Title

Parent Strategies for Improving Joint Engagement and Language in a Diverse Sample of Limited Language Preschoolers with Autism Spectrum Disorder

Author

Toolan, Christina Kang

Publication Date

2019

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Parent Strategies for Improving Joint Engagement and Language in a Diverse Sample of Limited Language Preschoolers with Autism Spectrum Disorder

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy in Education

by

Christina Kang Toolan

2020

ABSTRACT OF THE DISSERTATION

Parent Strategies for Improving Joint Engagement and Language in a Diverse Sample of Limited Language Preschoolers with Autism Spectrum Disorder

by

Christina Kang Toolan

Doctor of Philosophy in Education

University of California, Los Angeles, 2020

Professor Connie L. Kasari, Chair

Children's early language, communication, and social skills are often learned through social interactions with their caregivers. Being jointly engaged with caregivers provides the referential context for children to learn these early skills; however, many children with autism spectrum disorder (ASD) are impaired in their ability to share experiences with others and can thereby miss out on crucial opportunities for language and social development. There are many interventions for young children with ASD that teach children to share attention with others, from those that are more adult-driven and structured (e.g., Discrete Trial Training (DTT)) to child-led and naturalistic (e.g., Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER)). Training parents in intervention strategies is effective for improving a wide range of children's outcomes. This study aimed to: a) examine changes in parents' use of four ABA-based strategies during parent-child free play interactions over the course of intervention (entry, 2

months into the intervention, 4 months into the intervention, and exit) and b) explore the relationship between parents' use of strategies and children's joint engagement and language outcomes over time. The current study was a secondary data analysis of a randomized controlled trial that compared two different interventions for children with ASD. Children (*n*=156) with limited expressive language ability received either 6 months of DTT or JASPER from an interventionist. In the last 8 weeks of intervention, parents received weekly parent training in whichever intervention their children were randomized to. Parent strategies (responsiveness, pacing, prompting, and environmental arrangement), child joint engagement, and child language were coded from a 10-minute free-play assessment that was collected at each timepoint. Results indicated that parents increased in their appropriate use of parent strategies over time. Parents' pacing and environmental arrangement were related to children's joint engagement across time and across treatment groups, while only parents' pacing was related to children's language outcomes. Implications for parent-child interactions and for parent trainings within early intervention contexts are discussed.

The dissertation of Christina Kang Toolan is approved.

Alison Bailey

Sheryl Harumi Kataoka Endo

Jeffrey J. Wood

Connie L. Kasari, Committee Chair

University of California, Los Angeles

2020

Table of Contents

List of Tables

List of Figures

Christina Kang Toolan

EDUCATION

2014	M.A., Education, Division of Human Development and Psychology, University of California, Los Angeles
2011	B.S., Psychobiology, University of California, Los Angeles

TEACHING

2019	Adjunct Lecturer Department of Child Development Whittier College
2017-2019	Adjunct Lecturer Department of Child and Adolescent Development California State University, Northridge
2016-2017	Adjunct Lecturer Department of Child Development Department of Graduate Education California State University, Dominguez Hills
2015-2019	Teaching Fellow Department of Psychology Department of Education Department of Disability Studies University of California, Los Angeles

RESEARCH

2013-2019	Graduate Student Researcher Center for Autism Research and Treatment, UCLA Research Supervisor: Connie L. Kasari, Ph.D.

Publications

Toolan, C. K. & Kasari, C. L. (2018). Autism intervention in schools. In E. Hollander, R. Hagerman, & D. Fein (Eds.), *Autism Spectrum Disorders.* Arlington, Virginia: American Psychiatric Association Publishing.

Select Presentations

Toolan, C. K., Holbrook, A. C., Ngo, C. K., & Kasari, C. L. (2019, May). Differences between mothers and fathers in parent-child free play interactions with preschoolers. Poster presented at the annual meeting of the International Meeting for Autism Research. Montreal, Canada.

Toolan, C. K., Holbrook, A. C., Shire, S. Y., Landa, R. J., Smith, T. H., & Kasari, C. L. (2018, May). Challenging behavior in preschoolers with ASD. Poster presented at the annual meeting of the International Meeting for Autism Research. Rotterdam, Netherlands

Toolan, C. K., Holbrook, A. C., Shire, S. Y., Landa, R. J., Smith, T. H., & Kasari, C. L. (2018, April). Preschoolers with ASD: Challenging behavior and impact on the family over time. Symposium presentation at the annual meeting of the Gatlinburg Conference on Research and Theory in Intellectual and Developmental Disabilities. San Diego, CA.

Toolan, C. K., Holbrook, A. C., Shire, S. Y., & Kasari, C. L. (2017, May). The role of parents in a social communication intervention for minimally verbal preschoolers. Poster presented at the annual meeting of the International Meeting for Autism Research. San Francisco, CA.

Toolan, C. K., Holbrook, A. C., & Kasari, C. L. (2017, April). Parent-child interactions in ASD: Characterizing language and gesture use in low-rate communicators. Poster presented at the annual meeting of the Society for Research in Child Development. Austin, TX

Toolan, C. K., Holbrook, A. C., Smith, T. H., Landa, R. J., Kaiser, A. P., Shire, S. Y., Gulsrud, A. C., & Kasari, C. L. (2016, May). Parent expectancies: A self-fulfilling prophecy? Poster presented at the annual meeting of the International Meeting for Autism Research. Baltimore, MD.

Kang, C. H., Kasari, C. L., Smith, T. H., & Landa, R. J. (2016, March). Assessment of expressive language in minimally verbal children with ASD. Poster presented at the annual meeting of the Gatlinburg Conference on Research and Theory in Intellectual and Developmental Disabilities. San Diego, CA.

Kang, C. H. & Kasari, C. L. (2015, May). Questioning, directing, and commenting: Parent-child talk in autism. Posted presented at the annual meeting of the International Meeting for Autism Research. Salt Lake City, UT.

SERVICE

2015-2016	Student representative Division of Human Development and Psychology UCLA Graduate School of Education and Information Studies

Introduction

Children's early language, communication, and social skills are often learned through social interactions with their caregivers – namely, through episodes of joint engagement (i.e., shared and acknowledged experiences with one other) (Bakeman & Adamson, 1984; Tomasello & Farrar, 1986; Vygotsky, 1978). Many children with autism spectrum disorder (ASD) are impaired in their ability to share experiences with others, given that this is a core characteristic of the diagnosis (American Psychiatric Association, 2013; Sigman, Mundy, Sherman, & Ungerer, 1986). As a result, the development of language, communication, and social skills in children with ASD may emerge later and/or in a different developmental sequence than typically developing children (Adamson, Bakeman, Deckner, & Romski, 2009; Mundy et al., 2007). There are many interventions for young children with ASD that teach children to share attention with others, and there has been a recent push to also train children's parents in intervention techniques (Bearss, Burrell, Stewart, & Scahill, 2015), which can vary in approach (e.g., adult-driven and structured vs. child-led and more naturalistic). Parents' use of these intervention strategies in their interactions with their children may influence their children's language and social outcomes. Given the importance of these early interactions with parents, this study aims to: a) examine changes in parents' use of strategies during parent-child free play interactions over the course of intervention (which included a parent training element), and b) explore the relation between parents' use of strategies and children's joint engagement and language outcomes over time.

Theoretical Framework

Social-interactionist theory. The social-interactionist theory of development, based on the writings of Vygotsky (1978), states that learning occurs as the result of social interaction with

a more knowledgeable other. Oftentimes, this more knowledgeable other is an adult, such a parent. While learning and development are grounded in cognitive abilities, they operate and are modified based on environmental input. One key concept in social-interactionist theory is the zone of proximal development (ZPD), which represents the difference between what a child can already do independently and what the child currently cannot do without guidance. The theory states that the more knowledgeable other (e.g., the parent) should scaffold the child's learning and development by operating within that child's ZPD. Each child's ZPD constantly changes based on the child's mastery of certain skills.

Based on this perspective, parent-child interactions would be one of the most important influences in a child's language, social, and cognitive development. By supporting children's learning at their individual developmental levels, parents' behaviors (e.g., language, interaction style) would affect their children's developmental trajectories.

Social-pragmatic theory of language development. Social-pragmatic theory holds that language development is an inherently social process, such that social exchanges between a child and caregiver provide the context for learning (Tomasello, 2000). Specifically, joint engagement (i.e., a shared state of attention between two people around an object or activity) supports children's language development (Tomasello & Farrar, 1986; Tomasello, 2000). This theory, similar to Vygotsky's social-interactionist theory discussed above, considers social interactions to be critical to the development of language. However, while Vygotsky's social-interactionist theory is relevant to development more broadly, the social-pragmatic theory focuses exclusively on the development of language. According to this theory, joint engagement provides a referential context for children during social interactions to determine their partner's communicative intentions. Thus, sharing attention with others provides opportunities for children

to identify, replicate, and learn meaningful language. Moreover, through this process, children are able to learn to use language for a variety of purposes.

Relevance to current study. These two distinct, but related, theories of child development form the theoretical framework for the current study. Both theories highlight the importance of social interaction for child development – social interactions, particularly social interactions with adults (i.e., parents), are critical to early childhood development. Early language development is supported during episodes of joint engagement with parents, who are often children's first social partners. Joint engagement provides the context for parents to scaffold children's developing language skills through their shared attentional focus. These theories underscore the significance and usefulness of carefully examining parent-child interactions to better understand how early learning and development takes place. This may be particularly important when children have atypical social and language developmental trajectories and demonstrate consistent difficulty with joint engagement (Adamson et al., 2009), such as in children with autism spectrum disorder (ASD).

Early Interventions for ASD

Autism spectrum disorder (ASD) is a neurodevelopmental disorder – symptoms manifest in the first few years of childhood, and it is a lifelong condition. Current prevalence of ASD is estimated to be anywhere from 1 in 59 (Centers for Disease Control and Prevention, 2018; Baio et al., 2018) to 1 in 45 (Zablotsky et al., 2015). ASD is diagnosed when an individual exhibits impairment in two core domains: social communication as well as restricted interests and/or repetitive behaviors (American Psychiatric Association, 2013). Within the social communication domain, joint engagement, or the state of sharing attention around an object or event (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998) is considered a core deficit for many

individuals with ASD. Additionally, many individuals with ASD face challenges with acquiring spoken language. Due to the heterogeneity in behaviors, interests, and needs that characterize this condition, there is no single effective treatment for ASD. Currently, the only effective interventions for ASD are based in behavioral theory.

There is some evidence that children benefit most when intervention is provided early in childhood. Children who begin intervention between the ages 2 to 4 make more progress than older children who receive the same interventions (Fenske, Zalenski, Krantz, & McClannahan, 1985; Lovaas & Smith, 1988). This has resulted in a trend toward early intervention for ASD and the proliferation of many different types of early interventions for ASD, which target many different skills (e.g., language/communication, adaptive behavior, academics, social skills).

One of the most commonly practiced intervention approaches is Applied Behavior Analysis (ABA) (Baer, Wolf, & Risley, 1968), which is an umbrella term for a certain set of learning principles that underlie various interventions. There are three theoretical foundations of ABA: 1) classical conditioning, which states that behavior can be learned by manipulating antecedents (Pavlov, 1928); 2) operant conditioning, which states that behavior can be learned by manipulating consequences (Skinner, 1965); and 3) social learning theory, which states that behavior is learned by observing models (Bandura, 1971). By applying ABA principles in interventions, one can create meaningful, measurable change in observable behavior (e.g., teaching a new skill, modifying a behavior) by systematically manipulating both the antecedents *and* the consequences of a targeted behavior. The behaviors targeted should be socially significant – that is, these targeted behaviors should have real world applications and be meaningful for the child. The behaviors should also be observable and analyzable in order to

inform the course of an intervention. ABA principles form the foundation for many of the early interventions that exist today.

Structured interventions. Structured interventions, which are considered to represent the more traditional application of ABA, are a class of adult-directed interventions where adults provide instructions or set up the environment to elicit desired responses from the child. Learning occurs as the adult provides reinforcement for correct responses. In structured interventions, the adult drives the timing, pace, and direction of the adult-child interaction.

One such example of a structured intervention is Discrete Trial Training (DTT), which is one of the most commonly practiced ABA interventions in the community (Paynter et al., 2018; Stahmer, Collings, & Palinkas, 2005). DTT involves breaking a skill down into smaller components and systematically teaching each component skill. Teaching occurs through a series of discrete trials – that is, where the interventionist provides an instruction, waits for the child's response, provides some sort of consequence based on the appropriateness of the child's response (e.g., positive reinforcement or an informational "no"), and repeats the trial as necessary. A trial may also be prompted, where the interventionist provides an additional, external cue (e.g., hand-over-hand prompt, modeling the correct response) alongside the instruction (e.g., "Touch your head") in order to ensure a correct response from a child (e.g., child touches head).

Common targets in DTT include: imitation (e.g., motor actions, verbal language), matching, expressive language (e.g., responding to social questions), receptive language (e.g., following 2-step instructions), adaptive daily living skills (e.g., tying shoelaces) and play. DTT can be embedded into a child's daily schedule or practiced on its own. DTT has been shown to be effective in increasing children's IQ and placement in general education settings (Lovaas,

1987; Smith, Groen, & Wynn, 2000). Despite its usefulness in the treatment of children with ASD, DTT also has some limitations. Because DTT is predicated on children's responses to instructions/cues from an interventionist, children may have difficulty learning to initiate behaviors independently (Smith, 2001). Additionally, there is limited evidence that gains made in intervention are generalized to other contexts (Schreibman et al., 2015).

Naturalistic developmental behavioral interventions (NDBIs). NDBIs are another group of ABA-based interventions, developed in part of address some of the limitations of traditional ABA interventions (Schriebman et al., 2015). Key features of NDBIs are: teaching in natural context (often through play), allowing the child to initiate and lead activities, and providing natural and contingent reinforcement. This class of interventions places a strong emphasis on developmental principles in additional to behavioral techniques, such that targets of intervention are based on the child's individual developmental needs.

One example of an NDBI is the JASPER (Joint Engagement, Symbolic Play, Engagement & Regulation) intervention, which is a targeted, short-term, social communication intervention (Kasari et al., 2006, 2008). JASPER targets joint attention skills (e.g., gestures for the purpose of sharing), play (e.g., functional and symbolic play acts), language (e.g., commenting), and joint engagement through establishing play routines. Interventionists model play acts and language that is at or slightly above the child's developmental level, following the child's lead. Additionally, interventionists emphasize building and expanding on play routines and children's language use. JASPER is a modular intervention – it can be added into existing intervention programs and can be implemented flexibly across multiple settings (e.g., as an activity rotation in a school program).

JASPER has been shown to increase a number of socially and clinically meaningful outcomes, including joint attention skills and child-initiated joint engagement (Chang, Shire, Shih, Gelfand, & Kasari, 2016; Kasari et al., 2010, 2015; Lawton & Kasari, 2012; Shire, Gulsrud, & Kasari, 2016). By targeting core social communication deficits of ASD, gains through this intervention have a cascading effect in other developmental domains – including increasing complexity and frequency of play skills and improvements in spoken language (Goods et al., 2013; Kasari et al., 2010, 2014, 2015). Children make effective gains in as little as 3-6 months. Despite the short-term nature of the intervention, child outcomes have been generalized across contexts (Kasari et al., 2015) and sustained over time (Kasari et al., 2010, 2012). JASPER has been taught to and successfully implemented by interventionists, caregivers (Gulsrud, Hellemann, Shire, & Kasari, 2016), and teachers (Chang et al., 2016; Lawton & Kasari, 2012).

Shared components. Both interventions, which are used to teach children social and communication skills, operate on the principle that children learn through episodes of shared attention with an interventionist. Inherent to this is the idea that intervention sessions must be paced appropriately to promote attention between the interventionist and the child (i.e., timing bids, models, demands appropriately so as not to overwhelm or bore the child). Another shared component is the idea of contingent reinforcement for appropriate child behavior – this involves not only the interventionist teaching skills in the session, but also attending to and being responsive to the child's behavior. Both interventions also emphasize the importance of preparing the environment for sessions (i.e., setting up the intervention space so that it is not too cluttered, but having necessary materials on hand; sitting in front of the child).

School-based interventions. Both DTT and JASPER can be – and have been – implemented in school settings. This is significant because as children get older, the school become the primary site where most children with ASD receive intervention services (Sindelar, Brownell, & Billingsley, 2010; Brookman-Frazee et al., 2009). Conducting interventions in school settings provides a more naturalistic platform for implementation. More importantly, it allows researchers to reach a broad base of participants, which can allow for greater representativeness in studies. ASD intervention studies have commonly been conducted in university, laboratory, or clinic settings. As a result, much of the literature is based on a sample of majority white, middle-to-high SES children, with high IQs and language ability – which does not accurately represent the whole of the ASD clinical population (Weisz, Chu, & Polo, 2004). Conducting research in schools allows for the opportunity to include children who have traditionally been overlooked in intervention research – that is, children with limited language ability, who are from lower socioeconomic status families, and/or belong to under-represented minority groups.

Outcomes of Early Intervention

Many early interventions focus on improving core deficits in ASD, particularly the social communication domain. There are several different targets that social communication interventions can focus on. Two of the most socially meaningful outcomes, particularly because they present as challenges to children with ASD, include increasing shared attention and sustained engagement with others (joint engagement) and increasing language and communication.

Joint engagement. There is an important distinction that must be established between two similar, related, but ultimately distinct concepts previously touched on: joint attention and

joint engagement. Joint attention (JA) is the ability to share attention with another person (Bakeman & Adamson, 1984; Carpenter et al., 1998). JA involves a triadic interaction between two people around an event or object wherein all participants share attention (Tomasello & Farrar, 1986). JA is a skill that be demonstrated through eye contact, gesture use (i.e., pointing, showing, giving), and/or with language, all with the purpose of sharing attention.

Typically developing (TD) children naturally develop JA skills through interactions with their caregivers (Bruner, 1995). Some of the earliest JA skills (e.g., eye gaze, responding to gestures) develop in infancy and toddlerhood (Mundy et al., 2007; Scaife & Bruner, 1975), and children move from responding to joint attention to initiating joint attention (Carpenter et al., 1998). JA skills continue to develop in complexity during early childhood alongside the development of language and communication abilities (Adamson, Bakeman, & Deckner, 2004). In children with ASD, however, JA is often impaired — in fact, it has been characterized as a core deficit in individuals with ASD (Curcio, 1978; Charman, 2003; Mundy, Sigman, Ungerer, & Sherman, 1986). Children with ASD consistently demonstrate lower frequencies of JA than typically developing or developmentally delayed children (Dawson et al., 2004; Sigman & Ruskin, 1999). JA, however, is an important predictor for children's language in both typically developing populations (Tomasello & Farrar, 1986) as well as in ASD populations (Kasari et al., 2014; Mundy, Sigman, & Kasari, 1990).

Joint engagement (JE), on the other hand, is the use of these joint attention skills in a social interaction. While JA can be thought of as a discrete skill, JE is discussed in terms of engagement states – though it involves an individual's attention (and joint attention), conceptualizing JE as a state indicates that it has a duration and occurs in distinct episodes (Adamson, Bakeman, & Suma, 2016). Bakeman & Adamson (1984) consider six different

engagement states when studying children in caregiver-child interactions, defined by what the child is attending to: the caregiver, a shared referent (e.g., object, activity, or topic), both, or neither. These six engagement states are: 1) unengaged, when a child not engaged with a person, object, or activity; 2) onlooking, when a child observes the caregiver's actions, but does not take part in the interaction his/herself; 3) person engaged, when the child and caregiver are attending to each other in a purely social interaction without a shared referent (e.g., tickles, singing songs); 4) object engaged, when a child is only attending to an object (e.g., a toy) and not the caregiver, 5) supported JE, when a child and caregiver are actively engaged with a shared referent and the child is *aware* of the caregiver's participation, but the child does not repeatedly and/or overtly acknowledge the caregiver's participation, and 6) coordinated JE, defined as when a caregiver and child are actively involved in the same object/activity with the child repeatedly coordinating attention between the shared referent and caregiver. Coordinated JE may be demonstrated through the child's repeated eye contact, gestures, and/or language (i.e., JA skills).

Significance of joint engagement as an intervention outcome. Understanding engagement – particularly joint engagement – is crucial to understand children's early development. JE is a significant predictor in children's linguistic and social development. In line with the social-pragmatic theory of language development described earlier, JE supports language acquisition by providing a frame of reference for children in which to learn language – children are able to match language with a shared referent. Being in episodes of JE with caregivers supports children's vocabulary acquisition (Tomasello & Farrar, 1986; Tomasello, 1988) and early conversational skills (Tomasello, 1988) in typically developing populations. JE with caregivers also predicts gains in receptive (Adamson et al., 2009) and expressive language (Adamson et al., 2009; Kasari et al., 2008) in ASD populations.

JE is also linked with social behavior in children with ASD. Children who spend more time in JE also tend to demonstrate higher spontaneous interest in people (through eye contact, approach, and verbalizations) and higher language ability (Adamson et al., 2010). Additionally, child-initiated JE has been linked to a variety of social behaviors in toddlers, including affect, attention, joint attention, imitation, and interest (Patterson, Elder, Gulsrud, & Kasari, 2014). Given the social nature of today's society, social interaction, social communication, and engaging with others are becoming increasingly important skills for children to master.

However, children with ASD demonstrate consistent difficulty with JE in comparison to both typically developing and other developmentally delayed populations. It is natural for children to shift in and out of JE with other engagement states; however, while typically developing children spend the majority of their time jointly with their caregivers, children with ASD have a harder time both establishing and maintaining JE (Adamson et al., 2001, 2004, 2009). When children with ASD are jointly engaged with their caregivers, the intervals tend to be fleeting and short in duration. Spending less time in JE ultimately means that children with ASD are missing out on crucial opportunities for language and social development. As such, this highlights the importance of improving JE as an outcome of early interventions.

Language. Spoken language is one of the primary means of communication in today's social world. Although there are several different theories of how TD children learn language, current literature generally agrees that children naturally pick up spoken language through social interactions with caregivers (i.e., social interactionist theory; Vygostky, 1978). In fact, some have argued that it is the social nature of these interactions that facilitates language learning — both by serving as young children's motivation as well as providing important contextual information within episodes of joint engagement (Kuhl et al., 2003).

There are several early predictors of language acquisition that are identified in the TD literature. For instance, gaze following, imitation, gesture use, and responding to joint attention have been linked to the onset of vocabulary early language outcomes (Bruner & Sherwood, 1983; Watt et al., 2006). These skills underscore the importance of emerging social-cognitive development — understanding that others have communicative intent, and that communicative intent should be followed and shared — as an important predictor of language development (Carpenter et al, 1998). Others have focused on the role of play, particularly pretend play, in TD language development (Leslie, 1987; Ungerer & Sigman, 1984). These studies highlight the importance of symbolic representation, specifically the way that words can represent our thoughts and actions, in supporting language development. These early predictors of TD language development, however, represent core difficulties for individuals with ASD.

Language ability is highly variable within the ASD population, ranging from those who are verbally fluent to those who produce little spoken language and have minimal language comprehension. Although many children with ASD develop spoken language, approximately 25-30% of children with ASD do not acquire much spoken language by age 5, even when provided with early intervention (Anderson, Oti, Lord, & Welch, 2007; Tager-Flusberg & Kasari, 2013). This group is considered to be "minimally verbal" (sometimes referred to as "nonverbal"). Acquiring spoken language by school age is an important target for children with ASD because children who speak in sentences by that time have better social and adaptive outcomes than those who do not (Rutter, Greenfeld, & Lockyer, 1967). As such, spoken language has become an important target in many early interventions.

There are several phases of language development in children with ASD, described by Tager-Flusberg and colleagues (2009). These five phases are: 1) preverbal communication, 2)

first words, 3) word combinations, 4) sentences, and 5) complex language. Many children with ASD have mixed phase profiles – while they may have advanced vocabularies, they may have difficulty with using language for different functions (e.g., requesting vs. commenting). Indeed, when children with ASD do acquire spoken language, language tends to be used for the purpose of requesting, rather than for commenting or sharing information (Bruinsma, Koegel, & Koegel, 2004; Wetherby, 1986; Wetherby & Prutting, 1984). However, being able to use commenting language is a crucial stepping stone toward developing spoken language for other pragmatic uses (Tager-Flusberg et al., 2009).

Significance of language as an intervention outcome. Language delay is often one of the most conspicuous early symptoms of ASD, and many of the early "red flags" of ASD are concerned with language use or precursors for language (e.g., joint attention skills; Centers for Disease Control and Prevention, 2019). Parents consistently and frequently report language and communication as a major concern in the early development of their children with ASD (Coonrod & Stone, 2004; Guinchat et al., 2012; Ozonoff et al, 2009). One such study reported over 60% of parents having concerns regarding their children's language and communication when children were as young as 12 and 18 months (Ozonoff et al., 2009). Given these concerns, the goal of many early interventions is to increase children's language and communication (Warren et al., 2011).

Children's language ability is also correlated with challenging behavior, which is another commonly cited area of concern among parents (Jang et al., 2011). Children, especially those who have difficulty communicating using spoken language, may engage in challenging behavior as a means of communication (Boucher, 2017). This is evidenced by the fact that children with lower language ability also tend to engage in more frequent challenging behavior when

compared to children with higher language ability (Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Murphy, Beadle-Brown, Wing, Gould, Shah, & Holmes, 2005). Interventions that focus on increasing language have been shown to decrease children's challenging behavior (Goldstein, 2002), demonstrating the importance of targeting language as an intervention outcome in this population.

Lastly, language is an important outcome for early intervention because – as previously mentioned – acquiring phrase speech before kindergarten is a significant predictor of later social and adaptive outcomes (Rutter et al., 1967). Additionally, acquiring language by kindergarten also has implications for school placement, which in turn also affects the social and academic opportunities children will have (Venter, Lord, & Scholper, 1992). While many children with ASD are initially delayed in their language use and ability, most children with ASD will gradually acquire language during the preschool period. These children, who will use spoken language in the future, are thus considered "preverbal." Within the preverbal group, approximately 75% of children gain some words during preschool, and about half will use phrase speech by the time they enter kindergarten (Anderson, et al., 2007; Magiati, Moss, Charman, & Howlin, 2011; Turner, Stone, Pozdol, & Coonrod, 2006). On the other hand, about 25-30% of children with ASD will remain minimally verbal (Anderson et al., 2007; Tager-Flusberg & Kasari, 2013). This preverbal vs. minimally verbal distinction – and the importance of acquiring language before kindergarten – highlights just how significant the preschool years are for children with ASD. It also underscores the need for targeted language interventions during this time, in an effort to optimize outcomes for as many children as possible.

Parent Strategies and Child Outcomes

Parents play a critical role in improving the joint engagement and language outcomes described above. Parents are an important and influential social partner for children with ASD. Indeed, a broad array of literature has examined the effectiveness of parents' use of strategies on improving joint engagement and language. Four main parent strategies emerge from this literature: responsiveness, pacing, prompting, and environmental arrangement. These parent strategies – regardless of which intervention package they may be a part of – have been identified as being helpful for teaching parents how to interact with, engage with, and teach their children more effectively.

Responsiveness. Parental responsiveness in caregiver-child interactions is a significant predictor of several important social and linguistic outcomes in early childhood – across TD, DD, and ASD populations. In TD populations, parent responsiveness has been linked to positive language and social outcomes (receptive language: Baumwell, Tamis-LeMonda, & Bornstein, 1997; expressive language and social responsiveness: Landry, Smith, Swank, Assel, & Vellet, 2001; expressive language and social adaptive functioning: Saxon, Colombo, Robinson, & Frick, 2000; vocabulary development and language milestones: Tamis-LeMonda, Cristofaro, Rodriguez, & Bornstein, 2006). In children with developmental delay, the quality of parents' responsiveness (i.e., contingent and differential responsivity to children's behavior) predicts children's expressive language performance (Brady, Warren, & Sterling, 2009; Warren & Brady, 2007). In ASD populations, parent responsiveness in play interactions has been linked to improvements in children's social interaction and social-emotional functioning (Mahoney & Perales, 2003), as well as to child-initiated joint engagement and children's social behaviors (Patterson et al., 2014). Parents who demonstrate responsiveness by synchronizing their attention

with what the child already focused on also tend to have children with better JA and language outcomes over time (Siller & Sigman, 2002).

Responsiveness is a particularly interesting parent strategy to examine because parents of children with ASD trend toward directiveness. While parents of children with ASD are still sensitive and responsive, overall, parents of children of ASD tend to be more directive, controlling, intrusive in their interactions with their children than do parents of TD and DD children (Doussard-Roosevelt, Joe, Bazhenova, & Porges, 2003; Kasari, Sigman, Mundy, & Yirmiya, 1988; Lemanek, Stone, & Fishel, 1993). One possible explanation for this trend is that in their attempts to encourage their children's social interactions and responsiveness, some parents may be drawn into increasingly directive interactions. However, directive parental interactions, in fact, appear to *discourage* children from being socially engaged with their parents (Lussier, Crimmins, & Alberti, 1994). Given this, it is particularly important to teach, train, and target parent responsivity – to alter these parent-child interactions – in order to support best outcomes for children with ASD.

Pacing. Pacing describes the appropriate timing and parents' actions and language during parent-child interactions. Pacing is an important component of any parent-child interaction – too quick and the child may become overwhelmed and dysregulated, too slow and the child may become unengaged (upper and lower limits of the control systems model; Bell & Chapman, 1986). Appropriate pacing requires that the parent provides sufficient time and space for a child to respond or to initiate, and that the parent does not talk over the child. It also involves a delicate balance between capitalizing on moments when the child is motivated and jointly engaged to teach more complex skills, and knowing when to modulate pace based on the child's moment-to-moment needs.

Pacing an important element of the DTT intervention. In DTT, the adult initiates the teaching episodes through discrete trials. The adult provides an instruction, waits for a response, then delivers a contingent consequence (Smith, 2001). A key pacing element in DTT is that the adult must provide sufficient space for the child to respond, but not provide so much so that the child has the opportunity to disengage from the trial and engage in other behaviors. After each trial, the adult determines the length of the intertrial interval (i.e., the length of time between each discrete trial) before moving to the next trial. Short intertrial intervals (approximately one second) have been shown to more effective than long intertrial intervals (four or more seconds) in producing correct responses and rapid acquisition of skills (Koegel, Dunlap, & Dyer, 1980). Though in DTT, trials generally occur at a quick pace (Geiger et al., 2012), it may that there is an optimal duration for the intertrial interval, depending on the individual needs, behaviors, and targets of the child.

The importance of pacing has also been demonstrated within the JASPER intervention. Pacing – specifically mirrored pacing, a strategy that involves not only timing of actions and words, but also appropriate timing and placement of imitated and modeled actions (i.e., within the child's attentional focus) – was identified as an "active ingredient" of the JASPER intervention (Gulsrud et al., 2016). Mirrored pacing mediated the relationship between treatment and child JE. However, because mirrored pacing is a complex strategy that is actually made up of multiple different strategies (pacing, modeling, imitation), it is difficult to know exactly if it is one particular (or the conjunction of all three elements) that is driving the change.

Prompting. Prompting is the use of physical guidance, verbal commands, gestures, or modeled language/actions to elicit a desired response from a child. Prompting is an evidence-based practice for instructing children with ASD (Callahan, Henson, & Cowan, 2008) and has

been shown to be an effective strategy for teaching children language skills (Laski, Charlop, & Schreibman, 1988). By nature, to be effective, prompts should occur during episodes of joint engagement, where children and adults would be sharing attention. One way to do this is to prompt in naturalistic parent-child play interactions, which has been shown to improve children's language when paired with responsive parent behaviors (Ingersoll & Wainer, 2013; Kaiser, Hancock, & Nietfeld, 2000; Hardan et al., 2015).

Prompting is a strategy that is built into several interventions, including both structured, behavioral approaches such as DTT and naturalistic developmental approaches such as JASPER (Ingersoll, 2010). Prompts are an important tool for initially teaching skills, but the ultimate goal of interventions should be spontaneous initiations and generalizations of skills children have learned (Kasari, Gulsrud, & Jeste, 2017). Therefore, prompts should gradually be faded out as children acquire skills, lest children become too dependent on prompts (Cooper, Heron, & Heward, 2007). Also, once skills are acquired, prompting procedure should follow a least-to-most hierarchy (i.e., providing the least intrusive prompt possible initially, gradually increasing the intrusiveness of the prompt as necessary based on child's response). Parents' use of prompts is an important strategy for teaching children new skills. As such, parents' appropriate use of prompting strategies is important to examine in parent-child interactions.

Environmental arrangement (EA). EA has been identified as an important strategy across a wide range of interventions (Halle, Baer, & Spradlin, 1981; McGee, Morrier, & Daly, 1999). EA refers to the parent's placement of their own body (sitting face-to-face, at eye level) as well as materials in relation to the child. The environment should not be too cluttered so as to minimize distraction, and parents should be able to easily access and manipulate the materials they need. Moreover, the environment should be arranged in such a way that promotes the

child's attention, creates opportunities for child communication, provides opportunities for teaching (Kaiser, Ostrosky, & Alpert, 1993; Smith, 2001).

Successful use of EA can lead to increases in children's communication and social interactions. Parents' use of EA has been linked to increases in the frequency of communicative acts by children (Kashinath, Woods, & Goldstein, 2006). Additionally, EA has been a significant predictor of children's joint engagement in a parent-delivered intervention (Gulsrud et al., 2016). Because EA involves the dynamic ability to shift both one's body and materials in conjunction with the child's moment-to-moment developmental needs, it is an important strategy for supporting a state of shared attention, and thereby, language.

Differences Between Mother-Child and Father-Child Interactions in ASD

As stated above, a broad base of early intervention literature has established the important role that parents play as social partners – and intervention agents – for children with ASD. However, much of this literature has tended to focus on mothers and mother-child interactions within the context of intervention. Few studies specifically report on fathers' involvement in interventions (Flippin & Crais, 2011). At the same time, however, fathers are increasingly taking on the primary caregiving role in the family. US Census Bureau (2013) estimates state that fathers are the primary caregivers for 21% of preschoolers in the US, representing an increase over the past 30 years. Fathers of children with ASD remain underrepresented in the research and thus, our understanding of fathers remains relatively limited.

Research that does compare mothers and fathers of children with ASD has generally focused on their differences in stress and coping strategies. Parenting a child with ASD has been associated with higher levels of stress than parenting a child with a different developmental disability (Baker-Ericzén et al., 2005; Belchic, 1996; Davis & Carter, 2008; Estes et al., 2009).

And while some studies report no differences between mothers and fathers of children with ASD in terms of parental stress (e.g., Hastings, Kovshoff, Brown, Ward, Espinosa, & Remington, 2005), most studies have found that mothers of children with ASD experience higher levels of stress than do fathers of children with ASD (Davis & Carter, 2008; Dabrowska & Pisula, 2010; Herring, Gray, Taffe, Tonge, Sweeney, & Einfeld, 2009). Additionally, research has identified differences in coping strategies between mothers and fathers. For instance, mothers report relying more on social support, emotional strength, and communicating with other parents and health professionals than do fathers (Hall & Graff, 2011). Mothers also report more frequently using active avoidance and problem-focused coping strategies than fathers (Hastings et al., 2005) — in all, highlighting that there are indeed differences in the ASD parenting experience between mothers and fathers.

Less is known, however, about mothers' and fathers' involvement in intervention studies, and particularly in their intervention strategy usage. Few studies have examined father-child interaction in interventions, and many of the studies are single-subject designs (Flippin & Crais, 2011). What has been established is that fathers of children tend to be more directive with their children, less active in the interaction, less consistently responsive to their children's initiations (Elder & Goodman, 1996; Elder, Valcante, Won, & Zylis, 2003; Konstantareas, Mandel, & Homatidis, 1988; Wolchik, 1983). Additionally, fathers tend to engage in more active, rough-and-tumble play, often assuming the role of play partner (Labrell, 1996), though the difficulties with social engagement and symbolic play characteristic of ASD can make sustaining play difficult for parents. Fathers have reported initial frustrations with not knowing how to play with their children during play sessions, but can make progress in incorporating strategies such as imitation with animation (Elder et al, 2003; Elder et al, 2011).

In all, fathers have unique interaction styles that can support children's development. Understanding differences in parent strategy usage can provide valuable information for parent training. It can highlight areas where mothers or fathers may need additional support to facilitate their children's social communication skills, allowing interventionists to tailor the parent training experience to suit parents' needs.

Current Study

A broad base of literature has highlighted the importance of parent-child interactions in supporting children's social and language development. These interactions may be particularly interesting to examine in a sample of children whose social and language development tend to be impaired, such as in children with ASD. Interventions have been developed to address the developmental needs of children with ASD, and parent involvement and training in ASD interventions has increased – particularly by implementing interventions in school contexts, which also allows for increased inclusion of ethnically, racially, and socioeconomically diverse children in research studies.

Several parent behaviors and strategies (some of which are taught as intervention components) have been identified as being particularly effective for engaging and interacting with children with ASD. However, these strategies (responsiveness, prompting, pacing, EA) had not yet been examined in comparison with each other, across interventions, or with the minimally verbal population.

Therefore, the current study, which is a secondary data analysis of an RCT comparing two different interventions for preschoolers with ASD, examined parents' use of intervention strategies common to both treatment approaches. Specifically, it explored how parent strategy use changed over the course of intervention and by treatment group. This allowed us to evaluate

the extent to which parent training in the two interventions differ from each other. Additionally, change in parent strategy use was examined in relation to children's JE and language outcomes over time – allowing us to identify which parent strategies were *most* effective in improving children's social communication outcomes. This study sought to investigate the following specific aims:

Aim 1: Explore the relation between parent strategy use (responsiveness, pacing, prompting, EA), time (entry, 2 month, 4 month, exit), and treatment group (DTT, JASPER).

1(a): Determine if parent responsiveness, pacing, prompting, and/or EA changes over time and by treatment group.

1(b): Determine if there are differences in strategy use by parent gender.

Aim 2: Explore the relation between child joint engagement, parent strategy use, time, and treatment group.

2(a): Determine whether parent strategy use (responsiveness, pacing, prompting, EA), time, and treatment group predict the amount of time that children spend in jointly engaged with their caregivers, object engaged, or unengaged/other.

Aim 3: Explore the relation between child language, parent strategy use, time, and treatment group.

3(a): Determine whether parent strategy use (responsiveness, pacing, prompting, EA), time, and treatment group predict child's spontaneous communicative utterances and number of different words used.

Method

Participants

This study used entry, 2 month, 4 month, and exit data from a large, multisite randomized controlled trial of ASD intervention. Participants for the original study were preschoolers with ASD (along with their parents) recruited for a social communication intervention study. In addition to having a previous clinical diagnosis of ASD (confirmed by the Autism Diagnostic Observation Schedule; Lord et al., 2012), children needed to meet the following inclusion criteria to be eligible for the study: a) receive at least 12.5 hours/week of early intervention services or preschool special education, some of which should be provided in the school setting, b) attain an average nonverbal mental age equivalent of at least 12 months as assessed by the Mullen Scales of Early Learning (MSEL; Mullen, 1995), and c) use fewer than 30 spontaneous, functional words across entry behavioral assessments. 181 children were originally screened for the study. 17 children did not meet inclusion criteria, and 3 children enrolled in the study but dropped out before study completion, leaving a total of 161 participants for the original study. The current study includes 156 participants (n_{female}=25, M_{age}=45.08 months, SD=5.48 months, range=32-56 months). Participants may have been excluded if assessments were completed with multiple parents across timepoints (n=2), not completed with a parent (n=2), or if assessments were not able to be coded or transcribed due to language issues (n=1).

As shown in Table 1, the average nonverbal IQ at entry was 55.76 (SD=12.98). The mean receptive language age equivalent was 16.32 months (SD=8.27 months), and the mean expressive language age equivalent was 15.58 months (SD=6.93). In terms of race/ethnicity, approximately 15% of the sample was Hispanic/Latino, 17% was Asian, 14% was black, 37% was white, 12% was multiracial, and 5% was undisclosed/other (see Table 2).

Approximately 78% of caregivers were mothers, and 21% of caregivers were fathers (which aligns with US Census Bureau statistics (2013) for fathers as primary caregivers of preschoolers). About 15% of mothers had graduate or professional training, 31% were college graduates, 30% attended some college, and 22% were high school graduates or lower. Approximately 17% of fathers had graduate or professional training, 22% were college graduates, 28% attended some college, and 28% were high school graduates or lower. There were no differences in MSEL scores, race, or parent characteristics by treatment group.

Original Study Design

The original study compared two different approaches to social communication intervention: Discrete Trial Training (DTT), and Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER). DTT is a more structured and adult-led intervention, while JASPER is considered a more naturalistic, child-led intervention. After completing screening assessments, children were randomized into either the DTT or JASPER treatment group condition. Children received 6 months of their assigned intervention at school for one hour per day, five days a week, in a 1:1 format. Interventionists were graduate students or staff researchers who trained in the intervention approaches. Children were assessed at study entry, two months into the intervention, four months into the intervention, and at study exit (six months after study entry).

Parent training. In the final two months of intervention, parents received weekly training in the intervention strategies of their children's assigned treatment condition (either DTT or JASPER). Training took place in either the school or home context and was delivered by the child's interventionist. Each training lasted for approximately one hour, once a week, for a total of eight sessions (eight hours) of parent training for the study. These weekly trainings replaced one intervention session per week. Children were also present for each parent training session.

Trainings included going over didactic intervention-specific modules and handouts, videos demonstrating intervention strategies, role playing or modeling intervention strategies by the interventionist, and parents practicing intervention strategies with their children with coaching from the interventionist. Trainings were individualized to each parent and child and were based on the child's current progress in the intervention program. All parent training sessions were videotaped.

Parent training in DTT. Parent training in DTT was composed of six weekly training modules, with two supplementary modules of the parent's choice. In addition to providing overviews of ABA and DTT, the six modules provided behavioral skills training in DTT in areas such as: preparing the environment, pacing of trials, prompting, reinforcement, selecting teaching plans, trial-by-trial data collection, graphing, analyzing data, and troubleshooting. The supplementary modules covered topics such as transitioning between activities, increasing compliance, and embedding DTT in everyday settings. Parents were taught the basics of DTT in the context of programs and skills their child was currently working on with their interventionist at school. Parents and interventionists went over videos, handouts, and activity sheets together before role play, modeling, and practice with the child.

Parent training in JASPER. Parent training in JASPER was also made up of weekly modules. The first six modules covered the basics and mechanics of the intervention, including: joint engagement, play levels, setting up the environment, following the child's lead, establishing play routines, prompting for joint attention and language, expanding on the child's language, imitation, and modeling. The seventh week was reserved as a session to review any previous modules of the parent's choice. The final week was designated for practice. There was also an optional handout on managing challenging behavior that was to be distributed if the child was

frequently dysregulated during the parent training sessions. This optional handout could be used during any week of the parent training. Parents were taught to implement these intervention strategies in a way that was individualized to their child's current developmental level (play level and language). Parents and interventionists went over a PowerPoint presentation, videos, and handouts before role playing, modeling, and practicing with the child.

Measures and Procedure

Parent-child interaction (PCX). Each parent-child dyad completed a videotaped 10-minute free play assessment using a standardized set of toys called the Parent-Child Interaction (PCX). The PCX was conducted at study entry, 2 month, 4 month, and exit timepoints in school, home, or clinic settings. Parents were instructed to engage their children in play using the toys in the manner in which they would typically play together at home.

Parent strategies. Parent strategies ratings were determined from the PCX. Parents were rated on their use of four strategies that are common across *both* intervention approaches and are taught in parent training for both intervention groups. Specifically, parents were rated on the following items:

1) Responsiveness to child's communication: Responding to both the child's verbal cues as well as nonverbal cues. This item captures the frequency, consistency, and supportiveness of parent's responses to the child's behaviors (e.g., language, vocalizations, gestures, facial expressions, body language) throughout the interaction, which may or may not always be directed toward the parent.
2) Pacing: Timing and the appropriateness of parent's actions (paired with language or not) during the interaction. This describes the rate at which parents are taking action vis-à-vis their child to keep the child engaged (e.g., pausing to allow time and space

for the child to communicate and not talking over the child). This item also rates if parents are able to modulate their pace as appropriate based on child's needs – for instance, increasing the pace of the interaction to keep a child from becoming unengaged.

3) Prompting: Quality and appropriateness of parent's use of prompts. This item is rated based on the parent's use of the prompt hierarchy throughout the interaction (using minimally invasive prompts when possible, use of most-to-least vs. least-to-most depending on behavior), as well as if the parent selects appropriate skills, behaviors, and language to prompt.
4) Environmental arrangement (EA): Parent's placement of their body and materials in relation to the child. This item measures whether parents position themselves to be in front of their children (face-to-face) at eye level. It also assesses the parent's arrangement and manipulation of materials (i.e., making toys readily accessible, placing toys in between parent and child, cleaning up the area as needed).

Items were rated on a 5-point Likert scale, where higher ratings indicate more fluent and more appropriate use of the strategy in the interaction. For example, when rating a parent's responsiveness during the PCX, a rating of 1 indicated minimal or ineffective strategy use, corresponding to infrequent, inconsistent responses to the child's play, social activities, facial expressions, vocalizations, gestures, body language, and intentions. The parent may ignore or be oblivious to the child's communication. A rating of 3 indicated moderate or moderately appropriate strategy use, such that the parent responds to *most* of the child's bids for attention or communication and *some* of the child's non-demand behaviors (i.e., behaviors that may not be directed toward the parent, including subtle and hard to detect gestures, vocalizations, and other

behaviors). Parent's responses could be mixed in quality between being supportive of the child's activity and not (e.g., unrelated to child's activity). A rating of 5 indicated fluent and appropriate strategy use, where the parent responds to almost all of the child's bids and most of the child's non-demand behaviors. The parent's responses would almost always be supportive and be related to the child's activity.

Items, definitions, and anchors were adapted from the *Maternal Behavior Rating Scale* (MBRS; Mahoney, Powell, & Finger, 1986) and *Joint Engagement Rating Inventory* (JERI; Adamson, Bakeman, Deckner, & Nelson, 2016). The anchors were designed to span the range of possibilities observed in interactions between parents and their young children.

Coding reliability was determined for each of the items by computing intraclass correlations (ICCs; Shrout & Fleiss, 1979). Three raters were trained to a high degree of reliability, and approximately 30% of videos were coded for reliability. The average ICC for responsiveness was .90 (range=.86-.95), the average for pacing was .88 (range=.83-91), the average for prompting was .87 (range=.85-.90), and the average of environmental arrangement was .85 (range=.75-.92).

Child outcome measures. ***Engagement.*** Engagement states were coded using a modified version of the scheme described in Adamson, Bakeman, Deckner, & Romski (2009). Six engagement states, which characterized the child's attention to people and objects, were initially coded and then collapsed into three macro categories: joint engagement, object engagement, and unengagement/other. This approach is consistent with prior studies using the same engagement states (Kasari et al., 2010).

Joint engagement (JE) involved attention to a shared referent (e.g., object, activity, or topic) and a partner. There were two different JE states: coordinated JE and supported JE.

Consistent with previous studies using the same engagement states (Shire et al., 2016; Kasari et al., 2015), supported JE and coordinated JE codes were combined into one JE variable. *Object engagement* was coded when a child was only attending to an object (e.g., a toy) and not the caregiver (e.g., a child focused on rolling a car back and forth without acknowledging of the parent's presence). The last category, *unengagement/other,* combined three engagement states: person engagement, onlooking, and unengagement. Person engagement was coded when the child and caregiver were attending to and were engaged with each other, but there was no other shared referent (i.e., an object). Examples of person engagement involved tickling, person games (e.g., peekaboo, pat-a-cake), or singing songs (e.g., singing "Row Row Row Your Boat" with accompanying hand/body movements). Onlooking was coded when the child watched a caregiver interact with a toy, but did not interact with the toy themselves. Unengagement was coded when a child was not interacting with a caregiver, object, or activity (e.g., wandering around the room; engaging in protest behavior).

Engagement was coded continuously (i.e., second by second) for the primary state of engagement, using a five-second decision rule to determine clear shifts in engagement states. Coders were blind to treatment group and timepoint. Four raters were trained to a high degree of fidelity, and coding reliability was determined by computing the percent agreement across 30% of videos. The average percent agreement across raters was .81 (range=.80-.83).

Language. PCXs were transcribed using Systematic Analysis of Language Transcription (SALT) conventions and analyzed using SALT software. Transcripts were analyzed for the number of child utterances (excluding scripted or completely unintelligible language) and number of different word roots. Additionally, children's language was coded for function and level of independence. Functions of language included comments (statements about a shared

activity) and requests (eliciting a response from the social partner). Utterances that were not clearly comments or requests were coded as "other" (e.g., saying "hello" or "goodbye," answering a test question). Levels of independence for children's language included: spontaneous utterances, which were completely unprompted, elicited language, which occurred in response to a parent's questions (e.g., "What color is it?" or "What do you want to play with?"); imitated language, where children repeated part or all of the parent's previous utterance; and prompted language, which was in response to a parent's verbal prompt (e.g., "Say 'help'"). Number of different word roots and spontaneous communicative utterances (combining spontaneous comments, requests, and "other" statements) were analyzed as outcome variables.

Transcribers were trained to a high level of fidelity in both transcription and transcription coding. Each transcript was viewed at least twice – once for the actual transcription and coding and once more for verification of transcript and codes by another reliable transcriber. The average ICC for transcript coding was .98 (range=.96-.99).

Baseline characteristics. Several variables from baseline measures were included as control variables in subsequent analyses. Parent education information, children's gender, and children's birthdate was reported on demographics form at intake. Children's chronological age was calculated based on the birthdate provided.

Children's non-verbal IQ was derived from the Mullen Scales of Early Learning (MSEL; Mullen, 1995). The MSEL is a standardized assessment that measures cognitive ability and motor development in infants and young children and was used as a screening measure for the original study. The MSEL was administered and scored individually by blinded, trained assessors before the original study began. Assessors completed four subscales: Visual Reception, Fine Motor, Receptive Language, and Expressive Language. Nonverbal IQ was calculated as an

average of the scaled mental age equivalent scores on baseline visual reception and fine motor subscales (Bishop et al., 2011).

The Autism Diagnostic Observation Scales (ADOS; Lord et al., 2012) was used to determine autism severity. The ADOS is a semi-structured diagnostic assessment that has different modules to account for the different ages and varying language levels of individuals with ASD. While all participants were administered an ADOS, there were not only differences in which module of the ADOS was completed, but also which version of the ADOS was completed (ADOS vs. ADOS-2). To account for this variability, calibrated severity scores were calculated as a way to standardize scores (Gotham, Pickles, & Lord, 2009).

Results

Parent Strategies

Change in parent behavior was examined by time and by treatment group. Ratings of each of the four coded parent strategies (responsiveness, prompting, pacing, EA) for each timepoint (entry, 2 month, 4 month, exit) were analyzed using a separate linear mixed model for each parent strategy, using time as a repeated measure. A time by treatment group interaction was also examined in each model. Each model controlled for site, child gender, child age, non-verbal IQ, and the adult in the interaction (mother or father). Descriptive statistics for each parent strategy can be found in Tables 3-6.

Responsiveness. There was a significant time by treatment interaction for parents' responsiveness, $F(3, 413.23)=3.36$, $p=.019$ (Table 7). Responsiveness ratings for parents in the DTT group remained stable across all four timepoints, while responsiveness ratings for parents in the JASPER group increased over time, most notably between entry and exit (Figure 1).

Pacing. There were no significant effects of time, treatment, or a time by treatment interaction on parents' appropriate pacing (Table 9). While the overall effect of time was not significant, $F(3, 416.03)=.86$, $p=.461$, pairwise contrasts of the parameter estimates indicated that there was a significant difference in ratings between entry and exit for both treatment groups, $t(418.80)=-2.47$, $p=.014$ (Table 10 & Figure 2).

Prompting. The time by treatment interaction was not statistically significant, $F(3, 416.88)=2.39$, $p=.068$ (Table 11); however, the trends indicated that prompting ratings for parents in the DTT group remained stable across all four timepoints, while ratings for parents in the JASPER group increased over time (Figure 3). While there was no overall main effect of time, $F(3, 416.75)=2.39$, $p=.069$), pairwise contrasts of the parameter estimates indicated that there were significant differences in ratings between entry and exit, $t(419.64)=-3.62$, $p<.001$, and 4-month and exit, $t(418.42)=-.211$, $p=.036$) (Table 12). There were no treatment effects on ratings on parents' prompting.

EA. The time by treatment interaction was not statistically significant, $F(3, 416.32)=2.21$, $p=.087$ (Table 13). There was a significant treatment effect on parents' use of EA, $F(1, 142.44)=3.96$, $p=.048$. Parents in the DTT group (estimated marginal mean (*EMM*) =3.90, *SE*=.09) used EA more fluently across time than did parents in the JASPER group (*EMM*=3.70, *SE*=.09; Figure 4). Additionally, while the overall effect of time was not significant, $F(3, 416.19)=1.50$, $p=.216$, pairwise contrasts of the parameter estimates indicated that there was a significant difference in EA between entry and exit for across both treatment groups, $t(419.13)=-2.61$, $p=.009$ (Table 14).

Difference between mothers and fathers on parent strategies. The difference between mothers and fathers on responsiveness was not statistically significant, $F(1, 164.46)=3.57$,

p=.060 (Table 7). However, there were differences between mothers and fathers on the other parent strategies. On average, mothers (*EMM*=3.52, *SE*=.09) paced their interactions more appropriately than fathers (*EMM*=3.00, *SE*=.15) across timepoints and treatment groups, *t*(159.69)=3.36, *p*=.001 (Table 10). Mothers (*EMM*=3.41, *SE*=.09) also prompted more appropriately than fathers (*EMM*=3.04, *SE*=.15) across time and treatment, *t*(156.17)=2.37, *p*=.019 (Table 12). Lastly, mothers (*EMM*=3.59, *SE*=.12) received higher ratings on EA across time and treatment compared to fathers (*EMM*=3.01, *SE*=.07), *t*(155.51)=3.42, *p*=.001 (Table 14).

Engagement

Linear mixed models were also used to examine the relation between parent strategies and engagement, with separate models for the percentage of time spent in JE, and percentage of time spent in object engagement. A negative binomial mixed model was used to examine the relation between parent strategies and unengagement/other. For these analyses, each of the four parent strategies, treatment group, time, and a time by treatment interaction were included in the models as predictors. The models controlled for site, child gender, chronological age, non-verbal IQ, autism severity, and the adult in the interaction (mother or father).

Joint engagement. The time by treatment interaction was not significant for children's joint engagement, *F*(3, 395.47)=1.38, *p*=.249 (Table 15 & Figure 5). The percentage of time children spent in joint engagement increased over time, *F*(3, 396.20)=2.68, *p*=.046. At entry, it was estimated that children spent 32.1% of the free play assessment jointly engaged with their caregivers (*SE*=4.9%); by exit, children spent 37.5% of their time jointly engaged with their caregivers (*SE*=4.8%). There were no significant treatment effects on joint engagement, *F*(1, 145.88)=2.99, *p*=.086.

None of the parent strategies were significant predictors of children's joint engagement. However, pacing, $F(4, 468.39)=2.11$, $p=.078$, and environmental arrangement, $F(4, 474.60)=2.32$, $p=.056$, were highlighted as two strategies that may potentially influence children's joint engagement. Examination of the parameter estimates showed that there were significant differences in children's estimated joint engagement between parents with higher vs. lower ratings in pacing and EA (Table 16). Parents who were rated highest in pacing and EA had children who spent more time jointly engaged than did parents with lower ratings in pacing and EA.

Object engagement. The time by treatment interaction was not significant for children's object engagement, $F(3, 393.98)=.35$, $p=.790$ (Table 17 & Figure 6). There were also no overall significant effects of time, $F(3, 394.72)=2.46$, $p=.063$, or treatment, $F(1, 144.21)=.05$, $p=.822$. When a model containing only the entry and exit timepoints was run, however, there was a significant effect of time, $F(1, 143.46)=4.69$, $p=.032$, such that there was a decrease in the percentage of time spent in object engagement between entry (*EMM*=57.7%, *SE*=5.7%) and exit (*EMM*=52.5%, *SE*=5.6%).

There were no significant main effects of the parent strategies on children's object engagement. However, an examination of the parameter estimates again demonstrated that there were significant differences in children's estimated object engagement between parents with higher vs. lower ratings in pacing and EA (Table 18). Parents who were rated highest in pacing and EA had children who were significantly less object engaged than did parents with the lowest ratings in pacing and EA.

Unengagement/Other. There was a significant time by treatment interaction for the percentage of time children spent being unengaged/other, Wald $X^2(3)=7.98$, $p=.046$ (Table 19).

After correcting for post-hoc analyses, there were significant differences between the two treatment groups at the 2-month timepoint, p=.005 (Figure 7). Children in the DTT group (M=8.23%, SD=11.5%) were significantly less unengaged/other than children in the JASPER group (M=14.85%, SD=19.06%) at 2 months [note: reported means and SDs instead of estimated marginal means and SEs]. After corrections, there were no statistically significant differences between the two groups at the other timepoints.

There was a significant effect of pacing on unengagement/other, Wald $X^2(4)$=10.339, p=.035. Parents who paced their interactions more appropriately tended to have children who were less unengaged across time and across treatment. Similarly, there was also a significant effect of EA on unengagement/other, Wald $X^2(3)$=22.35, p<.001. Parents who received higher ratings on environmental arrangements tended to have children who were less unengaged/other across time and across treatment.

Language

Negative binomial mixed models were used to examine which parent strategies were related to language, with separate models for total spontaneous communicative utterances and the number of different word roots used. A negative binomial mixed model was specified due to the high number of participants with little to no spontaneous language. Each of the four parent strategies, treatment group, time, and a time by treatment interaction were included in the models as predictors. The models controlled for site, child gender, chronological age, non-verbal IQ, autism severity, and the adult in the interaction (mother or father).

Spontaneous communicative utterances. The time by treatment interaction was not significant for children's SCU, Wald $X^2(3)$=.30, p=.960 (Table 21 & Figure 8). Children's SCU increased over time, Wald $X^2(3)$=31.16, p<.001. At entry, the estimated marginal mean was 4.39

spontaneous utterances (*SE*=.97); by exit, the mean was 7.56 spontaneous utterances (*SE*=1.60). There were no significant treatment effects on SCU, Wald $X^2(1)=3.51$, $p=.061$.

Parents' pacing was a significant predictor of SCU, Wald $X^2(4)=12.32$, $p=.015$. Parents who paced more appropriately were more likely to have children with higher SCU across treatment and across time.

Number of different word roots. The time by treatment interaction was not significant for children's NDWR, Wald $X^2(3)=3.13$, $p=.371$ (Table 23 & Figure 9). Similarly to children's SCU, children's NDWR also increased over time, Wald $X^2(3)=33.17$, $p<.001$. At entry, the estimated marginal mean was 2.62 words (*SE*=.77); by exit, the estimated marginal mean was 4.95 words (*SE*=1.40).

Unlike with SCU, there was a significant treatment effect of DTT on NDWR, Wald $X^2(1)=3.51$, $p=.061$. Children in the DTT group ($M=4.71$, $SE=1.33$) had significantly higher word diversity than children in the JASPER group ($M=3.66$, $SE=1.03$) across time.

Pacing was also a significant predictor of NDWR, Wald $X^2(4)=18.80$, $p=.001$. Parents who paced their interactions more appropriately were more likely to have children with higher NDWR across treatment and across time.

Discussion

This study examined three primary research questions: 1) How does parent strategy usage change over the course of an RCT of social communication intervention for preschoolers with limited language? 2) How do these changes in parent strategy usage relate to children's engagement outcomes across time and by treatment? and 3) How do changes in parent strategy usage relate to children's language outcomes across time and by treatment? Parents improved in their use of four ABA-based intervention strategies (responsiveness, pacing, prompting, and

environmental arrangement) over a brief training period. Results also illustrated the important role of parents' pacing and environmental arrangement in supporting children's joint engagement and language outcomes, highlighting potential areas of focus for future parent training.

Parent Strategies

Responsiveness. Parents who received DTT remained stable in their responsiveness ratings, while parents who received JASPER increased in their ratings over the course of the intervention. It is worth noting that these ratings were all relatively high to begin with. The differences in trends between the two treatment groups may have to do with the way in which responsiveness is considered in each of the interventions. In DTT, parent responsiveness is conceptualized as contingent reinforcement (e.g., providing praise after a child successfully completes a trial); in JASPER, responsiveness is more about labeling and following in on a child's interest (whether on a toy, play act, or topic). The more naturalistic response style characteristic of JASPER may have been more conducive to promoting parental responsiveness. Additionally, the DTT intervention approach emphasizes the importance of ensuring that a child is ready – seated, attentive, and not distracted – before starting a trial. This may require adults to direct or redirect a child's attention to the task at hand, and it may have made it more difficult for a DTT parent to be considered responsive.

Whatever the underlying reason, parent training in JASPER appeared to be uniquely effective in teaching parents to contingently respond to their children's communication. This aligns with the strong emphasis in JASPER parent training on following the child's lead as well as imitating the child in the context of play – both of which would encourage parental responsiveness. It is encouraging to see changes in this parent outcome even after only a brief training period, especially given the importance of parental responsiveness in supporting child

outcomes in the literature (e.g., Siller & Sigman, 2002; 2008). In fact, increasing parental responsiveness to children's verbal and nonverbal communication has been a focus of various ASD early interventions (Green et al., 2010; Kasari et al., 2014; Mahoney & Perales, 2003; Siller, Hutman, & Sigman, 2013). Parental responsiveness is an important strategy not only in its relation to child outcomes, but also in how it improves the quality of parent-child social interactions – underscoring the practical significance of this result.

Pacing and prompting. Parents increased in their use of appropriate pacing and prompting over the course of intervention. Parent ratings of pacing increased from entry to exit across both treatment groups. Similarly, parent ratings of prompting also increased between entry to exit, but there was also a significant increase in ratings between the 4-month timepoint and exit. This is notable as the 4-month timepoint is when parent training started in the original intervention study, and it suggests parent training may have been particularly effective in teaching parents appropriate prompting strategies (e.g., prompting hierarchy) across both interventions.

Both appropriate pacing and appropriate prompting require the adult to acknowledge and understand their child's needs in the moment. For instance, appropriately pacing an interaction involves a balance between a child's moment-to-moment engagement with one's words and actions. Parents would need to know when it would be appropriate to modulate their pace based on what they notice about their child's behavior in order to best support joint engagement and language. Often this requires that the parent provides sufficient time and space for a child to respond and initiate with them. This balance is difficult given that joint engagement can be fragile and fleeting in children with ASD (Adamson et al., 2009), and too much time and space can lead to a child becoming unengaged (Lamella & Tincani, 2012). Similarly, appropriate

prompting requires knowledge and understanding of a child's abilities and capabilities, as well as knowing how and when to modulate the level of prompting needed in the moment.

Fluent use of both of these strategies represents parents' ability to scaffold within Vygostky's zone of proximal development (1978) – to understand the difference between what a child can do independently and what a child can achieve with support from a more knowledgeable other (i.e., a caregiver) – as well as parents' understanding of their own role in supporting child outcomes. This is particularly significant because children with ASD tend to demonstrate lower "readability" in their communicative bids to their parents, which in turn affects parents' ability to provide appropriate support during social interactions (Adamson et al., 2012). Parents' improvement in their use of pacing and prompting in this study demonstrates that even a brief parent training can teach parents to not only become more *aware* of their child's changing needs, but also the ways in which they can *modify* their own behavior to support their child's needs.

EA. There was a treatment effect of DTT on parents' EA ratings across time, indicating that DTT may have been better suited for teaching parents how to arrange their physical space with respect to the child. Parents were assessed with respect to their body placement (i.e., sitting face-to-face, at eye level) and placement of materials (i.e., in between themselves and the child) with relation to the child. Parents were also assessed on their ability to manage the environment – that is, minimizing clutter/potential distractions and shifting materials based on children's needs.

Because DTT is often conducted at a tabletop setting, training in this intervention may have been more conducive to parents receiving higher EA ratings. By sitting at a table, parents are already seated face-to-face and at eye level with the child, and any materials placed on the

table are in between both social partners. On the other hand, JASPER is generally conducted on the floor, and there are various toys and toy sets arranged around the intervention space. The fact that there are more materials to manage within a less contained space may have made it more difficult for JASPER parents to receive higher EA ratings. It should be noted, however, that parents were not asked to conduct intervention sessions during the PCX assessment; rather, they were asked to play with their children as they naturally would. Most PCXs took place on the floor rather than at a table. Despite this, it may be that the EA strategies learned during the parent training of each respective intervention were still being demonstrated during the assessment.

It is also important to note that the definition of EA in the current study differed from that of previous JASPER studies (e.g., Gulsrud et al., 2016, Chang et al., 2016). Specifically, it did not include the element of toy selection, which is a key component of JASPER. Toy selection encompasses parents' ability to select developmentally appropriate toys based on their child's play level. This aspect of EA was not included in the current study's definition because it was not a shared element across both interventions.

Mothers and fathers. This study included a considerable number of fathers who participated in parent training, especially when compared to previous JASPER studies (which ranged from 0-16% fathers participating in intervention). There were consistent differences between mothers and fathers on pacing, prompting, and EA across time and across interventions. Fathers' pacing, prompting, and EA tended to be less appropriate compared to that of mothers. These findings are practically significant, given the importance of parents' appropriate pacing, prompting, and EA in facilitating children's social communication (Gulsrud et al., 2016; Harden et al., 2015; Kashinath et al., 2006), and as such, there are several takeaways from these results.

First, there is a need for more father-focused interventions and father-focused trainings within the field of ASD intervention. There is an assumption in the literature that parent training outcomes for mothers also apply to fathers (Flippin & Crais, 2011); however, these findings illustrate that father-child interactions are not the same as mother-child interactions. More interventions should focus on addressing the unique characteristics – and unique needs – of father-child interactions. These findings also underscore the need for more father involvement in early intervention research in general, especially given the changing demographics of fathers as primary caregivers (US Census Bureau, 2013). This would allow for a better understanding of the father experience to inform tailoring of parent training practices for fathers.

Parent Strategies and Child Engagement

Parents' pacing and EA were identified as important strategies for supporting children's engagement. Appropriate pacing and EA did not necessarily predict higher joint engagement or lower object engagement in children, but there were significant differences in children's engagement between parents who had higher vs. lower ratings in both of these strategies. Pacing and EA did, however, negatively predict the amount of time children spent being unengaged or other (i.e., onlooking, person engaged).

These results are somewhat consistent with previous research finding that parents' use of pacing and EA were positively related to joint engagement (Gulsrud et al., 2016), though the relationship between strategies and engagement is not as strongly implied in the current study. In addition to the fact that Gulsrud et al. (2016) examined JASPER parent strategies rather than ABA-based strategies more broadly, these differences in results may be due to the different characteristics of the samples in each of the studies. Gulsrud et al. (2016) included a sample of toddlers (≤36 months), while the current study utilized a sample of minimally verbal

preschoolers. The language status of the participants is important to note because supported joint engagement (which was primarily the type of JE that was coded in this study) has a weak developmental trajectory for children who are minimally verbal (Adamson et al., 2009). As such, the children in the current study may have demonstrated less JE or may have been more difficult to establish JE with than those included Gulsrud et al. (2016). This may be a factor contributing to the weaker relationship between pacing, EA, and engagement in the current study.

Parent strategies did negatively predict the amount of time that children were unengaged, onlooking, or person engagement (unengaged/other). This is also notable. Although the current study may not have been able to establish a clear and definitive predictive relationship between parent strategies and joint engagement, it was able to establish a clear negative relationship between parent strategies and unengagement. Parents who paced their interactions and arranged their environments more appropriately tended to have children who were less unengaged across time and across treatment. Reducing unengagement is a meaningful outcome of intervention; it represents an improvement in the overall quality of a child's engagement. Spending less time unengaged/other provides the child with more opportunities to potentially be jointly engaged with a social partner.

Neither responsiveness nor prompting strategies were significantly related to children's engagement. This suggests that some, but not all, parent strategies may be related to child engagement in the context of intervention for minimally verbal preschoolers. However, parental responsiveness and appropriate prompting are still critical for supporting children's engagement outcomes in the extant literature. For instance, parent responsiveness and directiveness (which is related to prompting) have been clearly linked to joint engagement in a sample of toddlers with ASD (Patterson et al., 2014). The current study, however, also included ratings of parents'

pacing and EA, in addition to responsiveness and prompting. It may be that while responsiveness and appropriate prompting are an important base for quality parent-child interactions, these strategies alone (in the absence of other parent strategies) may not be enough to move child outcomes. Supporting child outcomes may also require higher intensity of parent training, as opposed to the brief training that parents received in the current study.

At the same time, these results are consistent with findings from other large-scale RCTs, such as the PACT study (Green et al., 2010). The authors found that the PACT intervention led to increases in parental synchrony (i.e., responsiveness) within parent-child interactions, but did not lead to downstream effects on shared attention (i.e., joint engagement) between parent and child. This highlights the fact that supporting the development of JE in children with ASD is a complex process. JE may be best supported as a result of a combination of parent strategies working in conjunction with each other, rather than as a result of one or two strategies in isolation.

Parent Strategies and Child Language

Findings from this study indicate that appropriately pacing interactions is an important strategy for supporting language in a minimally verbal sample across both treatments. Parents of children with ASD tend to implement a higher frequency of high intensity approaches with their children compared to TD parents (Doussard-Roosevelt et al., 2003). Parents of minimally verbal children, in particular, tend to initiate significantly more interactions with their children than TD parents. Children with ASD also demonstrate slower processing of information compared to TD controls (Mayes & Calhoun, 2007; O'Connor, 2012). Thus, appropriately pacing interactions often takes the form of generally reducing the frequency of parent initiations, which provides children with more time and space to process, respond, and initiate with their parents.

It may initially seem counterintuitive to reduce the amount and frequency of words and actions with a child who has low rates of communication. This, however, is in fact what the results seem to suggest. In other words, what may be important is not simply a reduction in parents' bids, but rather the importance of matched pacing. The pacing item was designed to capture if parents were meeting the child where they were at – that is, if parents were able to recognize their child's developmental level (whether it be language or engagement) and to subsequently modify their own behavior to be more aligned with that of the child. This often took the form of waiting several seconds for a child to respond to a demand, rather than repeatedly placing demands on the child. Pacing in this way, as rated in the current study, did support children's language outcomes over the course of the intervention, which is consistent with previous JASPER studies (e.g., Gulsrud et al., 2016).

Appropriate pacing is similar to the idea of "wait time" in educational practice. Teacher provision of sufficient time for students to cognitively process a question or a demand has been linked to increases in the quality of student responses, language, logic, and participation in content courses (Rowe, 1986; Tobin & Capie, 1983) as well as for English language learners (Echevarría, Vogt, & Short, 2012; Yaqubi & Rokni, 2012). Rowe (1986) also discusses implications for special education, stating that a potentially even longer wait time (about five seconds between question and response) may be particularly beneficial for children with developmental delays, such as children with ASD.

Strengths, Limitations, & Future Directions

This study makes some unique contributions to the literature. First, the sample – children with low rates of communication – is one that is frequently under-represented in ASD research (Tager-Flusberg & Kasari, 2013). This study captured children at a critical juncture in the course

of their language development – the point at which they are being designated as preverbal vs. nonverbal/minimally verbal – and aimed to identify parent strategies that support children's language. Understanding that parent's pacing affects these children's language is crucial to understanding atypical language development trajectories. The hope is that this research can inform future targeted early intervention research for children with limited language, particularly for identifying which strategies to focus on during parent training.

Additionally, a novel measure of parent strategies was developed for this study, and it was shown to be related to child outcomes. Parent training in the original intervention study was brief (1 hour sessions per week for a total of 8 weeks), and parent training at home was not the focus of the trial since the intervention was largely therapist-mediated at school. As such, parent fidelity of intervention strategies (of either intervention) was not the target – rather, the current study sought to identify strategies that parents might find helpful and effective as they interact and engage with their children. This novel measure, which defined each parent strategy more broadly, can be applied to a wider range of parent-child interactions for future studies – not just play, but also to home routines, book reading, etc. It could also be used to rate parent strategies within parent-child interactions with non-ASD populations as well.

The current study included a more demographically varied parent sample than many other intervention studies. This is significant because ethnically, racially, linguistically, and socioeconomically diverse children with ASD – and their families – tend to be underrepresented in ASD research (Pierce et al., 2014). The recruitment and inclusion of such a heterogeneous sample in this study allows us to better understand the effectiveness of interventions and parent training across wide range of participants.

There were also several limitations to the current study. Parent strategies were conceptualized as discrete strategies for the purposes of this study, yet the reality is that strategies are neither learned nor practiced in a vacuum. Parents' ability to learn or do well in one strategy likely influenced their ability across the other strategies as well. Future research should examine profiles of parent strategy usage, relating them to child outcomes, and should also consider changes in parent profiles over time and across treatment.

Pacing was identified as a key parent strategy for supporting children's outcomes, but less is known about how to best teach this skill to parents. More research is needed to determine if there are specific best practices for teaching parents how to pace appropriately or if other interventions are more or less effective in teaching parents appropriate pacing.

Environmental arrangement was also highlighted as an important parent strategy in this study. However, there was variability in the setting in which assessments took place (i.e., home, school, or clinic), which depended on parents' convenience and scheduling availability at each timepoint. The assessment setting may have affected parents' ability to maintain control over the environment and manipulate the materials. While the parent strategies rating system rating did attempt to account for this variability by focusing on the appropriateness and fluency of parents' strategy usage (even as children varied in their familiarity with the environment), it is possible that ratings may have been influenced by the assessment setting, and future studies should control for this variable.

Future studies should also examine the follow-up timepoint from the original study to assess the maintenance of both parents' and children's skills, as well as to see if the predictive relationship between parent strategies and child outcomes is maintained over time. Additionally, a cross-lagged panel model can be used to examine the directionality of the relationship between

children's JE and language. Moderators of parent strategy uptake (e.g., parent buy-in) could also be examined. Parents' motivation and expectations of their child's improvement as a result of intervention may have influenced their attitudes and behavior.

Conclusions

In all, the ways in which parents and children interact with each other is an important influence in children's development, particularly within ASD interventions. This study has highlighted both the importance of appropriate pacing for supporting children's language and the importance of pacing and environmental arrangement for supporting children's engagement within the context of intervention. This provides us with deeper insight into parent-child interactions in ASD intervention – particularly for young children with limited language – allowing us to gain a more comprehensive understanding of parent behaviors and child outcomes in ASD.

Appendix A

Table 1

Baseline Characteristics of Participants (N=156)

	DTT (n=80)				JASPER (n=76)				Total			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Age (months)	44.94	5.58	35.00	55.00	45.39	3.40	32.00	56.00	45.08	5.48	24.00	32.00
Nonverbal IQ	55.83	12.81	32.41	95.95	55.29	14.07	26.85	100	55.76	12.98	26.85	100
Receptive Language (age equivalents in months)	16.21	8.00	1.00	34.00	16.43	8.60	1.00	36.00	16.32	8.27	1.00	36.00
Expressive Language (age equivalents in months)	15.31	7.07	4.00	29.00	15.86	6.80	4.00	29.00	15.58	6.93	4.00	29.00
ADOS Severity	7.35	1.61	4.00	10.00	7.37	1.66	4.00	10.00	7.37	1.61	4.00	10.00

Nonverbal IQ, receptive language, and expressive language scores are from the Mullen Scales of Early Learning.
ADOS severity is the calibrated severity score from the Autism Diagnostic Observation Schedule.

Table 2

Demographic Characteristics of Participants (N=156)

	DTT (n=80)		JASPER (n=76)		Total	
	N	Percentage	N	Percentage	N	Percentage
Gender						
Female	12	15.0%	13	17.1%	25	16.0%
Parent Gender						
Father	18	22.5%	14	18.4%	32	20.5%
Race/Ethnicity (number of fathers)						
White	31 (5)	38.8%	27 (8)	35.5%	58 (13)	37.2%
Asian	14 (7)	17.5%	13 (3)	17.1%	27 (10)	17.3%
Hispanic/Latino	13 (0)	16.3%	10 (1)	13.2%	23 (1)	14.7%
Black	11 (2)	13.8%	11 (1)	14.5%	22 (3)	14.1%
Multiracial	9 (2)	11.3%	10 (1)	13.2%	19 (3)	12.2%
Other/Not disclosed	2 (0)	2.5%	5 (2)	6.6%	7 (2)	4.5%
Mother's Education Level						
High school graduate or less	16	20%	19	25.0%	35	22.4%
Some college	23	28.8%	24	31.6%	47	30.1%
College graduate	29	36.3%	19	25.0%	48	30.8%
Graduate school/Professional training	11	13.8%	12	15.8%	23	14.7%
Father's Education Level						
High school graduate or less	23	28.8%	20	26.3%	43	27.6%
Some college	20	25%	23	30.3%	43	27.6%
College graduate	16	20%	19	25.0%	35	22.4%
Graduate school/Professional training	17	21.3%	10	13.2%	27	17.3%

Table 3

Parent Responsiveness Ratings by Timepoint and Treatment

	DTT					JASPER				
	N	Mean	SD	Minimum	Maximum	N	Mean	SD	Minimum	Maximum
Entry	78	4.12	0.95	2.00	5.00	73	3.81	0.83	2.00	5.00
2 month	71	4.08	0.91	1.00	5.00	71	4.13	0.79	2.00	5.00
4 month	70	4.11	0.86	2.00	5.00	71	3.90	0.85	2.00	5.00
Exit	77	4.06	1.02	1.00	5.00	68	4.25	0.92	2.00	5.00

Table 4

Parent Pacing Ratings by Timepoint and Treatment

	DTT					JASPER				
	N	Mean	SD	Minimum	Maximum	N	Mean	SD	Minimum	Maximum
Entry	78	3.35	1.15	1.00	5.00	73	3.12	1.08	1.00	5.00
2 month	71	3.38	1.05	1.00	5.00	71	3.31	1.05	1.00	5.00
4 month	70	3.50	1.07	1.00	5.00	71	3.21	1.05	1.00	5.00
Exit	77	3.43	1.13	1.00	5.00	68	3.54	1.07	1.00	5.00

Table 5

Parent Prompting Ratings by Timepoint and Treatment

	DTT					JASPER				
	N	Mean	SD	Minimum	Maximum	N	Mean	SD	Minimum	Maximum
Entry	78	3.35	1.02	1.00	5.00	73	2.99	1.01	1.00	5.00
2 month	71	3.34	0.96	1.00	5.00	71	3.30	1.03	1.00	5.00
4 month	70	3.44	1.02	1.00	5.00	71	3.18	1.18	1.00	5.00
Exit	77	3.36	1.08	1.00	5.00	68	3.54	1.11	1.00	5.00

Table 6

Parent Environmental Arrangement Ratings by Timepoint and Treatment

	DTT					JASPER				
	N	Mean	SD	Minimum	Maximum	N	Mean	SD	Minimum	Maximum
Entry	78	3.95	0.84	2.00	5.00	73	3.58	1.04	2.00	5.00
2 month	71	3.85	0.84	2.00	5.00	71	3.89	0.71	2.00	5.00
4 month	70	3.99	0.93	2.00	5.00	71	3.69	1.08	2.00	5.00
Exit	77	4.01	0.93	1.00	5.00	68	3.97	0.85	1.00	5.00

Table 7

Linear Mixed Model for Responsiveness by Time and by Treatment

Predictor	$df_{Numerator}$	$df_{Denominator}$	F	p-value
(Intercept)	1	141.64	42.35	.000
Timepoint	3	413.12	2.12	.097
Treatment	1	143.82	1.26	.265
Timepoint x Treatment	3	413.23	3.36	.019
Site	2	144.33	0.38	.685
Gender	1	141.72	0.44	.511
Chronological Age	1	142.26	0.09	.769
Nonverbal IQ	1	146.60	1.36	.245
Adult Gender	1	164.46	3.57	.060

Table 8

Linear Mixed Model for Responsiveness by Time and by Treatment: Parameter Estimates

Parameter	Estimate	SE	df	t	p-value	95% CI
(Intercept)	3.88	0.61	145.61	6.40	<.001	2.68 – 5.08
Predictors						
Entry vs. Exit	-0.41	0.11	416.01	-3.57	<.001	-0.63 – -0.18
2 month vs. Exit	-0.11	0.11	416.45	-0.96	.338	-0.33 – 0.12
4 month vs. Exit	-0.29	0.11	414.63	-2.52	.012	-0.51 – -0.06
DTT vs. JASPER	-0.10	0.15	367.06	-0.70	.487	-0.39 – 0.19
Entry x DTT	0.47	0.16	413.18	3.02	.003	0.16 – 0.78
Entry x JASPER	0[a]	0	.	.	.	.
2 month x DTT	0.15	0.16	415.33	0.92	.360	-0.17 – 0.46
2 month x JASPER	0[a]	0	.	.	.	.
4 month x DTT	0.30	0.16	414.93	1.86	.064	-0.02 – 0.61
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Controls						
UCLA vs. KKI	0.10	0.14	143.11	0.70	.487	-0.18 – 0.37
Rochester vs. KKI	-0.01	0.15	145.07	-0.08	.938	-0.30 – 0.28
Male vs. Female	-0.10	0.15	141.72	-0.66	.511	-0.41 – 0.20
Chronological Age	0.00	0.01	142.26	-0.29	.769	-0.02 – 0.02
Nonverbal IQ	0.01	0.00	146.60	1.17	.245	0.00 – 0.01
Mothers vs. Fathers	0.26	0.14	164.46	1.89	.060	-0.01 – 0.54

[a] Parameter is set to zero because it is redundant.

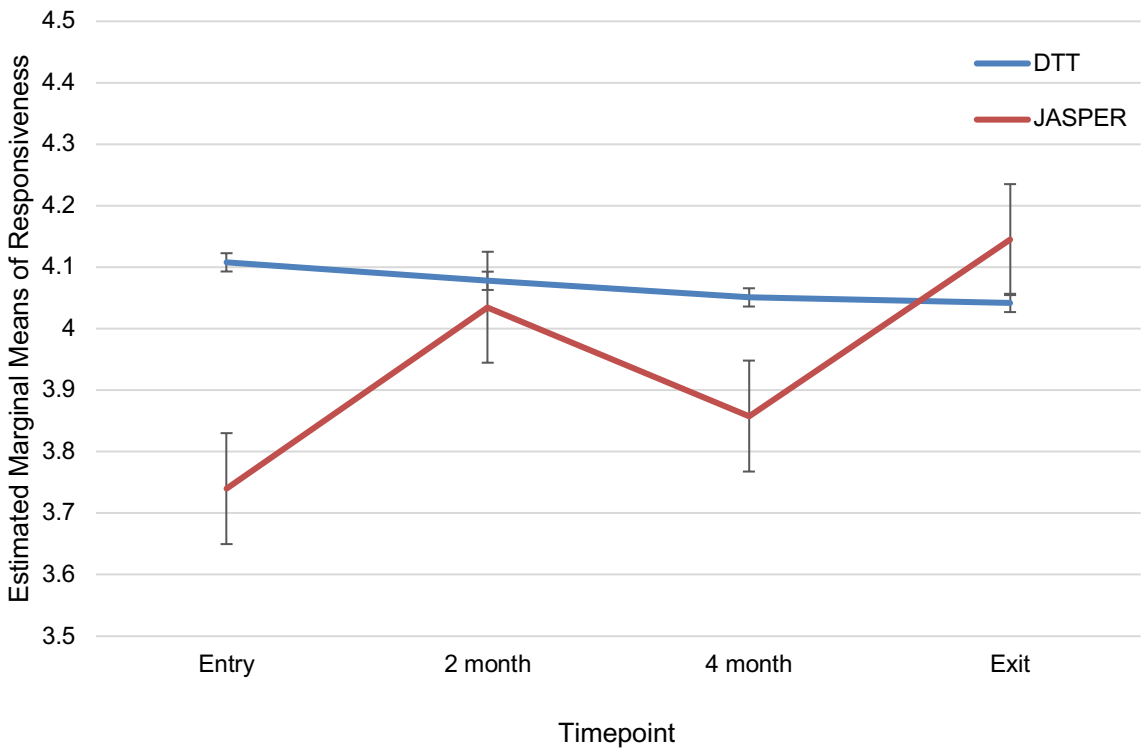

Figure 1. Estimated marginal means of responsiveness by time and by treatment.

Table 9

Linear Mixed Model for Pacing by Time and by Treatment

Predictor	$df_{Numerator}$	$df_{Denominator}$	F	p-value
(Intercept)	1	141.28	26.21	<.001
Timepoint	3	415.90	1.48	.219
Treatment	1	144.08	1.72	.191
Timepoint x Treatment	3	416.03	0.86	.461
Site	2	144.60	0.03	.967
Gender	1	141.46	1.28	.260
Chronological Age	1	142.15	1.12	.291
Nonverbal IQ	1	147.15	2.79	.097
Adult Gender	1	159.69	11.30	.001

Table 10

Linear Mixed Model for Pacing by Time and by Treatment: Parameter Estimates

Parameter	Estimate	SE	df	t	p-value	95% CI
(Intercept)	3.31	0.67	146.68	4.93	<.001	1.98 – 4.64
Predictors						
Entry vs. Exit	-0.36	0.15	418.80	-2.47	.014	-0.65 – -0.07
2 month vs. Exit	-0.20	0.15	419.85	-1.33	.185	-0.49 – 0.09
4 month vs. Exit	-0.24	0.15	417.60	-1.65	.100	-0.53 – 0.05
DTT vs. JASPER	-0.02	0.18	428.75	-0.13	.901	-0.37 – 0.32
Entry x DTT	0.30	0.20	415.65	1.48	.140	-0.10 – 0.69
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	0.18	0.21	418.58	0.86	.390	-0.23 – 0.58
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	0.26	0.21	418.12	1.28	.200	-0.14 – 0.67
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Controls						
UCLA vs. KKI	0.01	0.15	142.86	0.06	.951	-0.30 – 0.32
Rochester vs. KKI	-0.03	0.16	145.60	-0.18	.857	-0.35 – 0.29
Male vs. Female	-0.19	0.17	141.46	-1.13	.260	-0.53 – 0.14
Chronological Age	-0.01	0.01	142.15	-1.06	.291	-0.04 – 0.01
Nonverbal IQ	0.01	0.01	147.15	1.67	.097	0.00 – 0.02
Mothers vs. Fathers	0.52	0.16	159.69	3.36	.001	0.22 – 0.83

[a] Parameter is set to zero because it is redundant.

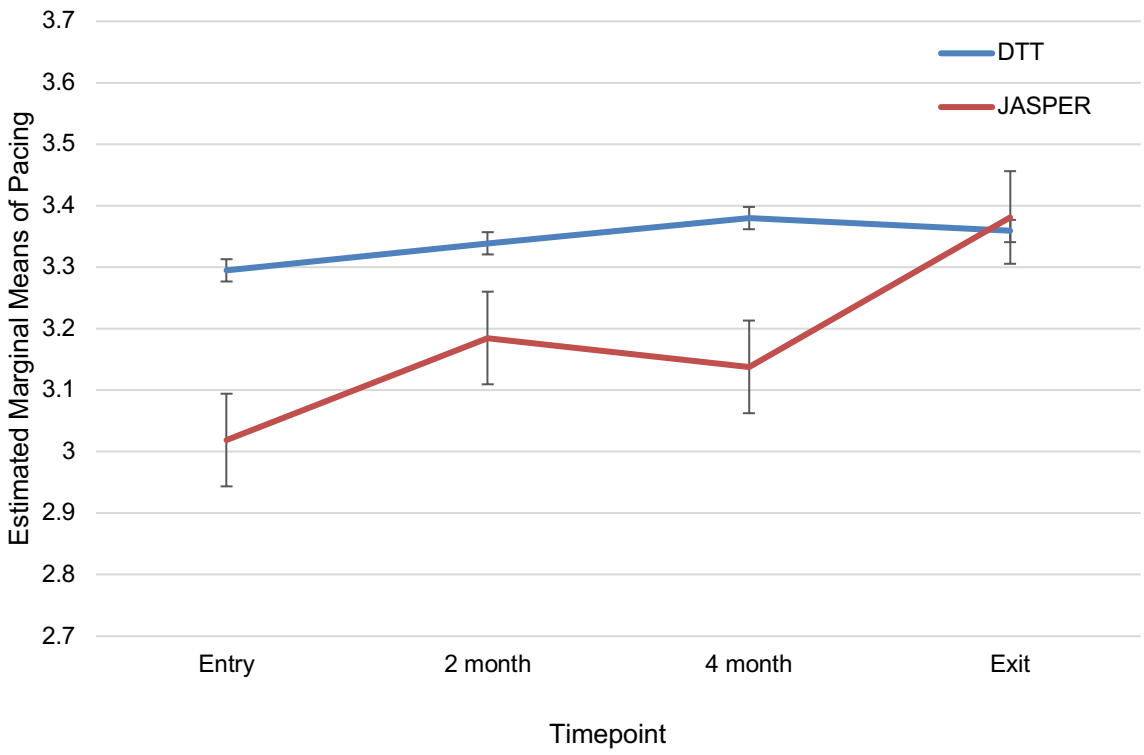

Figure 2. Estimated marginal means of pacing by time and by treatment.

Table 11

Linear Mixed Model for Prompting by Time and by Treatment

Predictor	$df_{Numerator}$	$df_{Denominator}$	F	p-value
(Intercept)	1	138.09	12.80	<.001
Timepoint	3	405.45	2.18	.089
Treatment	1	141.03	1.84	.177
Timepoint x Treatment	3	405.53	2.29	.078
Site	2	141.38	0.18	.834
Gender	1	138.20	0.10	.758
Chronological Age	1	139.12	0.06	.801
Nonverbal IQ	1	144.15	8.00	.005
Adult Gender	1	156.17	5.61	.019

Table 12

Linear Mixed Model for Prompting by Time and by Treatment: Parameter Estimates

Parameter	Estimate	SE	df	t	p-value	95% CI
(Intercept)	2.38	0.66	142.96	3.57	<.001	1.06 – 3.69
Predictors						
Entry vs. Exit	-0.49	0.14	407.38	-3.44	.001	-0.78 – -0.21
2 month vs. Exit	-0.21	0.14	410.50	-1.43	.154	-0.49 – 0.08
4 month vs. Exit	-0.29	0.14	407.34	-2.03	.043	-0.58 – -0.01
DTT vs. JASPER	-0.10	0.17	413.03	-0.58	.560	-0.44 – 0.24
Entry x DTT	0.49	0.20	404.84	2.47	.014	0.10 – 0.88
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	0.21	0.20	408.17	1.05	.296	-0.18 – 0.60
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	0.37	0.20	407.19	1.86	.063	-0.02 – 0.77
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Controls						
UCLA vs. KKI	-0.09	0.15	139.49	-0.60	.549	-0.40 – 0.21
Rochester vs. KKI	-0.06	0.16	142.24	-0.35	.729	-0.38 – 0.27
Male vs. Female	-0.05	0.17	138.20	-0.31	.758	-0.38 – 0.28
Chronological Age	0.00	0.01	139.12	0.25	.801	-0.02 – 0.03
Nonverbal IQ	0.01	0.00	144.15	2.83	.005	0.00 – 0.02
Mothers vs. Fathers	0.37	0.15	156.17	2.37	.019	0.06 – 0.67

[a] Parameter is set to zero because it is redundant.

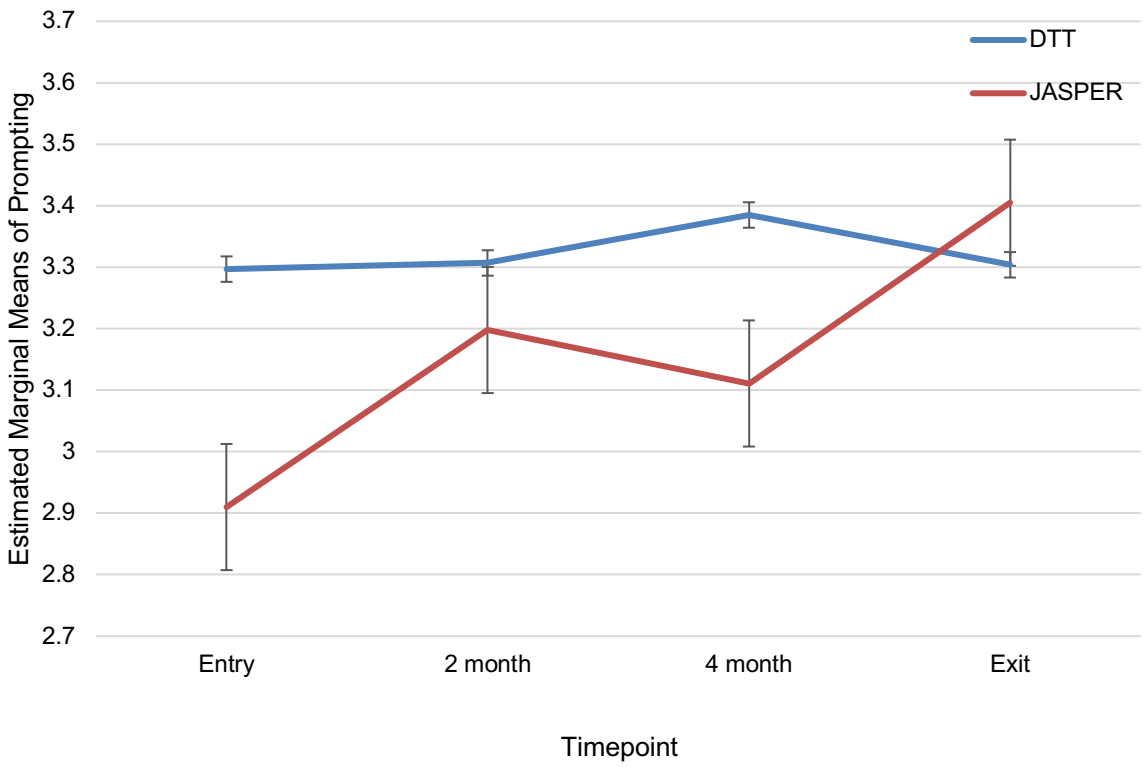

Figure 3. Estimated marginal means of prompting by time and by treatment.

Table 13

Linear Mixed Model for Environmental Arrangement by Time and by Treatment

Predictor	$df_{Numerator}$	$df_{Denominator}$	F	p-value
(Intercept)	1	139.23	50.09	<.001
Timepoint	3	416.19	1.49	.216
Treatment	1	142.44	3.96	.048
Timepoint x Treatment	3	416.32	2.21	.087
Site	2	142.97	1.76	.176
Gender	1	139.47	2.73	.101
Chronological Age	1	140.27	0.14	.705
Nonverbal IQ	1	145.73	1.51	.221
Adult Gender	1	155.51	11.68	.001

Table 14

Linear Mixed Model for Environmental Arrangement by Time and by Treatment: Parameter Estimates

Parameter	Estimate	SE	df	t	p-value	95% CI
(Intercept)	3.72	0.54	145.70	6.94	<.001	2.66 – 4.77
Predictors						
Entry vs. Exit	-0.34	0.13	419.13	-2.61	.009	-0.59 – -0.08
2 month vs. Exit	-0.06	0.13	420.58	-0.44	.659	-0.31 – 0.20
4 month vs. Exit	-0.22	0.13	418.05	-1.73	.084	-0.48 – 0.03
DTT vs. JASPER	0.10	0.15	465.50	0.71	.479	-0.19 – 0.39
Entry x DTT	0.32	0.18	415.72	1.80	.073	-0.03 – 0.66
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	-0.11	0.18	419.18	-0.60	.548	-0.46 – 0.25
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	0.16	0.18	418.71	0.88	.379	-0.20 – 0.51
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Controls						
UCLA vs. KKI	-0.02	0.12	140.86	-0.18	.861	-0.26 – 0.22
Rochester vs. KKI	-0.22	0.13	144.12	-1.68	.095	-0.47 – 0.04
Male vs. Female	-0.22	0.14	139.47	-1.65	.101	-0.49 – 0.04
Chronological Age	0.00	0.01	140.27	-0.38	.705	-0.02 – 0.01
Nonverbal IQ	0.00	0.00	145.73	1.23	.221	0.00 – 0.01
Mothers vs. Fathers	0.42	0.12	155.51	3.42	.001	0.18 – 0.67

[a] Parameter is set to zero because it is redundant.

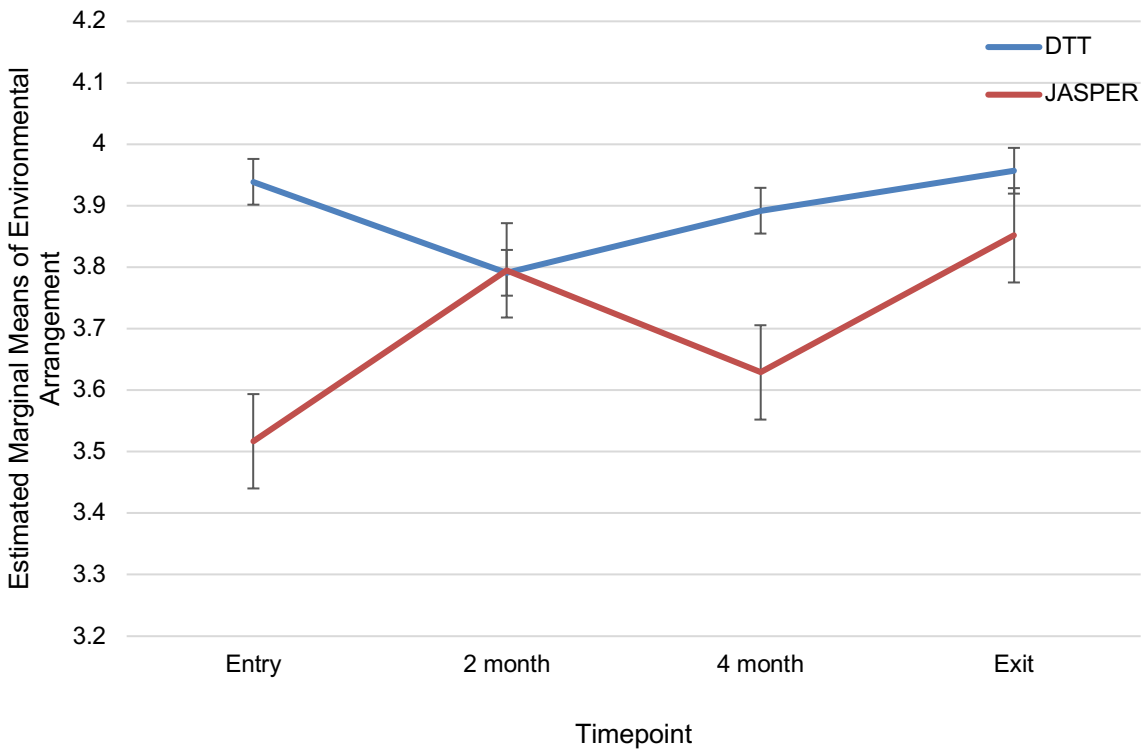

Figure 4. Estimated marginal means of environmental arrangement by time and by treatment.

Table 15

Linear Mixed Model for Child Joint Engagement Predicted by Parent Strategies, Time, and Treatment

Predictor	$df_{Numerator}$	$df_{Denominator}$	F	p-value
(Intercept)	1	155.28	1.42	.235
Timepoint	3	396.20	2.68	.046
Treatment	1	145.88	2.99	.086
Timepoint x Treatment	3	395.47	1.38	.249
Responsiveness	4	480.14	0.49	.745
Pacing	4	468.39	2.11	.078
Prompting	4	468.77	0.75	.561
Environmental Arrangement	4	474.60	2.32	.056
Site	2	145.35	2.08	.128
Gender	1	140.13	0.48	.490
Chronological Age	1	141.06	2.44	.121
Nonverbal IQ	1	147.11	13.33	<.001
ADOS Severity	1	147.63	15.35	<.001
Adult Gender	1	168.08	0.33	.567

Table 16

Linear Mixed Model for Child Joint Engagement Predicted by Parent Strategies, Time, and Treatment: Parameter Estimates

Parameter	Estimate	SE	df	t	p-value	95% CI
(Intercept)	0.47	0.18	148.50	2.66	.009	0.12 – 0.82
Predictors						
Entry vs. Exit	-0.02	0.03	403.63	-0.76	.446	-0.08 – 0.04
2 month vs. Exit	-0.02	0.03	399.81	-0.55	.586	-0.08 – 0.04
4 month vs. Exit	-0.01	0.03	397.08	-0.36	.717	-0.07 – 0.05
DTT vs. JASPER	0.06	0.04	382.47	1.59	.113	-0.01 – 0.13
Entry x DTT	-0.06	0.04	398.30	-1.42	.157	-0.14 – 0.02
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	0.02	0.04	398.04	0.56	.576	-0.06 – 0.11
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	-0.01	0.04	394.36	-0.25	.800	-0.09 – 0.07
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Responsiveness						
1 vs. 5	0.00	0.20	454.86	0.00	.999	-0.40 – 0.40
2 vs. 5	-0.02	0.05	519.99	-0.35	.730	-0.13 – 0.09
3 vs. 5	0.03	0.03	501.99	0.84	.400	-0.04 – 0.10
4 vs. 5	0.00	0.02	482.51	-0.09	.932	-0.05 – 0.04
Pacing						
1 vs. 5	-0.16	0.07	469.96	-2.41	.016	-0.29 – -0.03
2 vs. 5	-0.08	0.05	467.91	-1.80	.073	-0.17 – 0.01
3 vs. 5	-0.09	0.04	462.10	-2.49	.013	-0.16 – -0.02
4 vs. 5	-0.05	0.03	462.65	-1.74	.082	-0.11 – 0.01
Prompting						
1 vs. 5	-0.04	0.06	482.98	-0.67	.502	-0.17 – 0.08
2 vs. 5	-0.07	0.04	457.85	-1.50	.133	-0.15 – 0.02
3 vs. 5	-0.05	0.04	464.11	-1.27	.205	-0.12 – 0.03
4 vs. 5	-0.02	0.03	449.64	-0.60	.548	-0.08 – 0.04
Environmental Arrangement						
1 vs. 5	-0.36	0.28	472.95	-1.28	.203	-0.91 – 0.19
2 vs. 5	-0.12	0.05	481.98	-2.73	.007	-0.21 – -0.04
3 vs. 5	-0.04	0.03	481.53	-1.19	.236	-0.09 – 0.02
4 vs. 5	0.00	0.02	480.87	-0.20	.843	-0.05 – 0.04
Controls						
UCLA vs. KKI	-0.03	0.04	142.20	-0.82	.415	-0.10 – 0.04
Rochester vs. KKI	-0.07	0.04	146.37	-2.02	.045	-0.15 – 0.00
Male vs. Female	-0.03	0.04	140.13	-0.69	.490	-0.10 – 0.05
Chronological Age	0.00	0.00	141.06	1.56	.121	0.00 – 0.01
Nonverbal IQ	0.00	0.00	147.11	3.65	<.001	0.00 – 0.01
ADOS Severity	-0.04	0.01	147.63	-3.92	<.001	-0.06 – -0.02
Mothers vs. Fathers	-0.02	0.04	168.08	-0.57	.567	-0.09 – 0.05

[a] Parameter is set to zero because it is redundant.

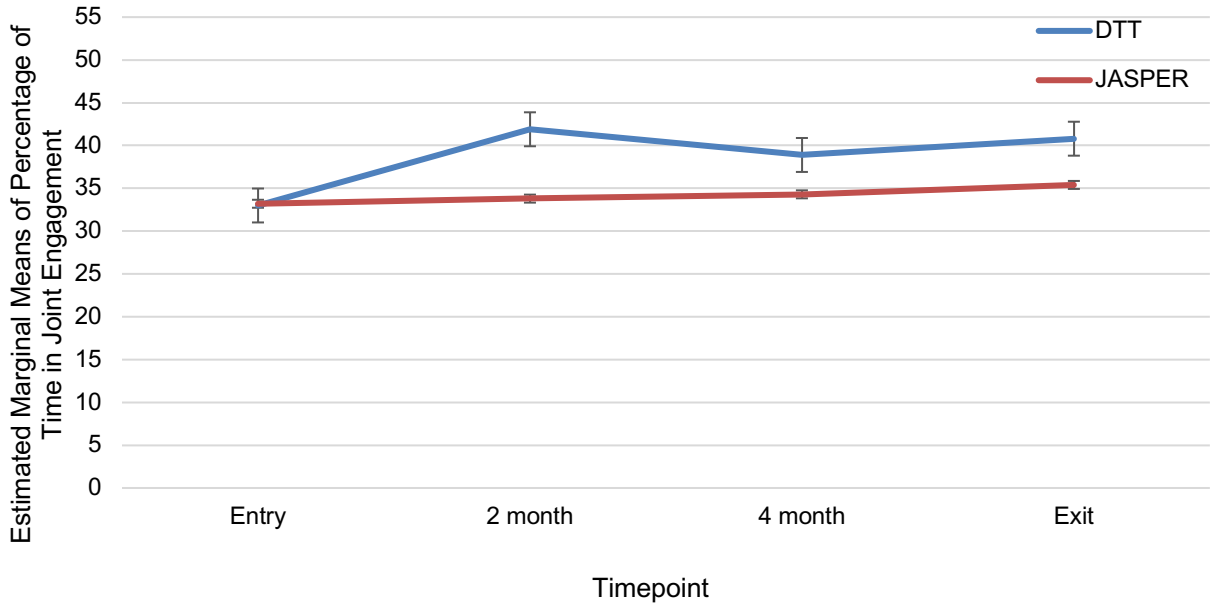

Figure 5. Estimated marginal means of percentage of time in joint engagement by time and by treatment.

Table 17

Linear Mixed Model for Child Object Engagement Predicted by Parent Strategies, Time, and Treatment

Predictor	$df_{Numerator}$	$df_{Denominator}$	F	p-value
(Intercept)	1	153.60	9.04	.003
Timepoint	3	394.72	2.46	.063
Treatment	1	144.21	0.05	.822
Timepoint x Treatment	3	393.98	0.35	.790
Responsiveness	4	479.94	0.45	.772
Pacing	4	468.10	1.59	.176
Prompting	4	468.47	0.40	.808
Environmental Arrangement	4	474.38	1.34	.253
Site	2	143.69	0.93	.396
Gender	1	138.48	1.59	.209
Chronological Age	1	139.40	3.32	.070
Nonverbal IQ	1	145.44	0.36	.552
ADOS Severity	1	145.95	9.85	.002
Adult Gender	1	166.14	0.01	.929

Table 18

Linear Mixed Model for Child Object Engagement Predicted by Parent Strategies, Time, and Treatment: Parameter Estimates

Parameter	Estimate	SE	df	t	p-value	95% CI
(Intercept)	0.32	0.18	146.84	1.75	.082	-0.04 – 0.68
Predictors						
Entry vs. Exit	0.04	0.03	402.23	1.15	.251	-0.03 – 0.10
2 month vs. Exit	0.02	0.03	398.37	0.64	.523	-0.04 – 0.08
4 month vs. Exit	0.01	0.03	395.60	0.21	.835	-0.06 – 0.07
DTT vs. JASPER	-0.01	0.04	382.27	-0.17	.862	-0.08 – 0.07
Entry x DTT	0.04	0.04	396.83	0.88	.377	-0.05 – 0.13
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	0.00	0.04	396.57	-0.01	.995	-0.09 – 0.09
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	0.02	0.04	392.85	0.34	.731	-0.07 – 0.10
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Responsiveness						
1 vs. 5	-0.22	0.21	454.39	-1.04	.300	-0.64 – 0.20
2 vs. 5	-0.04	0.06	520.20	-0.64	.524	-0.15 – 0.08
3 vs. 5	-0.02	0.04	502.15	-0.59	.554	-0.09 – 0.05
4 vs. 5	0.00	0.02	482.43	0.13	.894	-0.05 – 0.05
Pacing						
1 vs. 5	0.15	0.07	469.70	2.13	.034	0.01 – 0.29
2 vs. 5	0.07	0.05	467.61	1.50	.134	-0.02 – 0.16
3 vs. 5	0.06	0.04	461.73	1.64	.101	-0.01 – 0.14
4 vs. 5	0.01	0.03	462.29	0.40	.692	-0.05 – 0.07
Prompting						
1 vs. 5	0.05	0.07	482.89	0.70	.483	-0.08 – 0.18
2 vs. 5	0.04	0.05	457.39	0.96	.336	-0.05 – 0.13
3 vs. 5	0.01	0.04	463.74	0.24	.810	-0.07 – 0.09
4 vs. 5	0.01	0.03	449.07	0.42	.675	-0.05 – 0.08
Environmental Arrangement						
1 vs. 5	0.60	0.29	472.67	2.06	.040	0.03 – 1.17
2 vs. 5	0.03	0.05	481.87	0.70	.485	-0.06 – 0.13
3 vs. 5	0.00	0.03	481.42	-0.01	.990	-0.06 – 0.06
4 vs. 5	0.02	0.02	480.79	0.69	.493	-0.03 – 0.07
Controls						
UCLA vs. KKI	0.02	0.04	140.54	0.41	.681	-0.06 – 0.09
Rochester vs. KKI	0.05	0.04	144.71	1.32	.189	-0.03 – 0.13
Male vs. Female	0.05	0.04	138.48	1.26	.209	-0.03 – 0.13
Chronological Age	0.00	0.00	139.40	-1.82	.070	-0.01 – 0.00
Nonverbal IQ	0.00	0.00	145.44	-0.60	.552	0.00 – 0.00
ADOS Severity	0.03	0.01	145.95	3.14	.002	0.01 – 0.05
Mothers vs. Fathers	0.00	0.04	166.14	-0.09	.929	-0.08 – 0.07

[a] Parameter is set to zero because it is redundant.

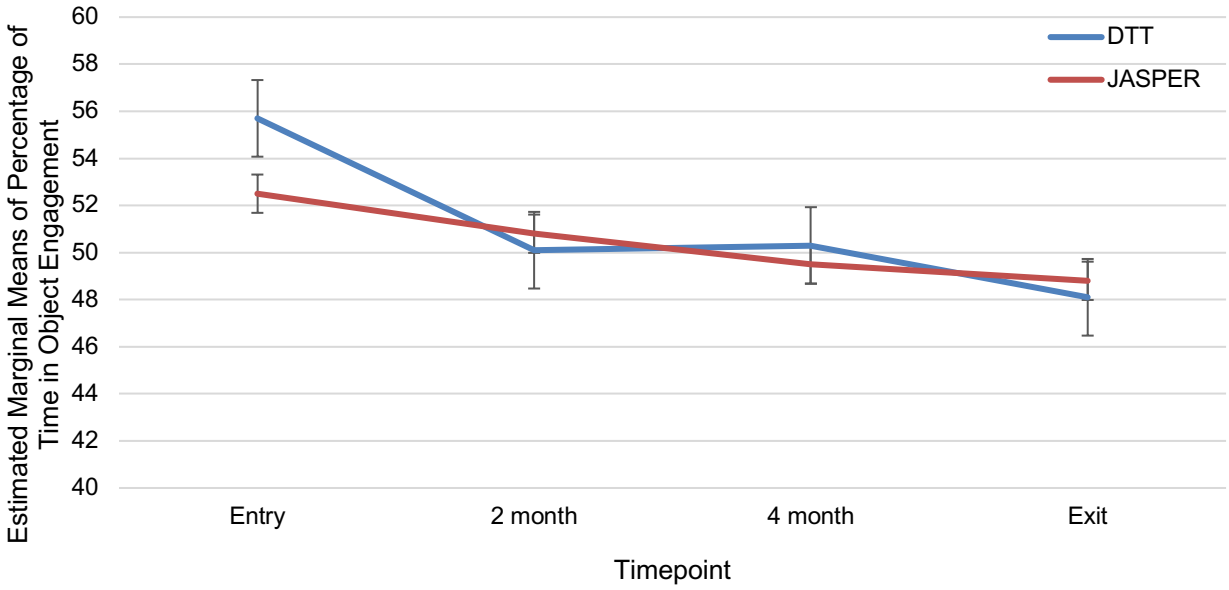

Figure 6. Estimated marginal means of percentage of time in object engagement by time and by treatment.

Table 19

Negative Binomial Mixed Model for Child Unengagement/Other Predicted by Parent Strategies, Time, and Treatment

Predictor	Wald X^2	df	p-value
(Intercept)	113.57	1	<.001
Timepoint	5.19	3	.159
Treatment	22.91	1	<.001
Timepoint x Treatment	7.98	3	.046
Responsiveness	4.72	4	.317
Pacing	10.34	4	.035
Prompting	6.99	4	.136
Environmental Arrangement	21.35	3	<.001
Site	9.95	2	.007
Gender	8.92	1	.003
Chronological Age	0.30	1	.584
Nonverbal IQ	101.05	1	<.001
ADOS Severity	4.14	1	.042
Adult Gender	7.17	1	.007

Table 20

Negative Binomial Mixed Model for Child Unengagement/Other Predicted by Parent Strategies, Time, and Treatment: Parameter Estimates

Parameter	B	SE	Wald X^2	df	p-value	95% CI
(Intercept)	5.50	0.58	88.91	1	<.001	4.35 – 6.64
Predictors						
Entry vs. Exit	-0.13	0.18	0.50	1	.480	-0.49 – 0.23
2 month vs. Exit	-0.13	0.18	0.49	1	.483	-0.48 – 0.23
4 month vs. Exit	-0.29	0.19	2.49	1	.114	-0.66 – 0.07
DTT vs. JASPER	-0.58	0.18	10.63	1	.001	-0.93 – -0.23
Entry x DTT	0.34	0.25	1.81	1	.179	-0.15 – 0.82
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	-0.20	0.25	0.65	1	.421	-0.69 – 0.29
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	0.44	0.25	2.92	1	.088	-0.06 – 0.93
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Responsiveness						
1 vs. 5	0.96	1.07	0.79	1	.373	-1.15 – 3.06
2 vs. 5	0.13	0.27	0.22	1	.639	-0.41 – 0.66
3 vs. 5	-0.22	0.17	1.66	1	.197	-0.56 – 0.11
4 vs. 5	0.00	0.12	0.00	1	.980	-0.24 – 0.23
Pacing						
1 vs. 5	-0.13	0.35	0.14	1	.705	-0.82 – 0.56
2 vs. 5	0.15	0.24	0.38	1	.536	-0.33 – 0.63
3 vs. 5	0.44	0.20	4.92	1	.027	0.05 – 0.82
4 vs. 5	0.37	0.17	4.87	1	.027	0.04 – 0.69
Prompting						
1 vs. 5	0.18	0.34	0.29	1	.591	-0.49 – 0.86
2 vs. 5	0.36	0.23	2.33	1	.127	-0.10 – 0.82
3 vs. 5	0.48	0.20	5.67	1	.017	0.09 – 0.88
4 vs. 5	0.24	0.17	1.89	1	.169	-0.10 – 0.58
Environmental Arrangement						
2 vs. 5	0.99	0.23	18.41	1	<.001	0.54 – 1.43
3 vs. 5	0.30	0.15	3.82	1	.051	0.00 – 0.60
4 vs. 5	0.02	0.12	0.04	1	.847	-0.21 – 0.25
Controls						
UCLA vs. KKI	0.33	0.12	7.13	1	.008	0.09 – 0.57
Rochester vs. KKI	0.34	0.12	7.86	1	.005	0.10 – 0.57
Male vs. Female	-0.37	0.13	8.92	1	.003	-0.62 – -0.13
Chronological Age	-0.01	0.01	0.30	1	.584	-0.02 – 0.01
Nonverbal IQ	-0.04	0.00	101.05	1	<.001	-0.05 – -0.03
ADOS Severity	0.07	0.03	4.14	1	.042	0.00 – 0.13
Mothers vs. Fathers	0.32	0.12	7.17	1	.007	0.09 – 0.55

[a] Parameter is set to zero because it is redundant.

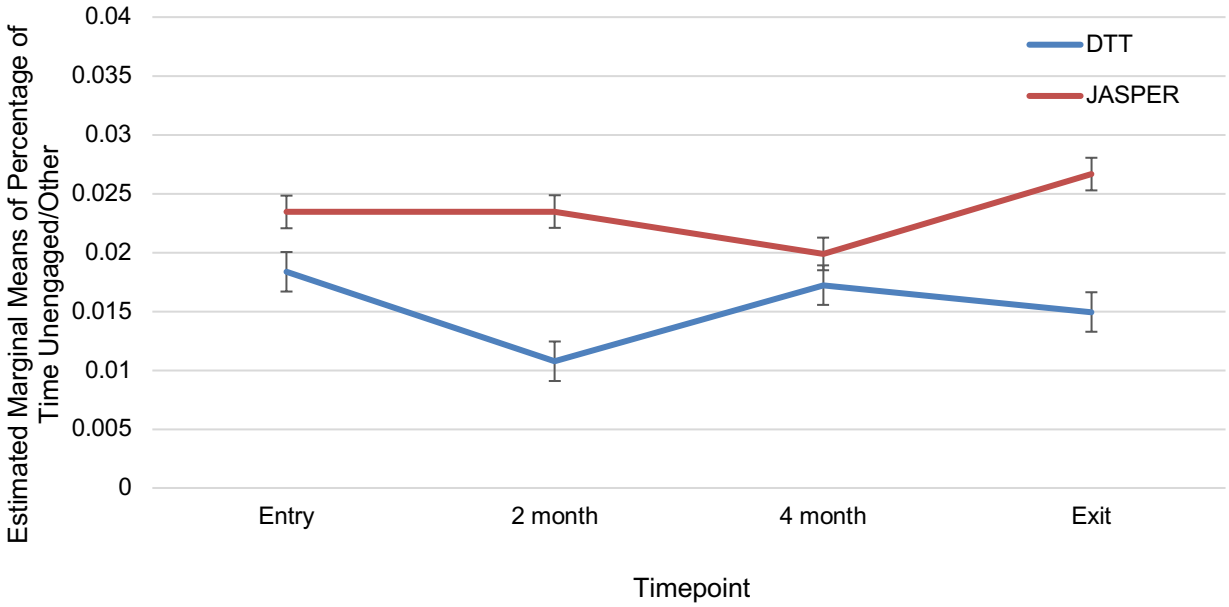

Figure 7. Estimated marginal means of percentage of time unengaged/other by time and by treatment.

Table 21

Negative Binomial Mixed Model for Child Spontaneous Communicative Utterances Predicted by Parent Strategies, Time, and Treatment

Predictor	Wald X^2	df	p-value
(Intercept)	6.78	1	.009
Timepoint	31.16	3	<.001
Treatment	3.51	1	.061
Timepoint x Treatment	0.30	3	.960
Responsiveness	3.38	4	.496
Pacing	12.32	4	.015
Prompting	7.12	4	.129
Environmental Arrangement	3.05	4	.549
Site	4.16	2	.125
Gender	2.91	1	.088
Chronological Age	53.76	1	<.001
Nonverbal IQ	41.63	1	<.001
ADOS Severity	36.93	1	<.001
Adult Gender	1.68	1	.195

Table 22

Negative Binomial Mixed Model for Child Spontaneous Communicative Utterances Predicted by Parent Strategies, Time, and Treatment: Parameter Estimates

Parameter	B	SE	Wald X^2	df	p-value	95% CI
(Intercept)	-0.98	0.64	2.36	1	.125	-2.23 – 0.27
Predictors						
Entry vs. Exit	-0.47	0.20	5.74	1	.017	-0.66 – 0.38
2 month vs. Exit	-0.07	0.19	0.12	1	.729	-0.56 – 0.47
4 month vs. Exit	0.20	0.19	1.11	1	.292	-0.57 – 0.46
DTT vs. JASPER	0.24	0.18	1.75	1	.186	-0.12 – 0.60
Entry x DTT	-0.14	0.27	0.29	1	.588	-0.15 – 0.82
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	-0.05	0.26	0.03	1	.861	-0.69 – 0.29
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	-0.05	0.26	0.04	1	.839	-0.06 – 0.93
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Responsiveness						
1 vs. 5	-1.81	1.32	1.87	1	.171	-4.40 – 0.78
2 vs. 5	0.19	0.29	0.44	1	.508	-0.37 – 0.75
3 vs. 5	0.19	0.20	0.94	1	.333	-0.20 – 0.58
4 vs. 5	0.11	0.14	0.61	1	.434	-0.17 – 0.40
Pacing						
1 vs. 5	-0.63	0.40	2.47	1	.116	-1.42 – 0.16
2 vs. 5	-0.76	0.28	7.25	1	.007	-1.32 – -0.21
3 vs. 5	-0.79	0.24	10.97	1	.001	-1.26 – -0.32
4 vs. 5	-0.56	0.18	9.50	1	.002	-0.92 – -0.21
Prompting						
1 vs. 5	-0.58	0.37	2.50	1	.114	-1.30 – 0.14
2 vs. 5	-0.09	0.28	0.11	1	.746	-0.64 – 0.46
3 vs. 5	-0.20	0.24	0.71	1	.400	-0.67 – 0.27
4 vs. 5	0.09	0.20	0.22	1	.639	-0.30 – 0.48
Environmental Arrangement						
1 vs. 5	1.19	1.20	0.98	1	.322	-1.16 – 3.53
2 vs. 5	0.13	0.25	0.29	1	.590	-0.36 – 0.62
3 vs. 5	0.11	0.17	0.43	1	.512	-0.23 – 0.46
4 vs. 5	0.20	0.13	2.16	1	.142	-0.07 – 0.46
Controls						
UCLA vs. KKI	0.19	0.12	2.55	1	.110	-0.04 – 0.43
Rochester vs. KKI	0.25	0.13	3.67	1	.056	-0.01 – 0.50
Male vs. Female	-0.22	0.13	2.91	1	.088	-0.48 – 0.03
Chronological Age	0.07	0.01	53.76	1	<.001	0.05 – 0.09
Nonverbal IQ	0.03	0.00	41.63	1	<.001	0.02 – 0.04
ADOS Severity	-0.19	0.03	36.93	1	<.001	-0.25 – -0.13
Mothers vs. Fathers	-0.16	0.12	1.68	1	.195	-0.39 – 0.08

[a] Parameter is set to zero because it is redundant.

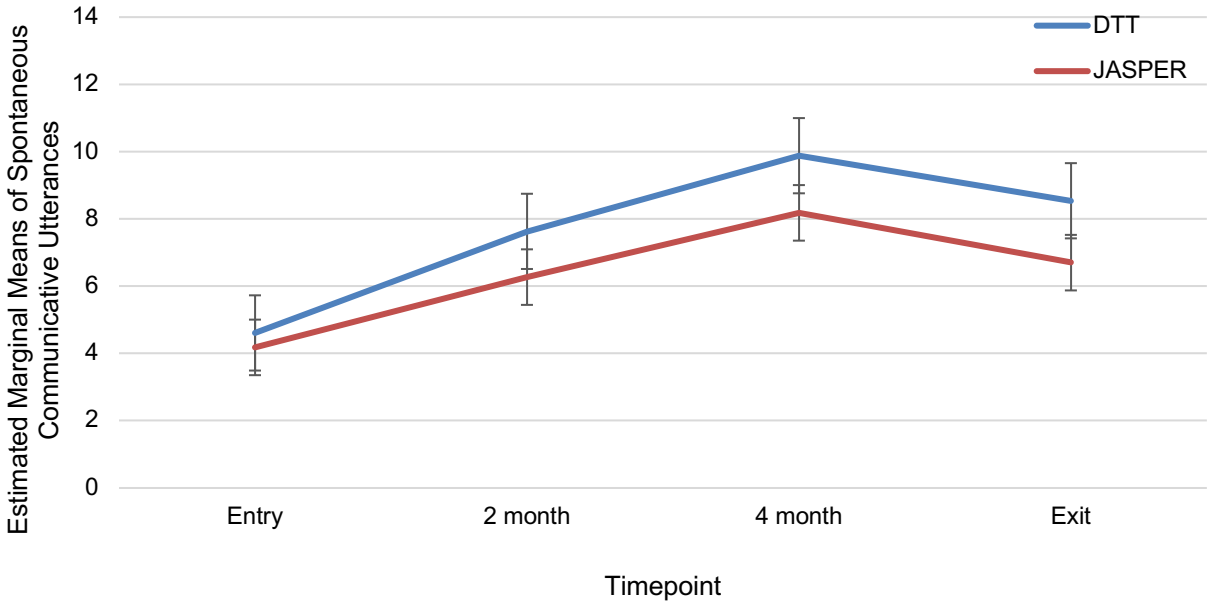

Figure 8. Estimated marginal means of spontaneous communicative utterances by time and by treatment.

Table 23

Negative Binomial Mixed Model for Child Number of Different Word Roots Predicted by Parent Strategies, Time, and Treatment

Predictor	Wald X^2	df	p-value
(Intercept)	18.74	1	<.001
Timepoint	33.17	3	<.001
Treatment	6.55	1	.011
Timepoint x Treatment	3.13	3	.371
Responsiveness	1.90	4	.755
Pacing	18.80	4	.001
Prompting	6.76	4	.149
Environmental Arrangement	4.77	4	.311
Site	1.55	2	.462
Gender	2.65	1	.104
Chronological Age	68.91	1	<.001
Nonverbal IQ	57.56	1	<.001
ADOS Severity	31.42	1	<.001
Adult Gender	3.03	1	.082

Table 24

Negative Binomial Mixed Model for Child Number of Different Word Roots Predicted by Parent Strategies, Time, and Treatment: Parameter Estimates

Parameter	B	SE	Wald X^2	df	p-value	95% CI
(Intercept)	-1.69	0.64	7.05	1	.008	-2.94 – -0.44
Predictors						
Entry vs. Exit	-0.47	0.20	5.58	1	.018	-0.86 – -0.08
2 month vs. Exit	-0.02	0.19	0.01	1	.935	-0.39 – 0.36
4 month vs. Exit	0.07	0.19	0.13	1	.723	-0.31 – 0.44
DTT vs. JASPER	0.39	0.18	4.54	1	.033	0.03 – 0.75
Entry x DTT	-0.33	0.27	1.49	1	.223	-0.85 – 0.20
Entry x JASPER	0[a]	0.00	.	.	.	.
2 month x DTT	-0.28	0.27	1.13	1	.287	-0.80 – 0.24
2 month x JASPER	0[a]	0.00	.	.	.	.
4 month x DTT	0.04	0.26	0.03	1	.871	-0.47 – 0.56
4 month x JASPER	0[a]	0	.	.	.	.
Exit x DTT	0[a]	0	.	.	.	.
Exit x JASPER	0[a]	0	.	.	.	.
Responsiveness						
1 vs. 5	-2.00	1.53	1.70	1	.192	-4.99 – 1.00
2 vs. 5	0.03	0.29	0.01	1	.923	-0.54 – 0.60
3 vs. 5	0.03	0.20	0.02	1	.890	-0.36 – 0.41
4 vs. 5	0.04	0.14	0.09	1	.762	-0.24 – 0.33
Pacing						
1 vs. 5	-0.67	0.40	2.82	1	.093	-1.44 – 0.11
2 vs. 5	-0.71	0.27	6.69	1	.010	-1.25 – -0.17
3 vs. 5	-0.87	0.23	14.14	1	<.001	-1.33 – -0.42
4 vs. 5	-0.71	0.18	16.16	1	<.001	-1.06 – -0.37
Prompting						
1 vs. 5	-0.62	0.36	2.89	1	.089	-1.33 – 0.10
2 vs. 5	-0.14	0.27	0.27	1	.603	-0.67 – 0.39
3 vs. 5	-0.17	0.23	0.53	1	.466	-0.63 – 0.29
4 vs. 5	0.10	0.19	0.28	1	.596	-0.28 – 0.48
Environmental Arrangement						
1 vs. 5	-0.62	0.36	2.89	1	.089	-3.18 – 2.12
2 vs. 5	-0.14	0.27	0.27	1	.603	-0.17 – 0.81
3 vs. 5	-0.17	0.23	0.53	1	.466	-0.13 – 0.55
4 vs. 5	0.10	0.19	0.28	1	.596	0.01 – 0.53
Controls						
UCLA vs. KKI	0.12	0.12	0.92	1	.337	-0.12 – 0.36
Rochester vs. KKI	0.15	0.13	1.40	1	.238	-0.10 – 0.41
Male vs. Female	-0.22	0.13	2.65	1	.104	-0.47 – 0.04
Chronological Age	0.08	0.01	68.91	1	<.001	0.06 – 0.10
Nonverbal IQ	0.03	0.00	57.56	1	<.001	0.03 – 0.04
ADOS Severity	-0.18	0.03	31.42	1	<.001	-0.24 – -0.12
Mothers vs. Fathers	-0.21	0.12	3.03	1	.082	-0.45 – 0.03

[a] Parameter is set to zero because it is redundant.

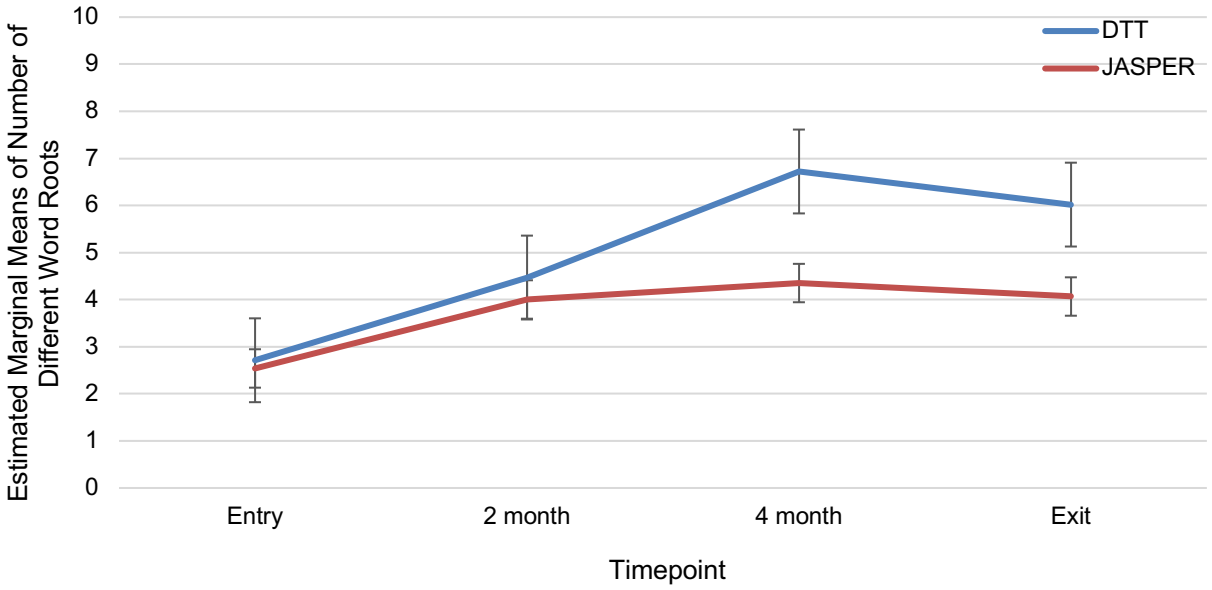

Figure 9. Estimated marginal means of number of different word roots by time and by treatment.

Appendix B

Parent Strategies Rating Scale

Items are rated on a 5-point Likert scale, where higher ratings indicate more fluent and more appropriate use of the strategy in the interaction. Anchors are designated at ratings of 1, 3, and 5, though parents can be given a rating of 2 or 4. A rating of 1 indicates minimal or ineffective strategy use, a rating of 3 indicates moderate or moderately appropriate strategy use, and a rating of 5 indicates fluent and appropriate strategy use.

Responsiveness to child's communication

Responding to both the child's verbal bids as well as nonverbal bids. This item captures the frequency, consistency, and supportiveness of parent's responses to the child's behaviors (e.g., language, vocalizations, gestures, facial expressions, body language) throughout the interaction, which may or may not always be directed toward the parent.

1 Parent responds rarely/infrequently to the child and usually only to behaviors that demand a response. The parent rarely reacts to the child's play and social activities, facial expressions, vocalizations, gestures, body language, and intentions that do not demand a response. The parent may ignore or be oblivious to the child's communication.

3 Parent responds to the majority of the child's bids for attention or communication and sometimes responds to the child's non-demand behaviors (i.e., behaviors that may not be directed toward the parent, including subtle and hard to detect gestures, vocalizations, and other behaviors). Parent's responses are mixed in quality between being supportive of the child's activity and not (e.g., unrelated to child's activity). Parent's responses may be inconsistent.

5 Parent responds to almost all the child's bids for attention or communication and most of the child's non-demand behaviors (i.e., behaviors that may not be directed toward the parent, including subtle and hard to detect gestures, vocalizations, and other behaviors). The parent's responses are almost always supportive in insofar as they encourage the child's activity. The majority of the parent's responses match the child's behavior such that the parent's responses are directly related to what the child is doing. For example, if the child is playing the parent responds with actions to the child's activity; if the child is vocalizing or communicating the parent responds by vocalizing or communicating.

Other indicators:

- Tone of voice
- Contingency and appropriateness of response
- Prompted vs. unprompted child responses

Pacing

Timing and the appropriateness of parent's actions (paired with language or not) during the interaction. This describes the timing at which parents are taking action vis-à-vis their child to keep the child engaged (e.g., pausing to allow time and space for the child to communicate and not talking over the child). This item also rates if parents are able to modulate their pace as appropriate based on child's needs – for instance, increasing the pace of the interaction to keep a child from becoming unengaged.

1 Parent does not pace the interaction effectively. The parent either does not pause after an utterance, or the parent is either silent or rate of action/communication is much too slow. Pace is not matched to the needs of the child.

3 Parent pauses after an action/utterance/communicative act to allow sufficient time and space for the child to communicate, respond, or take a play turn about half of the time. Parent's pace is mixed between poor timing (i.e., too quick [not allowing the child to initiate or respond, e.g., talking over the child, repeating instructions in rapid succession without sufficient pause] or too slow) and appropriate timing. Parent's pace should be appropriate about half of the time.

5 Parent pauses after most utterances/communicative acts to allow sufficient time and space for the child to communicate, respond, or take a play turn most of the time. Parent's pace is modulated to be quicker or slower when needed to sustain the interaction.

Other indicators:

- Parent does not talk over child
- Parent does not dominate play
- Allows least 3 seconds for response

Prompting

Quality and developmental appropriateness of parent's use of prompts. This item is rated based on the parent's use of the prompt hierarchy throughout the interaction (using minimally invasive prompts when possible, only prompting when needed, use of most-to-least vs. least-to-most depending on behavior). Parent selects appropriate skills, behaviors, and language to prompt.

1 Parent does not prompt appropriately. The parent either prompts inappropriate behaviors, skills, and language (e.g., when a child can already do something) or at inappropriate levels (e.g., too intrusive or not enough support to help the child be successful).

3 Parent mostly uses the prompt hierarchy appropriately, but there are some instances of inappropriate prompt level usage (e.g., too intrusive or not enough support to help the child be successful). The parent generally targets appropriate skills, behaviors, or language to prompt.

5 Parent's use of prompts demonstrates understanding of the prompt hierarchy, using minimally invasive prompts when possible. The parent provides prompting only when necessary. Almost all prompts are appropriately delivered and target appropriate skills, behaviors, or language.

Prompt hierarchy:

- Full physical (e.g., hand-over-hand) <most intrusive>
- Partial physical (e.g., guiding by touching elbow)
- Verbal (e.g., parent instructs child)
- Model (e.g., parent shows child what to do)
- Gestural (e.g., pointing to where something should go)
- Environmental (e.g., holding up two objects to prompt a request) <least intrusive>

Other things to consider:

- Directiveness not always a negative thing
- Does the prompting interrupt the interaction?

Environmental arrangement

Appropriateness and quality of parent's placement of their body and materials in relation to the child. This item measures whether parents position themselves to be in front of their children (face-to-face) at eye level. It also assesses the parent's arrangement and manipulation of materials (i.e., making toys readily accessible, placing toys in between parent and child, cleaning up the area as needed).

1 Parent does not position themselves in the environment to be in front of the child (face-to-face) and at eye level. The parent does not set out materials appropriately and does not clean up the environment when needed.

3 Parent positions themselves to be in front of the child and at eye level approximately half of the time. The parent sets out materials appropriately approximately half of the time, and sometimes cleans up the environment when needed. The parent may sometimes remove/replace an item that is distracting.

5 Parent positions themselves to be in front of the child and at eye level most of the time. The parent consistently sets out materials appropriately and clean up the environment when needed.

Other quality indicators:

- Ability to manipulate materials (body placement only = 3 or below)
- Body placement in consideration of child's behaviors (e.g., eloping)
- Parent moves rather than asking child to move

References

Adamson, L. B., McArthur, D., Markov, Y., Dunbar, B., & Bakeman, R. (2001). Autism and joint attention: Young children's responses to maternal bids. *Journal of Applied Developmental Psychology*, *22*(4), 439-453.

Adamson, L. B., Bakeman, R., & Deckner, D. F. (2004). The development of symbol-infused joint engagement. *Child Development*, *75*(4), 1171-1187.

Adamson, L. B., Deckner, D. F., & Bakeman, R. (2010). Early interests and joint engagement in typical development, autism, and Down syndrome. *Journal of Autism and Developmental Disorders*, *40*(6), 665-676.

Adamson, L. B., Bakeman, R., & Suma, K. (2016). *The joint engagement rating inventory (JERI)*. (Technical Report 25). Atlanta, GA.

Adamson, L. B., Bakeman, R., Deckner, D. F., & Nelson, P. B. (2012). Rating parent–child interactions: Joint engagement, communication dynamics, and shared topics in autism, Down syndrome, and typical development. *Journal of Autism and Developmental Disorders*, *42*(12), 2622-2635.

Adamson, L. B., Bakeman, R., Deckner, D. F., & Romski, M. (2009). Joint engagement and the emergence of language in children with autism and Down syndrome. *Journal of Autism and Developmental Disorders*, *39*(1), 84.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed., text rev.)*. Washington, DC.

Anderson, D. K., Oti, R. S., Lord, C., & Welch, K. (2007). Patterns of growth in adaptive social abilities among children with autism spectrum disorders. *Journal of Abnormal Child Psychology, 37*(7), 1019-1034.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, *1*(1), 91.

Baio, J., Wiggins, L., & Christensen, D. L., et al (2018). Prevalence of autism spectrum disorder among children aged 8 years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2014. *MMWR Surveillance Summary, 67,* 1–23.

Bakeman, R., & Adamson, L. B. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development*, 1278-1289.

Baker-Ericzén, M. J., Brookman-Frazee, L., & Stahmer, A. (2005). Stress levels and adaptability in parents of toddlers with and without autism spectrum disorders. *Research and Practice for Persons with Severe Disabilities*, *30*(4), 194-204.

Bandura, A. (1971). Social learning theory. Morristown.

Baumwell, L., Tamis-LeMonda, C. S., & Bornstein, M. H. (1997). Maternal verbal sensitivity and child language comprehension. *Infant Behavior and Development*, *20*(2), 247-258.

Bearss, K., Burrell, T. L., Stewart, L., & Scahill, L. (2015). Parent training in autism spectrum disorder: What's in a name?. *Clinical Child and Family Psychology Review*, *18*(2), 170-182.

Belchic, J. K. (1997). *Stress, social support, and sense of parenting competence: A comparison of mothers and fathers of children with autism, Down syndrome, and normal development across the family life cycle*. (Doctoral dissertation, Rutgers University, New Brunswick, USA).

Bell, R. Q., & Chapman, M. (1986). Child effects in studies using experimental or brief longitudinal approaches to socialization. *Developmental Psychology*, *22*(5), 595.

Bishop, S. L., Guthrie, W., Coffing, M., & Lord, C. (2011). Convergent validity of the Mullen Scales of Early Learning and the differential ability scales in children with autism

spectrum disorders. *American Journal on Intellectual and Developmental Disabilities*, *116*(5), 331-343.

Boucher, J. (2017). *Autism spectrum disorder: Characteristics, causes, and practical issues (2nd edition)*. London, England: SAGE Publications Ltd.

Brady, N., Warren, S. F., & Sterling, A. (2009). Interventions aimed at improving child language by improving maternal responsivity. *International Review of Research in Mental Retardation*, *37*, 333-357.

Brookman-Frazee, L., Baker-Ericzén, M., Stahmer, A., Mandell, D., Haine, R. A., & Hough, R. L. (2009). Involvement of youths with autism spectrum disorders or intellectual disabilities in multiple public service systems. *Journal of Mental Health Research in Intellectual Disabilities*, *2*(3), 201-219.

Bruinsma, Y., Koegel, R. L., & Koegel, L. K. (2004). Joint attention and children with autism: A review of the literature. *Developmental Disabilities Research Reviews*, *10*(3), 169-175.

Bruner, J., & Sherwood, V. (1983). Thought, language and interaction in infancy. *Frontiers of Infant Psychiatry*, *1*, 38-52.

Bruner, J. (1995). From joint attention to the meeting of minds: An introduction. *Joint attention: Its origins and role in development*, 1-14.

Callahan, K., Henson, R. K., & Cowan, A. K. (2008). Social validation of evidence-based practices in autism by parents, teachers, and administrators. *Journal of Autism and Developmental Disorders*, *38*(4), 678-692.

Carpenter, M., Nagell, K., Tomasello, M., Butterworth, G., & Moore, C. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development*, i-174.

Centers for Disease Control and Prevention. Data & Statistics on Autism Spectrum Disorder. (2018). Retrieved December 4, 2019.

Centers for Disease Control and Prevention. Signs and Symptoms of Autism Spectrum Disorders. (2019). Retrieved December 4, 2019.

Chang, Y. C., Shire, S. Y., Shih, W., Gelfand, C., & Kasari, C. (2016). Preschool deployment of evidence-based social communication intervention: JASPER in the classroom. *Journal of Autism and Developmental Disorders, 46*(6), 2211-2223.

Charman, T. (2003). Why is joint attention a pivotal skill in autism?. *Philosophical Transactions of the Royal Society B: Biological Sciences, 358*(1430), 315-324.

Coonrod, E. E., & Stone, W. L. (2004). Early concerns of parents of children with autistic and nonautistic disorders. *Infants & Young Children, 17*(3), 258-268.

Cooper, H., & Heron, T. Heward, W. (2007). *Applied behavior analysis (2nd ed.)*. Upper Saddle River, NJ: Pearson.

Curcio, F. (1978). Sensorimotor functioning and communication in mute autistic children. *Journal of Autism and Childhood Schizophrenia*, *8*(3), 281-292.

Dabrowska, A., & Pisula, E. (2010). Parenting stress and coping styles in mothers and fathers of pre-school children with autism and Down syndrome. *Journal of Intellectual Disability Research*, *54*(3), 266-280.

Davis, N. O., & Carter, A. S. (2008). Parenting stress in mothers and fathers of toddlers with autism spectrum disorders: associations with child characteristics. *Journal of Autism and Developmental Disorders, 38*(7), 1278- 91.

Dawson, G., Toth, K., Abbott, R., Osterling, J., Munson, J., Estes, A., & Liaw, J. (2004). Early social attention impairments in autism: social orienting, joint attention, and attention to distress. *Developmental Psychology*, *40*(2), 271.

Dominick, K. C., Davis, N. O., Lainhart, J., Tager-Flusberg, H., & Folstein, S. (2007). Atypical behaviors in children with autism and children with a history of language impairment. *Research in Developmental Disabilities, 28*(2), 145-162.

Doussard–Roosevelt, J. A., Joe, C. M., Bazhenova, O. V., & Porges, S. W. (2003). Mother–child interaction in autistic and nonautistic children: Characteristics of maternal approach behaviors and child social responses. *Development and Psychopathology, 15*(02), 277-295.

Echevarria, J., Vogt, M., & Short, D. (2008). Making content comprehensible for English l earners: The SIOP model. *TESL-EJ, 17*(3), 1-5.

Elder, J. H., & Goodman, J. J. (1996). Social turn-taking of children with neuropsychiatric impairments and their parents. *Issues in Comprehensive Pediatric Nursing*, *19*(4), 249-261.

Elder, J. H., Donaldson, S. O., Kairalla, J., Valcante, G., Bendixen, R., Ferdig, R., ... & Serrano, M. (2011). In-home training for fathers of children with autism: A follow up study and evaluation of four individual training components. *Journal of Child and Family Studies*, *20*(3), 263-271.

Elder, J. H., Valcante, G., Won, D., & Zylis, R. (2003). Effects of in-home training for culturally diverse fathers of children with autism. *Issues in Mental Health Nursing*, *24*(3), 273-295.

Estes, A., Munson, J., Dawson, G., Koehler, E., Zhou, X. H., & Abbott, R. (2009). Parenting stress and psychological functioning among mothers of preschool children with autism and developmental delay. *Autism*, *13*(4), 375-387.

Fenske, E. C., Zalenski, S., Krantz, P. J., & McClannahan, L. E. (1985). Age at intervention and treatment outcome for autistic children in a comprehensive intervention program. *Analysis and Intervention in Developmental Disabilities, 5*(1-2), 49-58.

Flippin, M., & Crais, E. R. (2011). The need for more effective father involvement in early autism intervention: A systematic review and recommendations. *Journal of Early Intervention*, *33*(1), 24-50.

Geiger, K. B., Carr, J. E., LeBlanc, L. A., Hanney, N. M., Polick, A. S., & Heinicke, M. R. (2012). Teaching receptive discriminations to children with autism: A comparison of traditional and embedded discrete trial teaching. *Behavior Analysis in Practice*, 5(2), 49-59.

Goldstein, H. (2002). Communication intervention for children with autism: A review of treatment efficacy. *Journal of Autism and Developmental Disorders, 32*(5), 373-396.

Goods, K. S., Ishijima, E., Chang, Y. C., & Kasari, C. (2013). Preschool based JASPER intervention in minimally verbal children with autism: Pilot RCT. *Journal of Autism and Developmental Disorders, 43*(5), 1050-1056.

Gotham, K., Pickles, A., & Lord, C. (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *39*(5), 693-705.

Green, J., Charman, T., McConachie, H., Aldred, C., Slonims, V., Howlin, P., ... & Barrett, B. (2010). Parent-mediated communication-focused treatment in children with autism (PACT): A randomised controlled trial. *The Lancet*, *375*(9732), 2152-2160.

Guinchat, V., Chamak, B., Bonniau, B., Bodeau, N., Perisse, D., Cohen, D., & Danion, A. (2012). Very early signs of autism reported by parents include many concerns not specific to autism criteria. *Research in Autism Spectrum Disorders, 6*(2), 589-601.

Gulsrud, A. C., Hellemann, G., Shire, S., & Kasari, C. (2016). Isolating active ingredients in a parent-mediated social communication intervention for toddlers with autism spectrum disorder. *Journal of Child Psychology and Psychiatry, 57*(5), 606-613.

Hall, H. R., & Graff, J. C. (2011). The relationships among adaptive behaviors of children with autism, family support, parenting stress, and coping. *Issues in Comprehensive Pediatric Nursing*, *34*(1), 4-25.

Halle, J. W., Baer, D. M., & Spradlin, J. E. (1981). Teachers' generalized use of delay as a stimulus control procedure to increase language use in handicapped children. *Journal of Applied Behavior Analysis, 14*(4), 389-409.

Hardan, A. Y., Gengoux, G. W., Berquist, K. L., Libove, R. A., Ardel, C. M., Phillips, J., ... & Minjarez, M. B. (2015). A randomized controlled trial of Pivotal Response Treatment Group for parents of children with autism. *Journal of Child Psychology and Psychiatry, 56*(8), 884-892.

Hastings, R. P., Kovshoff, H., Brown, T., Ward, N. J., Espinosa, F. D., & Remington, B. (2005). Coping strategies in mothers and fathers of preschool and school-age children with autism. *Autism*, *9*(4), 377-391.

Ingersoll, B., & Wainer, A. (2013). Initial efficacy of Project ImPACT: A parent-mediated social communication intervention for young children with ASD. *Journal of Autism and Developmental Disorders*, *43*(12), 2943-2952.

Ingersoll, B. (2010). Brief report: Pilot randomized controlled trial of reciprocal imitation training for teaching elicited and spontaneous imitation to children with autism. *Journal of Autism and Developmental Disorders*, *40*(9), 1154-1160.

Jang, J., Dixon, D. R., Tarbox, J., & Granpeesheh, D. (2011). Symptom severity and challenging behavior in children with ASD. *Research in Autism Spectrum Disorders*, *5*(3), 1028-1032.

Kaiser, A. P., Hancock, T. B., & Nietfeld, J. P. (2000). The effects of parent-implemented enhanced milieu teaching on the social communication of children who have autism. *Early Education and Development*, *11*(4), 423-446.

Kaiser, A. P., Ostrosky, M. M., & Alpert, C. L. (1993). Training teachers to use environmental arrangement and milieu teaching with nonvocal preschool children. *Journal of the Association for Persons with Severe Handicaps*, *18*(3), 188-199.

Kasari, C., Paparella, T., Freeman, S., & Jahromi, L. B. (2008). Language outcome in autism: randomized comparison of joint attention and play interventions. *Journal of Consulting and Clinical Psychology*, *76*(1), 125.

Kasari, C., Gulsrud, A., Paparella, T., Hellemann, G., & Berry, K. (2015). Randomized comparative efficacy study of parent-mediated interventions for toddlers with autism. *Journal of Consulting and Clinical Psychology*, *83*(3), 554.

Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1988). Caregiver interactions with autistic children. *Journal of Abnormal Child Psychology*, *16*(1), 45-56.

Kasari, C., Freeman, S., & Paparella, T. (2006). Joint attention and symbolic play in young children with autism: A randomized controlled intervention study. *Journal of Child Psychology and Psychiatry*, *47*(6), 611-620.

Kasari, C., Gulsrud, A. C., Wong, C., Kwon, S., & Locke, J. (2010). Randomized controlled caregiver mediated joint engagement intervention for toddlers with autism. *Journal of Autism and Developmental Disorders*, *40*(9), 1045-1056.

Kasari, C., Gulsrud, A., Freeman, S., Paparella, T., & Hellemann, G. (2012). Longitudinal follow-up of children with autism receiving targeted interventions on joint attention and play. *Journal of the American Academy of Child & Adolescent Psychiatry*, *51*(5), 487-495.

Kasari, C., Kaiser, A., Goods, K., Nietfeld, J., Mathy, P., Landa, R., ... & Almirall, D. (2014). Communication interventions for minimally verbal children with autism: A sequential multiple assignment randomized trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, *53*(6), 635-646.

Kasari, C., Gulsrud, A., Jeste, S. (2017). Update on early interventions for autism spectrum disorder: Timing, targets and mechanisms. In J. Luby (Ed), *Handbook of preschool mental health, 2nd Edition*. Guilford Press.

Kashinath, S., Woods, J., & Goldstein, H. (2006). Enhancing generalized teaching strategy use in daily routines by parents of children with autism. *Journal of Speech, Language, and Hearing Research*, *49*(3), 466-485.

Koegel, R. L., Dunlap, G., & Dyer, K. (1980). Intertrial interval duration and learning in autistic children. *Journal of Applied Behavior Analysis*, *13*(1), 91-99.

Konstantareas, M. M., Mandel, L., & Homatidis, S. (1988). The language patterns mothers and fathers employ with their autistic boys and girls. *Applied Psycholinguistics*, *9*(4), 403-414.

Kuhl, P. K., Tsao, F. M., & Liu, H. M. (2003). Foreign-language experience in infancy: Effects of short-term exposure and social interaction on phonetic learning. *Proceedings of the National Academy of Sciences*, *100*(15), 9096-9101.

Labrell, F. (1996). Paternal play with toddlers: Recreation and creation. *European Journal of Psychology of education*, *11*(1), 43-54.

Lamella, L., & Tincani, M. (2012). Brief wait time to increase response opportunity and correct responding of children with autism spectrum disorder who display challenging behavior. *Journal of Developmental and Physical Disabilities*, *24*(6), 559-573.

Landry, S. H., Smith, K. E., Swank, P. R., Assel, M. A., & Vellet, S. (2001). Does early responsive parenting have a special importance for children's development or is consistency across early childhood necessary?. *Developmental Psychology*, *37*(3), 387.

Laski, K. E., Charlop, M. H., & Schreibman, L. (1988). Training parents to use the natural language paradigm to increase their autistic children's speech. *Journal of Applied Behavior Analysis*, *21*(4), 391-400.

Lawton, K., & Kasari, C. (2012). Brief report: Longitudinal improvements in the quality of joint attention in preschool children with autism. *Journal of Autism and Developmental Disorders*, *42*(2), 307-312.

Lemanek, K. L., Stone, W. L., & Fishel, P. T. (1993). Parent-child interactions in handicapped preschoolers: The relation between parent behaviors and compliance. *Journal of Clinical Child Psychology*, *22*(1), 68-77.

Leslie, A. M. (1987). Pretense and representation: The origins of "theory of mind." *Psychological Review*, *94*(4), 412.

Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., & Bishop, S. (2012). Autism diagnostic observation schedule–Second edition (ADOS-2). *Los Angeles: Western Psychological Services*.

Lovaas, O. I., & Smith, T. (1988). Intensive behavioral treatment for young autistic children. In *Advances in clinical child psychology* (pp. 285-324). Springer, Boston, MA.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, *55*(1), 3.

Lussier, B. J., Crimmins, D. B., & Alberti, D. (1994). Effect of three adult interaction styles on infant engagement. *Journal of Early Intervention*, *18*(1), 12-24.

Magiati, I., Moss, J., Charman, T., & Howlin, P. (2011). Patterns of change in children with Autism Spectrum Disorders who received community based comprehensive interventions in their pre-school years: A seven year follow-up study. *Research in Autism Spectrum Disorders*, *5*(3), 1016-1027.

Mahoney, G., & Perales, F. (2003). Using relationship-focused intervention to enhance the social—emotional functioning of young children with autism spectrum disorders. *Topics in Early Childhood Special Education*, *23*(2), 74-86.

Mahoney, G., Powell, A., & Finger, I. (1986). The maternal behavior rating scale. *Topics in Early Childhood Special Education*, *6*(2), 44-56.

Mayes, S. D., & Calhoun, S. L. (2007). Learning, attention, writing, and processing speed in typical children and children with ADHD, autism, anxiety, depression, and oppositional-defiant disorder. *Child Neuropsychology*, *13*(6), 469-493.

McGee, G. G., Morrier, M. J., & Daly, T. (1999). An incidental teaching approach to early intervention for toddlers with autism. *Journal of the Association for Persons with Severe Handicaps*, *24*(3), 133-146.

Mullen, E. M. (1995). *Mullen scales of early learning* (pp. 58-64). Circle Pines, MN: AGS.

Mundy, P., Block, J., Delgado, C., Pomares, Y., Van Hecke, A. V., & Parlade, M. V. (2007). Individual differences and the development of joint attention in infancy. *Child Development*, *78*(3), 938-954.

Mundy, P., Sigman, M., & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders*, *20*(1), 115-128.

Mundy, P., Sigman, M., Ungerer, J., & Sherman, T. (1986). Defining the social deficits of autism: The contribution of non-verbal communication measures. *Journal of Child Psychology and Psychiatry*, *27*(5), 657-669.

Murphy, G. H., Beadle-Brown, J., Wing, L., Gould, J., Shah, A., & Holmes, N. (2005). Chronicity of challenging behaviours in people with severe intellectual disabilities and/or autism: A total population sample. *Journal of Autism and Developmental Disorders*, *35*(4), 405-418.

O'Connor, K. (2012). Auditory processing in autism spectrum disorder: a review. *Neuroscience & Biobehavioral Reviews*, *36*(2), 836-854.

Ozonoff, S., Young, G. S., Steinfeld, M. B., Hill, M. M., Cook, I., Hutman, T., ... & Sigman, M. (2009). How early do parent concerns predict later autism diagnosis?. *Journal of Developmental and Behavioral Pediatrics*, *30*(5), 367.

Patterson, S. Y., Elder, L., Gulsrud, A., & Kasari, C. (2014). The association between parental interaction style and children's joint engagement in families with toddlers with autism. *Autism*, *18*(5), 511-518.

Pavlov, I. P. (1928). *Lectures on conditioned reflexes: Twenty-five years of objective study of* the higher nervous activity (behaviour) of animals. New York, NY, US: Liverwright Publishing Corporation.

Paynter, J., Sulek, R., Luskin-Saxby, S., Trembath, D., & Keen, D. (2018). Allied health professionals' knowledge and use of ASD intervention practices. *Journal of Autism and Developmental Disorders*, 1-15.

Pierce, N. P., O'Reilly, M. F., Sorrells, A. M., Fragale, C. L., White, P. J., Aguilar, J. M., & Cole, H. A. (2014). Ethnicity reporting practices for empirical research in three autism-related journals. *Journal of Autism and Developmental Disorders, 44*(7), 1507-1519.

Rowe, M. B. (1986). Wait time: slowing down may be a way of speeding up!. *Journal of Teacher Education, 37*(1), 43-50.

Rutter, M., Greenfeld, D., & Lockyer, L. (1967). A five to fifteen year follow-up study of infantile psychosis: II. Social and behavioural outcome. *The British Journal of Psychiatry*, *113*(504), 1183-1199.

Saxon, T. F., Colombo, J., Robinson, E. L., & Frick, J. E. (2000). Dyadic interaction profiles in infancy and preschool intelligence. *Journal of School Psychology*, *38*(1), 9-25.

Scaife, M., & Bruner, J. S. (1975). The capacity for joint visual attention in the I nfant. *Nature*, *253*(5489), 265-266.

Schreibman, L., Dawson, G., Stahmer, A. C., Landa, R., Rogers, S. J., McGee, G. G., ... & McNerney, E. (2015). Naturalistic developmental behavioral interventions: Empirically validated treatments for autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *45*(8), 2411-2428.

Shire, S. Y., Gulsrud, A., & Kasari, C. (2016). Increasing responsive parent–child interactions and joint engagement: Comparing the influence of parent-mediated intervention and

parent psychoeducation. *Journal of Autism and Developmental Disorders*, *46*(5), 1737-1747.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*(2), 420-428.

Sigman, M., Mundy, P., Sherman, T., & Ungerer, J. (1986). Social interactions of autistic, mentally retarded and normal children and their caregivers. *Journal of Child Psychology and Psychiatry, 27*(5), 647-656.

Sigman, M., & Ruskin, E. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the Society for Research in Child Development, 64*(1), 1-114.

Siller, M., Hutman, T., & Sigman, M. (2013). A parent-mediated intervention to increase responsive parental behaviors and child communication in children with ASD: A randomized clinical trial. *Journal of Autism and Developmental Disorders*, *43*(3), 540-555.

Siller, M., & Sigman, M. (2002). The behaviors of parents of children with autism predict the subsequent development of their children's communication. *Journal of Autism and Developmental Disorders, 32*(2), 77-89.

Siller, M., & Sigman, M. (2008). Modeling longitudinal change in the language abilities of children with autism: Parent behaviors and child characteristics as predictors of change. *Developmental Psychology*, *44*(6), 1691.

Sindelar, P. T., Brownell, M. T., & Billingsley, B. (2010). Special education teacher education research: Current status and future directions. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children*, *33*(1), 8-24.

Skinner, B. F. (1965). *Science and human behavior*. Simon and Schuster.

Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on Autism and Other Developmental Disabilities*, *16*(2), 86-92.

Smith, T., Groen, A. D., & Wynn, J. W. (2000). Randomized trial of intensive early intervention for children with pervasive developmental disorder. *American Journal on Mental Retardation*, *105*(4), 269-285.

Stahmer, A. C., Collings, N. M., & Palinkas, L. A. (2005). Early intervention practices for children with autism: Descriptions from community providers. *Focus on Autism and Other Developmental Disabilities*, *20*(2), 66-79.

Tager-Flusberg, H., & Kasari, C. (2013). Minimally verbal school-aged children with autism spectrum disorder: The neglected end of the spectrum. *Autism Research, 6*(6), 468-478.

Tager-Flusberg, H., Rogers, S., Cooper, J., Landa, R., Lord, C., Paul, R., ... & Yoder, P. (2009). Defining spoken language benchmarks and selecting measures of expressive language development for young children with autism spectrum disorders. *Journal of Speech, Language, and Hearing Research*, *52*(3), 643-652.

Tamis-LeMonda, C. S., Cristofaro, T. N., Rodriguez, E. T., & Bornstein, M. H. (2006). Early Language Development: Social Influences in the First Years of Life. In L. Balter & C. S. Tamis-LeMonda (Eds.), *Child psychology: A handbook of contemporary issues* (pp. 79-108). New York, NY, US: Psychology Press.

Tobin, K., & Capie, W. (1983). The influence of wait-time on classroom learning. *European Journal of Science Education*, *5*(1), 35-48.

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child Development,* 1454-1463.

Tomasello, M. (1988). The role of joint attentional processes in early language development. *Language Sciences*, *10*(1), 69-88.

Tomasello, M. (2000). The social-pragmatic theory of word learning. *Pragmatics*. *10*(4), 401-413.

Turner, L. M., Stone, W. L., Pozdol, S. L., & Coonrod, E. E. (2006). Follow-up of children with autism spectrum disorders from age 2 to age 9. *Autism*, *10*(3), 243-265.

Ungerer, J. A., & Sigman, M. (1984). The relation of play and sensorimotor behavior to language in the second year. *Child Development*, 1448-1455.

U.S. Census Bureau (2013). Who's minding the kids? Child care arrangements: Spring 2011. Retrieved from https://www2.census.gov/library/publications/2013/demo/p70-135.pdf

Venter, A., Lord, C., & Schopler, E. (1992). A follow-up study of high-functioning autistic children. *Journal of Child Psychology and Psychiatry*, *33*(3), 489-597.

Vygotsky, L. (1978). Interaction between learning and development. *Readings on the Development of Children,* 34-41.

Warren, S. F., & Brady, N. C. (2007). The role of maternal responsivity in the development of children with intellectual disabilities. *Developmental Disabilities Research Reviews*, *13*(4), 330-338.

Warren, Z., McPheeters, M. L., Sathe, N., Foss-Feig, J. H., Glasser, A., & Veenstra-VanderWeele, J. (2011). A systematic review of early intensive intervention for autism spectrum disorders. *Pediatrics*, *127*(5), e1303-e1311.

Weisz, J. R., Chu, B. C., & Polo, A. J. (2004). Treatment dissemination and evidence-based practice: strengthening intervention through clinician-researcher collaboration. *Clinical Psychology: Science and Practice*, *11*(3), 300-307.

Wetherby, A. M., & Prutting, C. A. (1984). Profiles of communicative and cognitive-social abilities in autistic children. *Journal of Speech, Language, and Hearing Research*, *27*(3), 364-377.

Wetherby, A. M. (1986). Ontogeny of communicative functions in autism. *Journal of Autism and Developmental Disorders*, *16*(3), 295-316.

Wolchik, S. A. (1983). Language patterns of parents of young autistic and normal children. *Journal of Autism and Developmental Disorders*, *13*(2), 167-180.

Yaqubi, B., & Pourhaji Rokni, M. (2013). Teachers' limited wait-time practice and learners' participation opportunities in EFL classroom interaction. *Journal of English Language Teaching and Learning*, *4*(10), 127-161.

Zablotsky, B., Black, L. I., Maenner, M. J., Schieve, L. A., & Blumberg, S. J. (2015). *Estimated prevalence of autism and other developmental disabilities following questionnaire changes in the 2014 National Health Interview Survey* (National Health Statistics Reports No. 87). Retrieved from https://stacks.cdc.gov/view/cdc/38790.