereotyped movements, insistence on sameness, restricted interests, and unusual responses to sensory input. While these hallmark characteristics suggest a certain level of homogeneity of symptoms, autism is a spectrum disorder, meaning there is vast variability of symptoms across individuals with ASD. The extent and nature of the deficits, that is, how the hallmark characteristics of ASD are manifested in each individual's daily life, is quite heterogeneous (Jones & Klin, 2009). Across the heterogeneity, many aspects of a child's functioning are impaired, including motor, sensory, behavioral, communicative, and social functioning. Deficits in these domains cumulatively affect a child's ability to participate in developmentally appropriate occupations.

Equine-assisted activities and therapies (EAATs), which incorporate horses and the equine environment into interventions to promote health and well-being, are becoming increasingly popular for individuals with ASD; in fact, 10% of parents identify that their child with ASD has participated in an EAAT (Lindly, Thorburn, Heisler, Reyes, & Zuckerman, 2017).

However, there are many questions individuals with ASD and their families must consider: which types of EAATs are best suited for individuals with ASD? For whom on the autism spectrum are these interventions appropriate? What types of outcomes might these interventions promote?

Empirical research can help to answer these questions and more. However, although EAATs have been used as treatment strategies since the mid twentieth century (Scott, 2005), to the best of my knowledge the first study investigating their use for people with ASD was published in 2003 (Candler, 2003), indicating that empirical development of these common interventions is relatively new. Therefore, there is a need for further empirical investigation into EAATs for individuals with ASD, in order to guide the practitioners that deliver the interventions, as well as the decisions of families affected by ASD who choose to participate in them.

Purpose of the Dissertation

The overarching purpose of this dissertation is to systematically map, and then advance, the state of scientific and theoretical development of equine-assisted activities and therapies for children with ASD.

Structure of the Dissertation

This dissertation is composed of two large studies that will result in four manuscripts. The first study is a systematic mapping review of EAATs for children with ASD that has resulted in two manuscripts. Chapter 2 contains the first manuscript, which synthesizes the current state of scientific development by reporting on the interventions, participants, outcomes, and methods found in peer-reviewed research on EAATs for children with ASD. This manuscript was recently published in the *Journal of Autism and Developmental Disorders* (McDaniel-Peters & Wood,

2017). Chapter 3 contains the second manuscript, which synthesizes the current state of theoretical development of peer-reviewed literature on EAATs for children with autism. This manuscript was recently submitted to a peer-reviewed journal.

The second study in this dissertation is a convergent parallel mixed-methods investigation of occupational therapy in an equine environment (OT^{ee}) for children with ASD. As illustrated in Figure 1.1, in convergent parallel mixed-methods designs, the quantitative and qualitative strands occur concurrently, but data for each strand are collected and analyzed separately from one another (Creswell & Plano-Clark, 2011). After data have been collected and analyzed, the results of each strand are compared or related to one another, to allow for an overall interpretation. In the quantitative stand, I investigated the occupational, social, and behavioral outcomes of OT^{ee} for children with ASD: Chapter Four contains a manuscript that reports the results of the quantitative strand, which will soon be submitted to a peer-reviewed journal. In the qualitative strand, I aimed to conceptually develop the theoretical framework guiding OT^{ee}; Chapter Five presents preliminary results from the qualitative strand, which will be further developed into a fourth manuscript in the future. In the final chapter of my dissertation, I will (a) describe how the findings of each of these manuscripts relate to one another, (b) integrate the quantitative and qualitative findings of the second study, (c) situate my research in relation to occupation and rehabilitation science, and (d) offer personal reflections on what I have learned throughout my doctoral program.

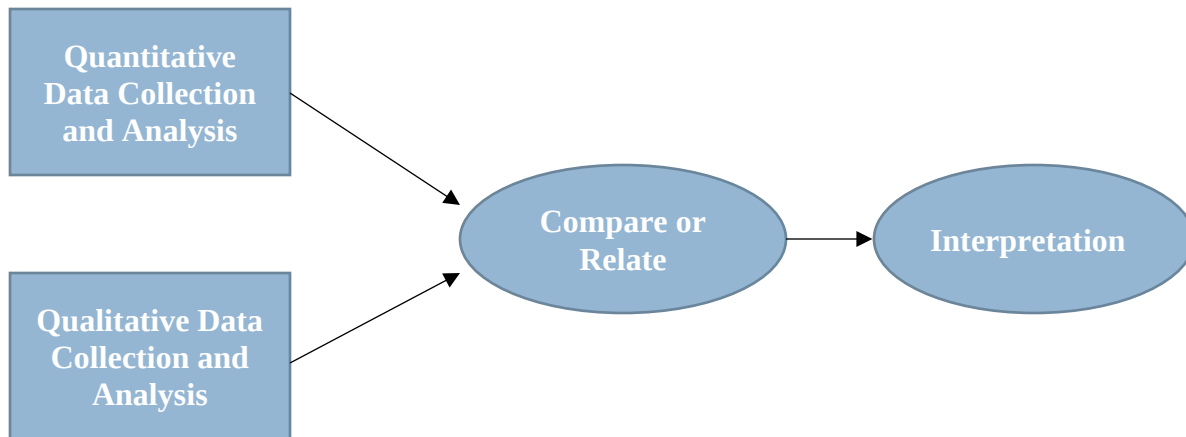


Figure 1.1. Illustration of the convergent parallel mixed-methods design. Adapted from *Designing and Conducting Mixed Methods Research* (p. 69) by J.W. Creswell and V.L. Plano-Clark, 2011, Los Angeles, California: SAGE Publications.

Conceptual Framework of the Dissertation

Figure 1.2 below provides a conceptual framework for how these four papers relate to one another. The first two manuscripts resulted from a large systematic mapping review of EAATs for individuals with ASD. Manuscript 1 demonstrated the need for systematic tracks of research, and illustrated a gap in the research related to social functioning and behavior as outcomes of equine-assisted therapies for children with ASD. Manuscript 2 demonstrated the need for further conceptual development of theories of change for specific EAATs for children with ASD. To address these two critical needs, I designed and conducted a mixed-methods investigation of OT^{ee} for children with ASD. Manuscript 3, the quantitative strand, addresses the need for research on social-behavioral outcomes of equine-assisted therapy. A future Manuscript 4, the qualitative strand, will address the need for further theoretical development.

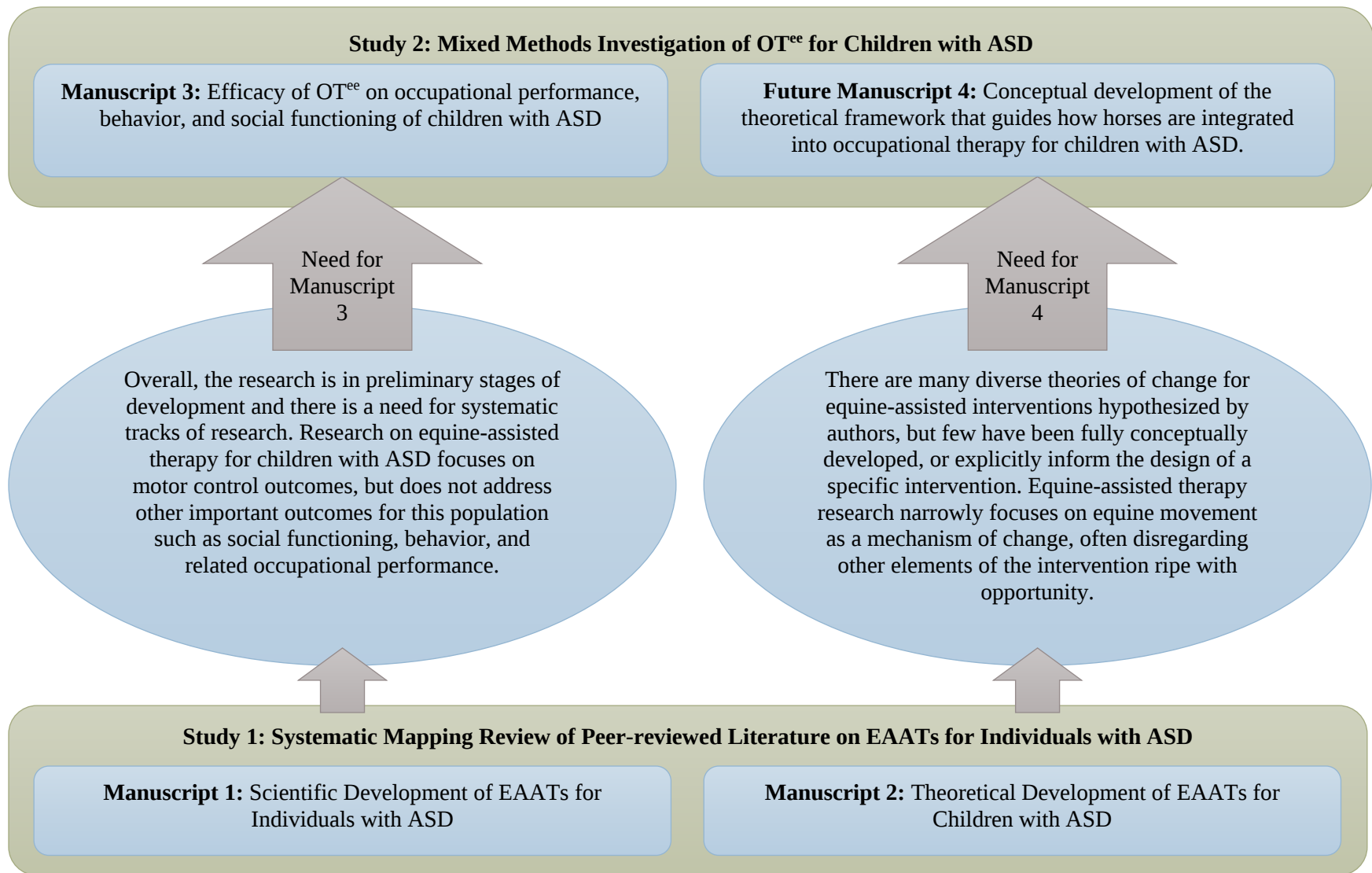


Figure 1.2. Conceptual framework of the relationships among the four manuscripts included in this dissertation. ASD = autism spectrum disorders; EAATs = equine-assisted activities and therapies; OT^{ee} = occupational therapy in an equine environment

Paradigm Positioning

Historically, paradigms of inquiry often associated with quantitative research (positivism and post-positivism), have claimed that a single, universal truth exists that can be approximated through objective research methods. On the other end of the spectrum, paradigms such as constructivism and interpretivism that often underpin qualitative inquiry have claimed there is no single reality; there are multiple subjective realities constructed by individuals' experience (Guba & Lincoln, 1994). These paradigms seem contradictory, thus making it difficult for mixed methods researchers who use both quantitative and qualitative methods to situate their research within a single paradigm. Pragmatism offers an alternative perspective that does not focus as heavily on ontological assertions about the nature of reality, so much as the problem to be studied and the practical consequences of the research (Feilzer, 2010).

Pragmatists believe that there is a socially constructed false dichotomy between objective and subjective realities; instead they believe reality has multiple layers some of which can be objective, subjective, or both (Feilzer, 2010). As Morgan (2014) wrote, "ontological arguments about either the nature of the outside world or the world of our conceptions are just discussions about two sides of the same coin" (p. 1048). Furthermore, while pragmatists do not reject the idea that a "true reality" may exist, they question how it is we will know when we have uncovered it (Cherryholmes, 1992).

Rather than attempting to characterize or uncover reality, pragmatists posit that we focus our questions on utility. James (1907/1981) wrote, "The pragmatic method... is to try to interpret each notion by tracing its respective practical consequences. What difference would it practically make if this notion rather than that notion were true?" (p. 27). Therefore, the process of inquiry involves recognizing a problem, proposing a solution that is likely to have the desired

consequences, and then taking action (Morgan, 2014). This focus on utility invites a variety of methodological approaches; investigators ought to choose their approach based on its ability to answer the question at hand. Cherryholmes (1992) explains, “pragmatists choose some explanations or theories or stories and dismiss others when the former produce results they desire better than the latter... our choice simply means that one approach is better than another at producing anticipated or desired outcomes” (p. 15). Therefore, pragmatism as a paradigm of inquiry can support quantitative, qualitative, or mixed-methods approaches depending on the research question(s) of interest. The following sections explore how pragmatism as a paradigm of inquiry has guided this dissertation.

Practical Solutions to Important Problems

Several scholars have contributed to the development of pragmatism, and thus, there are many versions of pragmatism. An exploration of the different “flavors” of pragmatism and their respective impact on the conduct of research is beyond the scope of this dissertation; for the sake of this dissertation, I will draw primarily on Deweyan pragmatism, largely developed by John Dewey and expanded upon more recently by contemporary scholars. Dewey proposed an approach to inquiry that contains five steps, summarized by Morgan (2014) as:

1) Recognizing a situation as problematic; 2) Considering the difference it makes to define the problem one way rather than another; 3) Developing a possible line of action as a response to the problem; 4) Evaluating potential actions in terms of their likely consequences; 5) Taking actions that are felt to be likely to address the problematic situation. (p. 1047)

Both studies that constitute this dissertation address the overall problem that the empirical development of EAATs for children with autism is still in preliminary stages of development, and therefore does not yet offer strong evidence of effectiveness. There are an abundance of treatment options for children with ASD, and families often spend much of their time taking their child to various therapies. Therefore, it is important that the interventions families choose to

pursue have empirical evidence supporting their effectiveness to ensure they are likely to benefit the child with ASD. The first study in this dissertation offers an important initial step in addressing this practical problem by mapping the current state of scientific and theoretical development of EAATs for children with ASD, in order to guide future practice and research. The quantitative strand of the second study begins to address this problem by producing initial evidence that OT^{ee} may improve occupational performance, behavior, and social functioning. The qualitative strand of the second study aims to develop the theoretical framework supporting OT^{ee}, in order to refine and eventually manualize the intervention. Our research team chose to conduct each of these studies because of the practical consequences they would produce, in line with pragmatism's emphasis on utility.

Belief-action Cycle

A central pragmatic concept is the belief-action cycle, which posits that one's beliefs shape one's actions, and in turn, one's actions shape one's beliefs; this belief-action cycle continuously occurs within the context of human experience (Morgan, 2014). The belief-action cycle has many consequences for the conduct of my dissertation research. First, I am aware that my beliefs as a researcher will directly shape my research actions. Therefore, I have included in this introductory chapter a section on my perspective, in order to position myself in relation to this research.

Also in line with the belief-action cycle, I strongly believe that the beliefs of the providers who deliver EAATs will shape how the intervention is delivered and therefore what outcomes are achieved; this assumption has shaped both of the studies in this dissertation. In the first manuscript, we intentionally reported data about the background of the providers that delivered each intervention. In the second manuscript, we thoroughly described the theoretical

explanations put forward by the authors of each paper, as we believe these theoretical understandings of each intervention are essential to their future development and refinement. Finally, in the qualitative strand of the mixed-methods investigation of OT^{ee}, I interviewed the occupational therapists who provided the intervention in order to gain a deep understanding of how their beliefs shaped the delivery of the intervention, therefore contributing to the theoretical framework of OT^{ee}.

Transactional Understanding of Human Experience

A central concern within Deweyan pragmatism is human experience. Maxcy (2003) wrote, “The main features of sound inquiry method began and ended in experience for Dewey” (p. 70). Dewey had a holistic understanding of human experience; he claimed that experiences can be intellectual, emotional, and purposeful, “yet the experience [is] not a sum of these different characters; they [are] lost in it as distinctive traits” (p. 556). In other words, experiences cannot be broken down into separate parts, but rather are marked by unity and wholeness. Later in his life, Dewey worked with Arthur Bentley to integrate these concepts into a view of “transaction,” which claims that people and the worlds they live in are not separate, independent entities; rather, they are part of one another, a concept expressed as “organism-in-environment-as-a-whole” (Bentley & Dewey, 1949, p. 109). More recently in the realm of occupational science, these Deweyan concepts have been further explored and expounded upon in relation to occupation. Dickie, Cutchin, and Humphry (2006) claimed that “occupation can be viewed as a transaction joining person and situation” (p. 90). In other words, people and their environments are inextricably a part of one another, and *occupation* (i.e., purposeful doing) is the element that brings the two together; the things that people *do* in their environment, the affordances the

environment offers for *doing*, and how *doing* shapes both the person and the environment, provide a means of understanding the person-environment relationship.

This transactional understanding of experience drives my interest in developing the theory of change of OT^{ee}. At the time I designed the second study, current research on equine-assisted therapies emphasized manipulation of equine movement to target sensorimotor development as the essential component of the intervention that led to improved motor control. Yet, this reductionist understanding diminished the experience of OT^{ee} into just one of its component parts, without recognizing that OT^{ee} can be inherently social and emotional as well. Furthermore, this understanding implied a dualistic view of humans and their environments, whereby the horse is an independent entity that affects the child. This view neglected the transactional nature of a complex intervention whereby the child, the horse, the provider, and various other elements of the equine environment continually transact with one another through occupation; from this transaction emerges an individualized and ever-changing intervention. In developing the theory of change of OT^{ee}, I hope to capture the nature of OT^{ee} as an intervention that is emergent from complex transactions within the equine environment, resulting in a holistic experience that is simultaneously physical, social, and emotional in nature.

Researcher's Perspective

My interest in ASD began as an undergraduate student studying psychology, where I was intellectually captivated by the many mysteries we do not yet understand about ASD. Soon after, I began volunteering as a respite care provider for children with developmental disabilities, which gave autism a face and a name; my intellectual curiosity transformed into a personal passion as I witnessed the unique challenges, strengths, setbacks, and triumphs of children with ASD and their families. As a student of occupational therapy, I had the opportunity to join a

research team investigating EAATs for all populations; in searching for a niche of this research that could be my own, the choice to focus on individuals with ASD was easy. Therefore, since 2013, my graduate research has focused on EAATs for children and adolescents with ASD.

Given my pragmatic philosophy, and having witnessed the everyday challenges of individuals with ASD and their families, I am passionate about conducting applied research that can offer immediate benefits to the ASD community. I believe EAATs have the potential to benefit children with ASD because they engage the child in developmentally appropriate activities that can be structured and graded to accommodate each child's individualized needs. Furthermore, horses can often be highly motivating for children, therefore capturing the child's attention and eliciting active engagement in the activity. Finally, horseback riding can be an inherently physical, sensory, and social activity, and therefore may promote the child's development in each of these domains. In other words, as an occupational therapist, I strongly believe that the activities people engage in to occupy their time directly affect their health and well-being; considering the unique nature of horseback riding described above, I believe it has the potential to promote the development and general well-being of individuals with ASD.

CHAPTER TWO: AUTISM AND EQUINE-ASSISTED INTERVENTIONS: A SYSTEMATIC MAPPING REVIEW¹

This paper reports on a systematic mapping review of peer-reviewed literature on equine-assisted interventions for individuals characterized as having ASD published over 35 years, from 1980 through 2015. Because only 9% of included studies confirmed that their respective research participants had diagnoses of autism spectrum disorder (ASD), findings reported herein may or may not generalize to individuals with true ASD. This limitation noted, the comprehensive map of equine-assisted interventions portrayed as relevant and beneficial to individuals with ASD generated through this systematic mapping review appears both needed and timely.

Preliminary evidence suggests that equine-assisted interventions for people with ASD are promising. A systematic review found preliminary proof of concept for animal-assisted interventions, or interventions that incorporate animals in therapeutic activities (Animal Assisted Intervention International, 2013), for individuals with autism spectrum disorders (ASD) (O’Haire, 2017). While most of the 28 studies in the review had methodological weaknesses, they collectively offered evidence that people with ASD who participate in animal-assisted interventions may experience improvements in social interaction, positive emotions, stress, communication, and motor skills. Horses were incorporated in 12 of the 28 studies on animal-

¹ McDaniel-Peters, B.C., & Wood, W. (2017). Autism and equine-assisted interventions: A systematic mapping review. *Journal of Autism and Developmental Disorders*, 42(10), 3220-3242.

assisted interventions, suggesting that opportunities for beneficial experiences with horses may appeal to people with ASD, their families and caregivers.

Other indicators likewise suggest that equine-assisted interventions for individuals with ASD are growing in popular appeal. Indeed, popular culture has promoted the idea that horses have a healing power for people with ASD. For instance, a popular film portrayed the transformative impact of horses on Temple Grandin (Bellows et al., 2010), presumably the world's most famous person with ASD. In like fashion, a 2015 story in a national newspaper on therapeutic riding (TR) and ASD reported that “parents and caretakers are almost unanimous: There's something about horses. The relationships and bonds that the children form with the animals can be transformative” (Mellen, 2015). The Professional Association of Therapeutic Horsemanship International (2015; PATH, Intl) has also reported that people with ASD are more frequently served by its affiliated centers than any other group. Yet because no single equine-assisted intervention exists, there is a need to educate consumers about the respective emphases, benefits, and limitations of distinct interventions.

The industry of equine-assisted activities and therapies (EAAT) recognizes two broad categories of interventions: equine-assisted activities (EAAs) and equine-assisted therapies (EATs). PATH, Intl (2017) defines EAAs as specific activities in which the clients, volunteers, instructors and horses of particular equine centers are involved. For example, different types of EAAs include, among others, TR, equine-assisted learning, therapeutic vaulting, stable management, or the use of ground activities such as tacking or grooming horses. A widely recognized distinction among EAAs and EATs is that credentialed health professionals provide the latter. Occupational therapists, physical therapists, and speech and language therapists commonly provide the EAT of hippotherapy (HPOT), whereas psychologists, social workers and

other mental health professionals commonly provide the EATs of equine-assisted psychotherapy or counseling (American Hippotherapy Association, 2017; Professional Association of Therapeutic Horsemanship International, 2017b). Across different types of EATs, health professionals incorporate horses in ways that help to meet the goals and needs of clients in accord with the practice standards of their specific professions. The industry of EAAT accordingly encompasses a diverse range of interventions, and new approaches specific to ASD are emerging (e.g. Isaacson, 2009).

Broadly speaking, equine-assisted interventions can be considered complex interventions. As defined by Craig et al. (2008), complex interventions are comprised of several different components and target a wide array of outcomes. Developing and evaluating complex interventions is no easy task; researchers must consider what components are key ingredients that lead to change, what outcomes to measure, how to best measure them, and feasibility of implementation. Furthermore, researchers investigating interventions for individuals with ASD must bear in mind the heterogeneity of ASD symptoms across individuals, the need for individualized treatment, and the fact that most individuals with ASD participate in multiple pharmacological and psychosocial interventions concurrently (Lord et al., 2005). In view of these methodological challenges, a working group organized by the National Institute of Mental Health proposed that no single research design is ideal for studies of psychosocial interventions for people with ASD (T. Smith et al., 2007). This group accordingly developed a framework of four phases of research that include formulation, manualization, efficacy testing, and effectiveness testing and associated each phase with ideal research designs.

The current systematic mapping review addresses several gaps in the literature on equine-assisted interventions for ASD. Our initial literature review suggested that scholarly interest in

ASD and EAAT emerged in the 1980s. To our knowledge, however, peer-reviewed literature dating to and since the 1980s had yet to be comprehensively gathered, categorized, described, and synthesized. Previous reviews have also not described key distinctions among the equine-assisted interventions to which people with ASD are drawn (e.g., Mapes & Rosén, 2016; O’Haire, 2017). Nor has the state of scientific development of equine-assisted interventions been described in a manner that considers how complex psychosocial interventions for people with ASD are best empirically developed. We therefore conducted a systematic mapping review in order to develop a comprehensive ‘map’ of three decades of peer-reviewed literature that could help guide future practice and research pertaining to equine-assisted interventions for people with ASD. The review had three specific aims:

1. Describe people with ASD who have participated in equine-assisted interventions.
2. Describe the characteristics of specific equine-assisted interventions for ASD, including their respective a) prevalence in the literature, b) classification as EAA or EAT, c) intervention components, and d) therapeutic goals and measured outcomes.
3. Summarize the state of scientific development of equine-assisted interventions for ASD as evidenced by each paper’s respective research design.

Method

Systematic mapping reviews are one of 14 types of reviews in the family of systematic review research (Grant & Booth, 2009; Hammick, 2005). Because the broad scope of systematic mapping reviews allows for inclusion of research reports at varying levels of rigor, systematic mapping reviews are a review method of choice when a focused area of inquiry is in early scientific development. While systematic mapping reviews do not involve formal assessments of the quality of research, they can be an important first step in helping to develop evidence-based

practices (Grant & Booth, 2009). Systematic mapping reviews involve the application of three filters to gather, select and extract relevant information from the literature, as next described.

Filter One: Search Procedure

A library scientist constructed and executed comprehensive searches in the following nine databases to serve multiple projects related to EAAT for all populations: CAB Abstracts (EBSCO), CINAHL (EBSCO), PsycINFO (EBSCO), PubMed (NCBI), Social Sciences Abstracts (EBSCO), Social Services Abstracts (ProQuest), Social Work Abstracts (EBSCO), SPORTDiscus (EBSCO), and Web of Science (Thomson Reuters). To allow for ongoing analyses and increase the likelihood that papers published in 2015 would be located, three searches were run across all nine databases, and the final search was completed in fall 2016. The search strategy was adapted for each database, and included more than 45 search criteria to retrieve papers related to EAAT. The searches were restricted to retrieval of English language articles published between 1980 and 2015 and, when facilitated by the given database, to retrieve specifically peer-reviewed journal articles. Unique results resulting from all three database searches were aggregated in one EndNote library for screening. EndNote allows for organization and management of references in review research (King, Hooper, & Wood, 2011).

Filter Two: Inclusion and Exclusion

Unique results were reviewed for inclusion and exclusion in two phases. In *phase one*, we developed inclusion and exclusion criteria to capture original peer-reviewed papers that were published in English from 1980 to 2015, and primarily focused on equine-assisted interventions for all populations. Three reviewers blindly assessed 20% of all sources that had been retrieved during the first search, achieving 95% agreement on their decisions for inclusion or exclusion. These reviewers then independently assessed remaining papers from the first search for inclusion

and exclusion. This process was repeated for records located in the two subsequent searches. The three searches resulted in 2,245 unique records. After reviewers had applied inclusion and exclusion criteria to all unique records, they then searched the reference lists of included papers for other relevant articles, finding 176 additional unique records. After this first phase of review, 397 papers remained from 2,421 unique records that had been identified through database searches and manual reference list searching. In *phase two*, the first author further reduced this set of 397 papers by applying two additional exclusion criteria. First, in original research papers, 20% or more of participants had to be characterized as having ASD, a pervasive developmental disorder (PDD) or Asperger Syndrome (AS). Of note, to be included in this review papers did not need to independently confirm the diagnosis of participants. Second, in non-research papers, individuals with ASD, PDD, or AS had to be identified as a population served by equine-assisted interventions. Application of these criteria further narrowed the database to 54 papers, which included 33 original research reports and 21 conceptual and descriptive papers. To address the specific aims of this manuscript, we extracted data only from the 33 research reports, which are herein referred to as studies.

Filter Three: Data Extraction.

Following standard protocol for systematic mapping reviews (Hammick, Dornan, & Steinert, 2010), a data extraction tool (DET) was developed to guide extraction of information from each paper.

Related to *Aim 1*, the DET guided extraction of information pertaining to the ages, diagnoses, gender, race and ethnicity of participants in equine-assisted interventions, as well as assessment tools used to describe participants.

Related to *Aim 2*, the DET guided extraction of information pertaining to characteristics of equine-assisted interventions, beginning with the type of intervention that was the primary focus of each paper. The DET guided reviewers to adopt the exact terminology that the author(s) had employed to describe the intervention that had been the focus of study (e.g., TR, HPOT). The DET also provided guidelines for classifying interventions as either EAAs or EATs. Related to specific interventions, the DET guided extraction of information pertaining to doses, or the amount of an intervention used to bring about desired changes and outcomes (Melnyk & Morrison-Beedy, 2012). Doses were recorded as the length and number of sessions and overall duration of an intervention. In addition, the DET guided extraction of intervention pertaining to individualized participant goals and specific components that constituted the intervention package.

Also related to *Aim 2*, the DET guided extraction of information on measured outcomes; this information included authors' descriptors of outcomes, as well as methods used to measure outcomes such as standardized assessments, behavioral observations, surveys, or interviews. The DET additionally provided guidelines for sorting outcomes into three general categories. One category was influenced by the *International Classification of Function (ICF)* (World Health Organization, 2001; WHO). This category encompassed outcomes related to body functions, or "physiological functions of body systems," activity or "the execution of a task or action," and participation or "involvement in a life situation" (WHO, 2002, p. 10). Activity and participation, two levels of function in the ICF, were combined in the DET since sufficient detail to distinguish between them was rare. A second category captured outcomes related to *autism severity* as measured by ASD diagnostic tools or the Autism Treatment Evaluation Checklist. A third general category captured *other* measured outcomes that were not classified as ICF or

autism severity outcomes. Table 2.1 provides non-exhaustive examples of specific outcomes that were grouped into the general categories of the ICF and other. Lastly, to help identify promising interventions, and based solely on how the author(s) reported findings, the DET provided guidelines for sorting outcomes into three other general categories related to the nature of findings. The category of *statistically-significant finding* included desired or hypothesized positive outcomes, which the author(s) had described as statistically significant. The category of *other positive finding* included positive trends, which the author(s) had described as having possible clinical significance even though statistical significance had not been obtained or was not reported. The category of *negative finding* pertained to hypothesized outcomes, which the author(s) had indicated were unsupported statistically or were unrelated to clinical significance. The intention in using these three categories was to map reported outcomes as a basis for identifying promising interventions.

For Aim 3, the DET guided extraction of information pertaining to research methods, including broad classifications as quantitative, qualitative, or mixed methods and identification of specific research designs within these classifications. Based solely on their reported research methods, each paper was also classified into one of the four phases of research development for psychosocial interventions for people with ASD described by T. Smith et al. (2007). Phase one, “formulation and systematic application of a new intervention,” calls for experimental single-subject designs and between-group designs; phase two, “manualization and protocol development,” calls for multi-site pilot studies, surveys, and focus groups; phase three, “efficacy studies,” calls for randomized clinical trials; and phase four “community effectiveness studies,” calls for randomized clinical trials or other between-group designs (p. 357-358).

To support data extraction and analysis, a research consultant developed a customized database in Microsoft Access, a database management system. The consultant entered the finalized DET into this database, which also listed every included paper. This database made systematic extraction of data from included studies possible, as well as assessment of inter-rater reliability. The first author oversaw a training process that led to a minimum of 90% agreement on the use of the DET across six reviewers. Kappa coefficients also ranged from .65 - .74, likewise indicating substantial agreement. We repeatedly performed inter-rater reliability checks to guard against intra- and inter-rater drift.

After data were extracted, we used the Microsoft Access query tool to analyze items on the DET and intersections among them that pertained to the study's aims. We then imported query results into Microsoft Excel for further analyses using Excel's pivot table tool, which allows for summarization of large, detailed data sets. We created pivot tables to accomplish each research aim, producing descriptive statistics of frequency counts and proportions.

Results

As previously noted, from 2,421 unique records identified through database and manual reference searches, 33 research reports, or studies, were analyzed to address three specific aims. While the search dated to 1980, the earliest study was published in 2003, suggesting that empirical investigation of equine-assisted interventions for people with ASD began relatively recently. Since 2003, studies have been published in 25 different journals representing 12 countries. Figure 1 illustrates the distribution of the studies across the broad classifications of EATs and EAAs, and the proportion of studies that included only individuals with ASD, AS, or PDD. Detailed findings related to each specific aim are next presented.

Aim 1: Participants with ASD in Equine-assisted Interventions

Table 2.2 summarizes findings related to Aim 1. In 25 of the 33 studies (76%), all participants were characterized as having ASD, AS, or PDD; in six studies (18%), participants had a variety of diagnoses; in two studies (6%), typically developing children were included, either as part of the intervention (Erdman, Miller, & Jacobson, 2015) or as a control group (Chen, Crews, Mundt, & Ringenbach, 2015). Only 11 studies (33%) used a standardized assessment of hallmark autism characteristics, either to characterize the participants (Table 2.2) or as an outcome measure (Table 5). Only three studies (9%) required participants to meet clinical cut-offs on a standardized assessment of ASD characteristics to be included in the study (Gabriels et al., 2012; Gabriels et al., 2015; Kern et al., 2011). Therefore, 30 studies (91%) did not independently confirm the diagnosis of research participants before they were included in the study, and 22 studies (67%) did not use any standardized assessment of ASD at all.

Research participants characterized as having ASD, AS or PDD ranged in age from two to 16 years old, indicating a scientific focus on children and younger adolescents. Thirty of the 33 studies (91%) identified the gender of participants with ASD, AS, or PDD; across these studies, 78% of all participants were male. Only four of the 33 studies (12%) reported the race or ethnicity of participants (Gabriels et al., 2015; Kern et al., 2011; Page, 2014; Zabriskie, Lundberg, & Groff, 2005). While participants in these studies were predominantly Caucasian, they also included participants who were African American, American Indian, Asian, Hispanic, or multiracial. Only eight of the 33 studies (24%) described participants using a standardized assessment tool that was not also an outcome measure, the most common of which was the Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988).

Aim 2: Characteristics of Equine-assisted Interventions

Table 2.3 provides the types of equine-assisted interventions found in the research along with their respective abbreviations, and Table 2.4 provides detailed information on characteristics of each intervention.

Types of Equine-assisted Interventions. Twenty-four studies collectively investigated the following five complex equine-assisted interventions classified as EAAs: TR, *psychoeducational horseback riding* (PER), a *community-based therapeutic recreation* (CTR) program, an *equine-facilitated learning* (EFL) program, and a *riding for the disabled* (RDA) program. In addition, one study investigated a single common component of EAAs, *grooming the horse* (GRM). Twenty of the 25 EAA studies (80%) identified providers of interventions, but rationales underlying the selection of particular providers were not thoroughly developed.

TR commanded the most scientific attention overall and also internationally. Seventeen studies of TR were conducted in Hungary, Iran, the United States, South Africa, and South Korea; these studies collectively comprised 52% of all 33 included studies, and 68% of the 25 studies of various EAAs. Variations in interventions called TR were evident across these studies, especially related to their designations of providers, dosages, and comparative emphases on riding and horsemanship skills (as later developed). With respect to providers, 11 of the 17 studies (65%) of TR described providers as therapeutic riding instructors or as a ‘trained’ or ‘riding’ instructor; four other studies described providers as a therapist, coach, or trainer. While the average duration of the TR programs was about 12 weeks ($M = 11.80$, $SD = 7.56$), these programs ranged from one to 30 weeks.

Four studies investigated PER, one of which was based in Portugal while the other three were based in Japan. Across these four studies, PER was described as an autism-specific

intervention that aimed to enhance the motor, cognitive and emotional development of children with ASD and PDD. Durations of PER ranged from one month to seven years. One study each investigated the CTR program, the RDA program, and the GRM component in the United States. The *CTR program* involved horseback riding, as well as skiing, and ranged from three to five weeks in duration; there were 37 participants in the horseback riding program (Table 2.2). The *RDA program* was designed to give children with disabilities choices and control through horseback riding. While the program's duration was unspecified, data were collected over six sessions. Lastly, one study investigated an *EFL program* in New Zealand. This intervention emphasized teaching social interaction skills through groundwork activities; it paired each child with ASD with a typically-developing peer for a 10-week intervention period.

Eight studies collectively investigated four complex interventions classified as EATs. These interventions included *hippotherapy* (HPOT), a *short-term equine-assisted therapy* (ST-EAT), a *simulated developmental horse-riding* (SDHR) program, and an intervention named simply equine-assisted therapy, which we termed *EAT-unspecified* to distinguish it from other types of EATs. Across these eight studies, providers were identified as occupational therapists, physical therapists, a therapeutic riding instructor, or as an otherwise unspecified therapist or specialist.

HPOT commanded the second greatest scientific attention overall. Five studies of HPOT were conducted in Australia, Spain, and the United States, collectively comprising 15% of all 33 included studies and establishing HPOT as the most studied EAT for ASD. In the study conducted in Spain, HPOT aimed to maximize the bond between the child and the horse (Tabares et al. 2012). In contrast, in the two studies conducted in the United States (Ajzenman, Standeven & Shurtleff, 2013; Silkwood-Sherer et al., 2012) and the one study conducted in

Australia (Liddiard, 2009), HPOT was described as a treatment strategy during which occupational therapists, physical therapists and speech and language pathologists manipulated equine movement. Across all five studies, actual providers of HPOT included occupational therapists, physical therapists, and a specialist. While Liddiard (2009) explicitly linked the disciplinary perspective of occupational therapy to the design of the HPOT intervention, rationales for selections of providers were not thoroughly developed in the other four studies. Among three of the five HPOT studies (60%), HPOT was described as involving providers' deliberate manipulation of the horse's movement aimed at improving motor outcomes such as posture, movement, or balance (Ajzenman, Standeven, & Shurtleff, 2013; Liddiard, 2009; Silkwood-Sherer, Killian, Long, & Martin, 2012). The remaining two studies focused on improved volition (Taylor et al., 2009) or hormonal changes indicative of social attitudes (Tabares et al., 2012) as outcomes of HPOT. HPOT interventions averaged around 10 weeks in duration ($M = 9.6$, $SD = 4.27$) and ranged from one to four months.

The three remaining types of EATs were investigated in one study each. ST-EAT was based on the belief that “simply being around the horse, grooming and working with the horse has a healing power” and can improve “motivation, self-esteem, better concentration and academic performance” (Memishevijk & Hodzhikj, p. 58-59); this intervention was provided over 10 weeks to children in special education schools in Sarajevo, Bosnia and Herzegovina. The SDHR program was developed in Taiwan as an ASD-specific intervention; it incorporated a mechanical horse in occupational therapy, was provided over 20 weeks, and aimed to improve motor proficiency and sensory integrative functioning. The intervention, EAT-unspecified, was studied in the United States. EAT was defined in this study as “a collective term for all types of therapeutic activities using horses [that] use riding as a tool in a therapeutic process” (Hawkins,

Ryan, Cory, & Donaldson, 2014, p. 136). This intervention was provided over five weeks to help improve gross motor skills.

Components of Equine-assisted Interventions. Table 4 lists the twelve most common intervention components, ordered by frequency from left to right, and shows which studies included each component. Thirty-two of the 33 studies (97%) described intervention components, yet at varying levels of detail. For example, one study of TR stated simply that the intervention included times for riding, grooming, equine education and barn care (Candler, 2003), whereas another study of TR used an entire page of text to describe mounting and dismounting, horsemanship activities, exercises, riding skills, and mounted games (Bass, Duchowny, & Llabre, 2009). Overall, strong emphases on mounted activities were evident. Thirty-one of the 33 studies (94%) identified riding the horse as an intervention component. Yet while mounted activities were commonplace, studies of EAAs had different emphases than studies of EATs.

Across the 25 studies of various EAAs, instruction in riding skills (e.g., proper posture on the horse, how to control the horse with verbal and nonverbal cues, how to sit or post a trot) and horsemanship skills (e.g., how to groom, tack, and lead the horse) were commonly identified as components of interventions. Specifically, teaching the child to groom the horse (13 studies; 52%), and steer the horse (10 studies; 40%) were common components of TR, PER, RDA, or EFL.

Also across these 25 studies of EAAs, interventions tended to emphasize activities that promoted communication and social interaction. Thirteen of these studies (52%) reported using group sessions so that children could together engage in activities during TR, PER, EFL, and the CTR, and RDA programs. Ten studies (40%) described social activities such as structured

interactions with side-walkers or playing social games like ‘Simon Says’ during TR, PER, and the EFL program. Nine studies (36%) likewise described various language activities like encouraging the child to direct the horse with verbal commands during TR, PER, and the RDA program. Lastly, seven of these 25 studies (28%) indicated that asking the child to respond to verbal cues or commands was integral to TR, PER, and the RDA program.

While several components of various EAAs were not described frequently enough to be included in Table 4, they bear reporting. Specifically, the EFL program emphasized the importance of groundwork activities, such as leading the horse through obstacles. One PER paper included back-riding as part of the intervention, where the instructor sat behind the participant on a bareback horse, providing additional physical and emotional support (Leitão, 2003). One paper investigated TR in context of a week-long day camp targeted at improving sensory processing (Candler, 2003). Finally, several TR and PER studies listed certain ASD-specific accommodations such as the use of visual schedules (Gabriels et al., 2015; Keino & Kawakita, 2010), ASD teaching techniques (Gabriels et al., 2015; García-Gómez, Risco, Rubio, Guerrero, & García-Peña, 2014), and communication devices that allowed the child to request the horse to ‘walk’ or ‘trot’ by pushing a button (Kern et al., 2011).

Across the eight studies of EATs, one study each of HPOT and EAT-unspecified described the use of individual sessions, wherein there was a 1:1 ratio between the provider and the child receiving therapy. Otherwise, group or individual sessions were not specified. Across all eight studies, however, providers’ uses and manipulation of the horse’s movement to challenge, stimulate and improve the child’s sensorimotor functioning constituted the most commonly described therapeutic approaches. Specifically, common components of HPOT, ST-EAT, the SDHR program, and EAT-unspecified included riding at different gaits such as

walking and trotting (5 papers; 63%), riding in different positions such as prone or quadruped (5 papers; 63%), mounted stretches and exercises such as rotating to reach for the horse's tail (5 studies; 63%), and ground courses such as weaving through cones and obstacles (4 studies; 50%). HPOT also included mounted activities unique to each paper, such as "writing with chalk on the horse's rump" (Liddiard, 2009, p. 80) or "interactive play and social activities" (Ajzenman et al., 2013, p. 655). Unlike the other interventions classified as EATs, two interventions included unmounted activities along with riding activities: the ST-EAT included grooming and groundwork components, and one HPOT intervention included grooming and tacking the horse (Tabares et al., 2012). Altogether, therefore, interventions classified as EATs most strongly emphasized sensorimotor functioning and various physical capacities.

Therapeutic Goals and Measured Outcomes. Among the 25 studies concerning EAAs, six (24%) referred to individualized participant goals, including five studies on TR, and one on the CTR program. Whether goals encompassed horsemanship and riding skills or distinct therapeutic objectives varied, however. For example, one study of TR listed examples of riding goals such as "student will learn to canter" (Holm et al., 2013, p. 938). Another study reported that activities used in TR were designed to address horsemanship skills, as well as therapeutic goals related to social, cognitive, physical, psychological, and social skills (Gabriels et al., 2012). With respect to measured outcomes, however, most were therapeutically oriented outcomes, and only one study measured improved horsemanship or riding skills.

Table 2.5 provides detailed information about measured outcomes. The most commonly coded specific measured outcome in the 25 studies concerning EAAs was *behavior* (11 studies; 44%), such as behaviors of the child while riding, aberrant behaviors, or parent-identified target behaviors. Among the eleven studies of TR or PER that measured behavior, nine (82%) reported

at least one aspect improved; specifically behaviors of the child while riding (e.g., emotional displays, stereotyped movements) and negative behaviors after the intervention (e.g., irritability, hyperactivity, and aggression). Behavior was most often measured through structured observations or the Aberrant Behavior Checklist- Community (ABC-C) (M.G. Aman, Singh, Steward, & Field, 1985).

The next most commonly measured outcomes in the 25 studies of EAAs pertained to *interpersonal interactions* (10 studies; 40%), which included development of social skills and improved relationships with family and friends, and *communication* (9 studies; 36%), which included receptive and expressive communication. Among the ten studies of TR or EFL that measured interpersonal interactions, nine (90%) reported improvements in one or more domains of interpersonal interaction, including adaptive social behaviors, mood and tone of parent-child interactions, social cognition, social communication, and overall social functioning. The most common outcome assessment used to measure interpersonal interaction was the Social Responsiveness Scale (SRS) (Constantino, 2012). Among the nine studies (89%) of TR or PER that measured communication, eight (89%) reported improvements in one or more domains of communication, such as adaptive communication behaviors and expressive verbal communication. Communication was most often measured through behavioral observations and the Vineland Adaptive Behavior Scale, Second Edition (VABS-II; Sparrow, Cicchetti, & Balla, 2006).

Also among the 25 studies of EAAs, *sensory processing* (7 studies; 28%), *control of voluntary movement* (6 studies; 24%), *autism severity* (4 studies; 16%), and *quality of life* (4 studies; 16%) were commonly measured outcomes. Among the seven studies of TR that measured sensory processing, five (71%) reported improvements. Sensory processing included

changes in sensory seeking behaviors, sensory registration, sensory sensitivity, multisensory processing, and other sub-domains of sensory processing, most commonly measured with the Sensory Profile (Dunn, 1999). Among the six studies of TR or PER that measured control of voluntary movement, four (67%) reported improvements. Control of voluntary movement was most often measured with the Bruininks-Osteretsky Test of Motor Proficiency, Second Edition (BOT-2) (Bruininks & Bruininks, 2005). Autism severity improved in all four studies of TR or PER that measured it, and was mostly assessed with the Gilliam Autism Rating Scale-2 (Gilliam, 2006). Finally, quality of life improved in all four studies of TR or the CTR program that measured it.

The eight studies of EATs emphasized outcomes related to movement and functional abilities (Table 5). Among the five studies (63%) that measured *control of voluntary movement*, all (100%) reported improvements after HPOT, EAT-unspecified, or the SDHR program. Control of voluntary movement referred to outcomes such as balance, postural control, and various gross and fine motor skills (e.g., running, jumping, and paper and pencil tasks). The two studies of HPOT that measured *self-care* outcomes (e.g., bathing, toileting, dressing) reported statistically-significant improvements.

While studies of EATs generally focused on motor-related outcomes, there were some exceptions. The study of ST-EAT, an intervention that had a strong psychosocial dimension, measured autism severity. One study of HPOT measured volition during play, while one other study of HPOT measured salivary cortisol and progesterone. All of these studies reported improvements in their respective outcomes. Of note, only the study of EAT-unspecified mentioned individualized goals for the child.

Altogether across the 33 studies, 114 outcomes were identified and organized into the general categories of ICF activity/participation (ICF-AP), ICF body functions (ICF-BF), autism severity, and other. Outcomes concerning activity/participation and body functions were most prevalent. Indeed 37% of outcomes were categorized as ICF-AP in comparison to 30% that were categorized as ICF-BF and 26% that were categorized as other. Only 7% of all outcomes were categorized as pertaining to autism severity. Furthermore, authors tended to report positive findings: 45% of all outcomes were reported to be statistically-significant; 22% were reported as otherwise positive findings (especially outcomes in single-subject design research); and 33% were reported as negative findings.

Lastly, in the sole study with qualitative findings, parents were interviewed and reported positive changes in their children after EFL, such as having “an easier time at school,” interacting “with peers much more,” and paying “attention to consequences of behavior” (Erdman et al., 2015, p. 32).

Aim 3: State of Scientific Development

Thirty-two of the 33 research studies (97%) were quantitative in nature. Only one paper (3%) used a mixed methods design that incorporated qualitative methods (Erdman et al., 2015).

As shown in Table 5, empirical methods were mostly consistent with the first phase of research development that, according to T. Smith et al. (2007), aims to formulate and systematically apply interventions. Twenty-four of the 25 studies (96%) of EAAs, and all eight studies (100%) of EATs employed methods consistent with phase one research.

The second phase of research calls for the development of manuals that standardize interventions while also allowing for their individualization (T. Smith et al., 2007). After promising results from a phase one study of TR (Gabriels et al., 2012), Shoffner and Gabriels

(2008) developed a manual for therapeutic riding tailored specifically to the needs of children and adolescents with ASD. This protocol represents the only approach to TR that appeared consistent with the second phase of research development, although the manual itself is not peer-reviewed and therefore was not included in this review. In one of the pretest-posttest studies of HPOT, Silkwood-Sherer et al. (2012) included an intervention protocol describing the specific components of the HPOT intervention aimed at improving balance deficits. Thus these studies enter into the second phase of research development focused on manualization and protocol development (Smith et al., 2007).

The third phase of research development is aimed at evaluating the efficacy of interventions using randomized controlled trials across study sites (T. Smith et al., 2007). Only one study implemented a randomized controlled trial to assess the efficacy of TR and thus approximated the third phase of research development focused on efficacy.

Discussion

In this systematic mapping review, we comprehensively gathered, described, categorized, and synthesized the research literature on equine-assisted interventions and ASD published in English from 1980 through 2015. The earliest study was published in 2003. Since 2003, scholarly interest in equine-assisted interventions and ASD appears to have grown as suggested by an average of five studies published annually from 2013 through 2015. The 33 included studies also suggest that equine-assisted interventions for ASD are international in scope and have cross-cultural appeal. Collectively, participants with ASD in the 33 studies were predominantly children and younger adolescents. Incorporation of horses was the sole common element across the nine distinct types of interventions and the GRM component identified in this review, and riding horses was the most widely shared component. Yet this review also found

that equine-assisted interventions for children and young adolescents with ASD are highly heterogeneous in nature. We next elaborate on key findings pertaining to each research aim, and discuss implications for future practice and research.

A Focus on Children and Young Adolescents

Very few of the 33 included studies were found to have confirmed diagnoses of ASD in research participants. Therefore it is impossible to determine if participants included in these studies truly had ASD, and generalization to the ASD population may not be completely accurate. Participants characterized as having ASD, AS, and PDD were, however, predominantly male and nearly exclusively included children and young adolescents no older than 16 years. The preponderance of male participants approximated gender ratios of four to five males for one female in the general ASD population described by Gotham et al. (2015). The predominant focus on children and young adolescents with ASD coincides with demographics reported by PATH, Intl (2015), indicating that most participants at its centers worldwide are under the age of 18. This emphasis on youth is also consistent with other reported evidence that services and interventions for adults with ASD are undeveloped more broadly (Gotham et al., 2015; Pellicano, Dinsmore, & Charman, 2014).

Related to research participants, therefore, these findings have several implications for advancing the practice and science of equine-assisted interventions for people with ASD. To better clarify for whom, on the broad autism spectrum, equine-assisted interventions may be indicated, our findings suggest that researchers could more comprehensively characterize samples of participants. A critical quality criterion of research on interventions for individuals with ASD is administration of standardized assessments to confirm the ASD diagnosis of research participants, in conjunction with administration of assessments of adaptive functioning

and intelligence to further characterize the sample (Smith et al., 2007). In addition, characterization of the sample by race, ethnicity, and socio-economic status could help to illuminate if certain groups appear to have greater access to these interventions than others. Lastly, given an exclusive focus on children and youth, equine-assisted interventions could be developed to target priorities identified by adults with ASD and their legal guardians; namely, to promote life skills, provide vocational and educational opportunities, and advance public acceptance (Gotham et al. (2015).

Diverse Nature of Equine-assisted Interventions for Autism

The prevalence of sparse descriptions of the components of interventions made it challenging, in this systematic mapping review, to characterize interventions precisely and thoroughly, and to compare and contrast key components of different interventions. These challenges notwithstanding, this review found that equine-assisted interventions for children and adolescents with ASD are quite diverse. Incorporation of horses was the common element across all studies, and some similarities were also found among interventions variously classified as either EAAs or EATs. On the other hand, as next elaborated, the five interventions classified as EAAs differed from one another in key respects, as did the four interventions classified as EATs. Moreover, some notable differences were found in how similarly named interventions, especially TR and HPOT, were described and provided.

While the five interventions classified as EAAs were generally social in nature, differences among them were evident. For example, whereas TR and the CTR and RDA programs more sharply emphasized teaching horsemanship skills in interactive group settings, PER and the EFL program more strongly emphasized activities designed to promote social communication and appropriate behaviors. In comparison to the interventions classified as

EAs, those classified as EATs were generally more individual and oriented towards sensorimotor development. Yet differences across these interventions were also evident. For example, HPOT, EAT-unspecified, and the SDHR program generally focused on manipulation of the horse's (or simulated horse's) movement through use of different equine gaits and speeds and different rider positions; in contrast, ST-EAT more strongly emphasized groundwork activities.

Across the studies that investigated TR and HPOT, variations *within* these similarly named interventions were also evident. Within both TR and HPOT, there were a variety of different disciplinary backgrounds of the providers, as well as considerable variability in dosages. In regards to the nature of TR, interventions varied in the extent to which they were therapeutically or recreationally oriented. In addition, only a minority of TR studies reported individualizing participant goals and autism-specific accommodations, suggesting that these strategies may be present but are not commonplace. We also found differences in how authors represented HPOT. That is, HPOT conducted in Spain focused on maximizing the bond between the child and the horse while HPOT conducted in Australia and the United States focused on the manipulation of equine movement by occupational therapists and physical therapists. Findings also suggested that HPOT varied depending on the disciplinary background of the provider. For example, in the study by Silkwood-Sherer et al. (2012), a physical therapist provided HPOT following a treatment protocol designed to help improve the postural stability of children with balance problems. When provided by occupational therapists, HPOT aimed to improve the fine motor and writing skills of children with disabilities in the study by (Liddiard, 2009); and the motor control, adaptive behaviors, and participation of children with ASD in daily activities in the study by Ajzenman et al. (2013).

Considering that only two studies of TR (Gabriels et al., 2012; Gabriels et al., 2015) and three studies of PER (Hiromi Keino et al., 2009; Keino & Kawakita, 2010; Hiromi Keino et al., 2009) evidenced progressive tracks of research, these variations within TR and HPOT may reflect the standard practices, as well as the priorities, community needs, opportunities and constraints that prevail in local contexts. For instance, the websites of two PATH Premiere accredited centers located 40 miles apart in the United States variously described TR as helping “riders to achieve therapeutic and other life goals” (Colorado Therapeutic Riding Center, 2017), and as a recreational activity that helped riders learn “the skill of horseback riding and improving weekly at that skill” (My Heroes, 2017). The variations may also reflect the influence of cultural and historical factors. HPOT, for example, emerged largely from the practices of physical therapists in Europe in the mid-20th century (Saywell, 1988); it was subsequently additionally adopted by occupational therapists (Engel, 1984) and speech and language pathologists (Dismuke, 1984) in the United States.

The heterogeneity of different types of EAAs and EATs found in this systematic mapping review, as well as variations within TR and HPOT, have several implications for advancing the practice and science of equine-assisted interventions for ASD. To clarify what a particular intervention entails, researchers are encouraged to detail its exact doses, as well as its exact activities, activity sequences, and therapeutic strategies such as autism-specific accommodations that comprise the intervention. In addition to providing a basis for replication studies, such comprehensive descriptions can help to explicate why an intervention has been designed as it has, why it is needed, and why it is believed to be effective; that is, what its ‘active ingredients’ are understood to be (Melnyk & Morrison-Beedy, 2012). Moreover, because TR and HPOT are indeed complex, hence, neither generic nor homogenous interventions, they do not lend

themselves to uniform delivery irrespective of who provides them. It is well-documented that the personal contexts of educators and healthcare providers influence how they teach and practice (Hooper, 2008; Hooper et al., 2014). In particular, different disciplinary perspectives, plus differing assumptions underlying an individual's worldview, have been shown to strongly shape teaching and clinical practices. Conceivably, then, the interventions termed TR and HPOT identified in this review may have been even more diversified than previously described or readily visible by merit of who provided them. For novel and emerging interventions that are not yet standardized or manualized, we encourage researchers to explicate rationales for selecting particular providers. People with ASD who may partake in an equine-assisted intervention would also benefit from examining how their personal goals and needs, or those of their legal guardians, align with the areas of expertise, beliefs or professional backgrounds of providers.

Needs of Participants with ASD and Promising Outcomes and Practices

Pellicano et al. (2014) mapped patterns of funding autism research in the UK onto the concerns of the autism community and their priorities for research. They found that whereas most funding supported projects that investigated basic biological and neurological processes implicated in ASD, members of the autism community prioritized research that would help “autistic people” learn life skills and manage their day-to-day lives “with whatever difficulties they have” (p. 761). While it was beyond the scope of this systematic mapping review to provide a similar assessment, the diverse range of outcomes identified in the review shed light on the extent to which research of equine-assisted interventions has addressed immediate practical concerns of everyday life, or has been aligned with the priorities of participants with autism and their families and caregivers.

For instance, most reviewed studies did not individualize goals. While it cannot be presumed that their interventions were unaligned with the priorities of participants and their legal guardians, consistent explicit attention of researchers to congruencies among the aims of their studies and the wants and needs of research participants is merited. We also classified over one third of all reported outcomes as falling in the ICF category of activity and participation; these outcomes appeared to align well with learning practical skills needed to manage day-to-day life. The relationship of differently classified outcomes to participants' day-to-day lives was not as obvious: specifically, outcomes classified as other, as pertaining to autism severity, and as pertaining to the ICF category of body functions. While outcomes pertaining to activity and participation in the ICF most directly relate to managing day-to-day life, participants with ASD and their legal guardians may strongly value many of these differently classified outcomes. The challenge, it therefore seems, lies in demonstrating that improvements observed during equine-assisted interventions, or improvements in bodily functions or reduced ASD symptoms, truly generalize to and account for positive differences in the everyday lives of people with ASD.

With the above general observations noted, this review identified several specific promising findings. Across the five interventions classified as EAAs, the most promising findings related to social interaction and communication are consistent with findings from O'Haire's (2017) review of interventions for children with ASD that incorporated dogs, guinea pigs, dolphins, companion animals or horses. Promising findings in our review related to improvements in behavior are inconsistent, however, with O'Haire's mixed results pertaining to reductions of problem and stereotypic behaviors. The unique multisensory nature of horseback riding may explain the more promising results reported in studies of equine-assisted interventions. Many authors proposed that the sensory nature of riding a horse, including graded

vestibular, proprioceptive, and tactile input, promotes self-regulation of children with ASD. For example, Gabriels et al. (2012) wrote, “Horses may help organize or provide input to the ASD child’s sensory system. This factor may contribute to helping the child feel calm” (p. 586). This notion is consistent with literature suggesting that interventions that include graded sensory input for children with ASD can improve academic responding behaviors, on-task behaviors, and stereotypic behaviors (Escalona, Field, Singer-Strunck, Cullen, & Hartshorn, 2001; Field et al., 1997; Hartshorn et al., 2001; Koenig, Buckley-Reen, & Garg, 2012; Van Rie & Heflin, 2009). This review found that EAA outcomes pertaining to sensory processing and motor control improved inconsistently across studies, and therefore are somewhat less promising but merit further investigation.

In interventions classified as EATs, the most promising outcome was improved voluntary motor control. This outcome may reflect the emphases of these interventions that often aimed to improve sensorimotor functioning through the manipulation of equine movement by providers. Another promising and possibly related outcome of HPOT was improvement in self-care tasks. For instance, Ajzenman et al. (2013) theorized that improved motor skills as a result of HPOT helped children perform more independently in everyday activities.

Overall, our map of outcomes reported by authors suggests that the two most studied interventions of TR and HPOT demonstrate the strongest empirical support (Table 5). This map also illustrates the diverse targeted outcomes of interventions. Moreover, Tables 3 and 4 collectively show that there is neither one TR nor one HPOT but, rather, multiple ‘therapeutic ridings’ and multiple ‘hippotherapies.’ Parents and other legal guardians accordingly need to be cognizant of the specific components and targeted outcomes of a specific intervention in order to assess its appropriateness for their child or adolescent with ASD. As developed below, research

of equine-assisted interventions for ASD additionally reflects an early phase of scientific development, including most if not all studies of TR and HPOT. There are, thus, needs for systematic tracks of research in which specific interventions are more thoroughly formulated (conceptualized), refined and rigorously investigated.

The State of the Science of Equine-assisted Interventions for ASD

The variability within and across different types of equine-assisted interventions identified through this systematic mapping review suggests that the science of these interventions is mainly locally situated and in early development. In other words, most studies resembled pilot studies and were conducted by independent investigators across the globe. Best research practices involve the systematic development of interventions using “the best available evidence and appropriate theory” in order to test interventions in “a carefully phased approach [beginning] with a series of pilot studies” (Craig et al., p. 980). When considering the entire body of literature included in this review, there is a need for systematic tracks of research in which interventions are thoroughly conceptualized, progressively refined, and tested in subsequent phases of scientific development.

Keeping these principles in mind, Gabriels et al.’s (2015) study of TR appeared to offer the strongest empirical evidence across all studies included in this review. This study emerged from a systematic approach to developing and evaluating a TR intervention. Because the intervention was manualized and investigated in a randomized controlled trial, the study reflected the second and third phases of scientific development of complex interventions for ASD identified by T. Smith et al. (2007). Accordingly, next steps for investigating such manualized equine-assisted interventions would include feasibility testing at multiple sites,

assessments of acceptability through surveys and focus group with families and clinicians, and increased use of blinded outcome measures within future experimental studies.

Although all studies of HPOT reflected the first phase of research development, promising results for children with ASD clearly warrant more systematic and advanced research development. A key next task would involve development of manuals for the multiple ‘hippotherapies’ for ASD identified in this review. Manualization can help to clarify salient differences in HPOT when provided by practitioners with different disciplinary backgrounds or when offered at specific dosages.

Lastly, inquiry into the appropriateness of equine-assisted interventions for ASD was conspicuously absent in this systematic mapping review as were, perhaps relatedly, descriptive and qualitative studies. *Appropriateness* addresses “the impact of an intervention from the perspective of its recipient” and is, thus, a vital consideration in determining an intervention’s effectiveness (D. Evans, 2003, p. 81). This review underscores a need for research that examines how people with ASD, their families and caregivers, may experience particular equine-assisted interventions, including whether or how, in their estimations, the interventions align with their needs and benefit them.

Limitations

Few studies included in this systematic mapping review verified diagnoses of ASD in research participants. Thus while our syntheses of outcomes have identified potentially promising equine-assisted interventions for ASD, these findings cannot be unequivocally generalized to the ASD population. We also associated studies of particular interventions with specific phases of scientific development in order to help advance the scientific development of interventions. Yet because systematic mapping reviews do not require formal quality

assessments of the rigor of research (Grant & Booth, 2009), we cannot verify the efficacy of any intervention identified as promising. Although executed database searches were intentionally broad in order to retrieve papers of relevance to equine-assisted interventions, we may have missed relevant sources for two reasons: 1) we did not use search terms specific to autism, and 2) relevant sources were not indexed, or not yet indexed, in searched databases. In addition, because retrieval was restricted to English papers, papers on equine-assisted interventions and ASD published in other languages were not represented. Lastly, we adopted the terminology that researchers used to describe the equine-assisted intervention that they had investigated. This adopted terminology did not always adhere, however, to industry standards. For example, Hawkins et al. (2014) reported that a therapeutic riding instructor provided an intervention called “equine-assisted therapy” (p. 135). Yet both PATH, Intl(2017b) and the American Hippotherapy Association (2017) stipulate that one must be a credentialed health profession to provide an EAT. Thus in an effort to represent studies accurately, the terminology that we adopted from authors did not always reflect prevailing industry standards.

Conclusion

The 33 studies included in this systematic mapping review collectively provide general proof of concept that equine-assisted interventions can benefit children and adolescents with ASD. To our knowledge, this is the most comprehensive review of peer-reviewed literature on equine-assisted interventions for ASD to date. We found considerable heterogeneity across and within five distinct types of equine-assisted activities and four distinct types of equine-assisted therapies. Promising outcomes thus far support continued empirical investigations through systematic tracks of research. In particular, the use of treatment manuals is needed to help standardize interventions and better illuminate their distinct emphases, active ingredients, and

specific benefits. There is also a need for more systematic, phased tracks of research that empirically develop and evaluate these complex interventions through rigorous documentation of efficacy. Plus there is a need for research that privileges the voices and perspectives of people with ASD, their families and caregivers, regarding whether or how particular equine-assisted interventions benefit them. We propose as well that there is a potential for developing equine-assisted interventions that meet the needs of adults with ASD.

Figures and Tables

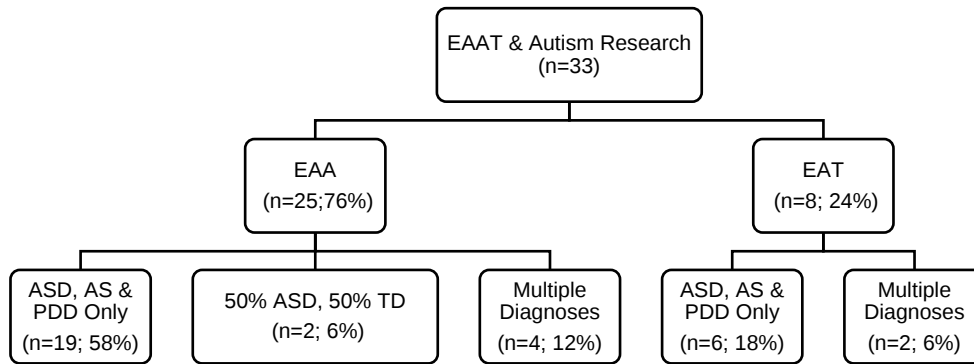


Figure 2.1. Distribution of included papers by categorization of the intervention as an equine-assisted activity or therapy, and diagnoses of research participants. n = number of studies; EAAT = equine-assisted activities and therapies; EAA = equine-assisted activity; EAT = equine-assisted therapy; ASD = autism spectrum disorder; AS = Asperger syndrome; PDD = pervasive developmental disorder; TD = typically developing.

Table 2.1

Examples of Specific Outcomes Coded Under General Outcome Categories

ICF Body Functions	ICF Activity / Participation	Other
Control of Voluntary Movement	Communication	Behavior
Muscle Power	Interpersonal Interactions and Relationships	Quality of Life
Sensory Processing	Self-care	Riding Skills
Cognitive Functions	Recreation	

Note. ICF = International Classification of Functioning, Disability, and Health

Table 2.2

Characteristics of Participants (Aim 1)

1 st Author (year)	Country	N	Diagnoses	% Male ^a	Age	Standardized Assessments ^b
Candler (2003)	US	12	50% ASD/AS	100%	5-13	-
Leitão (2003)	Portugal	5	All ASD	80%	5-10	-
Zabriskie (2005)	US	37	22% ASD	- ^c	3-73	-
Evans (2007)	New Zealand	8	38% ASD	100%	6-16	-
Bass (2009)	US	34	All ASD/AS	85%	4-10	-
Keino, Keino (2009)	Japan	52	All PDD	79%	4-16	-
Keino, Funahashi (2009)	Japan	4	All PDD/ASD	100%	4-9 ^d	-
Liddiard (2009)	Australia	7	29% ASD	- ^c	7-12	-
Taylor (2009)	US	3	All ASD	-	4-6	-
Keino (2010)	Japan	18	All PDD	89%	3-9 ^d	-
Memishevikj (2010)	Bosnia and Herzegovina	4	All ASD	50%	8-10	-
Wuang (2010)	Taiwan	60	All ASD	78%	6-10	-
Kern (2011)	US	20	All ASD	75%	3-12	-
Nelson (2011)	US	3	All ASD	100%	2-4	-
Gabriels (2012)	US	42	All ASD /AS	86%	6-16	ADOS Leiter-R SCQ
Silkwood-Sherer (2012)	US	16	25% PDD/ ASD/AS	50%	5-16	-
Tabares (2012)	Spain	8	All ASD	100%	8-16	-
Ajzenman (2013)	US	6	All ASD	57%	5-12	-
Ghorban (2013)	Iran	6	All ASD	17%	6-12	-
Jenkins (2013)	US	7	All ASD	86%	6-14	VABS-II
Kang (2013)	South Korea	26	23% ASD	50%	7-12	-
Ward (2013)	US	21	All ASD	71%	K-5 th grade	CAB-T

Chen (2014)	US	4	50% ASD 50% TD	50%	2-3	M-CHAT
Garcia-Gomez (2014)	Spain	16	All ASD	81%	7-14	CARS
Hawkins (2014)	US	2	All ASD/PDD	50%	7-11	CARS
Holm (2013)	US	3	All ASD	100%	6-8	CARS KTEA-2
Lanning (2014)	US	25	All ASD	84%	4-15	-
Naidoo (2014)	South Africa	5	All ASD	60%	6-14	-
Page (2014)	US	13	All ASD/AS	54%	5-12	-
Erdman (2015)	US	6	50% ASD 50% TD	100%	11-15	-
Gabriels (2015)	US	116	All ASD	87%	6-16	ADOS Leiter-R SCQ
Minoei (2015)	Iran	18	All ASD	100%	8-10	-
Steiner (2015)	Hungary	26	All ASD	46%	10-13	-

Note. Number of participants and age refer to all research participants, while % male and standardized assessments refer only to children with ASD, AS, or PDD. US = United States; ASD = autism spectrum disorder; AS = Asperger syndrome; PDD = pervasive developmental disorder; TD = typically developing; - = information not provided; ADOS = Autism Diagnostic Observation Schedule; SCQ = Social Communication Questionnaire; VABS-II = Vineland Adaptive Behavior Scales, Second Edition; CAB-T = Clinical Assessment Battery Teacher Rating Form; M-CHAT = Modified Checklist for Autism in Toddlers; CARS = Childhood Autism Rating Scale; KTEA = Kaufman Test of Educational Achievement- Second Edition; Leiter-R = Leiter International Performance Scale- Revised

^a % Male refers to percentage of participants with ASD, PDD, or AS that were male.

^b Standardized assessments refer to all standardized assessments used to characterize participants with ASD, AS, or PDD that were not also outcome assessments. (See Table 5 for outcome assessments.)

^c Gender reported for entire sample, but gender of participants with ASD, AS, or PDD not reported

^d These ages refer to the age of participants when they began the intervention

Table 2.3

Types of Complex Equine-assisted Interventions and Their Abbreviations

Equine-assisted Activity (abbreviation)	Equine-assisted Therapy (abbreviation)
Community-based Therapeutic Recreation (CTR)	Equine-assisted Therapy Unspecified (EAT-unspecified)
Equine-facilitated Learning (EFL)	
Psychoeducational Horseback Riding (PER)	Hippotherapy (HPOT)
Riding for the Disabled (RDA)	Short-term Equine-assisted Therapy (ST-EAT)
Therapeutic Riding (TR)	Simulated Developmental Horse-riding (SDHR) ^a

Note. Not represented in this table is the study solely focused on the horsemanship skill of grooming the horse (GRM) as it is not considered a complex intervention, but rather a common component of equine-assisted interventions.

^a SDHR did not involve an actual horse, but rather a mechanical horse that simulated riding

Table 2.4

Characteristics of Equine-assisted Interventions (Aim 2)

1 st Author (year)	Type of EAAT		Provider	Sessions			Intervention Characteristics														
							Components														
							Ride the Horse	Groom the Horse	Equine Gaits and Speeds	Steer the Horse	Mounted Exercises	Follow Verbal Commands	Language Activities	Social Activities	Match Horse & Participant	Tack the Horse	Ride Ground Course	Different Rider Positions	Group Session	Individual Session	Individualized Goals
Candler (2003)	TR	-	TRI	1 wk	7	3.75 hrs	✓	✓	-	-	-	-	-	-	-	-	-	-	✓	-	✓
Leitão (2003)	PER	-	“Riding technician”	16 wks	16	1.5 - 2 hrs	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
Zabriskie (2005)	CTR	-	-	3-5 wks	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓
Evans (2007)	RDA	-	“Experienced riders”	-	6	-	✓	-	-	-	-	✓	-	✓	-	-	-	-	✓	-	-
Bass (2009)	TR	-	“Trained instructor”	12 wks	12	1 hr	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓	-	✓	-	-
Keino, Keino (2009)	PER	-	-	1 month – 7 years	-	-	✓	-	✓	-	-	-	✓	✓	-	-	-	-	✓	-	-

Keino, Funahashi (2009)	PER	-	-	-	-	-	✓	-	✓	-	-	✓	✓	✓	✓	-	-	-	-	-	-
Liddiard (2009)	-	HPOT	OT	10 wks	10	45 mins	✓	-	✓	-	✓	-	-	-	✓	-	-	✓	-	-	-
Taylor (2009)	-	HPOT	PT	16 wks	16	45 mins	✓	-	✓	-	-	-	✓	-	✓	-	✓	-	-	✓	-
Keino (2010)	PER	-	“instructor”	1 month – 8 years	-	-	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-	-	-	-	-
Memishevikj (2010)	-	ST- EAT	OT	10 wks	10	30 mins	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
Wuang (2010)	-	SDHR	OT	20 wks	40	1 hr	✓	-	-	-	✓	-	-	-	-	-	-	✓	-	-	-
Kern et al. (2011)	TR	-	“riding instructor”	24 wks	24	1 hr	✓	✓	-	✓	-	-	✓	-	✓	✓	-	-	-	-	-
Nelson (2011)	TR	-	“therapist”	-	-	-	✓	-	✓	-	-	✓	✓	-	-	-	-	✓	-	✓	-
Gabriels (2012)	TR	-	TRI	10 wks	10	1 hr	✓	✓	-	-	-	-	-	-	✓	✓	-	-	✓	-	✓
Silkwood- Sherer (2012)	-	HPOT	PT	6 wks	12	45 mins	✓	-	✓	-	✓	-	-	-	-	-	✓	✓	-	-	-
Tabares (2012)	-	HPOT	“specialist”	4 wks	4	30 mins	✓	✓	-	✓	-	-	-	-	-	✓	-	-	-	-	-
Ajzenman (2013)	-	HPOT	OT	12 wks	12	45 mins	✓	-	✓	-	-	✓	-	✓	-	-	✓	✓	-	-	-
Ghorban (2013)	TR		“trainers”	4 wks	8	45 mins	✓	✓	✓	✓	-	-	✓	✓	-	-	-	-	✓	-	-

Jenkins (2013)	TR	-	TRI	9 wks	9	1 hr	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jenkins (2013)	TR	-	-	20 wks	40	30 mins	✓	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
Ward (2013)	TR	-	TRI	30 wks	18	-	✓	✓	✓	✓	-	✓	✓	✓	✓	-	-	-	✓	-	-
Chen (2014)	GRM	-	-	-	1	1 min	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
Garcia-Gomez (2014)	TR	-	-	12 wks	24	45 mins	✓	✓	-	-	-	-	-	-	-	✓	-	-	✓	-	-
Hawkins (2014)	-	EAT-U	TRI	5 wks	15	30 mins	✓	✓	✓	✓	✓	-	✓	-	-	-	✓	✓	-	✓	✓
Holm (2013)	TR	-	TRI	4 wks	4-20	45 mins	✓	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	✓
Lanning (2014)	TR	-	TRI	12 wks	12	1 hr	✓	✓	-	✓	-	-	-	-	✓	-	✓	-	✓	✓	✓
Naidoo (2014)	TR	-	TRI	-	-	15-25 mins	✓	-	-	✓	✓	-	-	✓	✓	-	-	-	-	✓	✓
Page (2014)	TR	-	TRI	15 wks	15	30 mins	✓	-	-	✓	✓	-	✓	✓	✓	-	-	-	-	-	-
Erdman (2015)	EFL	-	TRI & “equine specialist in mental health”	10 wks	10	75 mins	✓	✓	-	-	-	-	-	✓	✓	-	-	-	✓	-	-
Gabriels (2015)	TR	-	TRI	10 wks	10	45 mins	✓	✓	✓	✓	-	-	-	-	✓	✓	-	-	✓	-	-
Minoei (2015)	TR	-	“coach”	6 wks	12	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-

Steiner (2015)	TR	-	“therapist”	8 wks	8	30 mins	✓	-	-	-	✓	-	-	-	-	✓	-	-	-	-
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Note. EAAT = equine-assisted activities and therapies; EAA = equine-assisted activity; TR = therapeutic riding; PER = psychoeducational horseback riding; CTR = community-based therapeutic recreation; RDA = riding for the disabled; GRM = grooming activity; EFL = equine-facilitated learning; HPOT = hippotherapy; ST-EAT = short-term equine-assisted therapy; SDHR = simulated developmental horseback riding; EAT-U = equine-assisted therapy unspecified; TRI = therapeutic riding instructor; OT = occupational therapist; PT = physical therapist; wk = week; # = number of sessions; hr = hour; mins = minutes

Table 2.5

Scientific Development and Measured Outcomes (Aims 2 and 3)

1 st Author (year)	Scientific Development		Outcomes	
	Research Phase	Study Design	Assessment Methods	Outcome Classification and Significance Level
Candler (2003)	1	Pre-post	COPM	◆ Other: Parent-identified occupational performance goals
Leitao (2003)	1	Quantitative case study	PEP-R	◇ ICF-BF: Control of Voluntary Movement (gross and fine motor, coordination) ◇ ICF-BF: Cognitive Functions (imitation, perception, cognition)) ◇ Other: Behavior
			ATEC	◇ Autism Severity
			Observations	◇ ICF-AP: Interpersonal Interactions (relating, affect) ◇ ICF-AP: Communications (language)
Zabriskie (2005)	1	Post-test	Questionnaire	◇ Other: Quality of Life (descriptive statistics) ◇ Other: Athletic Identity (descriptive statistics)
Evans (2007)	1	Single subject	Observations	— ICF-BF: Attention ◇ ICF-BF: Emotional Functions (enjoyment) — Other: Risk during riding ◇ Other: Riding Skills (mounting & dismounting horse)
Bass (2009)	1	Randomized Group Comparison	SP SRS	◆ ICF-BF: Sensory Processing ◆ ICF-AP: Interpersonal Interactions (total score, social motivation)
Keino, Keino (2009)	1	Group comparison	Questionnaire	◆ ICF-AP: Communication (5 / 10 questions significant improvement) — ICF-AP: Communication (5 / 10 questions no finding) ◆ Other: Behavior (3 / 10 questions significant improvement) — Other: Behavior (7 / 10 questions no finding)

Keino, Funahashi (2009)	1	Pre-post	HEIM	◆ Other: Behavior (while riding horse; 7 /10 questions) — Other: Behavior (while riding horse; 3/10 questions)
Liddiard (2009)	1	Single subject	ETCH M-FUN	◇ ICF-AP: Other Activity (Handwriting) ◆ ICF-BF: Control of Voluntary Movement (Fine and Gross Motor) — ICF-BF: Control of Voluntary Movement (Visual Motor)
Taylor (2009)	1	Single subject	PVQ	◇ ICF-BF: Cognitive Functions (Volition)
Keino (2010)	1	Pre-post	HEIM	◆ Other: Behavior (while riding horse)
Memishevikj (2010)	1	Quantitative case study	ATEC	◇ Autism Severity
Wuang (2010)	1	Group comparison	BOTMP TSIF	◆ ICF-BF: Control of Voluntary Movement ◆ ICF-BF: Sensory Processing
Kern (2011)	1	Pre-post	TPCIS SP CARS QLES-QR	— ICF-AP: Interpersonal Interactions (total score) ◆ ICF-AP: Interpersonal Interactions (mood and tone subscale) — ICF-BF: Sensory Processing (total score) ◆ ICF-BF: Sensory Processing (Auditory threshold subscale) ◆ Autism Severity ◆ Other: Quality of Life
Nelson (2011)	1	Single subject	Observations	◇ ICF-AP: Communication (verbal) ◇ Other: Behavior (aberrant)
Gabriels (2012)	1	Group comparison	SIPT BOT-2 VABS-II ABC-C	◆ ICF-BF: Sensory Processing (verbal and postural praxis) ◆ ICF-BF: Control of Voluntary Movement ◆ ICF-AP: Interpersonal Interactions (socialization) ◆ ICF-AP: Communication ◆ ICF-AP: Other Activity (Daily Living) ◆ Other: Behavior (irritability, lethargy, stereotypy, hyperactivity, inappropriate speech)

Silkwood-Sherer (2012)	1 & 2	Pre-post	PBS ASKp	◆ ICF-BF: Control of Voluntary Movement ◆ ICF-AP: Self-care ◆ ICF-AP: Walking and Moving
Tabares (2012)	1	Pre-post	Salivary Sample	◆ ICF-BF: Endocrine Functions (cortisol & progesterone levels)
Ajzenman (2013)	1	Pre-post	Force Plates & VMC VABS-II CACS	◆ ICF-BF: Control of Voluntary Movement (postural control) — ICF-BF: Control of Voluntary Movement (fine and gross motor) ◆ ICF-AP: Interpersonal Interactions (socialization) ◆ ICF-AP: Communication — ICF-AP: Other Activity (Daily Living Skills) ◆ ICF-AP: Self-care ◆ ICF-AP: Recreation and Leisure (low-demand) ◆ ICF-AP: Interpersonal Interactions (social interaction) — ICF-AP: Walking and Moving (community mobility) — ICF-AP: Recreation and Leisure (high-demand) — ICF-AP: Domestic — ICF-AP: Education
Ghorban (2013)	1	Pre-post	SSRF	◆ ICF-AP: Interpersonal Interactions (social skills)
Jenkins (2013)	1	Single subject	Observations CBCL	◆ ICF-BF: Control of Voluntary Movement (posture) — ICF-BF: Emotional Functions (happiness) — ICF-AP: Communication (spontaneous initiations, responses to initiations, commands to direct the horse) — Other: Behavior (off-task, problem, compliance) — Other: Behavior (internalizing, externalizing, problem)
Kang (2013)	1	Pre-post	DynaDisc Equilibrium Cushion	◆ ICF-BF: Control of Voluntary Movement (static equilibrium)

Ward (2013)	1	Pre-post	SPSC	◆ ICF-BF: Sensory Processing (registration, sensitivity, school factors 1&4, auditory, visual, touch) — ICF-BF: Sensory Processing (seeking, avoiding, movement, behavior, school factors 2&3)
			GARS-2	◆ Autism Severity (autism index, social interaction) — Autism Severity (stereotyped behavior, communication)
Chen (2014)	1	Group comparison	EEG	◇ Other: Frontal lobe brain activity
Garcia-Gomez (2014)	1	Group comparison	BASC-T	◆ Other: Behavior (aggressive) — Other: Behavior (all 16 other behaviors)
			Questionnaire	◆ Other: Quality of Life (interpersonal relations and social inclusion) — Other: Quality of Life (emotional, physical and familial well-being; personal development; self-determinism; total score)
Hawkins (2014)	1	Single subject	BOT-2	◇ ICF-BF: Control of Voluntary Movement (body coordination, agility) ◇ ICF-BF: Muscle Power (strength)
Holm (2013)	1	Single subject	SP	— ICF-BF: Sensory Processing
			SRS	— ICF-AP: Interpersonal interactions (social awareness, social cognition, social communication, social motivation, and autistic mannerisms)
			Observations	◇ ICF-AP: Communication (expressive verbal) ◇ Other: Behavior (parent-identified negative behaviors)
			ABC-C	— Other: Behavior (irritability, lethargy, stereotypy, hyperactivity, inappropriate speech)
Lanning (2014)	1	Group comparison	PedsQL 4.0	◆ Other: Quality of Life (physical and psychosocial summary scores)
			CHQ	◇ Other: Quality of Life (health-related quality of life)
Naidoo (2014)	1	Pre-post	Actiheart Monitor	— ICF-BF: Cardiovascular Functions (heart rate, inter-beat intervals) ◆ ICF-BF: Cardiovascular Function (root mean squared differences of the standard deviation, high frequency, low frequency, ratio)

Page (2014)	1	Group comparison	SP	◆ ICF-BF: Sensory Processing (multisensory processing) — ICF-BF: Sensory Processing (behavioral and emotional)
			SRS	◆ ICF-AP: Interpersonal Interactions (social communication, autistic mannerisms, total score)
			SCQ	◆ ICF-AP: Communication
			CBCL	— Other: Behavior (internalizing, externalizing, competence, total scale)
Erdman (2015)	1	Mixed methods case study	SRS	◇ ICF-AP: Interpersonal Interactions (social awareness, social cognition)
			Observations	◇ ICF-AP: Interpersonal Interactions (social awareness, social cognition, social communication, social motivation) ◇ Other: Confidence ◇ Other: Humor
Gabriels (2015)	3	Randomized Controlled Trial	BOT-2	— ICF-BF: Control of Voluntary Movement
			SIPT	— ICF-BF: Sensory Processing (postural praxis, praxis on verbal command)
			PPVT-4	— ICF-AP: Communication (receptive)
			VABS-II	— ICF-AP: Communication (adaptive communication) — ICF-AP: Interpersonal Interactions (socialization) — ICF-AP: Other Activity (Daily living)
			SALT	◆ ICF-AP: Communication (# words used, # different words used)
			SRS	◆ ICF-AP: Interpersonal Interaction (social cognition, social communication) — ICF-AP: Interpersonal Interactions (social awareness, social motivation, autistic mannerisms)
			ABC-C	◆ Other: Behavior (irritability, hyperactivity) — Other: Behavior (lethargy, stereotypy, inappropriate speech)
Minoei (2015)	1	Group comparison	GARS-2	◆ Autism Severity (stereotyped behaviors) — Autism Severity (communication, social interaction)
Steiner (2015)	1	Randomized Group Comparison	APAS	◆ ICF-BF: Gait Patterns
			PAC	— ICF-BF: Control of Voluntary Movement (gross and fine motor) ◆ ICF-AP: Communication ◆ ICF-AP: Interpersonal Interaction ◆ ICF-AP: Self-care

Note. COPM = Canadian Occupational Performance Measure; PEP-R = Psychoeducational Profile, Revised; ATEC = Autism Treatment Evaluation Checklist; SP = Sensory Profile; SRS = Social Responsiveness Scale; HEIM = Human-Equids Interaction on Mental activity scale; ETCH = Evaluation Tool of Children's Handwriting; M-FUN = Miller Function and Participation Scales; PVQ = Pediatric Volitional Questionnaire; BOTMP = Bruininks-Oseretsky Test of Motor Proficiency; TSIF = Test of Sensory Integration Functioning; TPCIS = Timberlawn Parent-Child Interaction Scale; CARS = Childhood Autism Rating Scale; QLES-QR = Quality of Life Enjoyment and Satisfaction Questionnaire, revised for this study; SIPT = Sensory Integration and Praxis Test; BOT-2 = Bruininks-Oseretsky Test of Motor Proficiency, second edition; VABS-II = Vineland Adaptive Behavior Scales, second edition; CACS = Child Activity Card Sort; SSRF = Social Skills Rating Form, a subscale of the Triad Social Skills Assessment, second edition; CBCL = Child Behavior Checklist; SPSC = Sensory Profile School Companion; GARS-2 = Gilliam Autism Rating Scale, second edition; EEG = electroencephalogram; BASC = Behavior Assessment for Children- Teacher Form; ABC-C = Aberrant Behavior Checklist- Community; PBS = Pediatric Balance Scale; ASKp = Activities Scale for Kids-Performance; VMC = video motion capture; PedsQL 4.0 = Pediatric Quality of Life 4.0 Generic Core Scales; CHQ = Child Health Questionnaire; PPVT-4 = Peabody Picture Vocabulary Test, fourth edition; SALT = Systematic Analysis of Language Transcripts; APAS = Ariel Performance Analysis System; PAC = Pedagogical Analysis and Curriculum Test; ICF-BF = International Classification of Functioning, Disability, and Health- Body Functions; ICF-AP = International Classification of Functioning, Disability, and Health- Activity/Participation; ♦ = statistically significant finding; ◇ = other positive finding; — = negative finding.

CHAPTER THREE: THEORETICAL DEVELOPMENT OF EQUINE-ASSISTED ACTIVITIES AND THERAPIES FOR CHILDREN WITH AUTISM: A SYSTEMATIC MAPPING REVIEW

This paper reports on a systematic mapping review that details the current state of theoretical development of equine-assisted activities and therapies (EAATs) for children with autism spectrum disorders (ASD). ASD is characterized by restricted and repetitive behaviors, and impairments in social communication (American Psychiatric Association, 2013). While a myriad of treatment options is available, children with ASD often participate in EAATs as complementary treatments (K. C. Thomas, Morrissey, & McLaurin, 2007). EAATs incorporate horses and the equine environment into interventions aimed at promoting the health and well-being of individuals with a variety of health conditions. For the past decade, centers accredited by the Professional Association of Therapeutic Horsemanship, International ([PATH, Intl], 2017a) have served individuals with ASD more than any other group. Across different types of EAATs for different populations, several theoretical speculations concerning elements of interventions that promote positive outcomes, including what horses contribute, exist (see Hallberg, 2008).

In a previous paper reporting a subset of findings from this systematic mapping review, our team found proof of concept for EAATs for children with ASD (reference omitted for blinding); we found numerous types of EAATs for children with ASD, each of which differed in important ways. Therapeutic riding (TR), which is mostly led by a certified riding instructor and focuses on teaching participants riding and horsemanship skills, was the most frequently studied equine-assisted *activity* for children with ASD; TR studies often found improvements in

behavior, social interaction, and communication. The most frequently studied equine-assisted *therapy*, hippotherapy (HPOT), is delivered by occupational therapists, physical therapists, and speech-language pathologists and aims to achieve functional goals specific to the health professional's area of practice; HPOT studies often found improvements in motor control and related functional activities. Considering the diverse nature of EAATs for children with ASD, the theoretical frameworks that guide different types of EAATs may also be quite diverse.

A well-developed theoretical framework explains why and how the intervention occurs as it does and identifies these elements: 1) the problem being addressed, 2) mediating processes, 3) an intervention that addresses the problem, and 4) outcomes produced by the intervention (Fleury & Sidani, 2012). Children with ASD may experience “problems” in many aspects of their development, including motor, social, sensory, behavioral, and occupational functioning; hence, theoretical frameworks guiding EAATs for children with ASD need to delineate the nature of the problem(s) targeted by the intervention. A theoretical framework then directly links the identified problem(s) to mediating processes, or *mechanisms*, defined by Kazdin (2007) as “the basis for the effect, i.e., the processes or events that are responsible for the change; the reasons why change occurred or how the change came about” (p. 3). Mechanisms of change are perhaps the most elusive elements of a theoretical framework; yet clear understandings of such mechanisms allow for optimization of the process of change, perhaps leading to more effective interventions. Clear causal links among all elements of a theoretical framework are essential and allow the intervention to be tailored to individuals' unique needs.

The development of a theoretical framework guiding an intervention is no simple task. Theories in applied fields often originate in “personal theories-in-practice” (Lynham, 2002, p. 223); or, as applied here, in how people who have been immersed in EAATs for ASD understand

and explain their experiences. To develop into credible and trustworthy theories, the premises of personal theories must be clearly conceptualized, operationalized, applied and confirmed, and continuously refined in practice and through research (Lynham, 2002). Such systematic development of theoretical frameworks allows investigators “to move beyond a simplistic, outcomes-focused approach to examining the central processes underlying program effects” (Fleury & Sidani, 2012, p. 12). To advance the science of EAATs for children with ASD, identification and development of theoretical frameworks that may drive various interventions is thus imperative. To our knowledge, however, no review of the literature on EAATs for children ASD has synthesized the state of theoretical development of diverse approaches to EAATs.

We derived findings reported herein from a systematic mapping review of peer-reviewed papers published from 1980 through 2015 concerning EAAT for children with ASD. In a previous paper derived from this review we described participants, interventions, and outcomes evident in research on EAATs for children with ASD (reference omitted for blinding). In the current paper, we describe the state of theoretical development of EAATs for children with ASD as a basis for illuminating promising theoretical frameworks that may help guide future practice and research. Three specific aims are to:

1. Examine how research pertaining to EAATs for children with ASD addresses theory, including to what extent each study applied, tested, or generated theory;
2. Describe a) informally theorized mechanisms of change, and b) formally developed theories evident across peer-reviewed literature on EAATs for children with ASD; and
3. Describe mechanisms of change in research studies on TR and HPOT, the two most common types of EAATs for children with ASD.

Methods

Systematic mapping reviews are a method of choice when researchers want to create a ‘map’ or topography of current knowledge related to a focused area of inquiry. This type of review allows for inclusion of descriptive and conceptual papers along with research reports at varying levels of rigor (Hammick, 2005). Systematic mapping reviews are conducted in a three-step process: (a) gathering relevant literature through comprehensive searching, (b) selecting papers through inclusion and exclusion coding, and (c) extracting important information from each included paper. (Reference omitted for blinding) detailed each of these steps that were conducted for the larger systematic mapping review, which we summarize next.

Figure 3.1 provides an overview of the methods of this study. A library scientist executed comprehensive searches in nine databases to serve multiple projects related to EAATs for all populations, which resulted in 2,421 unique records. A process of inclusion and exclusion narrowed the database to 397 papers pertinent to EAATs for all populations, of which 54 papers were relevant to ASD; therefore, 54 papers were included in this review. Table 3.1 presents inclusion and exclusion criteria; of note, while many studies did not confirm participant diagnoses using standardized assessments, given the broad inclusion criteria of systematic mapping reviews we included studies if participants were characterized as having ASD, Asperger syndrome, or pervasive developmental disorder.

To achieve the aims of the overall systematic mapping review, the first and second authors developed a data extraction tool (DET). A consultant uploaded the DET into a Microsoft Access database so that trained reviewers could electronically extract information from each included paper. During the data extraction process, reviewers remained as close to the authors’ language and use of theory as possible. Related to the Aims 2 and 3 of this paper, the DET

guided extraction of references to *formal* theories in the social sciences or health professions that were posed as helping to explain the mechanisms or benefits of EAATs. We considered formal theories to be those that authors explicitly named or cited (e.g., Dynamic Systems Theory [Lewis, 2000]). Furthermore, the DET guided extraction of *informally* theorized mechanisms that authors proposed concerning how and why EAATs lead to benefits. The first and second authors, along with four other members of the research team, attained 90% agreement on use of the DET; kappa coefficients ranged from .65 - .71 indicating substantial agreement (Viera & Garrett, 2005). The first author coded all 54 papers included in this review, and created Microsoft Access queries and Microsoft Excel pivot tables to produce frequency counts of each formal theory or informal mechanism of change.

Quantitative analyses of extracted data produced ranked frequencies of the most-oft-cited formal theories and informal mechanisms of various types of EAATs. We also qualitatively analyzed included papers to generate rich and contextualized basic qualitative descriptions of all theoretical content. Basic qualitative descriptions are “straight” descriptions of phenomenon not overlaid by layers of interpretation (Sandelowski, 2000). To generate such basic descriptions, we uploaded all included papers into the software program, NVivo (Edhlund, 2012) for qualitative analysis; we next describe the methods guiding qualitative analysis specific to each aim.

For Aim 1 (how theory is addressed), we generated and applied codes about how and where theory had been mentioned or conceptualized in each *research study*. The final inductively generated codes included these: general theoretical suppositions in the introduction, rationale for intervention design, theory or hypothesis generating, theory-driven research, and theory applied or tested. Each code was defined in NVivo, and the first and third authors obtained 85% blind agreement on the application of the codes to 10 included papers; we resolved

all coding discrepancies and the first author coded all other included papers independently.

For Aim 2a (informal theories), we used the 10 informal mechanisms that had been most often cited *in research studies*, identified through the quantitative strand, as start codes for the qualitative strand related to this aim. We then qualitatively coded *all included papers* to provide rich descriptions of these 10 informal mechanisms. For Aim 2b (formal theories), we coded *all included papers* for information about formal theories.

We answered Aim 3 (mechanisms of change in TR and HPOT) using both quantitative and qualitative data. First, we identified which mechanisms were most often cited in TR and HPOT *research studies*, and then we provided qualitative description of these mechanisms.

Results

In this systematic mapping review, we identified 33 research studies (Table 3.2) and 21 non-research papers (Table 3.3) pertinent to EAATs for children with ASD. The earliest non-research paper was published in 1985, while the earliest research study was published in 2003. All non-research papers addressed EAATs for people with various diagnoses, hence none was exclusively about EAATs for children with ASD. As authors mentioned ASD only briefly in some non-research papers, we only coded theoretical content pertinent to children with ASD in non-research papers. Twenty-five of the 33 studies (76%) exclusively included children with ASD, while the other studies included participants with a variety of diagnoses, including ASD. Research participants with ASD ranged in age from 2 to 16 years old.

Aim 1: How is Theory Addressed in Research Studies?

Table 3.2 lists inductively generated categories that describe how the literature addressed theory, ordered by frequency from left to right; it also illustrates which studies fall into each

category. Of note, we did not code any studies as “theory tested or applied,” because no studies aimed to test or further refine an existing theory.

Seventeen of the 33 research studies (52%) contained general “theoretical suppositions in the introduction” about why EAATs may be effective. These suppositions were often broad presumptions or speculations made by the authors. For instance, Memishevikj and Hodzhikj (2010) claimed that “equine-assisted therapy relies on the belief that simply being around the horse, grooming and working with the horse has a healing power” (p. 58). As another example, Lanning et al. (2014) posited, “the therapeutic effects of horseback riding for children with autism come from the relationship that develops over time with the horse as well as other human interactions that had been non-existent prior to the equine experience” (p. 1898). As a coding rule, we coded papers in this category when authors described theoretical suppositions in the introduction to a study; the theoretical suppositions did not necessarily influence how the intervention was conceptualized or designed.

Thirteen of the 33 studies (39%) provided a “rationale for intervention design,” indicating that authors had explained why certain components were included in the intervention. For example, Hawkins et al. (2014) wrote, “the physical movements and activities implemented during the riding sessions were designed to challenge and improve the participant’s gross motor skills” (p.145). In regards to components designed to improve communication, Page (2014) described that participants were “instructed to verbalize commands, such as ‘walk on,’ ‘please turn right/left,’ or ‘whoa,’ as a way to target social communication and awareness” (p. 51). These studies demonstrate preliminary theoretical development, whereby the intervention was designed, presumably, based on implicit theoretical beliefs about how to effect change. However,

studies coded in this category did not link these surface-level explanations to a theoretical framework or mechanism as to *why* the intervention component may cause change.

Only seven of the 33 studies (21%) contained “theory-driven interventions,” indicating that a developed theoretical framework or mechanism of change explicitly drove how authors designed the intervention. For example, in the introduction to their study, I. M. Evans and Bingham (2007) developed a theoretical framework claiming that the inclusion of choices is an essential element in programs for children with disabilities in order to promote autonomy and well-being; accordingly, the equine-assisted activity intentionally fostered choice and control. As another example, Silkwood-Sherer et al. (2012) posited that “hippotherapy provides benefits of mass practice in an activity that forces a client to develop and refine motor patterns with concurrent practice in integrating sensory information in a controlled environment as a whole-task activity” (p. 708). Hence, the intervention included activities that used different equine gaits, ground courses, and rider positions to intentionally provide massed practice to participants in responding to disturbances in postural control while integrating multiple sources of sensory information. Finally, using principles from applied behavioral analysis, Nelson et al. (2011) proposed that equine movement could be used as a reinforcement for social communication; in line with this assertion, the equine-assisted activity required participants to use verbal or nonverbal communication to begin an activity, which was reinforced by the horse beginning to walk. These few studies demonstrated that some authors formulated theoretical frameworks that explicitly informed the intervention design.

While most authors did not intentionally design an intervention based on pre-existing theoretical beliefs, 19 of the 33 studies (58%) did contain interpretations of findings that generated theoretical hypotheses, and thus we coded them as “theory or hypothesis generating.”

For example, Bass et al. (2009) found improvements in fewer sedentary behaviors and speculated that “it is possible these results were obtained because interaction with a horse demands a high level of active and physical engagement” (p. 1266). Furthermore, Gabriels et al. (2012) wrote, “the increased expressive communication behaviors observed in this study were unexpected in this pilot study, and may have been influenced by the human–horse interaction engaging and motivating experience inherent in the THR [therapeutic horseback riding] intervention.” (p. 586). These studies demonstrate that some authors attempted to interpret their findings in light of potential mechanisms or theoretical frameworks.

In summary, most studies contained general theoretical suppositions about the therapeutic nature of the intervention, and many authors interpreted their findings to generate theoretical hypotheses. However, less than half of the studies contained an explanation for inclusion of certain intervention components, and even fewer intentionally designed an intervention based on a well-developed theoretical framework.

Aim 2a: Rich Descriptions of the Most Prevalent Mechanisms of Change

Table 3.2 lists the ten most prevalent informal mechanisms found in the research studies, ordered by frequency from left to right, and illustrates which studies identified each mechanism. The following sections provide rich descriptions, generated from both research and non-research papers, of each of the most prevalent mechanisms. These mechanisms were not always found to be completely distinct from one another, but rather, to be occasionally co-defining or mutually influential. Therefore, we next present the mechanisms of change in an order relevant to how they relate to one another, to help illuminate logical linkages among them.

Horse-human Interaction. Eighteen of the 33 studies (55%) proposed that there was therapeutic value in the horse-human relationship. For instance, some authors suggested that if a

child is bonded to the horse, then the child may exhibit fewer problem behaviors throughout the therapy session (e.g. Hawkins et al., 2014). Other authors suggested that children may be able to first form a social connection with the horse, which would then allow them to form a social attachment to people (Erdman et al., 2015; Hiromi Keino et al., 2009; Kern et al., 2011). For example, Erdman et al. (2015) wrote, “horses can serve as ‘transactional objects’ allowing a child to bond first to the animal and then to other people” (p. 21). Similarly, Siporin (2012) referenced attachment theory and claimed that “a friendly therapy horse can serve as a supplemental attachment figure” (p. 460). Some authors posited that the presence of horses was beneficial because horses promote social interaction (Chen et al., 2015; Erdman et al., 2015; Rothe, Vega, Torres, Soler, & Pazos, 2005). For example, Rothe et al. (2005) wrote, “conversation and socialization are stimulated through interaction with the animal” (p. 380). Furthermore, some authors suggested interaction with horses can teach children with ASD improved self-control because aggressive behaviors are not tolerated around the horses. For example, Biery (1985) wrote that a boy “now modifies his behavior while mounted, knowing that lack of self-control will lose him the one experience that he craves—contact with the pony” (p. 350). As next described, several authors proposed that this horse-human interaction was particularly beneficial due to the unique nature of horses.

Equine Qualities. Seven of 33 studies (21%) described how various qualities unique to horses contributed to the value of EAATs. Several authors described how the horse’s sensitivity and reactions to human behaviors can benefit children with ASD. For example, Gabriels et al. (2012) wrote, “While ASD is characterized by a lack of human social understanding, horses are highly social animals who will respond to subtle human cues (Grandin, 1997). Such responsiveness is important for the cause-and-effect concrete learning styles of individuals with

an ASD” (p. 586). In addition to horses’ natural sensitivity, several physical aspects of a horse were hypothesized to contribute favorably to the intervention. Granados and Agis (2011) wrote, “Temperature of the body of the equine is about 1°–5° higher than that of a human... Relaxation exercises performed on the back of a horse, allowing the rider to feel the warmth and the massaging motions of the horse, enhance the rider’s overall sense of relaxation” (p. 193). And Erdman et al. (2015) wrote, “the size of horses creates a unique perception by children, who are usually awed by their size and power” (p. 22). Several authors also proposed that the quality of movement produced by the horse and transferred to the rider can be therapeutic, which we describe further in a separate section. These unique characteristics of horses may all offer important contributions to EAATs.

Communication. Eight of the 33 studies (24%) proposed that the communication involved in EAATs is beneficial for the participant. Authors claimed that receptive, expressive, verbal, and nonverbal communication are all emphasized in various EAATs. For example, Ajzenman et al. (2013) claimed, “The social opportunities provided in the HPOT setting could enhance receptive communication, because participants practiced attending, comprehending, and completing instructions provided by their therapists during turn taking, planning, and sequencing activities” (p. 660). Furthermore, Rothe et al. (2005) suggested, “When the horse responds to [a] request when being led or ridden, the horse subordinates power to the child [and] the therapist can observe, comment and instruct the child in effective development of communication skills, both verbal and nonverbal” (p.381). This need for effective communication was present during both mounted and unmounted activities. Erdman et al. (2015) described, for instance, that “in groundwork activities, the child is solely responsible for the movement and behaviors of the horse so the need for effective interactive skills is particularly emphasized” (p. 24). Ratliffe and

Sanekane (2009) similarly noted that “Verbal and nonverbal communication is essential between horses and humans in order to cooperate during riding” (p. 37).

Many authors posited that opportunities for communication are particularly valuable because the horse provides an immediate reward for effective communication. For example, Biery (1985) wrote, “the student strives to coordinate his hands and legs, to master a skill such as halting the horse. The horse consistently refuses to respond until the task is done correctly and then he gives credit where credit is due” (p. 352). Furthermore, Gabriels et al. (2012) wrote:

If the child says ‘Walk on’, the horse responds... A horse’s immediate response to the behaviors (however subtle) of an ASD child can be used in treatment to help the child better understand or become more aware of the impact of his or her social-communication behavior (p. 586).

Nelson et al. (2011) referenced applied behavioral analysis while making a similar claim, suggesting, “increased social behavior could be the function of a reinforcer/behavior contingency. Within the context of riding the horse, the contingency would be between horse movement and social behavior” (p. 646). Therefore, in addition to effective communication, several authors also suggested that EAATs can foster appropriate social interaction.

Social Interactions with People. Fifteen of the 33 studies (45%) suggested the social interactions that occur throughout the intervention are beneficial; these interactions were with the instructor, volunteers, other participants, and even family members. For instance, Bracher (2000) claimed that equine-assisted therapies “require appropriate skills to effect a positive working relationship with the horse and other riders” (p. 279). Lanning et al. (2014) claimed that equine-assisted activities provide “structure and support for social skills development” (p. 1905). Furthermore, some authors suggested that EAATs promote joint attention skills; joint attention is commonly impaired in children with ASD. For example, Ward et al. (2013) claimed, “It may be that during TR the horse provides a shared reference for children with ASD and the instructor,

and the behavior expectation is isolated so that the child with ASD knows what to attend to” (p. 2197). Gabriels et al. (2015) furthermore suggested, “One hypothesis is that riding and working together with the horse to engage in therapeutic riding activities involves a nonverbal joint attention or shared attention experience that may serve as a platform for improving behaviors and social-communication skills” (p. 547). Granados and Agis (2011) claimed that equine-assisted therapies affect social interaction on three levels:

On one level, ... especially with peers who come to the group or other sessions, the child has the opportunity to share experiences and stories. On another level, because a number of helpers are needed in the therapy sessions, the child must develop relationships with them in order to communicate more successfully with the horse. On a third level, when the child leaves the therapeutic setting, the child returns to the world eager to report to those around him or her about their riding experiences. (p. 195)

These social interactions may also contribute to the recreational nature of EAATs.

Recreational Benefits. Six of the 33 studies (18%) suggested that participants benefit from the recreational nature of EAATs. Many authors suggested that the nature of horseback riding makes it an ideal recreational pursuit for this population.

This activity is particularly well matched to the specific characteristics of persons with autism, since it is based on an individual activity but at the same time brings into play multiple interactions in a context which is more structured and less chaotic than other team sports. Its essence is communication that is tactile and epidermal with the animal rather than verbal (which is usually altered in persons with ASD), and it is performed in a highly motivating natural environment. Thus, horse-riding, with the necessary adjustments to adapt it to this group of persons, is a sports and leisure activity that can well form part of the repertoire of activities suggested for persons with ASD. (García-Gómez et al., 2014, p. 121)

Several authors suggested that children who participate in EAATs may reap physical, social, and emotional benefits associated with engagement in recreational pursuits. For example, Zabriskie et al. (2005) claimed, “sport can have a positive impact on the identity formation of youth with disabilities by increasing their skills and competence; offering outlets for emotional expression, social interaction, and connections with others with a disability; and decreasing

awareness of disability” (p.180). Furthermore, Liddiard (2009) reported that “increased self-confidence and esteem, fitness and social benefits have been associated with engagement in a physical activity, particularly for children who have disabilities, whose physical activity levels are typically lower than non-disabled peers” (p. 85). Finally, children may be motivated to actively engage in EAATs due to their recreational and fun nature.

Motivation. Twelve of the 33 studies (36%) suggested that EAATs may be particularly motivating. Authors hypothesized that several different aspects of interventions may be motivating. For example, Bass et al. (2009) proposed that “The act of riding the horse may have been perceived as a rewarding stimulus that accounted for higher levels of motivation” (p. 1266). Berg (2014) claimed that “the bond formed between horse and participant is very likely a powerful motivating factor” (p. 74). Liddiard (2009) proposed that the context in which therapy occurs may be motivating: “performing therapy away from the clinic or classroom, while participating in an enviable activity, can foster necessary motivation and engagement to attempt challenging tasks and learn skills” (p. 75). Finally Biery (1985) posed that the element of risk involved in riding may improve motivation:

A hormone is released into the body during a risk activity and this might explain the feelings of euphoria and elation experienced by the student in a therapeutic riding session. Instructors and parents frequently observe this euphoria; many believe this elation may account for the increased motivation on the part of the student. (p. 346)

Regardless of what element of EAATs is motivating, most authors agreed that this motivation encourages active and sustained engagement in the therapy session, therefore improving outcomes. Lessick, Shinaver, Post, Rivera, and Lemon (2004) wrote, for instance, that “while traditional therapies often reach a plateau where a patient may lose motivation to keep trying, the excitement of riding stimulates the rider and encourages many patients to work through discomfort and increasing challenges” (p. 49). Furthermore, Ajzenman et al. (2013)

claimed that “performance of goal-oriented motor and imitation activities in children with ASD is typically more meaningful in purposeful situations, promoting willingness to engage in motor-based activities with peers (Baranek, 2002). HPOT has been suggested to have similar effects” (p. 654). Therefore, the motivating nature of EAATs may make other aspects of the intervention, such as the therapeutic effect of equine movement, more salient.

Equine Movement. Fourteen of the 33 studies (42%) claimed that the movement produced by the horse had positive effects on the rider. Several authors claimed that equine movement challenged and developed postural control or balance. As explained by Ajzenman et al. (2013), equine movement can be used to target postural control, ultimately improving participants’ ability to perform functional tasks:

Postural control was further challenged because the horse took several thousand steps during each treatment session. We theorize that the participants had to repeatedly respond to the variability in the horse’s movement, promoting learned righting and equilibrium reactions to remain stable to perform activities during therapy (Shurtleff et al., 2009). Involvement in HPOT thus has the potential to enable children with ASD to use newly improved automatic postural mechanisms to improve stability while standing and performing functional tasks. (p. 660)

Several authors also claimed that the three-dimensional movement of the horse, transferred to the rider, mimicked the typical pelvic motion of walking and therefore improved gross motor skills. Furthermore, Liddiard (2009) claimed that equine movement promoted attention: “rapidly changing speed or direction challenged attention and promoted active engagement in the session activities” (p. 80). In addition to challenging gross motor skills and promoting optimal attention throughout the therapy session, many authors claimed that the movement of the horse provided a beneficial sensory experience for children with ASD, as next described.

Sensory Experience of Riding. Thirteen of the 33 studies (39%) claimed that the sensory experience of riding a horse was beneficial for participants. Several authors claimed that

the demand to integrate sensory information during challenging motor tasks further improved gross motor outcomes. For example, Silkwood-Sherer et al. (2012) wrote, “Not only is the child required to react to the pelvic perturbations, but also the simultaneous forward movement through space provides an opportunity to respond to a variety of somatosensory, vestibular, and visual stimuli” (p. 708). Going beyond the focus on motor skills, several authors commented on the multisensory nature of EAATs, which provide a multitude of vestibular, proprioceptive, tactile, auditory, olfactory, and visual inputs. Granados and Agis (2011) brought in the theory of neuronal group selection when they hypothesized the value of this multisensory experience, stating, “Neuronal plasticity allows children undergoing hippotherapy to learn and develop new connections in the brain through the multisensorial stimulation that hippotherapy offers. In turn, these connections allow the learning of new skills for functioning in the world” (p. 194). Furthermore, some authors suggest that the sensory experience of riding a horse can promote optimal arousal during therapy. As posed by Gabriels et al. (2012), “Horses may help organize or provide input to the ASD child’s sensory system. This factor may contribute to helping the child feel calm” (p. 586). Liddiard (2009) similarly posed that “the speed and direction of the horse can be altered so that the sensory experience is more alerting or more calming – promoting attention and focus” (p. 76). Several authors drew on theoretical principles outside the industry of EAAT to describe the therapeutic effect of the sensory experience of riding. For example, some, but not all, authors related the sensory experience of riding to Ayres’ (1972) Sensory Integration Theory, which will be described further in Aim 2b. In addition, some authors drew on principles of motor learning.

Principles of Motor Learning. Four of the 33 studies (12%) integrated principles of motor learning to help explain the benefits of EAATs. No authors explicitly referenced a specific

motor learning theory, however principles such as the use of massed practice, feedback, task-oriented approaches, and the progression from gross to fine motor were all discussed. As explained by Silkwood-Sherer et al. (2012), “hippotherapy is a task-oriented strategy that allows children to discover their own solutions for improving postural control” (p. 708). In addition, Wuang et al. (2010) stated, “the child was encouraged to rely more on internal feedback and self-evaluation of performance than external feedback from others” (p. 121). Finally, Liddiard (2009) wrote, “Hippotherapy provides a whole body experience, engaging all of the senses in a repetitive and graded motor activity that requires an active response, thus optimising neural reorganisation for skilled performance” (p.76). Some authors proposed that this neurological reorganization and development occurs specifically in the cerebellum.

Cerebellar Stimulation. Five of the 33 studies (15%) hypothesized that TR may stimulate the cerebellum, a neuroanatomical structure often implicated in ASD. Within the included papers, the cerebellum was first mentioned in 1985, when Biery claimed that “the horse becomes the cerebellum, the unconscious part of the brain responsible for posture, balance, and coordination” (p. 348). However, in 2009 Bass et al. offered a more in-depth and ASD-specific hypothesis by describing that cerebellar abnormalities are common in individuals with ASD, and summarizing the cerebellum’s role in motor, sensory, and social functioning. Bass et al. (2009) then suggested, “it is possible that therapeutic horseback riding, an activity that demands motor learning skills, motor control, and social engagement, is linked to cerebellar functioning,” which may explain improvements in ASD symptoms (p. 1266). Several authors have since cited Bass’ hypothesis about the role of the cerebellum (See Table 3.2), but none has expounded upon or tested this hypothesis.

Aim 2b: Rich Descriptions of Formal Theories

Throughout the 54 papers in this review, we identified 10 formal theories that authors cited in relation to EAATs. We found no evidence of a formally developed theory specific to EAATs; rather, authors applied theories from outside fields to the equine context. In addition, authors often used formal theories to explain why certain components of an intervention may be beneficial, but rarely used the theory to design the intervention.

Theories of Sensory Integration. Five of the 54 papers (9%) referenced a theory of sensory integration. Three papers drew from Ayres' (1972) theory of sensory integration, while the other two papers referenced sensory processing theories in general, or Reeves' (2001) expansion on sensory integration theory. Drawing on Ayres, two non-research papers described that integration of information from all the senses is necessary for learning to occur (Bracher, 2000; Granados & Agis, 2011). For example, "Learning is dependent on the ability of normal individuals to take in sensory information derived from the environment and from movement of their bodies, to process and integrate these sensory inputs within the central nervous system and to use this sensory information to plan and organise behavior" (Bracher, 2000, p. 280). Two research studies claimed that children with ASD have particular difficulty processing sensory information (Ajzenman et al., 2013; Ward et al., 2013). For instance, "sensory processing theories suggest that children with ASD have decreased ability to regulate degree, intensity, and type of responses to sensory information, resulting in limited abilities to habituate and adapt during daily activities" (Ajzenman et al., 2013, p. 654). Three papers suggested that the multisensory experience of EAATs—including tactile, proprioceptive, vestibular, visual, auditory, and olfactory input—leads to improved sensory integration (Bracher, 2000; Granados & Agis, 2011; Wang et al., 2010). For example,

Our sense of touch, smell, taste, sight and sound, as well as physical movement and body awareness must function together. Sensory integration during hippotherapy occurs when riding stimulates the tactile sense, both through touch and environmental stimulation. Also, the vestibular system is stimulated by the horse's change of direction and speed... The olfactory system responds to many smells involved in a horse stable and ranch environment. Vision is used in controlling the horses. The many sounds of the ranch help to involve the auditory system. All of these senses work together and are integrated during the act of riding. (Granados & Agis, 2011, p. 193).

Dynamic Systems Theory. Two of the 54 papers (4%) referenced dynamic systems theory. Granados and Agis (2011) proposed that human behavior is determined by interactions among three main systems: the person, the task and the environment. Each of these systems has constraints, which determine how they interact with one another; developmental outcomes emerge from the interactions between systems. Granados and Agis claimed that “movement patterns in the patient emerge during hippotherapy as a result of the self-organizing process involving the interaction of multiple constraints” (p. 192). In particular, postural control, arousal, and motivation are important constraints in the child, while temperature and rhythm are important constraints within the horse. In contrast, Ratliffe and Sanekane (2009) referenced dynamic systems theory with more emphasis on systems within the child, stating:

Horseback riding is believed to influence multiple systems including sensorimotor (balance, touch, awareness of body position, eye movements, body movements), cognition, respiration, speech production, and behavioral, social and psychological domains (Casady & Nichols-Larsen, 2004; Heine, 1997). The interactions between these systems cause changes in the systems themselves including improvements in balance, strength, endurance, perception, and other functional skills. (p. 37)

Model of Human Occupation. Two of the 54 papers (4%) referenced the Model of Human Occupation (Kielhofner & Burke, 1980), a conceptual practice model in occupational therapy. Bracher (2000) gave an overview of the model, stating “the human being should be viewed as an open system, composed of three hierarchical subsystems: volition, habituation and performance. These three subsystems closely interrelate to control the choices people make in

engaging in particular occupations” (p. 279). Bracher went on to give examples of how TR may affect volition, through claims such as “the individual with a disability is able to feel in control through achievement in riding or care of the horse” (p. 279). Similarly, Taylor et al. (2009) used the Model of Human Occupation to introduce the concept of volition, which was the outcome measured in their study of HPOT.

Bandura’s Theory of Self-efficacy. Two of the 54 papers (4%) referenced Bandura’s (1977) theory of self-efficacy. Both papers claimed that self-efficacy can be fostered through four main methods: “positive feedback, emotional arousal, successful performance, and vicarious experience” (Westerman, Stout, & Hargreaves, 2012, p. 38). Westerman, Westerman, Hargreaves, and Verge (2008) claimed that these methods can be embedded within an equine-assisted activity. For example, “the vicarious experience aspect of the model is implemented by offering, when needed, a model of the new behavior that the instructors ask the riders to perform” (p. 62). Westerman et al. (2012) went on to describe how a TR program integrated a mentoring approach into their program, whereby volunteers served as mentors to the riders, intentionally fostering self-efficacy throughout the intervention. This paper also cited Vygotsky’s (1978) theory of zone of proximal development to explain how mentors can help riders achieve more difficult tasks by offering assistance.

Other Formal Theories. Each of the following formal theories was mentioned in one of the 54 included papers (2%): Vygotsky’s zone of proximal development (as cited in Westerman et al., 2012), applied behavioral analysis (as cited in Nelson et al., 2011), and theory of neuronal group selection (as cited in Granados & Agis, 2011). Siporin (2012) cited attachment theory, psychoanalytic theory, and Kohutian theory. We have already described most of these formal theories as they were relevant to the informal mechanisms of change identified in Aim2a.

Aim 3: Mechanisms of Change Associated with Specific Interventions

The mechanisms of change presented above were not found uniformly across all studies, but rather varied based on the type of intervention, indicating that certain types of EAATs drew more strongly on certain theoretical suppositions. While most types of EAATs were only examined in a few studies, TR and HPOT were investigated in five or more studies. We next describe the prominent mechanisms of change associated with TR and HPOT.

Therapeutic Riding. The most common mechanisms of change in the 17 studies of TR were horse-human interaction (10 studies; 58%), the sensory experience of riding a horse (9 studies; 53%), the movement of the horse (7 studies; 41%), social interactions with people (7 studies; 41%), motivation (6 studies; 35%) and communication (6 studies; 35%). A strong emphasis on social aspects of TR, including social interactions and communication with the horse and the people who were present, was thus evident. In addition, many authors discussed the physical experience of riding, focusing on equine movement that challenged gross motor skills and multisensory experiences of riding. Finally, many papers suggested that children actively engaged in both social and physical aspects of the intervention due to the horse's motivating power.

Hippotherapy. The most common mechanisms of change in the five studies of HPOT were motivation (4 studies; 80%), movement of the horse (3 studies; 60%), principles of motor learning (3 studies; 60%), and the sensory experience of riding a horse (2 papers; 40%). Three studies of HPOT presented remarkably similar mechanisms, proposing that equine movement can be manipulated by an occupational therapist (Ajzenman et al., 2013; Liddiard, 2009) or a physical therapist (Silkwood-Sherer et al., 2012) to challenge and improve the rider's postural control. Authors drew on several mechanisms to explain how HPOT challenged postural control:

the movement of the horse disrupts the child's center of balance; riders get massed and random practice in developing their own motor-responses to functional activities they find motivating; riders must integrate and respond to a variety of sensory information; and challenges to postural control can be graded by altering the horses' speed and direction, and the rider's position.

Silkwood-Sherer et al. (2012) summarized these mechanisms well: "Hippotherapy provides the benefits of massed practice in an activity that forces a client to develop and refine motor patterns with concurrent practice in integrating sensory information in a controlled environment as a whole-task activity" (p. 708). Conversely, two studies did not have this strong focus on motor development, but rather examined outcomes more related to social functioning, such as volition (Taylor et al., 2009) and levels of oxytocin (Tabares et al., 2012); the mechanisms leading to such improvements in social development were not clearly developed.

Discussion

In this systematic mapping review, we identified 33 research papers and 21 non-research papers of relevance to EAATs for children with ASD, and systematically extracted information to illuminate the current state of theoretical development of this body of literature. The first mention of ASD in peer-reviewed literature about EAATs occurred in 1985. Yet, it was not until 2003 that the effects of EAATs on children with ASD were first studied. Overall, the theoretical frameworks supporting EAATs for children with ASD were in early development. While many authors proposed mechanisms of change, few intentionally designed interventions based on a well-developed theoretical framework. No studies aimed to test or further refine an existing theory. We next critically evaluate the current state of theoretical development and propose three promising theoretical frameworks derived from the literature.

State of Theoretical Development and Emerging Theoretical Frameworks

Across the 54 papers included in this review, we identified several formally-developed theories that authors have related to EAATs for children with ASD. These formal theories may contribute to our understandings of EAATs; yet because they do not explicate the unique contributions of horses and equine environments, we propose that they are insufficient as stand-alone theoretical frameworks for EAATs. Authors also proposed a wide variety of mechanisms of change that may help to explain the process by which different types of EAATs promote positive outcomes in children with ASD. Yet authors only rarely applied theoretical understandings of mechanisms of change to their designs of interventions. Mechanisms of change must be more than speculative; that is, they must be explicitly linked to how interventions are devised and delivered, and to specific targeted outcomes (Fleury & Sidani, 2012). The heterogeneous nature of different types of EAATs will necessitate that future researchers develop individualized theoretical frameworks for distinct interventions, thus justifying the wide variety of intervention components and targeted outcomes that have previously been found across different interventions (reference omitted for blinding).

Conceptual development of a theoretical framework requires an explanation of the interdependence of the key elements of the theory (Lynham, 2002). We found that authors often only presented a few mechanisms of change in their papers, and oftentimes separately from one another; in practice, however, multiple mechanisms likely work in concert to effect change. There is thus a need to further explore how the many mechanisms of change identified in this systematic mapping review relate to one another and work together to effect beneficial outcomes in children with ASD. Further conceptual development of theoretical frameworks, and their operationalization into specific intervention components, will help future researchers confirm or

disconfirm key elements of proposed frameworks (Lynham, 2002). This phased, systematic approach is considered best practice for developing and evaluating complex interventions, since strong emphasis on theory development in early phases of intervention development is “more likely to result in an effective intervention” (Craig et al., 2008, p. 9).

Mechanisms of change often cannot be directly tested, but rather must be inferred by the convergence of multiple criteria (see Kazdin, 2007). One important criterion is that the proposed mechanism is plausible and coherent, that is, it is reasonable and aligns with other relevant research. We integrate below several identified mechanisms of change that seemed plausible, and coherent with one another and outside research. In doing so, we propose three theoretical frameworks (Figures 2, 3 and 4) that we regard as especially promising and identify the four key elements of each: problem(s), mechanisms, intervention components, and outcomes (Fleury & Sidani, 2012). Lastly, we propose steps for further developing each framework, based on Lynham’s (2002) five phases of theory development in applied disciplines: conceptual development, operationalization, confirmation or disconfirmation, application, and continual refinement.

Proposed theoretical framework: Occupational therapists and physical therapists may manipulate equine movement to challenge and improve postural control, possibly leading to improvements in gross and fine motor skills, and participation in daily activities.

Figure 3.2 illustrates this proposed theoretical framework. Children with ASD demonstrate impairments (*problems*) in gross and fine motor skills (Green et al., 2009), including impairments in postural control (Mache & Todd, 2016). Supported by several studies, we propose that occupational therapists and physical therapists can manipulate equine movement to challenge and improve riders’ postural control (Ajzenman et al., 2013; Liddiard, 2009;

Silkwood-Sherer et al., 2012). This assertion is coherent with outside literature reporting that HPOT can improve postural control in other populations, including children with cerebral palsy (Zadnikar & Kastrin, 2011) and adults with multiple sclerosis (Bronson, Brewerton, Ong, Palanca, & Sullivan, 2010). Improvements in postural control may occur through several different *mechanisms* identified in these studies: movement of the horse, manipulated and graded by the therapist, disrupts the child's center of balance; children experience massed and random practice in developing motor-responses in the context of a functional, motivating activity; and children must integrate and respond to a variety of sensory information. These principles are coherent with clinical recommendations for habilitating postural control in children, which include massed and random practice in reacting to disturbances in postural control, "functionally meaningful movements under varied conditions" (p. 39) and "gradually increasing the complexity of the sensory information" (Westcott & Burtner, 2004, p. 42).

Authors posited that improved postural control would also lead to improved gross motor and fine motor skills (*outcomes*), which is coherent with research that suggests postural control predicts motor abilities in children with ASD (Mache & Todd, 2016). In addition, authors hypothesized that improved motor control would lead to improved performance or participation in daily activities. While there is evidence that motor skills are related to daily living skills in children with ASD (Jasmin et al., 2009), prevailing thought in occupational therapy suggests that interventions solely targeting motor skills are insufficient; targeting of the environment and task demands is also necessary (e.g. Egilson & Traustadottir, 2009; Sood, LaVesser, & Schranz, 2014). Therefore, we suggest that treatment strategies focused on the manipulation of equine movement, or HPOT, may be one part of more comprehensive professional services by occupational therapists and physical therapists.

This theoretical framework is the most developed thus far. Silkwood-Sherer et al. (2012) provided a treatment protocol that operationalized this theoretical framework into *intervention components*, and three studies provided preliminary efficacy evidence that HPOT can indeed improve postural control, gross and fine motor skills, and performance or participation in everyday activities (Ajzenman et al., 2013; Liddiard, 2009; Silkwood-Sherer et al., 2012). However, all three studies implemented small sample sizes without control groups, and only one study was specific to children with ASD (Ajzenman et al., 2013). Thus, future research can focus on larger-scale, more rigorous studies to confirm and refine this theoretical framework.

Proposed theoretical framework: An equine-assisted activity or therapy may simultaneously motivate, capture attention, and provide physiological regulation, therefore promoting the child's engagement in the intervention, which may serve as a platform for social development and optimize other targeted outcomes.

Figure 3.3 illustrates this theoretical framework. The *problem* addressed is that children with ASD generally have impairments in social attention (Dawson et al., 2004) and joint engagement (Adamson, Bakeman, Deckner, & Ronski, 2009). A lack of social engagement and preference for non-social activities leads to further social impairment in children with ASD throughout the course of development, as children miss opportunities to learn from social situations (Jones & Klin, 2009).

Drawing upon several of the *mechanisms* identified in this review, we propose that an equine-assisted activity or therapy may promote active engagement in children with ASD. First, horses may be a particularly powerful motivator for children, motivating them to actively engage in intervention activities, which is coherent with outside literature that demonstrates that children with ASD are more social in the presence of animals (Fung & Leung, 2014; O'Haire, McKenzie,

Beck, & Slaughter, 2013; Silva, Correia, Lima, Magalhães, & de Sousa, 2011). In line with this mechanism, Beetz (2017) suggested that humans' innate affinity toward nature (i.e., the biophilia hypothesis), in addition to the experiential quality of interacting with animals triggers participants' intrinsic motivation. Second, the very nature of learning to ride a horse requires joint attention between the rider and the instructor/therapist, therefore capturing the child's attention and promoting engagement. Finally, equine movement and rider positions can be altered to be alerting or calming to promote optimal physiological arousal and support the child's ability to remain engaged. The use of equine movement to regulate arousal is in line with the common practice of using tactile, vestibular, and proprioceptive input to help regulate children's arousal levels (Lane, in press). Each of these three mechanisms, identified in this review, may work in concert to promote the child's active and sustained engagement in the intervention. Furthermore, these mechanisms are aligned with outside research. Three common components of best-evidence interventions for social communication in children with ASD include: (a) adult direction inserted into an (b) interactive activity the child is motivated to engage in, that also (c) addresses physiological regulation (Bottema-Beutel, Yoder, Woynaroski, & Sandbank, 2014).

A recent study investigated equine-assisted occupational therapy aimed at maximizing engagement in children with ASD (Llambias, Magill-Evans, Smith, & Warren, 2016); the authors monitored the fidelity of the intervention, therefore operationalizing this theoretical framework into *intervention components*. Children with ASD were more engaged during equine-assisted occupational therapy than they were during activities in a playroom, thus providing preliminary evidence in support of this theoretical framework.

Increased engagement during the intervention could plausibly contribute to a variety of *outcomes*. First, it is theorized that if children are engaged in their social environment, social

learning naturally occurs (e.g., body language, facial expressions, language, emotions) (Jones & Klin, 2009); therefore, simply being engaged in an equine-assisted activity or therapy could serve as a platform for social development. This potential outcome is coherent with research that found children with ASD who received an intervention targeting shared engagement also demonstrated improvements in language, play, and cognition (Chang, Shire, Shih, Gelfand, & Kasari, 2016). Second, increased engagement in an equine-assisted activity or therapy could make the intervention itself more potent, thus optimizing a variety of targeted outcomes. Take, for example, HPOT aimed at improving postural control. Children in this context may be very engaged in challenging motor tasks presented to them; hence they may experience larger improvements in postural control than would have otherwise occurred had they been distracted or un-engaged. In other words, increased engagement during an equine-assisted activity or therapy is a potential mediator of a variety of targeted outcomes.

One study thus far has addressed the conceptual development and operationalization of this theoretical framework (Llambias et al., 2016). Therefore, more research is needed to refine the conceptual development of the theoretical framework, continue to operationalize it into specific intervention components, and confirm or disconfirm engagement in an equine-assisted activity or therapy as a platform for social development and a mediator of other targeted outcomes (Lynham, 2002).

Proposed theoretical framework: An equine-assisted activity or therapy could positively reinforce social communication and provide structure and support for social interactions, thereby improving social communication.

Figure 3.4 illustrates this proposed theoretical framework. ASD is characterized by impairments (*problems*) in social communication and social interaction (American Psychiatric

Association, 2013). Drawing on several mechanisms of change presented in the literature, we propose that an equine-assisted activity or therapy can be tailored to address social communication and social interaction (*outcomes*). Several authors proposed that EAATs require both receptive and expressive communication; we propose the provider can grade these demands for communication to present the just-right challenge for each child. Furthermore, the provider can differentially reinforce appropriate social communication, and manipulate equine movement (i.e., walking, trotting) as particularly powerful reinforcements. The immediate and tangible nature of equine movement as a reinforcement for social communication may cater to the children's concrete learning style. This *mechanism*—concrete positive reinforcement for effective communication—is coherent with research that demonstrates reinforcement is an evidence-based practice to promote communication in children with ASD (Odom, Collet-Klingenberg, Rogers, & Hatton, 2010).

In addition to fostering communication, Lanning et al. (2014) suggested an additional *mechanism*: EAATs may provide structured support for social interactions. The specific strategies, that is, *intervention components*, for supporting social interaction within different types of EAATs have not been explicated in the literature. However, it is conceivable that several strategies for social skill development could be incorporated into an equine-assisted activity or therapy, such as task analysis and chaining, prompting, self-management techniques, perspective taking, or knowledge of social rules (Bellini, Gardner, & Markoff, 2014; Odom et al., 2010). In addition, as piloted by Erdman et al. (2015), typically developing peers can be involved in the intervention, which is coherent with research that supports the use of peer-mediated interventions (Chang & Locke, 2016). Finally, it is conceivable that horses and the equine-environment could be incorporated into a social skills group; in their review of many

social skills interventions, Reichow and Volkmar (2010) classified social skills groups as an evidence-based practice for children with ASD. These strategies for social skill development may be particularly potent when incorporated into an equine-assisted activity or therapy due to the motivating and engaging nature of the intervention, as described in the previous section. Furthermore, as suggested by several authors, children may first develop social skills in the context of interactions with a horse, a less-threatening and highly-motivating social partner, before generalizing them to human interactions. Further research is needed to determine if children with ASD can generalize social skills learned with a horse to human interactions, especially given that children with ASD often have difficulty generalizing skills across settings (Rao, Beidel, & Murray, 2008). Perhaps contributing to this theoretical framework, recent theory-building research suggests that experiencing success in the context of an EAAT may foster self-concept and self-efficacy, thus promoting the child's improved social participation in daily life (Goodwin, Hawkins, Townsend, Van Puymbroeck, & Lewis, 2017; Martin, Graham, Taylor, & Levack, 2017).

There is preliminary evidence providing support for this proposed theoretical framework. First, Nelson et al. (2011) demonstrated that equine movement can be an effective reinforcement for social communication. Second, across the literature on EAATs for children with ASD, improvements in social interaction and communication are two of the most promising outcomes (reference omitted for blinding). However, the proposed mechanism that EAATs offer structured support for social interactions requires further development. What occurs during interventions that leads to improved social skills requires clarification. Coherence with outside research on social skill interventions for children with ASD also requires clarification. There is a critical need to operationalize this theoretical framework into specific intervention components, and then

confirm or disconfirm their efficacy through applied research; such investigation could illuminate the “active ingredients” that address social communication in EAATs.

Limitations

The database searches were intentionally broad to capture papers related to EAATs for all populations. However, we may have missed relevant papers for two reasons: (1) we did not include autism in the search terms, or (2) relevant papers may not have been indexed in databases. Additionally, we only included papers published in English, so papers published in other languages were not represented. We identified three promising theoretical frameworks, based on their plausibility and coherence with other literature, to advance the state of theoretical development and illuminate next-steps for research. Because, however, systematic mapping reviews do not include formal quality assessments of papers included in the review (Grant & Booth, 2009), we cannot verify the veracity of any identified mechanism of change or theoretical framework. Finally, we remained consistent with authors’ terms and conceptualizations of theoretical content, which may or may not be consistent with broader industry standards or relevant literature. Regarding formal theories, authors’ application of such theories to EAATs may not always be consistent with the intended use of the theory. Regarding the names of interventions, authors’ terms may not always be consistent with prevailing industry standards. For instance PATH Intl (2017) requires that a credentialed health professional provide an equine-assisted therapy, yet Hawkins et al. (2014) stated that a therapeutic riding instructor provided an intervention they called “equine-assisted therapy.”

Summary and Conclusions

To our knowledge, this is the only review that has aimed to synthesize the state of theoretical development of EAATs for children with ASD. To help promote future theory

development, we offered three plausible and coherent theoretical frameworks, each drawn from the reviewed literature and supported with outside research. We urge future researchers to continue the academic discourse by building upon, critiquing, or testing these potential theoretical frameworks. While the first proposed theoretical framework is largely specific to HPOT, the others may be generalizable to many different EAATs. Therefore, future work can also focus on the development and testing of theoretical frameworks for specific interventions. Development of the theoretical frameworks that support different types of EAATs for children with ASD can help to clarify for whom the intervention is appropriate, the processes that lead to change, essential components of the intervention, and what outcomes are likely to be produced. In conclusion, we propose that further theoretical development of different types of EAATs for children with ASD is a critical step that can ultimately lead to interventions that are most effective and most worthy of widespread dissemination.

Figures and Tables

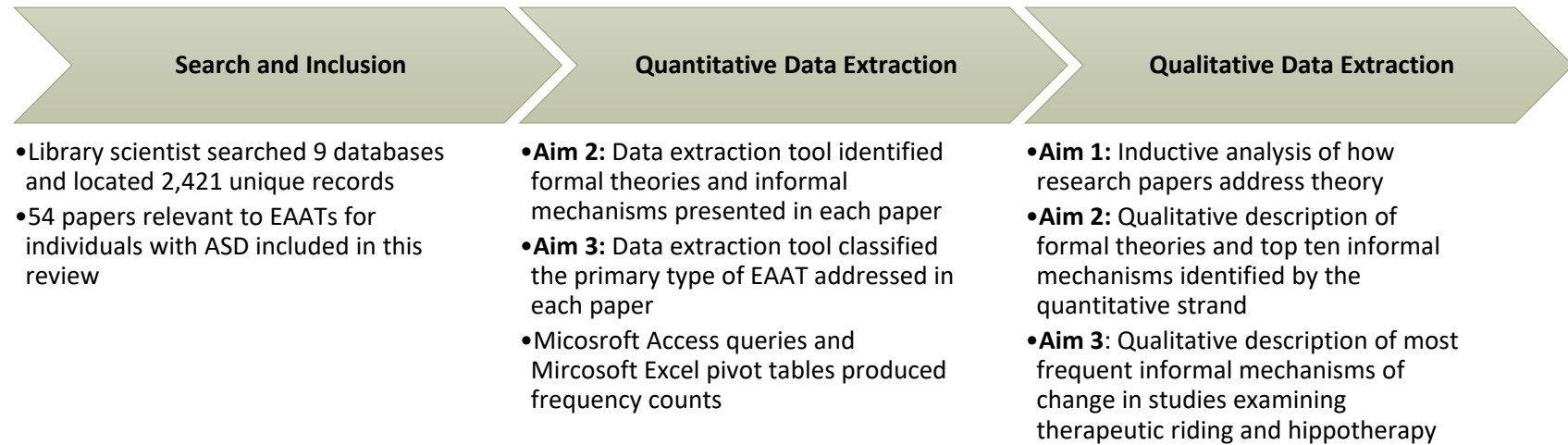


Figure 3.1. Summary of database searches, inclusion and exclusion coding, and quantitative and qualitative data extraction for each study aim.

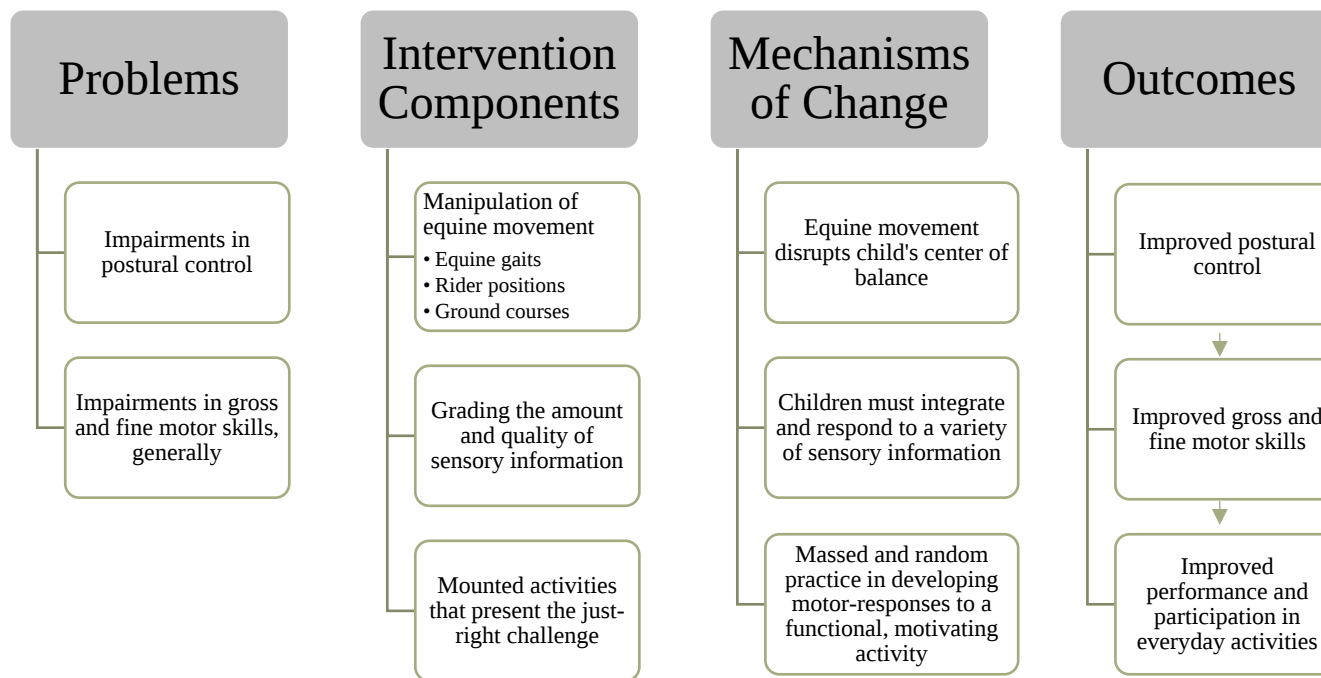


Figure 3.2. Proposed theoretical framework: occupational therapists and physical therapists may manipulate equine movement to challenge and improve postural control, possibly leading to improvements in gross and fine motor skills, and participation in daily activities.

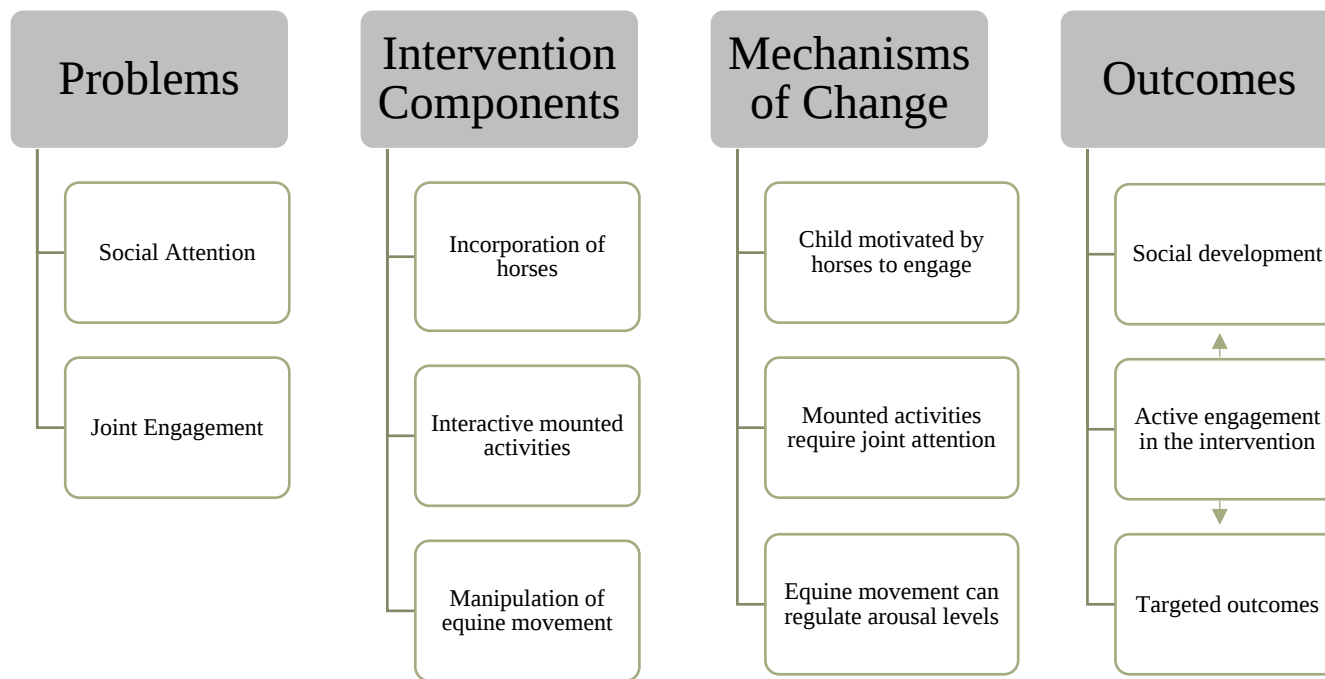


Figure 3.3. Proposed theoretical framework: an equine-assisted activity or therapy may simultaneously motivate, capture attention, and provide physiological regulation, therefore promoting the child's engagement in the intervention, which may serve as a platform for social development and optimize other targeted outcomes.

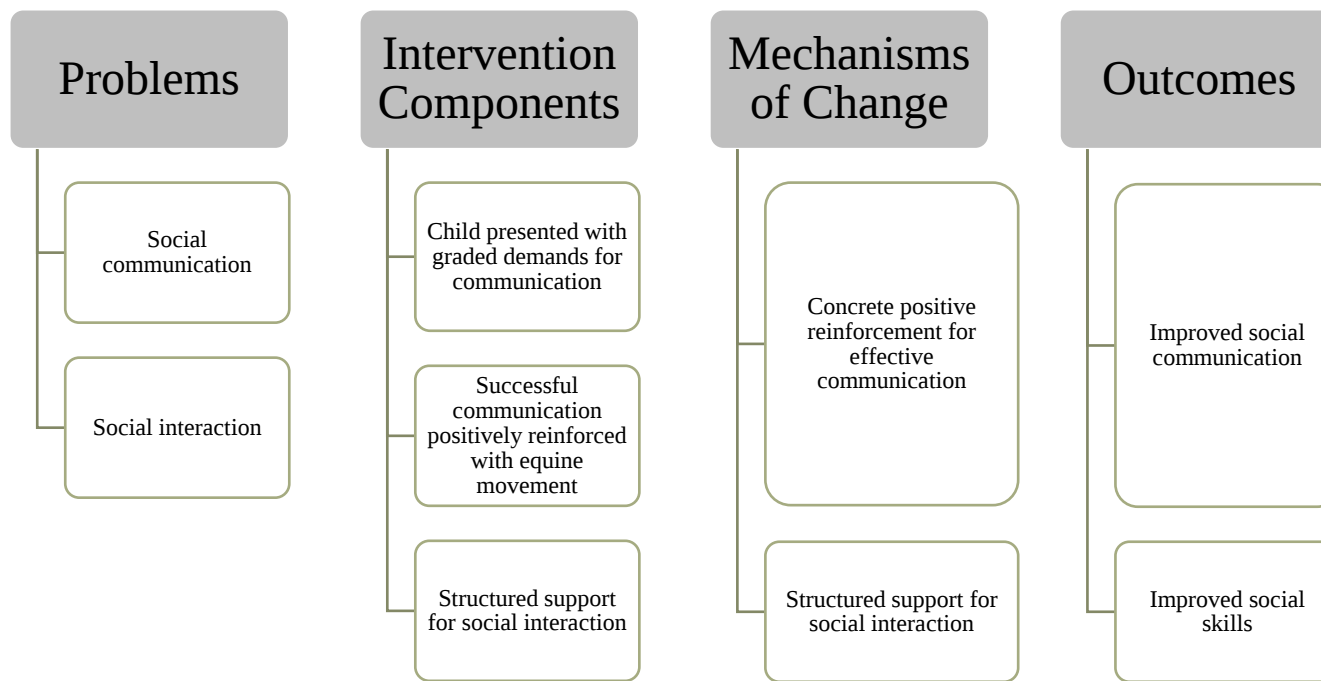


Figure 3.4. Proposed theoretical framework: an equine-assisted activity or therapy could positively reinforce social communication and provide structure and support for social interactions, thereby improving social communication.

Table 3.1

Inclusion and Exclusion Criteria

Inclusion	Exclusion
Peer-reviewed	EAATs are only a minor focus
Primary source	Provides a synopsis of a paper published elsewhere
Written in English	Not relevant to autism as determined by:
Published between 1980 – 2015	• < 20% of participants characterized as having ASD, AS, or PDD in research studies
Primarily focused on:	• Does not mention ASD, AS, or PDD as a population served by EAATs in non-research papers
• One or more kinds of EAAT; OR • Simulated horse of relevance to EAATs	
<i>Note.</i> EAATs = equine-assisted activities and therapies; ASD = autism spectrum disorder; AS = Asperger syndrome; PDD = pervasive developmental disorder	

Table 3.2

Theoretical Development of Research Pertaining to EAATs for Children with ASD

1 st Author (year)	Country	Type of EAAT		Diagnoses	Aim 1: How Theory is Addressed				Aim 2a: Informal Mechanisms of Change									
		EAA	EAT		Theory or Hypothesis Generating (19)	Theoretical Suppositions in Intro (17)	Rationale for Intervention Design (13)	Theory-driven Intervention (7)	Horse- Human Interaction (18)	Social Interactions (14)	Equine Movement (14)	Sensory Experience of Riding (13)	Motivation (12)	Communication (8)	Equine Qualities (7)	Recreational Benefits (6)	Cerebellar Stimulation (5)	Principles of Motor Learning (4)
Candler (2003)	US	TR	-	50% ASD/AS	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leitão (2003)	Portugal	PER	-	All ASD	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-	-
Zabriskie (2005)	US	CTR	-	22% ASD	-	-	-	✓	-	✓	-	-	-	-	-	✓	-	-
Evans (2007)	New Zealand	RDA	-	38% ASD	-	✓	-	✓	-	-	-	-	-	-	-	✓	-	-

Bass (2009)	US	TR	-	All ASD/AS	✓	✓	-	-	✓	-	-	✓	✓	-	-	-	✓	-
Keino, Keino (2009)	Japan	PER	-	All PDD	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
Keino, Funahashi (2009)	Japan	PER	-	All PDD/ ASD	✓	-	-	-	✓	✓	✓	-	-	✓	✓	-	-	-
Liddiard (2009)	Australia	-	HPOT	29% ASD	✓	✓	✓	-	-	-	✓	✓	✓	-	-	✓	-	✓
Taylor (2009)	US	-	HPOT	All ASD	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-
Hiromi (2010)	Japan	PER	-	All PDD	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
Memishevikj (2010)	Bosnia and Herzegovina	-	ST-EAT	All ASD	-	✓	✓	-	✓	-	-	-	-	-	-	-	-	-
Wuang (2010)	Taiwan	-	SDHR	All ASD	✓	✓	✓	✓	-	-	✓	✓	✓	-	-	-	-	✓
Kern (2011)	US	TR	-	All ASD	-	-	✓	-	✓	-	-	-	-	-	-	-	-	-
Nelson (2011)	US	TR	-	All ASD	✓	✓	-	✓	-	-	-	-	-	✓	-	-	-	-
Gabriels (2012)	US	TR	-	All ASD/AS	✓	-	-	-	✓	✓	✓	✓	✓	✓	-	-	-	-

Silkwood-Sherer (2012)	US	-	HPOT	25% PDD /ASD/AS	✓	-	-	✓	-	-	✓	✓	✓	-	-	-	-	✓
Tabares (2012)	Spain	-	HPOT	All ASD	✓	✓	✓	-	✓	-	-	-	✓	-	-	-	-	-
Ajzenman (2013)	US	-	HPOT	All ASD	✓	-	✓	✓	-	✓	✓	-	✓	-	-	-	-	✓
Ghorban (2013)	Iran	TR		All ASD	✓	-	✓	-	✓	✓	-	✓	✓	✓	✓	-	✓	-
Jenkins (2013)	US	TR	-	All ASD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kang (2013)	South Korea	TR	-	23% ASD	-	✓	-	-	-	-	✓	✓	-	-	-	-	✓	-
Ward (2013)	US	TR	-	All ASD	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	-	-	✓	-
Chen (2014)	US	GRM	-	50% ASD 50% TD	✓	✓	-	-	✓	-	-	-	-	-	✓	-	-	-
Garcia-Gomez (2014)	Spain	TR	-	All ASD	✓	✓	-	-	-	✓	-	-	✓		✓	✓	-	-
Hawkins (2014)	US	-	EAT-U	All ASD/ PDD	✓	✓	✓	-	✓	✓	✓	-	-	-	-	✓	-	-
Holm (2013)	US	TR	-	All ASD	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-

Lanning (2014)	US	TR	-	All ASD	✓	✓	-	-	✓	✓	✓	✓	-	-	-	-	-	-
Naidoo (2014)	South Africa	TR	-	All ASD	✓	✓	✓	-	✓	✓	✓	✓	-	-	-	-	-	-
Page (2014)	US	TR	-	All ASD/AS	-	✓	✓	-	-	✓	-	✓	-	-	-	-	✓	-
Erdman (2015)	US	EFL	-	50% ASD 50% TD	-	-	✓	-	✓	✓	-	-	-	✓	✓	-	-	-
Gabriels (2015)	US	TR	-	All ASD	✓	✓	-	-	✓	-	✓	✓	-	-	✓	-	-	-
Minoei (2015)	Iran	TR	-	All ASD	-	-	-	-	✓	-	-	-	-	-	✓	-	-	-
Steiner (2015)	Hungary	TR	-	All ASD	-	✓	-	-	✓	✓	✓	-	✓	-	-	✓	-	-

Note. US = United States; EAAT = equine-assisted activity or therapy; EAA = equine-assisted activity; EAT = equine-assisted therapy; TR = therapeutic riding; PER = psychoeducational horseback riding; CTR = community-based therapeutic recreation; RDA = riding for the disabled; GRM = grooming activity; EFL = equine-facilitated learning; HPOT = hippotherapy; ST-EAT = short-term equine-assisted therapy; SDHR = simulated developmental horseback riding; EAT-U = equine-assisted therapy unspecified; ASD = autism spectrum disorder; AS = Asperger Syndrome; PDD = pervasive developmental disorder; TD = typically developing.

Table 3.3

Non-research Papers that Mention ASD as a Population Served by EAATs

1 st Author (Year)	Country	Primary Type of EAAT
Biery (1985)	US	Multiple EAATs
DePauw (1986)	US	Multiple EAATs
Decker (1988)	New Zealand	EAA: Riding for the Disabled
Tyler (1994)	US	EAT: Equine Psychotherapy
Parsons (1996)	Canada	EAA: Therapeutic Riding
Bracher (2000)	England	EAT: Therapeutic Horse Riding and Occupational Therapy
Lessick (2004)	US	EAA: Therapeutic Riding
Hornacek (2005)	Slovak Republic	EAT: Hippotherapy
MacKinnon (2005)	Canada	EAT: Hippotherapy
Rothe (2005)	Spain	EAT: Equine-facilitated Psychotherapy
Young (2005)	England	EAT: Horsemastership and Occupational Therapy
Westerman (2008)	US	EAA: Therapeutic Riding
Luna (2009)	US	EAA: Therapeutic Riding
Ratliffe (2009)	US	EAT
Masini (2010)	US	EAT: Equine-assisted Psychotherapy
Granados (2011)	Spain	EAT: Hippotherapy
Thomas (2011)	US	EAT: Equine-assisted Psychotherapy
Siporin (2012)	US	EAT: Equine Psychotherapy
Westerman (2012)	US	EAA: Therapeutic Riding
Brandt (2013)	US	EAT: Equine-facilitated Psychotherapy
Berg (2014)	US	Multiple EAATs

Note. EAAT = equine-assisted activity and therapy; US = United States; EAA = equine-assisted activity; EAT = equine-assisted therapy.

CHAPTER FOUR: OCCUPATIONAL THERAPY IN AN EQUINE ENVIRONMENT FOR CHILDREN WITH AUTISM: A MULTIPLE BASELINE SINGLE-CASE EXPERIMENTAL DESIGN

Autism spectrum disorder (ASD) is a developmental disability characterized by restricted and repetitive behaviors and impairments in social interaction and social communication (American Psychiatric Association, 2013). Problematic behaviors are also common in children with ASD, including hyperactive behaviors (i.e., excessively active, impulsive, distractible) and irritable behaviors (i.e., self-injury, yelling, aggression, tantrums) (Kaat, Lecavalier, & Aman, 2014). Children with ASD therefore are at risk of experiencing occupational performance problems related to these impairments in social and behavioral functioning.

In a recent review (McDaniel-Peters & Wood, 2017), we found proof-of-concept evidence that equine-assisted interventions may decrease problematic behaviors and improve social functioning in children with ASD. To our knowledge, only four studies have investigated an equine-assisted intervention provided by an occupational therapist for children with ASD; the terms used to describe these interventions vary. Two studies measured outcomes relevant to social and behavioral functioning: Memishevikj and Hodzhikj (2010) found “equine-assisted therapy” improved core autism symptoms of some participants, and Llambias et al. (2016) found “equine-assisted occupational therapy” improved engagement in children with ASD, as measured during the therapy session and in a standard play room condition. Two studies found “hippotherapy” provided by an occupational therapist improved gross and fine motor skills of children with ASD, leading to improved performance and participation in daily activities (Ajzenman et al., 2013; Liddiard, 2009). In the current study, we extend this research by

investigating the effects of occupational therapy in an equine environment (OT^{ee}) on the occupational performance, behavior, and social functioning of children with ASD in their everyday contexts. We chose the term OT^{ee} because it foregrounds the importance of an occupational therapist designing the intervention, using the affordances of a horse and the equine environment.

An equine-assisted intervention is likely most effective when the practitioner understands the theoretical linkages of how the horse and equine environment can be incorporated into evidence-based practices (Llambias et al., 2016; Peters, Wood, Hepburn, & Bundy, manuscript in review). There are several occupational therapy practice guidelines for working on social and behavioral outcomes with individuals with ASD that may be readily applicable to the equine environment, including use of: activity-based interventions, behavioral techniques, physical activity, preferred interests, joint attention training, and multi-sensory activities (Tomchek & Koenig, 2016).

Moderate evidence supports use of activity-based interventions that engage children with ASD in collaborative tasks with the goal of increasing social skills; by nature, OT^{ee} is activity-based and can be structured by an occupational therapist to facilitate appropriate social interaction and address discrete social skills. Riding in particular may provide a powerful context for addressing joint attention, as joint attention between the rider, therapist, and horse is required in order to successfully complete mounted tasks (Gabriels et al., 2015). Furthermore, equine-related activities are often highly preferred, thus, behavioral techniques such as positive reinforcement for desired behaviors can capitalize on the highly motivating nature of horses. Finally, physical activities and multi-sensory activities both have moderate evidence suggesting they may improve behavioral regulation (Tomchek & Koenig, 2016); therefore, the physical

activity of riding in conjunction with the tactile, vestibular, and proprioceptive input received by the rider may aid in behavioral regulation. In particular, the therapist may manipulate equine movement by using different gaits (i.e., walking, trotting) to promote optimal arousal in the child with ASD, thus promoting improved engagement during therapy (Peters et al., manuscript in review). Overall, then, we propose that horses and the equine context provide powerful affordances that can be incorporated into occupational therapy for children with ASD.

The purpose of this study was to answer the question, what are the effects of OT^{ee} on occupational performance, behavior, and social functioning of children with ASD. We hypothesized that, in comparison to baseline, during and after 10 weeks of OT^{ee} participants' a) occupational performance on individualized goals would improve b) hyperactivity and irritability would decrease, and c) social functioning would improve.

Methods

This study implemented a multiple-baseline single-case experimental design. Participants were paired based on social communication abilities. Each pair was then randomized to a 6-week or 8-week no-treatment baseline phase, followed by 10 weeks of OT^{ee}. Colorado State University's Institutional Review Board approved all study procedures. Caregivers gave informed consent, and children with ASD gave verbal assent if able.

Instruments

Canadian Occupational Performance Measure (COPM). The COPM is a semi-structured interview administered by an occupational therapist during which caregivers identify problems in their child's ability to perform everyday life tasks (Law et al., 2014). While the full COPM interview was administered, the first author and occupational therapists collaborated with the family to establish an individualized occupational performance goal related to the child's

social and behavioral functioning, and which could be addressed given the nature of OT^{ee}. Certain goals were excluded if they were not a good fit for the equine context, for example, feeding goals. Types of goals are listed in Table 4.1.

Visual Analog Scale (VAS) Ratings of Individualized Goals. A VAS was used to track daily progress on individualized goals established by the COPM. A VAS is a simple tool that can be used to rate perceptions of a child's behavior. It requires the user to rate a behavior by placing a marker along a continuous scale, anchored at either end with a statement related to the goal behavior; poor performance is indicated on the left of the scale and strong performance is on the right. A VAS can be individualized to each participants' unique goals and is sensitive to behavioral change (Chafouleas, Sanetti, Kilgus, & Maggin, 2012). VAS ratings have concurrent validity with direct observation (R. L. Smith, Eklund, & Kilgus, 2018). Furthermore, the majority of variance in repeated VAS ratings is accounted for by changes in child behavior over time, indicating VAS is a reliable measure of behavior change, with reliability-like coefficients of 0.81 and 0.89 (Chafouleas et al., 2010). The first author created a VAS unique to each participants' individualized goal using Qualtrics, an advanced survey software.

Aberrant Behavior Checklist-Community (ABC-C). The ABC-C is a behavior rating scale that measures the extent of problem behaviors in children and adults with developmental disabilities. The irritability and hyperactivity subscales were used in this study. Test-retest reliability of parent-ratings on the ABC-C range from 0.80 to 0.95, and there is extensive evidence of concurrent validity with other measures of behavior (Aman & Singh, 2017) .

Social Responsiveness Scale-2 (SRS-2). The SRS-2 is a parent-report questionnaire that measures social functioning in domains related to ASD (Constantino, 2012). The 65-item questionnaire has five subscales: social awareness, social cognition, social motivation, social

communication, and restricted interests and repetitive behaviors. The SRS-2 was standardized on a sample of school-age children that closely matched the general U.S. population. The internal consistency coefficient for a clinical sample was 0.95, and test–retest reliability of the original Social Responsiveness Scale with similar items ranged from .88 to .95 (Bruni, 2014). The SRS-2 has evidence of concurrent validity with several other measures of social behavior.

Participants

Eight children met all inclusion criteria and were enrolled into the study; one participant dropped out of the study due to anxiety about missing school, and two participants were lost to follow-up. Therefore, seven participants completed the intervention, and five participants completed post-testing. One participant missed the first week of intervention, completing 9 weeks of baseline and 9 weeks of intervention. Table 4.1 provides participant characteristics and information on other services received throughout the baseline and intervention phases.

Inclusion criteria were: a) ages 6 – 12 years old, b) diagnosed with ASD, confirmed by meeting clinical cut-offs on the Social Communication Questionnaire (SCQ; ≥ 15) and the Autism Diagnostic Observation Schedule (ADOS), c) nonverbal IQ ≥ 55 as measured by the Leiter International Performance Scale – Third Edition (Leiter-3), d) demonstrated irritability or hyperactivity, as indicated by a combined score ≥ 11 on the irritability and hyperactivity subscales of the ABC-C, as established by Gabriels et al. (2015) and e) met all physical, mental, and emotional standards set forth by the Professional Association of Therapeutic Horsemanship, International (PATH, Intl). Children were excluded if a) they had participated >2 hours in any EAATs in the last six months, or b) weighed more than 200 pounds.

To recruit participants, the first author distributed fliers to local organizations, and conducted screening phone calls with interested participants. Next, eligible participants received

a packet in the mail that included the SCQ, the ABC-C, and an Enrollment Packet requiring a physician's signature. Finally, eligible participants attended a screening visit at the riding center which included administration of the Leiter-3, ABAS-3, and riding a horse for 10 minutes. If participants did not already have a documented ADOS score, the ADOS-2 was administered at a separate screening visit.

Intervention

Evaluation. Each participant and a caregiver participated in an occupational therapy evaluation that included the administration of the COPM to determine the participant's current level of functioning and the family's priorities for the intervention. Specific intervention activities, such as grooming, tacking, playing mounted games, or riding through obstacle courses, were individualized to address each child's unique goals.

Intervention Description. OT^{ee} occurred at a riding center with premiere PATH, Intl accreditation. Children attended weekly 45-60 minute OT^{ee} sessions for 10 weeks. There was a one-to-one ratio between the child and occupational therapist. Whenever possible, two individual OT^{ee} sessions of children with similar social communication abilities occurred simultaneously in the same arena. Occupational therapists structured activities to facilitate social interaction and provide positive reinforcement for communication. The manipulation of equine movement to affect functional outcomes (hippotherapy), was part of the overall intervention: occupational therapists manipulated equine movement to provide graded sensory stimulation, facilitating optimal arousal and active engagement in the therapy session. Visual aids were used to increase comprehension and task compliance. Each child was mounted on the horse for at least 20 minutes and also participated in unmounted activities. Trained volunteers served as horse leaders and sidewalkers; whenever possible, we paired each child with the same horse and volunteers for

the entire 10 weeks. At the end of each session, the occupational therapist provided the caregiver with strategies to try at home, and occasionally sent home visual aids or worksheets.

Interveners. Two experienced occupational therapists (eight and 16 years respectively) provided the intervention. Both held certifications from the American Hippotherapy Association and PATH, Intl.

Fidelity. One research assistant videotaped the intervention sessions. A second research assistant, blinded to the purpose of the study, used a checklist of elements described in the intervention description section to assess intervention fidelity of 20% of the sessions. The fidelity checklist is available in Appendix A. Average fidelity was 96%.

Data Collection

Caregivers completed the SRS-2 and COPM on the first day of baseline, the first day of the intervention, and one week after the intervention was completed. On a weekly basis throughout baseline and intervention phases, caregivers completed irritability and hyperactivity subscales of the ABC-C and a brief questionnaire about any changes in medication, therapy, or routines that may have impacted their child's behavior. On a daily basis throughout the baseline and intervention phases, caregivers rated their child's goal behaviors using a VAS presented in a survey texted to each participant. Three months after the intervention, caregivers completed the SRS-2, COPM, and irritability and hyperactivity subscales of the ABC-C a final time to determine maintenance of effects.

Data Analysis

Visual inspection was the primary method of data analysis to assess our hypotheses that OT^{ee} would improve occupational performance on individualized goals as measured by VAS ratings, and decrease irritable and hyperactive behaviors as measured by the ABC-C. We plotted

each participant's data on separate graphs; the dependent variable on the y-axis and time on the x-axis. As suggested by Kratochwill et al. (2013), we inspected data for changes in level, trend, variability within and between phases, overlap between phases, and immediacy of effect. Based on previous research (Gabriels et al., 2015), the expected latency of effect was 5 weeks, demonstrated by a vertical dotted line on the graphs. Depending on the data, we used mean or median lines to aid visual analysis.

To measure the effect size of occupational performance goals, irritability, and hyperactivity, we calculated the nonoverlap of all pairs (NAP) of each participant's VAS and ABC-C data. NAP measures the extent to which each data point in the baseline phase overlaps with each data point in the intervention phase, thereby calculating a percentage of non-overlapping data that serves as an effect size (Parker & Vannest, 2009). NAP outperforms other overlap methods on measures of precision, correlation with R^2 , and agreement with visual analysis judgements. Furthermore, cut-offs for interpretation of NAP effect sizes have been proposed specifically for multiple-baseline single-case designs, based on adequate sensitivity and specificity: scores ranging from 0 – 0.65 are considered weak effects, 0.66-0.92 medium effects, and 0.93-1.00 strong effects (Petersen-Brown, Karich, & Symons, 2012). The first author calculated NAP with the calculator available at www.singlecaseresearch.org/calculators/nap.

Because data did not appear normally-distributed, we conducted non-parametric statistical tests using SPSS Version 25. To supplement visual analysis of ABC-C data, we conducted a Wilcoxon signed-ranks test to compare averaged baseline data to the average of weeks 6 – 10 of the intervention, to account for the expected 5-week latency of effect. To assess our hypothesis that OT^{ee} would improve social functioning, we conducted a Wilcoxon signed-ranks test to compare SRS-2 scores from before and after the intervention.

Results

The results are next presented in order of our hypotheses.

Occupational Performance Goals

All participants improved in their individual occupational performance goals with OT^{ee}. Figure 4.1 presents children's occupational performance on individualized goals across baseline and intervention phases. Table 4.2 provides information on missing data, descriptive statistics, and NAP of VAS ratings. All participants had positive changes in median VAS ratings during intervention phase, and six of seven participants demonstrated less variability after five weeks of OT^{ee} in comparison to baseline. NAP analyses indicate that OT^{ee} had a weak or medium effect on individualized occupational performance goals when comparing baseline phase to the entire intervention phase (NAP ranges from 61% - 90%). However, when comparing baseline phase to the intervention phase after 5 weeks of OT^{ee} (the expected latency of effect), OT^{ee} had a medium to strong effect on individual occupational performance goals across all seven participants (NAP ranges from 70% to 99%). Due to the variability in their goals, we next discuss each participants' results separately.

Kayla's goal was to transition to non-preferred activities such as doing her math homework. Kayla began taking Vyvanse at the beginning of school, but this medication change likely did not affect the results of the study as it happened during the first week of baseline. On average, Kayla demonstrated smoother transitions during intervention phase than during baseline, with less variability and little overlap with baseline phase after about 7 weeks of OT^{ee}. However, Kayla did demonstrate a return to baseline levels for three days during the last week of intervention; this decrease in behavior may be attributed to her suspension from school for

hitting a peer. NAP indicated that OT^{ee} had a medium effect on Kayla's ability to transition to non-preferred activities, after 5 weeks of intervention.

Ryan's goal was to participate in reciprocal conversation about a topic chosen by a peer or family member; during baseline, he would often change the topic of conversation to his special interests, such as Minecraft. On average, Ryan was better able to participate in conversations on a non-preferred topic during intervention phase than during baseline. NAP indicated that OT^{ee} had a medium effect on Ryan's ability to participate in reciprocal conversation, after 5 weeks of intervention.

Fisher's goal was to don his shoes independently; during baseline he would often tantrum when asked to don his shoes, and required help to successfully don them. Therefore, we measured two aspects of his goal: smoothly transitioning to the activity of shoe donning, and donning his shoes independently. After about five weeks of OT^{ee}, Fisher donned his shoes independently the majority of the time, and after about seven weeks he consistently smoothly transitioned to shoe donning. Therefore, he demonstrated much less variability and almost no overlap with baseline after five weeks of OT^{ee}. NAP indicated that OT^{ee} had a strong effect on Fisher's ability to don his shoes, after 5 weeks of intervention.

Josh's goal was to transition to adult-directed activities, such as getting into the car. On average, he transitioned more smoothly during the intervention than baseline phase. After 5 weeks of intervention, he demonstrated much less variability and little overlap with baseline phase. NAP indicated that OT^{ee} had a strong effect on Josh's ability to transition to adult-directed activities, after 5 weeks of intervention. However, Josh underwent major medication changes throughout baseline and intervention phases, which likely contributed to his improvements in behavior.

Jorge's goal was to transition to adult-directed activities. On average, Jorge was able to transition better during the intervention than baseline phase. After 5 weeks of OT^{ee}, Jorge demonstrated less variability, and little overlap with baseline phase. Jorge was sick during the last week of intervention phase, which may have accounted for more variability that week. NAP indicated that OT^{ee} had a medium effect on Jorge's ability to transition to adult-directed activities, after 5 weeks of intervention.

Maya's goal was to identify and express her emotions; at the evaluation her mother stated she would often cry for long periods of time, but would not be able to express how she was feeling. During baseline phase, the research team referred Maya to psychotherapy after she expressed suicidal thoughts; therefore, psychotherapy may have contributed to Maya's results. On average, Maya was better able to identify and express her emotions during intervention phase than she was during baseline phase, and demonstrated less variability during intervention phase, especially after 5 weeks of OT^{ee}. NAP indicated that OT^{ee} had a medium effect on Maya's ability to express her emotions, after 5 weeks of intervention.

David's goal was to increase safety on community outings by remaining close to his mother. Throughout baseline, David had many high scores, representing safe days; therefore his median baseline score was 94. However, about once weekly during baseline phase David demonstrated very unsafe behavior, such as running away from his mother. During intervention phase, David's median scores only increased 4 points, however, his behavior in the community was much less variable; after five weeks of OT^{ee} his scores never dropped below 90, indicating a complete absence of very unsafe events. NAP indicated that OT^{ee} had a medium effect on David's safety during community outings, after 5 weeks of intervention.

Hyperactivity and Irritability

Figure 4.2 presents children's irritable and hyperactive behaviors across baseline and intervention phases. On average, children had significantly fewer irritable ($z = 2.00, p = 0.04$) and hyperactive ($z = 27, p = 0.03$) behaviors during the last five weeks of OT^{ee} than during baseline phase. Table 4.2 presents descriptive and NAP statistics of hyperactivity and irritability for each participant. The following sections present the results separately for children who responded to the intervention and those who did not.

Non-responders. Two participants, Jorge and Maya, did not demonstrate clinically significant irritability or hyperactivity during the baseline phase ($\leq 50^{\text{th}}$ percentile of children with ASD [Aman & Singh, 2017]), and accordingly did not improve with intervention. Of the five children who had clinically meaningful irritability and hyperactivity during baseline, one participant, Kayla, did not respond to the intervention. Kayla's irritable and hyperactive behaviors were highly variable during baseline and intervention, making it difficult to detect any effect of OT^{ee}. Kayla's irritability and hyperactivity did seem to improve during weeks 8, 9, and 10, a promising trend. However, overall, mean changes were negligible, and there was considerable overlap between baseline and intervention phases.

Responders. Visual analysis suggested that OT^{ee} had an effect on four of the five participants with clinically-significant irritability and hyperactivity during baseline phase: Ryan, Fisher, Josh, and David. These four children demonstrated decreases in mean number of irritable and hyperactive behaviors during OT^{ee}, trend changes, and little to no overlap with baseline after 5 weeks of OT^{ee}.

Three children demonstrated clear trend changes in both irritable and hyperactive behaviors: Fisher, David, and Josh (Table 4.2). Ryan demonstrated trend changes in

hyperactivity, but a consistent negative trend in irritability throughout baseline and intervention phases.

NAP analysis comparing baseline phase to the entire intervention phase revealed OT^{ee} had weak to medium effects on hyperactivity, and weak to strong effects on irritability (Table 4.2). In contrast, comparing baseline phase to the intervention phase after 5 weeks of OT^{ee}, NAP revealed strong treatment effects on both hyperactivity and irritability for Ryan, Fisher, Josh and David, indicating OT^{ee} had a stronger effect after 5 weeks.

Of the four responders, three completed three-month follow up measures. One participant, Josh, enrolled in OT^{ee} after the intervention phase of the study was complete, and maintained his improvements in hyperactivity and irritability three months later. The other two participants, who enrolled in different therapies during follow-up phase, returned to baseline levels of hyperactivity and irritability after OT^{ee} was withdrawn.

Social Functioning

Results of the SRS-2 indicated that children's social motivation was significantly improved with 10 weeks of OT^{ee} ($Mdn = 12$) in comparison to pre-test scores ($Mdn = 14$, $z = 0.00$, $p = 0.04$). Similarly, participants' social communication significantly improved with OT^{ee} ($Mdn = 38.00$) in comparison to pre-test ($Mdn = 40$, $z = 0.00$, $p = 0.04$). There were no significant changes in social awareness ($z = 4.00$, $p = 0.34$), social cognition ($z = 5$, $p = 1.00$), or restricted and repetitive behaviors ($z = 1.00$, $p = 0.66$). Three months after OT^{ee} was withdrawn, median social motivation scores remained at 14, and social communication scores increased by only 4 points to 42, indicating intervention effects may have been maintained. However, only five participants completed the follow-up SRS-2 assessment, four of whom enrolled in a new type of therapy during the follow-up phase, which could account for maintenance of effects.

Discussion

This study contributes to the body of research investigating the effects of integrating horses and the equine environment into occupational therapy for children with ASD. Results suggest that OT^{ee} can improve individualized occupational performance of children with ASD in their home and community environments; medium to strong effect sizes after five weeks of OT^{ee} suggest clinically significant improvements. We propose that individualizing the intervention, guided by the clinical reasoning of experienced occupational therapists, was imperative to achieving the wide diversity of goals included in this study. For instance, Ryan had difficulty engaging in social interaction with peers for extended periods of time, with particular difficulty following a peer's lead both in play and conversation. The occupational therapist integrated the following techniques into his OT^{ee} sessions: a) manipulation of equine movement to regulate Ryan's arousal levels, promoting improved engagement in therapy, b) mounted activities such as 'follow the leader' that required Ryan to interact with a peer, c) scaffolding of social interaction, and d) positive reinforcement for successful social interactions by allowing Ryan to choose the next, highly preferred, activity. These specific intervention strategies, embedded within OT^{ee}, likely contributed to Ryan's improved ability to participate in reciprocal conversations on a topic of a family-member's choosing at home. Many of these specific strategies are captured within the current study's fidelity checklist, but a key next step in this line of research will be to operationalize these strategies into a more comprehensive intervention manual to allow for replication and further refinement of the intervention.

This study also found that some, but not all, children with ASD who participated in OT^{ee} demonstrated decreased irritability and hyperactivity. Given that Latino mothers tend to report fewer autism symptoms in comparison to Anglo mothers (Blacher, Cohen, & Azad, 2014), Maya

and Jorge's low scores on the ABC-C throughout baseline and intervention phases may be attributed to cultural differences in parental perceptions of child behavior. Kayla was the only child with clinically significant irritability and hyperactivity during baseline that did not improve with OT^{ee}. In an attempt to explain Kayla's results, we retrospectively examined the videotapes of her OT^{ee} sessions. In four of ten sessions, Kayla rode for less than 20 minutes, either because unmounted tasks did not leave sufficient time for riding, or because her horse exhibited health problems that called for dismounting. Therefore, poor fidelity to the OT^{ee} protocol, specifically less time spent riding the horse, may have contributed to a lack of improvement in irritability and hyperactivity.

Strong effect sizes suggest that the improvements in irritability and hyperactivity for Ryan, Fisher, Josh, and David were clinically significant improvements. There is much to be learned still about the mechanisms of change by which OT^{ee} may improve irritability and hyperactivity; perhaps OT^{ee} improved children's self-regulation abilities. A recent scoping review found occupational therapists often implement "catalyst strategies" to improve client's self-regulation. A catalyst strategy "brings about a change in emotion or arousal, which will in turn foster a change in behavior" (Martini, Cramm, Egan, & Sikora, 2016, p. 10). Occupational therapists in the current study often used equine movement to bring about a change in arousal, thus improving self-regulation during the therapy session; therapists also taught the child and caregivers catalyst strategies to implement at home, such as a "push and pull" game that offers proprioceptive, vestibular, and deep-pressure input that can theoretically modulate the child's arousal levels at home (Lane, in press). Furthermore, occupational therapists arranged activities that gave children the opportunity to practice self-regulation. For example, David often vigorously swung his arms, causing the horse to move away; the occupational therapist taught

David a catalyst strategy of squeezing his arms, so he could successfully participate in grooming and tacking the horse. The horse's concrete reactions to David's behavior may have catered to the cause-and-effect learning style often characteristic of children with ASD (Gabriels et al., 2012). Thus, it is possible that OT^{ee} improved children's self-regulation abilities, therefore leading to decreases in irritability and hyperactivity in their daily lives.

Alternatively, or perhaps in conjunction with, the decrease in irritability and hyperactivity may be due to a more homeostatic arousal state overall, thus decreasing the need for children with ASD to self-regulate. Arousal refers to a person's state of consciousness and wakefulness, and is a neurological function dependent on sensory input (Lane, in press); children with ASD often experience unstable arousal levels, characterized by frequent states of over-arousal and under-arousal, likely contributing to irritable and hyperactive behaviors (Hirstein, Iversen, & Ramachandran, 2001). The possibility that OT^{ee} may lead to a more homeostatic arousal state is best understood through the lens of sensory integration theory, summarized by Short-DeGraff:

Sensory integration theory assumes that the brain is immature at birth and also is immature [or dysfunctional] in some individuals with learning problems. The goal of sensory integration therapy is to provide stimulation that will address certain brain levels (primarily subcortical), enabling them to mature [or function more normally], and thereby assisting the brain to work as an integrated whole. (Short-DeGraff, 1988, p. 200)
[Bracketed material added by Bundy & Murray, 2002, p. 11]

While OT^{ee} was not designed to meet all of the criteria of sensory integration therapy (e.g., use of suspended equipment [Parham, Cohn, Spitzer, & Koomar, 2007]), parallels are evident. In OT^{ee}, equine movement provides the child with proprioceptive, vestibular, and tactile stimulation, while the child is engaged in a purposeful activity and challenged to provide an adaptive response; thus OT^{ee} may be considered an intervention based on the principles of sensory integration (Bundy & Lane, in press). Given these parallels, perhaps OT^{ee} facilitates the

neurological maturation described by Short-DeGraff, including a more homeostatic arousal state, behaviorally evident as a decrease in irritable and hyperactive behaviors.

Across outcome measures, effect sizes were larger when comparing the last five weeks of intervention to baseline, as opposed to the entire intervention phase; these findings contribute to evidence that suggests children with ASD demonstrate improved behavior after about 5 weeks of equine-assisted intervention (Gabriels et al., 2015). Results also suggest that improvements in irritability and hyperactivity may be related to improvements in individualized occupational performance goals. Examining the results of the NAP analyses, the two children who demonstrated strong effects in their occupational performance goals (Fisher and Josh), also demonstrated strong effects in irritability and hyperactivity. However, children who demonstrated weak effects in irritability and hyperactivity (Kayla and Maya) only demonstrated medium effects in individual occupational performance goals. Therefore, it is possible that improvements in irritability and hyperactivity contributed to children's occupational performance at home and in the community. For example, Josh's decreased irritability and hyperactivity may have contributed to his ability to transition to adult-directed tasks.

Limitations

As a pilot study, this study was limited by the small sample size and participants' concurrent use of medication and other therapies throughout the course of the study. In addition, we used outcome measures that relied solely on parent report, which are likely influenced by parent bias; we urge future investigators to build upon this research with control trials that include physiological or blinded outcome measures.

Implications for Occupational Therapy Practice

- OT^{ee} for children with ASD can be delivered in adherence with a standardized protocol, while also individualized to address specific client goals; effective individualization requires clinical reasoning guided by professional philosophy and integration of best practices into the equine environment.
- OT^{ee} showed promise for improving individualized occupational performance goals, social motivation, social communication, irritability, and hyperactivity of children with ASD in their everyday contexts.
- This study adds to the body of evidence that suggests significant changes in behavior in home and community contexts begin to occur in children with ASD after about 5 weeks of equine-assisted intervention.

Figures and Tables

Table 4.1

Participant Characteristics

Pseudonym	Gender	Age	Race	Household Income	NVIQ	ABAS			Concurrent Treatments		Goal Behavior
						Conceptual	Social	Practical	Initial Therapies & Medications	Therapy and Medication Changes	
Kayla	Female	9	Caucasian	\$65,000 +	123 – 137	84	80	80	School SLP; Concerta	- Concerta + Vyvanse	Transitions
Ryan	Male	8	Caucasian	\$35,000 - \$45,000	105 – 117	79	78	68	-	-	Reciprocal Conversation
Fisher	Male	6	Caucasian	\$65,000 +	99 – 112	83	89	62	School OT; School SLP	-	Don Shoes
Josh	Male	8	Native American	\$65,000 +	71 – 83	51	54	51	OT; SLP; Psychiatry; Trileptal; Paliperidone	- Trileptal + Straterra + Risperidone +PT	Transitions
Jorge	Male	11	Hispanic	\$15,000 - \$25,000	43 – 55	48	57	53	-	-	Transitions
Maya	Female	13	Hispanic	\$35,000 - \$45,000	103 - 116	75	73	78	-	+ Psychology	Emotional Expression
David	Male	13	Multi	\$25,000 - \$35,000	71 - 83	51	57	50	SLP	-	Community Safety

Note. NVIQ = Nonverbal IQ (M = 100, SD = 15); ABAS = Adaptive Behavior Assessment System (M = 100, SD = 15); OT = Occupational Therapy; PT = Physical Therapy, SLP = Speech-language Pathology

Table 4.2

Descriptive Statistics of Visual Analog Scale Ratings, Hyperactivity, and Irritability

	Participant						
	Kayla	Ryan	Fisher	Josh	Jorge	Maya	David
Visual Analog Scale Ratings							
Missing Data							
Survey not completed	4/105 (4%)	8/105 (8%)	34/105 (32%)	16/105 (15%)	12/119 (10%)	37/119 (31%)	4/119 (3%)
Did not observe	1/105 (1%)	20/105 (19%)	31/105 (30%)	2/105 (2%)	2/119 (2%)	11/119 (9%)	39/119 (33%)
Median							
Baseline	37	30.5	23	39.5	69	36	94
Entire intervention	54	78.5	100	86	81	60.5	95.5
Standard Deviation							
Baseline	21.95	22.67	18.97	27.17	10.45	19.71	18.16
Entire intervention	31.09	25.44	31.07	17.62	8.75	13.51	14.16
Intervention weeks 6 - 10	30.14	17.42	8.24	5.10	7.39	13.25	2.72
Nonoverlap of All Pairs							
Entire intervention	61%	79%	90%	84%	83%	70%	64%
Intervention weeks 6 - 10	70%	89%	99%	93%	90%	75%	82%
Hyperactivity							
Missing Data	0/17	0/17	2/17	0/17	0/19	2/19	0/19
Mean							
Baseline	18.5	31	38	46	11.25	4.25	14.22
Intervention	16.2	27.4	26.11	41.3	10.89	7.25	11.44
Follow up	7	30	-	32	17	6	17
Slope							
Baseline	-0.14	0.29	0.46	-0.17	-0.05	-0.48	0.77
Intervention	-0.76	-1.25	-2.50	-1.96	-1.35	-0.72	-3.42
Nonoverlap of All Pairs							
Entire intervention	57%	70%	89%	73%	51%	30%	64%
Intervention weeks 6 – 10	65%	98%	100%	97%	73%	41%	100%
Irritability							
Missing Data	0/17	0/17	2/17	0/17	0/19	2/19	0/19
Mean							
Baseline	19.17	21.67	24	41.33	7.25	5.13	17.33
Intervention	20.4	15.5	14.89	33.5	6.56	7.25	14.11
Follow up	23	30	-	24	8	5	25
Slope							
Baseline	-0.43	-0.46	0.29	-0.74	-0.14	0.08	0.67
Intervention	-1.07	-0.41	-1.48	-1.76	-0.93	-0.74	-3.32
Nonoverlap of All Pairs							
Entire intervention	42%	88%	94%	92%	51%	35%	64%
Intervention weeks 6 – 10	58%	100%	100%	100%	73%	63%	100%

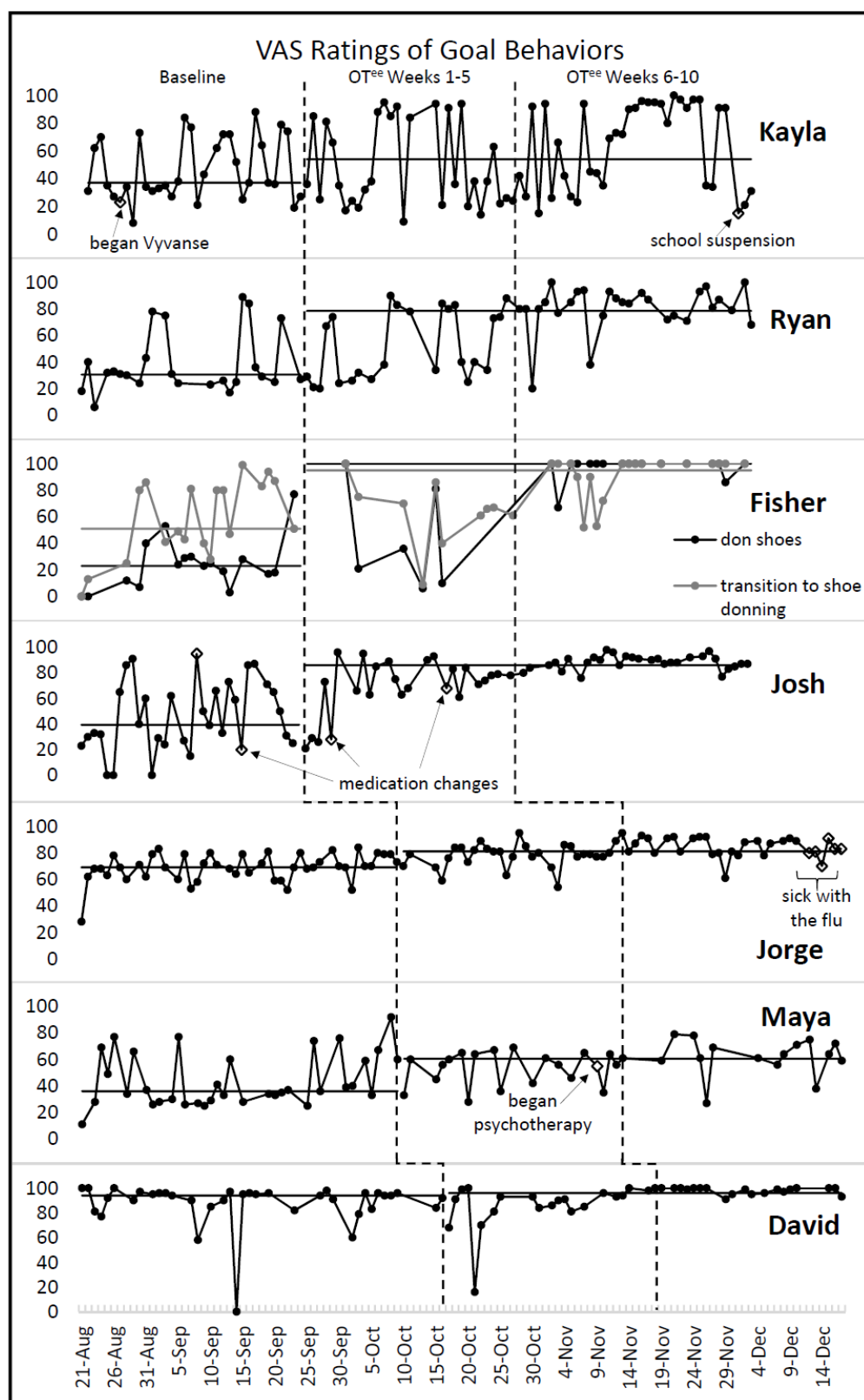


Figure 4.1. Daily Visual Analog Scale Ratings of Occupational Performance Goals. Horizontal lines indicate median scores throughout baseline or intervention phase.

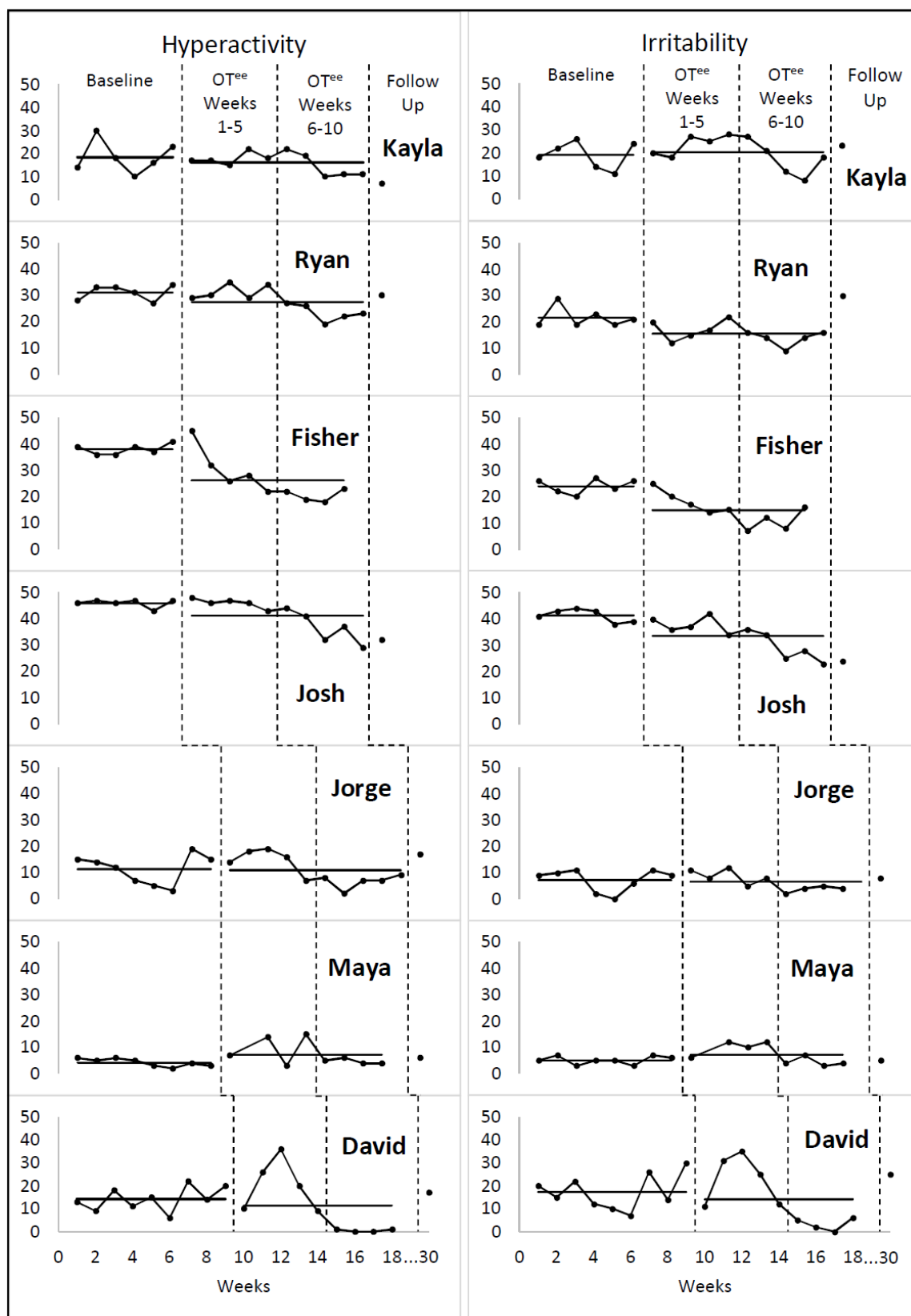


Figure 4.2. Weekly Ratings of Hyperactive and Irritable Behaviors. Horizontal lines indicate mean scores throughout baseline or intervention phase.

CHAPTER FIVE: PERSONAL THEORIES-IN-PRACTICE REGARDING OCCUPATIONAL THERAPY IN AN EQUINE ENVIRONMENT

Autism spectrum disorder (ASD) is a developmental disability characterized by impairments in social interaction and social communication, and restricted and repetitive behaviors (American Psychiatric Association, 2013). While there are many interventions available to help promote the health and well-being of individuals with ASD, available interventions often times do not fully meet the needs of children with ASD and their families (Lindly et al., 2017). Equine-assisted activities and therapies (EAATs) are emerging as complementary interventions that hold promise for children with ASD; there are many different types of EAATs that differ from one another in regards to components that comprise the intervention, professionals that deliver them, and outcomes they aim to achieve (McDaniel-Peters & Wood, 2017; Chapter 2). Our research team recently found promising outcomes of one type of EAAT—occupational therapy in an equine environment (OT^{ee})—on the occupational, social, and behavioral functioning of children with ASD (Chapter 4).

The Medical Research Council outlines theoretical development as a key early step in the development of complex interventions (Craig et al., 2008). Therefore, as our research team continues to develop this promising intervention, with eventual hopes of manualizing it for dissemination, there is a need to develop the theoretical framework supporting OT^{ee}. According to Fleury and Sidani (2012), “theory provides an understanding of the problem the intervention targets, the nature of the intervention, and the mechanisms underlying anticipated improvement in outcomes” (p.11). Beetz (2017) recently developed several potential theoretical frameworks that may explain the processes by which animal assisted intervention lead to change (i.e.,

biophilia, experiential learning, motivation); while these theories have relevance to OT^{ee}, they are intentionally broad, and therefore do not explicate the unique contribution of horses in interventions for children with ASD. In a recent review of theoretical frameworks supporting EAATs for children with ASD, I found that most theoretical frameworks are in early stages of development and are often under-developed; further research is needed to fully conceptually develop theoretical frameworks for specific interventions (Chapter 3).

Theoretical development in applied disciplines often begins with “personal theories-in-practice” (Lynham, 2002, p. 223), implicitly understood by the practitioner but not made explicit for use by others. According to Lynham’s phases of theory development, personal theories must be conceptually developed, operationalized, confirmed, applied, and continually refined in order to make them explicit and transferable. In this study I sought to address one of these phases, conceptual development, by elucidating “personal theories-in-practice” of the occupational therapists who delivered OT^{ee} to children with ASD. Therefore, the purpose of this paper is to conceptually develop the theoretical framework that guides OT^{ee} addressing occupational, social, and behavioral outcomes for children with ASD.

Methods

In this chapter, I report on the qualitative strand of a convergent-parallel mixed-methods investigation of OT^{ee} for children with ASD; in accordance with a convergent-parallel mixed-methods design, I collected and analyzed the quantitative and qualitative data separately from one another (Creswell & Plano-Clark, 2011). The qualitative strand, reported herein, did not follow a formal qualitative design, such as phenomenology or grounded theory, but rather took the form of generic qualitative inquiry. Percy, Kostere, and Kostere (2015) claimed generic qualitative inquiry is the method of choice when the problem requires qualitative methods, other

qualitative approaches are not suitable, and the researcher already has preliminary knowledge about a topic but seeks further understanding.

Site Selection

For the larger mixed-methods study, we selected Hearts and Horses Therapeutic Riding Center (HH) in Loveland, Colorado as the site for our study for the following reasons:

1. HH has obtained premiere accreditation from the Professional Association of Therapeutic Horsemanship, International
2. Three experienced occupational therapists consistently provide OT^{ee} to children with ASD at HH facilities
3. HH is dedicated to research, and has participated in research in the past
4. HH is located about 20 miles from Colorado State University

Participants

The participants in this study were two occupational therapists, each of whom provided the 10 weeks of OT^{ee} to 3-4 children with ASD, aimed at improving occupational performance, social functioning, and behavioral regulation that formed an important part of this dissertation research. These occupational therapists were chosen because they each had more than 5 years of experience providing OT^{ee} to children with ASD, and were working at HH providing the intervention at the time of the study.

Intervention

As described more fully in Chapter 4, OT^{ee} was individualized to address each participant's unique occupational performance goal. Therefore, specific intervention activities varied by child, but often included grooming, tacking, playing mounted games, or riding through obstacle courses. Each session was 45-60 minutes long; at least 20 minutes were spent mounted;

and each session also included an unmounted activity. Occupational therapists manipulated the movement of the horse to facilitate the child's optimal arousal and engagement throughout therapy. A trained horse leader and sidewalker also assisted in each therapy session.

Occupational therapists designed activities to facilitate social interaction and positively reinforce communication. Visual aids, such as picture schedules, were used as needed.

Our research team requested that therapists deliver OT^{ee} in line with these general principles, outlined in a fidelity checklist (Appendix A). Average fidelity was 96%. Therefore, the design of the intervention, and thus the content of the interviews, was undoubtedly influenced by the fidelity checklist.

Data Collection

I conducted four audiotaped interviews with each occupational therapist during the 10 weeks of OT^{ee}, resulting in eight interviews overall. The interviews were aimed at elucidating the clinical reasoning underlying the design and implementation of the OT^{ee} sessions. These interviews were each guided by a semi-structured interview guide that I created after watching videotapes of the previous week's OT^{ee} session, and reading the transcript of the previous interview; sample semi-structured interview guides are available in Appendix B. As categories emerged in the data, I began to include interview questions to further explore those categories, thus engaging in theoretical sampling by "seeking and collecting pertinent data to elaborate and refine categories in [an] emerging theory" (Charmaz, 2014, p. 192). For example, during open coding, it became evident that therapists often used equine movement as a mechanism to effect change; in subsequent interviews I included additional questions about equine movement, such as 'what about the movement is therapeutic?', and 'what outcomes might it lead to?'. Occasionally, one occupational therapist requested to answer questions in writing, as she

believed she could answer complex questions better with more time to think; therefore, one therapist submitted written answers on two occasions, and I followed up with probing questions at the subsequent interview. After all interviews had been analyzed, I conducted a member check with each occupational therapist to ensure emerging analyses were consistent with their intended meanings.

Data Analysis

A professional transcriptionist transcribed each interview verbatim into a Microsoft Word document. I performed theoretical thematic analysis with constant comparison using the qualitative data analysis software program, Nvivo (Edhlund, 2012). Consistent with a generic qualitative approach, theoretical analysis is conducted when the researcher begins data analysis with start codes derived from pre-existing knowledge (Percy et al., 2015). In line with the aim to create a theoretical framework, I began analysis by coding interviews with the start codes listed in Table 5.1, which are mechanisms of change our research team had previously identified in research on equine-assisted activities and therapies for children with ASD (Peters et al., manuscript in review; Chapter 3). Next, I conducted open coding, whereby the text was broken down, examined, conceptualized, and categorized (Strauss & Corbin, 1990). As I sub-categorized data within existing start codes as appropriate, some start codes changed in order to best represent the data, and I identified new categories. After open coding, I conducted axial coding, seeking to find links and relationships between and within categories and sub-categories. Throughout axial coding, I attempted to elucidate the following elements of a theoretical framework, derived from Fleury and Sidani's (2012) work on theory-guided interventions: 1) "problems" experienced by participants 2) intervention components designed to address

problems, 3) mediational processes, and 4) intended outcomes. As part of axial coding, I wrote memos about the relationships that emerged between and within parent and child codes.

Finally, I conducted selective coding graphically, creating a concept map that delineated specific contributions of the horse, mechanisms of change, mediators, and outcomes, as well as the complex relationships between them. Deviating from the axial-coding start codes, I chose to break apart mechanisms of change and mediators because they are separate, distinct concepts, that both can be useful in understanding how an intervention leads to change (Kazdin, 2007). Kazdin defined *mechanism* as “the basis for the effect, i.e., the process or events that are responsible for the change” and *mediator* as “an intervening variable that may account (statistically) for the relationship between the independent and dependent variable... a mediator may be a guide that points to possible mechanisms but is not necessarily a mechanism” (p. 3). The final themes that emerged were mostly potential outcomes of OT^{ee}, with various contributions of the horse, mechanisms and mediators related to each outcome.

Trustworthiness

I took several measures to contribute to the trustworthiness of the study. First, I triangulated data sources by conducting several interviews with two occupational therapists, and by using information gleaned through extensive literature review (Chapter 3). I also engaged in persistent observation by consistently meeting with HH staff (before, during and after the study) and watching all videotaped sessions in order to develop trust with participants and learn the culture of HH. In addition, I conducted two member checks with each therapist to ensure ongoing analyses were consistent with therapists’ intended meaning. Finally, my adviser, Wendy Wood, peer-reviewed the analyses after open coding and after selective coding.

Positionality

For the past five years, I have been a research assistant investigating EAATs for children with ASD. I am also an occupational therapist, working mostly with young children with ASD. In both my research and clinical endeavors, I am driven by a desire to improve the lives of individuals with ASD and their families. Having witnessed several children with ASD participate in EAATs, I believe that these interventions can contribute to the health and well-being of individuals with ASD. As an occupational therapist, I believe it is vital to understand the unique affordances that horses and the equine environment may offer, if clinicians are to effectively incorporate them into their interventions for children with ASD.

Results

Overall, the occupational therapists portrayed OT^{ee} as a holistic intervention that provides children with opportunities to learn and practice a variety of skills within a motivating context where children are purposefully engaged in equine-related occupations. The occupational therapists arranged the environment and different activities with the horse in order to work on specific, individual goals. Figure 5.1 provides a concept map that delineates seven common outcomes often addressed by OT^{ee}, as well as the contributions of the horse, mechanisms, and mediators related to those outcomes.

Cognitive Skills

The therapists often designed mounted activities, such as “red light, green light” in order to work on cognitive skills.

We’ve done some of the red light, green light with the visuals and the music; they have to attend. They have to first listen to the directions and understand the game. Then they have to process where they are visually in comparison to others. Then they have to listen to the music or look at the sign and they have to process what they’re going to tell the horse in order to stop. And then they need to wait and then they need to verbally cue to go. So there are a lot of built-in sort of cognitive skills there... sequencing those steps.

Unmounted activities, such as tacking, were also used to address cognitive skills.

In order to adjust the stirrups, we have to sequence three—two to three steps. So it's a multi-step [activity] and I broke it down one step at a time... he had to pull the leather out of the stirrup, and then pull the stirrup down, and then move the buckle up

Therapists discussed a variety of cognitive skills, including problem-solving, planning, sequencing multi-step activities, timing, and time management. Therapists also discussed that children are willing to take part in these challenging cognitive tasks because activities with the horse are motivating.

[Activities with the horse] seem to be good opportunities to bring about dialog and natural situations that are motivating- so promoting problem solving skills versus feelings of frustration and shutting down. Slowing down the process and helping him understand “when this happens then that can occur” and allowing him to think through the answers to “I wonder if you tried...” he can begin to execute cognitive processes and planning for success.

Working on cognitive skills such as timing and sequencing may also improve a child's ability to motor plan. For example, one therapist suggested “these skills to direct [the] horse [to] stop/go help with timing and sequencing for temporal aspect of learning and executing a motor plan that requires timing.” Therefore, as depicted in Figure 5.1, improved cognitive skills may also contribute to improved motor skills.

Motor Skills

Occupational therapists also often designed activities to work on motor skills, especially motor planning, and gross and fine motor control.

[Untacking is] another appropriate and useful activity to engage gross motor control, fine motor control, [and] strength. Clips on the reins require good strength in fine motor, which Ryan appears to have challenges with. The coordination aspect and motor plan of pulling [and] pushing—opposing forces and left [and] right sides of bodies having their own action sequence with putting stirrups up—gives us a great opportunity to practice and improve this for Ryan.

Equine movement in particular, graded by the therapist, may challenge and improve gross motor abilities such as postural control and dynamic balance. “Riding a horse is a challenge to dynamic

balance, which we can grade as necessary to make more or less challenging using different rider positions and speeds of the horse.” Again, children may be more willing to participate in these challenging motor tasks because they are motivated by the horse.

[Ryan has] difficulty with organizing new movements. So being highly motivated to ride, he is not resistive to the mounting process despite the awkward motor plan and difficulty organizing this. So we have the highly motivating horse and can still address the disorganization and motor planning and execution of new movements.

Therapists often hypothesized that improved motor skills would lead to improved performance and participation in everyday activities; therefore, as indicated by Figure 5.1, improved motor skills may also be related to improved social interaction in daily life.

If the child becomes more organized and successful with gross motor and fine motor coordination along with sequencing and planning tasks—there is more likelihood of being successful in engaging with others on a playground, at school, and not avoiding new games and social situations. So the outcome is a happier, more engaged, and more confident kiddo.

Attention and Engagement during Therapy

The therapists also discussed several ways in which OT^{ee} promoted the child’s active engagement in therapy. First, the movement of the horse, transferred to the child while riding, and graded by the occupational therapist, may regulate the child’s arousal levels. Two therapists discussed this concept in slightly different ways:

They’re not engaged enough. So as we use the movement of the horse, whether it’s this intermittent spurts of speed, so like some vestibular, and then that increases proprioceptive input... they like that input. It’s providing an arousing sensation, which then readies their nervous system.

When I look just at the movement, it does really seem to regulate him... he’s making more deliberate eye contact and he starts to sit stiller. Sometimes when he’s on the ground he’s either pacing or kind of participating in some sort of repetitive self-stimming sort of movement and he’s not fully, he doesn’t look like he’s fully engaged. So once he’s getting that input and he’s there, he’s able to put a lot more together... When I see his eye contact spans a lot longer when he’s on the horse, so to me it just looks like he is so much more controlled and regulated and aware of himself.

However, the therapists also recognized that too much input from riding may be over-arousing for children, thus necessitating a skilled therapist to grade the amount of stimulation.

How does the horse help? It's like it [riding] gets their body and their engine and their mind, just this total input, it's every part of their system engaging, but... there's plenty of times where I'm like that was just too much. We should have stopped 10 minutes ago.

Furthermore, children may be more engaged in the therapy session because of the motivating power of horses. "Since the horse is highly motivating and dynamic, it has huge therapeutic value in attention and eliciting opportunities for positive behaviors." The motivating aspect of the horse may be used to engage children in less preferred activities; "they're usually pretty compliant with the tasks that we choose on horseback." Finally, the equine-assisted tasks that children engage in during OT^{ee} demand their attention in order to be successful. "The unique aspect of equine-assisted therapy is that it is always dynamic. This aspect of therapy naturally requires an individual's attention." As a specific example, "to direct [the] horse [to] stop/go... demands attention—both cognitive and visual as well as being aware of others in [the] arena for safety." Overall then, the therapists asserted that OT^{ee} actively engages children with ASD, which may serve as a platform to address a variety of other skills.

Social Interaction in Daily Life

Occupational therapists also discussed several ways in which OT^{ee} addresses social interaction. Most commonly, therapists described scenarios in which children had the opportunity to "practice" appropriate social interaction during OT^{ee}. One therapist said "providing naturally occurring opportunities that might happen outside of therapy with peers is the best 'practice' for addressing social goals." Furthermore, "once we're in the arena and more of the outside world is closed off, then it's set up pretty successfully for them to interact." The structure of the activity varied based on which social skill the therapist wanted to address. For

example, while working on appropriate greetings, one therapist said, “we try to structure the sessions where they have opportunities to interact, and, so far, especially with David and Jorge, it has required a lot of set up and initiation and placement of us and saying, ‘oh look, let’s say hi’.”

With a different pair of children, the therapist tried to facilitate collaborative problem-solving:

There was an aspect [of cleaning up the arena after riding] where we’re kind of like, “okay, who’s going to do what?” They had to kind of play out this problem solving and turn-taking, so it did have kind of the social exchange. It was really nice and a naturally-occurring thing that might happen at home with siblings.

In addition to creating opportunities for social interaction, the therapists used a variety of strategies to help facilitate appropriate interaction. Therapists sometimes used highly motivating activities with the horse as a positive reinforcement for appropriate social interaction. For example, after two children successfully decided together on the next activity, one therapist commented “the positive reinforcement of [riding] the sensory trail and joy will hopefully overflow into the next social opportunity with peers to be open to that give and take aspect of friendship.” The therapists also often provided prompting, coaching, and modeling to help the participants interact effectively. For example, one therapist provided

Verbal cues to engage back and forth and prompts to steer conversation away from video game subjects. [Ryan was] able to redirect back to activity presented— obstacle course, tacking, etcetera—and Ryan has been cooperative and showing decreased tangents [or] perseveration on conversation unrelated to [the] activity at hand”

In addition to structuring and facilitating social interaction with peers, the therapists also arranged activities that required the child to effectively interact with either themselves (the occupational therapist), or volunteers.

There are a lot of times when we ask something of the client, I’ll leave it kind of open-ended so then if they get stuck -- like, for example, putting reins on or running the stirrups up -- use who’s around you. Our horse leader knows a lot about our horse. Our sidewalkers are here to keep you safe. If that looks like a hard activity or you’re afraid you’re not going to be able to reach and get it, we’ll support you; ask for help. So making sure that we do our job to explain everybody’s role, so if they know what our job is then

my hope is that they will then really utilize -- so not just for socialization purposes but also to help guide them through therapy, completing tasks and activities.

I think they realize these humans are going to help them get closer to the horse and help them ride their horse and do something that they want to do, and so we're kind of these magical people that they use us for to get closer to their horse.

Furthermore, OT^{ee} may provide a particularly powerful context to practice social interaction, because horses often elicit social interaction from the participants. In relation to a client who was often times unengaged and withdrawn from social interaction, a therapist noted “when she first comes in a lot of her talking is about the horse, so the horse kind of becomes this topic which provides her with this structure to talk about.” A different participant was “really interested in the horse’s head... he gets this smile and visual attention is really captured by her face and it usually leads to him initiating some comment or interaction.” Finally, working with horses may foster positive social-emotional skills, such as empathy, frustration tolerance, and responsibility. One therapist commented, “The value of the horse is that it needs care, nurturing, understanding, and patience.” A different therapist gave a specific example when she said,

Kayla and I had to do some flexible thinking since her horse wasn’t reacting in a typical manner. So and she also had to just think more emotionally, which she applied really well. She cared for the horse. She had to set a lot of her needs aside, because she did mention last week she did want to trot, and this week she wanted to go fast. And I said... ‘We really have to think about what’s going to be best for the horse today. So how is your horse feeling? Do you think it’s a good idea to trot or not to?’ And so then she didn’t.

One therapist believed that practicing appropriate social skills during OT^{ee} would lead to improved social interaction in participants’ daily lives. For example, “successes in these small group settings build new skills that will be able to be utilized in other social settings.” However, a different therapist was not as confident; when asked if she believes that social skills learned in OT^{ee} generalize to participants’ daily lives, she responded, “It’s hard to tell their level of generalization... my hope is yes, but that’s a great question.” Both therapists agreed that

participation in OT^{ee}, which involves participants in the age-appropriate activity of horseback riding, may create new socially appropriate conversation topics for participants to discuss with their family and peers. For example, “he has started communicating about his horse in his day at school and at home... we kept seeing how he would initiate that conversation and the horse piece throughout his life”

Communication

Therapists also discussed how OT^{ee} can improve participants’ receptive and expressive communication. In regards to receptive communication, OT^{ee} requires the child to listen to and follow directions from the occupational therapist. In addition, children must learn to understand the horse’s nonverbal communication as well; one therapist said it was important “to read your horse for safety reasons.” Another said, “The behaviors [and] reactions of the horse are a constant opportunity for learning...relating and noticing are constant with equine-assisted therapy.”

Similarly, OT^{ee} can address expressive communication as well. First, horses may elicit communication. For example, one therapist explained

Sometimes I’ll talk through the horse. I’ll say ‘Let’s tell Blanca that she did a good job today’... or ‘Blanca doesn’t know where she’s going, we need to help her out’. So sometimes talking through that horse then can—if they’re connecting to the horse—then they can start to put together other pieces of communication and they’re just more willing.

Building on the opportunities available for expressive communication, the therapists often used the concrete reactions of the horse to teach children about the effect of their communication. One therapist expressed this quite simply by stating “horses interact and react to how we behave and what our actions are.” As illustrated in the following two examples, these reactions were often used to teach children about the effect of their verbal or nonverbal communication:

What I have found in working with equines and kids of varying abilities is an ease in teaching cause/effect—the concept of something they say... or performed motorically – there is an effect, something that occurs due to this input... When a child says [something] too loud and a horse might startle and react, it creates a situation of learning. On the other hand if the voice is too soft and no reaction occurs with the horse, there is an opportunity for learning and grading our actions and how we perform. So when X was presented, Z happened. All in a natural and meaningful setting.

So if you want to go someplace... you have that opportunity to make a choice and then you have to follow through with communicating what that is. So the therapist might demand a verbal cue or a tactile, a physical gesture, or even visual attention towards where they want to go, just to indicate that choice, and then communicate that command, or that desire. So that's a good cause-and-effect. You tell your horse to do something. The horse will listen.

Furthermore, therapists often used highly preferred activities with the horse to positively reinforce successful communication. For example when one child was working on communicating by choosing between two options, the therapist “utilized things that [she] guessed were highly preferred versus non-preferred to begin setting him up for success and positive reward when he did appear to make a choice.” As another example, a therapist recounted:

My focus during this treatment had a lot to do with teaching him to express what he likes [or] wants. So if going faster was desirable and preferred, now is our chance to encourage appropriate communication while the horse is luring him in.

In addition, therapists did not reinforce ineffective communication, thus allowing participants to refine their communication to be more effective. For example,

We needed to know if he wanted to stay outside or go back to the barn, so just using yes or no, like ‘do you want to stay outside?’, and he just kept saying yes, yes, yes, yes. And then we said ‘do you want to go back to the barn?’ [He said] yes, yes, yes, yes. We're like well, that's yes for both things.

Behavior in Daily Life

Similar to communication, the horse's concrete reactions to behavior can teach participants about the effects of their behavior on others.

The behaviors [and] reactions of the horse are a constant opportunity for learning. This is beneficial for Ryan and Kayla in their understanding of what they do and how they behave has consequences and may cause others to think, act, or react in particular ways.

This cause and effect learning may be particularly powerful because of the motivating power of the horse. A therapist gave an example of how she used the behaviors of the horse to teach a client about the effect of his behavior on others:

As mom stated in the evaluation, he can play rough, not realizing that it might hurt other kids, etcetera. So the opportunity to apply and teach this using the horse is ideal and therapeutic. The therapeutic aspect is realized in the cause—effect behavior or reaction noticed in the horse. ‘When we are gentle, our horse is calm and likes this’... He seems to understand and be willing, [or] want to be gentle with the horse.

Equine-assisted therapy provides a myriad of opportunities to work on behavioral control, because activities with the horse require children to maintain appropriate behavior; “your horse feeds so much off of your arousal level, or your movements, your voice. So you really have to have a good sense of control over yourself.” One therapist noted that grooming the horse includes “demands for maintaining appropriate level of behavior and decreased impulsive movement.” In regards to a mounted activity, one therapist noted, “If we’re wiggling around then we need to check in with our horse and see how our horse is feeling. Because if the horse isn’t liking that, then we really need to then control ourselves.” The need for improved behavioral control offers natural opportunities for therapists to teach children self-regulation strategies. For example “a horse doesn’t want us wiggling up on his back. And so linking that self-regulation piece—can we identify a way to calm down?” As another example,

those actions [swinging his arms] can really increase the energy and make the horse feel uncomfortable and so we tried to... suggest other options like, okay, let’s pet the horse. That can be calming and the horse likes it more. If it is too loud, cover your ears. And he seemed to be really responsive to making eye contact and trying those with suggestion. So my hope is he would then, in other settings, even in school, instead of pounding on the desk... that he would just learn some other replacement behaviors and understanding that it might feel good to him, but it’s not really an appropriate sort of motor response.

Furthermore, within the context of therapy, the horse and motivating activities with the horse can be used to positively reinforce desired behaviors. For example, one therapist commented “knowing he appears highly motivated to be with the horse [and] ride, we are giving him this as the motivator and positive reinforcement when he does cooperate.” The sensory experience of riding may contribute to its motivating nature;

I think for kids that present like Jorge, that appear to demonstrate lots of sensory seeking behaviors and [are] highly motivated by being on the horse, it is our opportunity to promote positive and desirable behaviors. The continuous visual, proprioceptive and vestibular input while moving on the sensory trail and seeing new places appeared to be very pleasing to Jorge

In some instances, the horse was used as a positive reinforcement for desirable behaviors at home and in the community as well. For example, one participant “wouldn’t get on the bus one day after school to go home and then the parent said, ‘well, if you get on the bus then you’ll go home and ride your horse,’ and he got on the bus”

Safety in Daily Life

One particularly important subset of behavior that may improve with OT^{ee} is safety behavior in daily life. Many of the activities included during OT^{ee} require impulse control. For example, in reference to a stop-and-go game with the horse, a therapist reflected:

Jorge demonstrates very impulsive behaviors... mom also had reported concerns for his safety in regards to this [stopping] when at home or in [the] community. Weaving this into our treatment and helping him understand context and the temporal value of stopping, waiting for direction, versus continuous movement and impulsiveness, is another opportunity for learning in a meaningful and natural way.

Another therapist recounted that this stop-and-go game, along with other built-in opportunities to practice impulse control, may affect participants’ safety in the community.

we also wanted them to kind of understand the concept of stop and go for crossing the street... especially with if there's that impulsivity component where they see something across the street, they're so excited to get to the park or whatever it might be, oftentimes just that stopping and thinking about what you have to do first... With David in

particular, he wants to get on the horse right away but first let's stop. What do we need to get on our horse? So trying to slow down those actions before you get to this preferred activity, your destination. So stop and wait. Stopping and waiting is good practice for even just being out in the busy outside environment.

Other activities, particularly grooming and tacking, require spatial awareness and safety awareness. For instance, one therapist believes “the best opportunity to work on spatial awareness is during unmounted tasks, where the child has to be aware of where his [or] her body is in relation to the horse, in order to maintain safety.” Similarly, “applying the tacking situation to David was just to start practicing the safety components around the horse. So how do we walk up to the horse? How should we walk around the horse?” The nature of a horse being a large, powerful animal may contribute to this need for spatial and safety awareness:

We've talked about just spatial awareness and safety around the horse, so how might we move our body around the horse, keeping our distance, using a slower body speed, where to walk up to the horse if we do greet them. So trying to be aware of where our body is in space and realizing there's this large animal, just like maybe a car or something else that you really have to be cautious about.

Several Occupational Therapy “Best Practices” Are Embedded Within OT^{ee}

Regardless of what outcome they were addressing, occupational therapists consistently embedded occupational therapy best practices into the equine environment. Beginning sessions were often focused on rapport building: “I really find building rapport and making sure that the clients are comfortable first off is really, really important.” Occupational therapists also individualized the intervention to each participants’ needs, powerful motivators, and goals. For example, one participants’ goal was to don his shoes independently, so at the end of each session the participant and the therapist worked on doffing his shoes to get the sand out, and then re-donning them before leaving. As another example, a different participant had difficulty participating in a peer-directed activity or play scheme; the therapist stated “that’s kind of why we designated Kayla to be the leader of some [activities].”

Furthermore, therapists often reflected on the power of OT^{ee} lying in its occupational nature. For example, one therapist stated, “[OT^{ee}] doesn’t look as therapeutic where it’s like one task or demand after another. It’s guided a little bit gentler in the sense like yeah, we have to do these things, but we’re still just—we’re riding a horse.” Similarly, OT^{ee} presents “great opportunities to have really purposeful meaningful engagement.” Therapists often conducted task analyses of different equine-related tasks, in order to explain why they engaged a participant in a certain task. For example, in regards to directing the horse with reins, a therapist explained it “required bilateral coordination... as well as tactile awareness, which Ryan seems to have challenges with.” Within these occupational opportunities, therapists graded the task to present participants with the “just right challenge”; a therapist commented, “Finding the just right challenge that is not overwhelming but goal-oriented is important.” Furthermore, therapists often reflected back on activities that did not go as planned, and decided to adapt the activity in subsequent sessions;

As I’m getting to know Fisher, I do struggle... I want to be communicating steps of the way, but I also know he’s not fully tuning in to all that verbal language. So I think doing things differently I am going to back off in as much detail... being more concrete.

Therapists also incorporated positive behavior management strategies, such as offering choices and using visual cues to increase task compliance. To help transfer improvements to the home and community environment, therapists gave parents strategies to try at home on a weekly basis. Overall, it was evident that the clinical reasoning of an occupational therapist was vital to the design and implementation of each OT^{ee} session.

Discussion

This paper conceptually developed the theoretical framework guiding OT^{ee} for children with ASD by elucidating common intervention outcomes and the hypothesized mechanisms by

which they are achieved, including the specific contributions of the horse. I believe this study offers evidence to both confirm and expand previously proposed theoretical frameworks of EAATs for children with ASD.

Relation to Existing Theoretical Frameworks of EAATs for Children with ASD

In our recent review, we proposed three theoretical frameworks of EAATs for children with ASD that hold promise. The first framework purports that occupational therapists and physical therapists can manipulate equine movement to improve postural control, thus improving gross and fine motor skills. Interview data from the current study aligns with this proposed theoretical framework, but also expands upon it by highlighting motor planning as a key mediator of improved motor skills; therapists detailed several mounted and unmounted components of OT^{ee} that can address motor planning. In accordance with previous research, the therapists in this study also proposed that improved motor skills can contribute to improved performance and participation in everyday activities (Ajzenman et al., 2013; Silkwood-Sherer et al., 2012).

The current study also offers evidence that aligns with the second proposed theoretical framework, which asserts that various aspects of EAATs (i.e., equine movement, interactive activities, and the presence of a motivating horse) lead to improved attention and engagement in therapy. This emerging theoretical framework is coherent with recent hypothesized mechanisms of change in animal-assisted interventions, which suggest that humans' natural affinity towards nature (i.e., the biophilia hypothesis), combined with the experiential nature of interacting with animals, triggers participants' intrinsic motivation, fostering active engagement in animal-assisted interventions (Beetz, 2017). Beetz further suggested that the confluence of improved motivation and reduced stress fostered by animals creates an optimal state of arousal in

participants, thus providing an ideal platform for learning. The current study refines this broad theoretical framework, making it more specific to OT^{ee}, by highlighting the need for a skilled therapist to manipulate equine movement in order to effectively regulate participants' arousal levels.

Finally, the current findings also align with the third proposed theoretical framework of EAATs for children with ASD, which suggests EAATs can offer structured support for social interaction, including positive reinforcement of effective communication. Furthermore, the current study expands this theoretical framework by elucidating specific strategies embedded within OT^{ee} for supporting social interaction, including setting up social activities, grading task demands, and prompting and modeling appropriate social interaction.

In addition to expanding upon, and further specifying, previously proposed theoretical frameworks, the current study also elucidates novel mechanisms of change that contribute to OT^{ee}, Figure 5.1 details how working with horses demands behavioral control, thus providing meaningful opportunities to learn and practice self-regulation; self-regulation learning may be enhanced by horses' concrete reactions to human behavior. To our knowledge, this proposed mechanism of change is novel in peer-reviewed literature of EAATs for children with ASD, and is coherent with occupational therapy's role in promoting self-regulation (Martini et al., 2016). Related to improved behavior, Figure 5.1 also depicts that activities with the horse require impulse control, spatial awareness, and safety awareness, all of which may contribute to improved safety in daily life; to our knowledge these proposed mechanisms are also novel.

Significance

Theoretical development is a vital early task in the development of complex interventions (Craig et al., 2008). Understanding the mechanisms that cause change allow for clinicians and

researchers alike to refine an intervention. As Kazdin (2007) eloquently stated “by understanding the processes that account for therapeutic change, one ought to be better able to optimize therapeutic change... if we know how changes come about, perhaps we can direct better, stronger, different, or more strategies that trigger the critical change process(es)” (p. 4). The results of the current study have elucidated several processes by which OT^{ee} can improve occupational, social, and behavioral functioning of children with ASD. The conceptual development of these mechanisms will allow both our research team, as well as occupational therapists integrating horses into practice, to further refine OT^{ee} by optimizing the processes that lead to change. In addition, the results of this study can serve as a basis for future manualization of OT^{ee}, a key next step which will allow for future large-scale trials to further assess its efficacy (T. Smith et al., 2007).

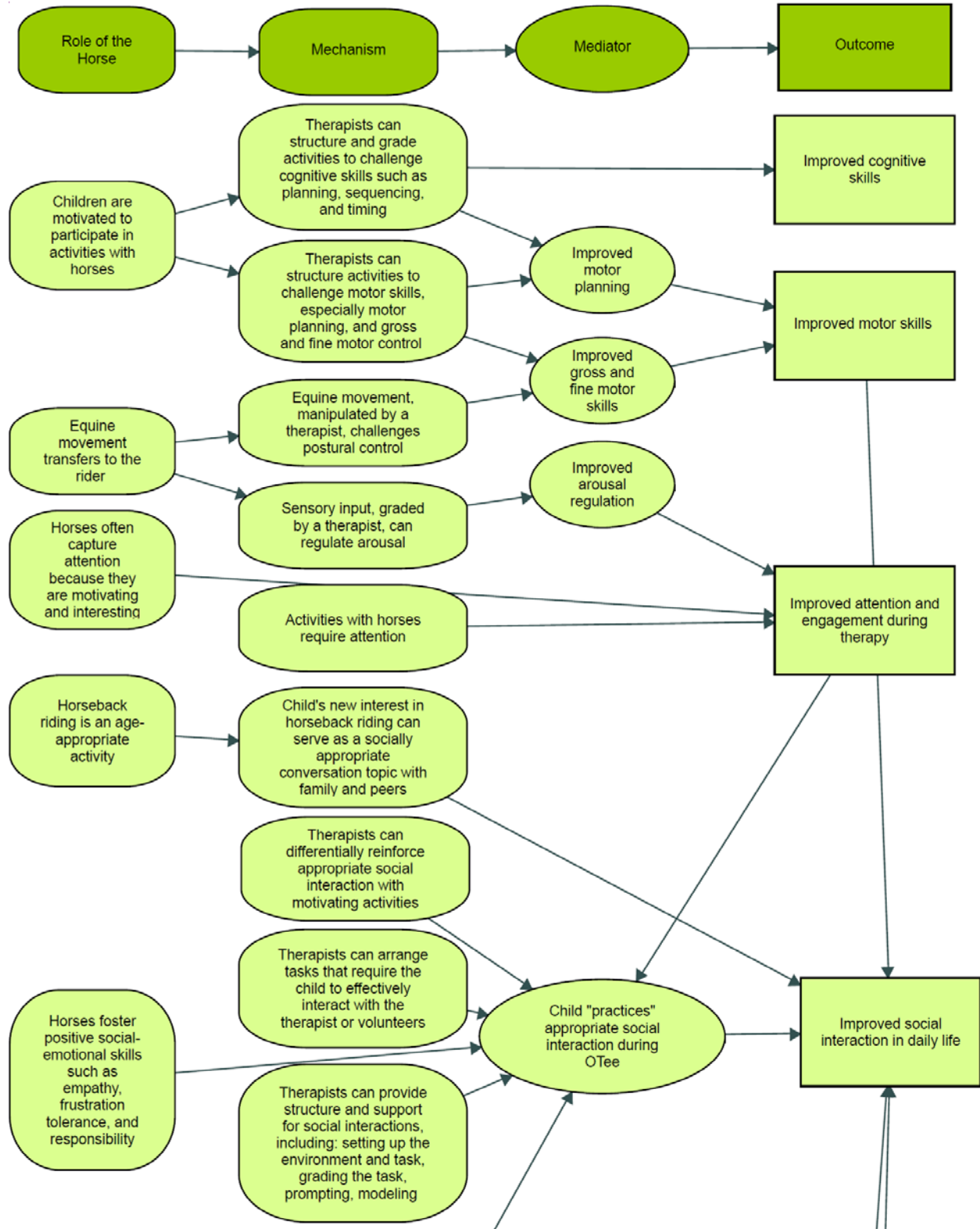
Limitations

This study was conducted as part of a mixed-methods investigation of OT^{ee} aimed at improving the occupational performance, behavior, and social functioning of children with ASD. Therefore, the transferability of these findings is limited; occupational therapists not confined to delivering OT^{ee} in accordance with a fidelity checklist may hold different “personal theories-in-practice” than those developed here. Furthermore, we only interviewed two occupational therapists, whose views are not intended to represent the views of all occupational therapists who integrate horses into their practice for children with ASD. These limitations notwithstanding, it is our hope that the current study elucidated unique contributions that horses and equine environments could offer to occupational therapy for children with ASD.

Conclusion

OT^{ee} is a complex, highly individualized intervention. The current study illuminated several unique affordances of horses and equine environments that may contribute to the processes by which OT^{ee} effects change in children with ASD. Given the complexity of the theoretical framework developed herein, we assert that OT^{ee} will be most effective when delivered by clinicians with a strong understanding of how to incorporate the unique affordances of the equine environment into individualized occupational therapy for children with ASD.

Figures and Tables



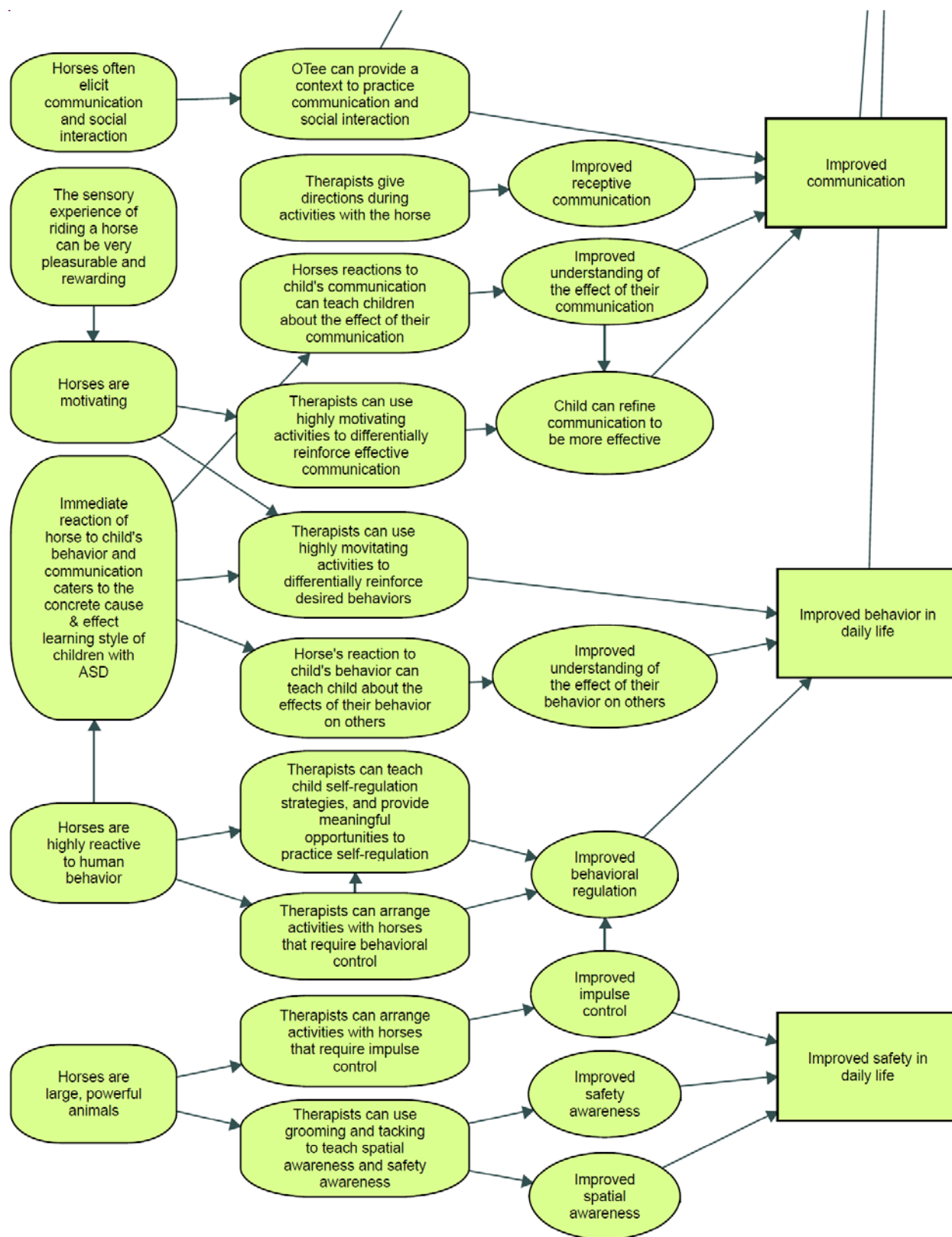


Figure 5.1. Theoretical Framework of OT^{ee} for Children with ASD

Table 5.1

Open Coding Start Codes

Horse-human interaction
Social interaction
Equine movement
Sensory experience of riding
Motivation
Communication
Equine qualities
Recreational benefits
Cerebellar stimulation
Principles of motor learning

CHAPTER SIX: REFLECTIONS AND FUTURE DIRECTIONS

Creating a Coherent Whole

The purpose of this dissertation was to systematically map, and then advance, the state of scientific and theoretical development of EAATs for children with ASD. To achieve this purpose, I conducted two studies that will result in four manuscripts. I believe the results of each of these four manuscripts build upon one another, complement one another, and together paint a more complete picture of EAATs for children with ASD than any one manuscript could on its own. In this section of the dissertation, I will attempt to bring together the four manuscripts to create one coherent “whole.”

Systematic Mapping Review Led to a Mixed-Methods Investigation

The first study, a systematic mapping review, mapped the current state of scientific and theoretical development of EAATs for children with ASD. Aligned with the purpose of my dissertation—to advance the current state of scientific and theoretical development of EAAT for children with ASD—I designed the second study to begin filling research gaps illuminated by the mapping review.

The systematic mapping review resulted in two manuscripts. In the first manuscript (Chapter 2), I reported the most promising outcomes of EAATs for children with ASD, including behavior, interpersonal interactions, and communication. Yet, these outcomes were largely found in studies of equine-assisted activities, while equine-assisted therapies tended to address motor outcomes. Although social-behavioral outcomes are well within occupational therapists’ domain of practice (Amini et al., 2014), no studies included in the review investigated an equine-assisted therapy provided by an occupational therapist aimed at improving social or behavioral outcomes.

Therefore, in designing Study 2, I was interested in studying OT^{ee} aimed at improving the social and behavioral functioning, and related occupational performance, of children with ASD. In addition, in the first manuscript I reported several methodological weaknesses common amongst EAAT research; authors often did not confirm ASD diagnoses using standardized assessments, characterize the adaptive functioning or IQ of participants in the sample, or measure fidelity of the intervention. In designing my dissertation study, I aimed to avoid these methodological weaknesses.

The second manuscript resulting from the systematic mapping review mapped the current state of theoretical development of EAATs for children with ASD (Chapter 3). In this manuscript, we concluded that theory-driven research—research that explicitly connects theorized mechanisms of change to specific intervention components and outcomes of EAATs—is rare. Therefore, in designing Study 2, I aimed to create clear theoretical linkages between the design of the intervention and the outcomes we measured. To do so, I created a fidelity checklist that included specific intervention components, such as positive reinforcement for communication, that were connected to the measured outcomes.

In manuscript 2 (Chapter 3), we also reported that theoretical frameworks supporting EAATs for children with ASD were not fully conceptually developed. Lynham (2002) claimed that theoretical development in applied disciplines can often begin as “personal theories-in-practice;” that is, as applied here, as implicit theoretical beliefs held by the occupational therapists who deliver the intervention. Therefore, I designed a qualitative strand of Study 2 aimed at conceptually developing the “personal theories-in-practice” guiding the occupational therapists who delivered the OT^{ee} for children with ASD. Overall, then, the results of Study 1 substantiated the need for, and informed the design of, Study 2.

Integrating the Quantitative and Qualitative Results of Study 2

Derived from the results of the systematic mapping review, the second study had two aims, each associated with a study strand. In the quantitative strand, reported in Chapter 4, we aimed to assess the efficacy of OT^{ee} on occupational performance, behavior, and social functioning of children with ASD. In the qualitative strand, reported in Chapter 5, we aimed to conceptually develop the theoretical framework that guides OT^{ee}. I propose that the results of the qualitative strand can help to explain the results of the quantitative strand, allowing for a more comprehensive understanding of OT^{ee} for children with ASD.

In the quantitative strand, we found that all participants demonstrated improvements in their individualized occupational performance goals. Given the diversity of goals included in the study, and the individualization of the intervention, the results of the quantitative strand leave the reader to speculate about the mechanisms by which each goal was achieved. For instance, David's occupational performance goal was to demonstrate increased safety on community outings by not running into the street or running away from his mother. Without further detail about how the intervention was specifically designed to address this goal, the theoretical connection between working with a horse and community safety is elusive. From a pragmatic perspective, evidence of an intervention's efficacy is useless if the intervention cannot be replicated by future clinicians and researchers. Yet, the qualitative strand illuminated several mechanisms of change that likely led to David's improved community safety, including activities structured to challenge and improve self-regulation, impulse control, and safety awareness; thus the qualitative strand helps to explain how individual occupational performance goals were likely achieved, allowing for future manualization and replication of OT^{ee}.

Similarly, the qualitative strand also offers potential explanations for the other, more standardized outcomes in the quantitative strand, including improvements in irritability, hyperactivity, social motivation, and social communication. Figure 5.1 illuminates several mechanisms that lead to improved behavior (i.e., less irritability and hyperactivity), including activities structured to teach children about the effect of their behaviors on others, and opportunities to practice self-regulation; these activities utilized the horse's concrete reactions to child behavior as a learning tool. Furthermore, Figure 5.1 elucidates several mechanisms that may lead to improved social motivation and social communication, such as positive reinforcement for effective social interaction and social communication. Overall then, the qualitative strand helps to explain the findings in the quantitative strand.

Furthermore, the quantitative strand can help us to understand aspects of the qualitative strand that are more or less promising, or that merit further investigation. For instance, in the qualitative strand occupational therapists speculated that activities with the horse can be structured to teach children about the effect of their communication, therefore allowing children to refine and improve their communication. A statistically-significant increase in social communication suggests that the strategies the therapists implemented were indeed effective at improving communication. Thus, the mechanisms of change described by the therapists that lead to improved communication may be particularly promising. However, while social motivation significantly improved, other aspects of social functioning such as social awareness and social cognition did not improve; further investigation is therefore warranted to examine why certain aspects of social functioning, but not others, improved with OT^{ee}. Similarly, the quantitative strand of this study did not measure some of the outcomes suggested by the therapists, such as cognition, motor skills, and attention; these outcomes merit further investigation.

When the quantitative and qualitative strands are woven together, they create one coherent tapestry; OT^{ee} for children with ASD is a dynamic, holistic, and highly individualized intervention that requires clinical reasoning to integrate the unique affordances of horses and equine environments into individualized occupational therapy; when tailored to the individual needs of children with ASD, OT^{ee} may improve occupational performance, hyperactivity, irritability, social communication, and social motivation.

Implications for Future Research

Study 2 provides preliminary evidence that OT^{ee} may improve the occupational performance, behavior, and social functioning of children with ASD. It also illuminates a hypothesized theoretical framework that details the mechanisms by which OT^{ee} improves these outcomes. Taken together, this mixed-methods investigation of OT^{ee} fits squarely within Smith's (2007) first phase of research on psychosocial interventions for children with ASD, "formulation and systematic application of a new intervention," which aims to "refine techniques and document clinical significance of effects" (p. 357). It is worth noting that we formulated the intervention based on common practices implemented by occupational therapists incorporating horses into interventions for children with ASD. However, this study was the first to operationalize and systematically apply these common practices in a specific intervention, and assess its impact on the occupational performance, behavior, and social functioning of children with ASD. Given the promising outcomes of the quantitative strand, and the detailed description in the qualitative strand concerning how outcomes may be achieved, I propose that this body of research is ready for Smith's second phase "manualization and protocol development" (p. 357). Therefore, future research endeavors may include development of a manual, testing its feasibility in community settings, and conducting small pilot studies to prepare for a future large-scale

efficacy trial. Building upon this dissertation research, key considerations in these pilot studies will include identification of objective outcome measures and appropriate comparison groups.

Relation to Occupational Science and Rehabilitation Science

I have completed this dissertation in partial fulfillment of the requirements for a Ph.D. in *occupation and rehabilitation science*. The mission of CSU's occupational therapy department is to "optimize human performance and participation in every day occupations and contexts across the lifespan" (Occupational Therapy Department, 2015). Occupational science and rehabilitation science both provide substantive contributions to an understanding of human performance and participation. This dissertation is particularly interested in the effects of OT^{ee} on the performance and participation of children with ASD. In the following sections, I will elucidate specific ways in which occupational science and rehabilitation science informed the design of this dissertation.

Rehabilitation Science

Rehabilitation science is concerned with function, and the factors that influence a person's ability to function. As the guiding framework widely adopted by rehabilitation science, the International Classification of Functioning (ICF) (World Health Organization, 2001) details three levels of functioning—body functions, activity, and participation—and various factors that may support or hinder functioning at each level. Similar to pragmatism's focus on utility, rehabilitation science's "goals are to contribute to better treatment and technology for persons with disabilities" (Seelman, 2000, p. 79). Thus, a rehabilitation science perspective clearly informed this dissertation, which is focused on the impact of EAATs on the *functioning* of children with ASD. In particular, the mixed methods investigation of OT^{ee} for children with ASD (Chapters 4 and 5) aimed to investigate the impact of OT^{ee} on the occupational, behavioral, and social *functioning* of children with ASD. In line with the priorities of rehabilitation science, as

well as my pragmatic philosophy, a clear goal guiding this research has been to “contribute to better treatment” for children with ASD.

Occupational Science

Occupational science is concerned with the study of human occupation as it relates to health and well-being. While several scholars have provided various definitions of occupation, I prefer Townsend’s (1997) definition as the “active process of living: from the beginning to the end of life, our occupations are all the active processes of looking after ourselves and others, enjoying life, and being socially and economically productive (p. 19). Simply stated, then, occupations are the ordinary and extraordinary activities that we do throughout our lives. From an occupational science perspective, occupation is viewed both as a means of achieving health, and as the very definition of health itself. Dickie (2014) wrote, “Occupation is associated with health and well-being, both as a means and as an end” (p.3). Therefore, occupational therapy interventions use occupation as a *means* of improving the *end* goal of occupational performance and participation. Hocking (2014) proposed that engagement in occupation promotes health through three basic mechanisms, it a) fulfills biological needs, b) develops capacities, and c) contributes to a sense of purpose and satisfaction.

An occupational science perspective informed the design of the mixed-methods investigation of OT^{ee}, in that occupation was used both as a means of promoting health, and as the intended outcome of the therapy. OT^{ee} is inherently occupation-based (Fisher, 2014), as it engages participants in equine-related occupations such as grooming, tacking, and riding a horse. The occupational therapists harnessed the therapeutic potential of these occupations in order to improve the individual occupational performance goals of children with ASD. In the qualitative

strand (Chapter 5), I attempted to elucidate the clinical reasoning that guided the practitioners' therapeutic use of equine-related occupations as agents of change.

Furthermore, as a science that studies the very nature of occupation, an occupational science perspective highlights the individual and situated nature of occupation. Dickie (2014) wrote, "person, occupation, and context are inseparable" (p. 6). Occupation is necessarily context-dependent; *what* people do is inextricable from the home, school, and community environments *where* they do it, and the individuals *who* do it. Furthermore, occupation is individual; the form, function, and meaning of occupation differs by individuals, and may well change throughout the course of one individual's life. In the quantitative strand (Chapter 4), this individualized and situated understanding of occupation influenced my decision to measure occupational performance using a visual analog scale; goals were *individualized* to each participant, and parents rated their child's behavior in their *everyday contexts* on a daily basis.

Convergence of Both Sciences

Overall, then, the convergence of occupational science and rehabilitation science guided the design of my dissertation research, focused on examining the impact of an *occupation-based* intervention (OT^{ee}) on the *individualized and situated occupational*, behavioral, and social *functioning* of children with ASD.

Reflections

Throughout my doctoral program, I believe I have grown not only in my knowledge of EAATs for children with ASD, but also in my understanding of what it means to be a scholar. In the following sections, I offer my reflections on these two areas.

On Becoming a Scholar

Throughout the past three years, one of the most important lessons I've learned is the value of working with a team. My adviser, Dr. Wendy Wood, along with my committee members have served as incredible mentors. In particular, I have appreciated the interdisciplinary nature of my mentors, as each person's unique perspective and expertise have helped to advance my research. Beyond their contributions to the research, I believe that my mentors have also contributed to my emerging identity as a scholar, by exemplifying in their own lives how to create a meaningful and productive career guided by passion for their work. I expect that my learning has only just begun, and therefore as I take the next step in my career, I will aim to continue to surround myself with mentors whom I respect.

On the opposite side of the same coin, throughout my doctoral program I had the opportunity to serve as a mentor to two Master's students as they completed their thesis work. For his Master's thesis, Christof Bentele videotaped the OT^{ee} sessions, and is qualitatively analyzing them from a transactional perspective. For her Master's thesis, Dorothy Kalmbach is conducting interviews with the parents of the children with ASD who participated in OT^{ee}, in order to investigate the appropriateness of the intervention. For both of these projects, I have been actively involved with mentoring the students by contributing to decisions on study design, data collection and analysis, and reviewing drafts of each thesis. Collaborating with these students has also allowed for our line of research to make much more progress than I would have been able to on my own, therefore teaching me the importance of partnering with other researchers with similar interests.

Throughout the doctoral program, I have also come to understand that my research does not exist inside of a vacuum. The research I choose to pursue is very much shaped by—an in turn

also contributes to—my identity and values. In my clinical work as an occupational therapist, I care deeply about my clients, and am guided by a passion to improve the lives of those with whom I work. This same outlook permeates my research as well, drawing me towards applied intervention research aimed at developing interventions that are likely to improve the lives of children with ASD. My clinical experience, largely with young children showing early signs of ASD, undoubtedly contributes to the ways in which I conceptualize my research. For example, in the discussion section of Chapter 3 we proposed a theoretical hypothesis about EAATs eliciting active engagement in children with ASD. My understanding about the importance of shared engagement in children with ASD was likely shaped by my clinical experiences working with two and three year olds with ASD, as a lack of shared engagement is a critical warning sign of possible ASD, and is often the target of early intervention. Going forward, it is important to me to maintain involvement in clinical practice; I believe staying involved in clinical practice will make my research stronger, and will help to ensure that the research I choose to conduct is relevant to practicing occupational therapists and the clients they serve.

Throughout the past few years I have also gained a deeper understanding, and appreciation for, the agency of a researcher. I have come to understand that my actions and decisions, with guidance from my mentors, are the strongest factor that shape my track of research. As such, I am compelled by the amount of intellectual creativity offered by a career in research. Furthermore, I am also struck by the ethical responsibility this places in the hands of an investigator; if the research we conduct is intended to influence practice and policy, then we have an incredible responsibility to conduct research of the highest quality. One lesson I have learned about conducting high-quality research is the importance of an a priori data analysis plan. For the quantitative strand of Study 2 (Chapter 4), I had a general a priori data analysis plan, but did not

fully consider the exact statistical test I would use to complement visual analysis of the VAS and ABC-C ratings. In exploring possible statistical analyses, I became acutely aware of the need to consider my bias as a researcher, and choose the plan that best represents the data, not just the test that was statistically significant. While I believe this exploratory analysis is common in pilot studies, if I am still involved in this research as it moves towards larger efficacy trials I will be sure to give ample time and thought to the a priori data analysis plan, to minimize the potential for researcher bias to influence the results. This is just one small example about how investigators hold agency over their work, and thus have an ethical responsibility to society to conduct high-quality research.

On EAATs for Children with ASD

Throughout the course of my doctoral program, my perspective on EAATs for children with ASD has also further developed. While conducting this research, I had the opportunity to interact with the participants during their screening visits, and then often times witness their first-ever interaction with a horse. The power of working with a horse became remarkably evident to me in those moments, as I witnessed children who were often withdrawn or pre-occupied with self-stimulatory behavior, transform into actively engaged horseback riders, skilled in completing the tasks given by their therapists. Throughout the course of this study, I have often pondered the nature of this ‘power’ so often assigned to the horse.

As an occupational therapist, I attribute great value to engagement in meaningful occupation. For many children on the spectrum, the nature of living with ASD can hinder participation in common childhood pursuits, such as soccer or dance. Horseback riding is an age-appropriate activity that can be adapted to the needs of children with ASD, allowing children

who may be occupationally-deprived to experience the joy, mastery, and positive identity formation that often accompanies recreational pursuit.

I have also pondered the nature of the therapeutic value of EAATs. While a more in-depth exploration of the theoretical framework supporting OT^{ee} is given in Chapter 5, I offer some general insights here. EAATs consist of interactive activities that are simultaneously physical, cognitive, sensory, and social in nature; I believe the multi-faceted nature of EAATs, in conjunction with the motivating effect of the horse, offer incredibly rich experiences that can be ‘harnessed’ by therapists to promote the health and well-being of children with ASD. In accordance, I believe that strong clinical reasoning skills are necessary, in order to effectively integrate the affordances of a horse and the equine-environment into individualized interventions for children with ASD.

Anecdotal parent reports have affirmed my belief that EAATs can be beneficial for children with ASD. I feel very privileged to have been a part of families’ lives throughout the course of the study, and interacting with parents has offered some new insights about EAATs for children with ASD. First, I believe watching their child ride a horse can allow a parent to see their child as ‘able’ instead of ‘disabled,’ sometimes for the first time, a powerful experience for both the parent and the child. Furthermore, parents often offered positive accounts of how EAATs have changed their child’s life in a variety of ways, including interacting more positively with the family pet, opening a water bottle independently, or finally attending an entire 2-hour class without a break. These accounts, while anecdotal, have further convinced me that EAATs can offer powerful benefits to children with ASD.

Despite these overall positive experiences, there are still aspects of EAATs that captivate my thoughts, as I grapple with their potential incongruence with my personal philosophy as an

occupational therapist. First, EAATs necessarily occur outside of a child's everyday home, school, and community contexts. The novel equine environment likely accounts for some of the power of EAATs, as children participate in new and exciting experiences. However, this also calls into question the ecological validity of equine-assisted therapy; given the contextual and situated nature of occupation, how is it that an occupational therapist can effect improved occupational performance without considering and perhaps intervening on the environments where children live, work, and play? While this dissertation offers preliminary evidence that OT^{ee} can improve the occupational performance of children with ASD in their everyday contexts, I believe further research is needed to investigate if and how the effects of EAATs can be transferred into a child's home life.

Second, I often contemplate what unique value, if any, an allied health professional such as an occupational therapist contributes to EAATs. One of the most common types of EAATs for children with ASD is therapeutic riding, provided by a riding instructor and often considered a recreational activity. Yet, the strongest research we reviewed in Chapter 2 found that therapeutic riding improved the social functioning, behavior, and communication of children with ASD (Gabriels et al., 2015). Thus, if therapeutic riding can achieve such positive outcomes, without an occupational therapist or other allied health professional, is there a need for equine-assisted *therapy*? Chapters 4 and 5 of this dissertation have begun to answer this question, by demonstrating the complex clinical reasoning needed to address individual occupational performance goals by incorporating the affordances of the equine environment. Yet, if we are to justify the additional cost of our services, I believe that increasingly rigorous research needs to empirically demonstrate the unique value of an allied health professional as opposed to a therapeutic riding instructor. These two internal deliberations that often captivate my thoughts

are not meant as negative critiques, but rather as fertile ground for future discourse and research in order to advance the practice and science of EAATs, with an ultimate goal of improving the lives of the children with ASD they serve.

Conclusion

The purpose of this dissertation was to systematically map, and then advance, the state of scientific and theoretical development of EAATs for children with ASD. It is my hope that this dissertation has served as one important step in a long line of research that will continue to advance EAATs, ultimately improving the lives of the children with ASD that they serve. This scientific purpose noted, I am confident that conducting this dissertation has served an additional educational purpose of advancing my emerging skills and identity as a scholar.

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APPENDIX A: FIDELITY CHIECKLIST

- o Session lasted at least 45 minutes
- o There was a one-to-one ratio between child and therapist
- o At least two volunteers were present for each child (1 horse leader and 1 side walker)
- o Child was mounted on the horse for at least 20 minutes
- o Child engaged in un-mounted activities such as grooming the horse or un-mounted games
- o Intervention was individualized for each participant (i.e. addressed participants' specific goals, incorporated child's interests and motivators, differs from the other child's session in some way)
- o Therapist facilitated social interaction between the child and other people (another child, side walker, family, etc.)
- o Child received positive reinforcement for communication (positive reinforcement could be through equine movement, verbal praise, preferred activity, etc.)
- o Intervention incorporated visual aids (to help with transitions, teach new skills, etc.).
- o Therapist gave caregiver strategies to try at home

APPENDIX B: EXAMPLE SEMI-STRUCTURED INTERVIEW GUIDE

In general, I'm interested in the rationale behind how what you're doing during equine-assisted therapy may or may not improve the everyday lives of children with autism in their home and community environments. In other words, what is it about this particular intervention that might make it effective? And what kind of outcomes do you think children may realize in their everyday lives, outside of the equine environment? There are no right or wrong answers, I am simply interested in your perspective. So with that in mind, I am going to ask you specific questions about what I see during each therapy session.

David

- At the beginning of David's session, you had David and Jorge greet one another. Can you tell me about the therapeutic value, if any at all, of these structured social interactions for David?
 - Is this connected to his occupational performance goal of increasing independence in initiating and responding to social greetings?
- David's main goal is to maintain safety on community outings (parks, grocery store) by demonstrating improved spatial awareness by not running into the street or not running away from mom. Have you addressed this goal in therapy, and if so, can you tell me how?
- When David was excited he tended to flail his arms, sometimes hitting his horse. At one point you told David he had to be gentle with the horse. Can you tell me the therapeutic value, if any, of these kinds of interactions with the horse for David?

- You had David scanning his environment for visual cues (letters on the wall or stop/go signs), and had him stop and go when he saw certain cues. Can you tell me the therapeutic value, if any, of having David attend to visual cues in his environment as part of this game?
- You had David making yes / no choices while using pictures of a thumbs up for yes, and a thumbs down for no. Can you tell me about the therapeutic purpose, if any, of this activity?
- You had David lead Blanca back into the stall. Can you tell me about the therapeutic value, if any, of this activity?
 - While in the grooming area, two new horses were brought in, so David had to move out of the way. Do you believe this was an opportunity for David to work on spatial awareness, and if so can you tell me about that?
- Overall, what unique contribution, if any, do you think the horse added to this therapy session?
- Is there anything else about the intervention that I haven't been asking about, that you believe is beneficial for David?

Maya

- You had Maya help plan how much time she wanted to spend doing different activities (riding, tacking, grooming) using a pie chart. Can you tell me about the therapeutic value, if any, of having Maya help plan her time?
- In our last interview, you began talking about how you are having Maya identify horse body language, and how that may transfer to understanding human body language. Can you tell me more about that?

- Maya has been very involved with grooming and tacking her own horse. Can you tell me about the therapeutic value, if any, of grooming and tacking for Maya?
- While riding, Blanca sometimes tried to stop when she wasn't supposed to. Maya had to be pretty assertive, using loud verbal and nonverbal cues. Do you think this assertiveness is helpful for Maya, and if so, can you tell me about that?
- Maya was excited that her sister got to see her ride, and waved at her sister while she passed the window. Can you tell me about the therapeutic value, if any at all, of Maya mastering new horsemanship and riding skills, and being able to demonstrate that to her family?
- Blanca had a spot she liked to stop, but you had her move to a different spot to work on making her comfortable with a change in routine. Then you asked Maya if she ever felt uncomfortable with a change in routine. Can you tell me about this moment, and if there was any therapeutic purpose for it, or not?
- Is there anything else about the intervention that I haven't been asking about, that you believe is beneficial for Maya?

Fisher

- You had Fisher help put the reins on. Can you tell me about the therapeutic value, if any, of this activity for Fisher?
- Fisher is using an English saddle, whereas some of the other children are using a western saddle or bareback pad. Can you tell me the reason, if any, you chose this tack specifically for Fisher?

- You had Fisher weaving in between cones, and going in different patterns like figure 8, can you tell me about the therapeutic value, if any, of doing these ground courses for Fisher?
- I've noticed that the riding arena is a very multisensory environment. Not only are children getting proprioceptive and vestibular input from the horse, but there are also plenty of sounds, sights, and smells. Do you believe this is beneficial for children with ASD, and if so, can you tell me about that?
- You had Fisher adjust his body so that he stayed in the middle of his horse. Do you believe that making these postural adjustments are beneficial for Fisher, and if so, can you tell me about that?
- You had Fisher playing the stop and go game, can you tell me about the therapeutic value, if any, of this game for Fisher?
 - Josh and Fisher played an interactive stop and go game, can you tell me about the therapeutic value, if any, of these structured social interactions between Fisher and a same-age peer?
 - It seemed much easier for Fisher to play the stop and go game using the visual cues, rather than the music, so using music seemed like a good challenge for Fisher. Can you tell me about the therapeutic value, if any, of the stop and go game using the music?
- This week Fisher was able to take his own helmet off. Can you tell me about that?
- Last interview, we talked a little bit about how you've been working with Fisher to read both horse and human body language, and how that's helpful for safety and other reasons within the context of the equine environment. I was wondering, do you think this is

beneficial for them in their everyday lives at home and in the community? In other words, you've been working on identifying horse and human emotions, how, if at all, do you think this will transfer outside of the equine environment, into their everyday lives?

- One of Fisher's goals is to respond when peers say hello to him, without prompts from his mom. Have you addressed this goal in therapy yet, and if so, can you tell me how you addressed it?
- Is there anything else about the intervention that I haven't been asking about, that you believe is beneficial for Fisher?

Kayla

- I've noticed that Kayla spends a lot of time grooming and tacking her horse. Can you tell me about the therapeutic value, if any, of these activities for her?
- At the beginning of the session, Ryan and Kayla were talking about how best to pet their horses. Can you tell me about the therapeutic value, if any, of these social interactions with a same-age peer for Kayla?
- You were working on deep breathing, and recognizing how that impacts Fiona. Can you tell me about that?
- Throughout the intervention, Kayla has been working on reading her horse's body language. Can you tell me about the therapeutic value, if any, of reading her horse's body language?
- Kayla and Ryan played an emotions game, where they had to act out with their bodies and faces what certain emotions look like. Can you tell me about the therapeutic value, if any, of this game for Kayla?

- o Is this related to her occupational performance goal of recognizing when peers are not interested in a conversation?
- Kayla's main occupational performance goal is to transition to non-preferred activities.
Have you addressed this goal during therapy, and if so, can you tell me how?