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Out of the Ivory Tower: Generalizing Caregiver-Delivered Interventions for Children with Autism Spectrum Disorder

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Out of the Ivory Tower:

Generalizing Caregiver-Delivered Interventions for Children with Autism Spectrum Disorder

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by

Maria Santina Pizzano

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ABSTRACT OF THE THESIS

Out of the Ivory Tower: Generalizing Caregiver-Delivered Interventions for Children with ASD

by

Maria Santina Pizzano

Master of Arts in Education

University of California, Los Angeles, 2018

Professor Connie L Kasari, Chair

The objective of the present secondary analysis was to compare two short-term caregiver training interventions or preschool children with autism spectrum disorder (ASD) in the primary outcomes of joint engagement and parent behavior in the context of the home. Participants included 28 caregiver-child dyads who were randomly assigned to receive intervention for three months, either group caregiver education (CEM), or 1:1 individualized caregiver mediated intervention (CMM). Joint engagement and parent behavior was coded from 30-minute home observations at entry, exit, and 3 months post-intervention. The CMM group saw a significant positive treatment effect, with gains in both child-initiated joint engagement and parent behavior ratings. Parent behavior mediated the effect of the individualized intervention on joint

engagement. This study is among the first to examine the outcomes of joint engagement and parent behavior in the natural context of the family's home.

The thesis of Maria Pizzano has been approved.

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2018

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Literature Overview

Due to a rise in prevalence and awareness of Autism Spectrum Disorder (ASD) and the importance of early and intensive access to specialized programs for individuals with ASD, effective interventions have been designed to improve the developmental trajectories of children with ASD. Autism is a developmental disorder characterized by difficulty communicating and coordinating interactions with others, engaging with toys and people appropriately, and regulating emotions (Mundy, Kasari, & Sigman, 1994; Gomez & Baird, 2005). Joint attention, coordinating attention between a social partner and object or event, has been noted as a core challenge for children with ASD (Tomasello & Farrar, 1986). With an estimated prevalence of 1 in 68 children in the United States, a diagnosis of ASD is not uncommon (Center for Disease Control Report, 2016). Interventions for ASD are frequently clinician-led, clinic-based, and developed with homogenous samples of families who are primarily well-educated or well-resourced, or Caucasian (Kasari & Smith, 2016). It has been shown that there is less access to early intervention by those who are African-American, Latino, or low-resourced (Liptak et al., 2008). Furthermore, many intervention studies for ASD use IQ as a measure of improvement even though it poorly reflects the core deficits of ASD (Kasari, 2002).

One key challenge identified with ASD interventions is the generalization of learned skills (Smith & Iadarola, 2015). This study addresses these shortcomings by examining the impact of a parent-led and community-based intervention on core deficits of ASD across activities and in a natural context with a sample of low-resourced families, approximately 66% of whom identify as a racial/ethnic minority. A parent-mediated targeted joint attention intervention will be compared to a group parent education intervention to determine whether the caregivers' strategy use leads to generalized learning of social communication skills across

activities (play, reading, mealtime, caregiving, reading books) in a natural context (30-minute home observations). The primary goal is to determine if joint engagement and parent behavior improves across entry, exit, and follow-up and whether the increases are greater for the intervention group across activity type. Secondary aims examine which parent strategies are used most effectively to improve child-initiated joint engagement.

What is Joint Attention and Why is it Important?

Joint attention and joint engagement. Autism Spectrum Disorder is characterized by social communication deficits and repetitive behaviors (American Psychological Association, 2013). Social communication is integral for language development, peer interaction, and learning (Mundy, et al., 1990; Charman, 2003). An essential aspect of social communication is joint attention, and children with ASD use joint attention less than their peers (Tomasello & Farrar, 1986). Joint attention skills mark the beginning of awareness that a social partner can see the same objects they can (Bakeman and Adamson, 1984). Joint attention skills are defined as behaviors that coordinate attention with another person to share the experience of an interesting object or event and are indicated by nonverbal use of eye contact and gestures (Seibert, Hogan, & Mundy, 1982; Mundy, et al., 1994). Joint attention skills are classified by actions, either a response to the actions or direction of a social partner (RJA) or an initiation by the child to share with a social partner (IJA) (Mundy, 1995). A group of 15 children with ASD were matched to children with intellectual disability, language, or developmental age and showed half as much joint attention as their peers (Mundy, et al., 1990).

While joint attention refers to specific skills that reveal coordinated attention, joint engagement refers to periods of time during which a child and social partner are actively coordinating attention (Adamson, Bakeman, & Deckner, 2004). Various levels of engagement

may occur over an interaction. Joint engagement is defined as a period of time when the child and their social partner are actively referencing each other as well as the current object or event and is comprised of joint attention acts (Adamson, Bakeman, Deckner, & Nelson, 2012). The states are broadly categorized and include joint engagement as well as 1) unengagement, or time spent without reference to any objects or people, 2) person engagement, or time spent referencing only a person and no objects or events and 3) object engagement, or time when a child only references an object without any clear awareness of their social partner. Joint engagement involves the entire triad and is when a child is referencing both an object or event and their social partner. Overall, it has been shown that children with ASD exhibit delayed trajectories in the development of joint attention and deficits in joint engagement (Mundy et al., 1990; Adamson et al., 2012).

Joint engagement and child outcomes. Children who use more joint attention skills gain language faster (Tomasello and Farrar, 1986). Within joint attention, response to joint attention predicts receptive language and initiation of joint attention leads to the development of expressive language (Anderson, et al., 2007; Sigman & McGovern, 2005, Kasari, Paparella, Freeman, & Jahromi, 2008; Kasari, Gulsrud, Freeman, Paparella, & Hellemann, 2012). Furthermore, joint engagement differences in children with ASD predict verbal language differences (Adamson, Bakeman, Deckner, & Romski, 2009). Joint engagement is a precursor to language development and therefore is vital to overall child outcome and independence.

Nearly 30-50% of preverbal preschoolers with ASD remain minimally verbal at 6 years old and do not develop more than 20 functional spontaneous words (NIH workshop, 2010). Having just one word prior to intervention is a predictor of treatment response, and the since verbal speech by age 5 is predictive of child adaptive functioning, the IACC has identified a goal

of ensuring that 90% of children with ASD have speech by this age (Stahmer, Schreibman, & Cunningham, 2011; The Interagency Autism Coordinating Committee, 2011). Language is a powerful predictor of child outcomes and is critical to developing independence later in life (Howlin, Mawhood, & Rutter, 2000). As joint engagement differences are predictive of verbal language differences, targeting joint attention and engagement in preschoolers with ASD has important downstream effects on language and adaptive functioning.

How Can Joint Attention Deficits be Improved?

Targeted interventions for joint attention have been developed to improve social communication skills in infancy and childhood (Schriebman, et al, 2015). By targeting joint attention in early childhood to improve IJA/RJA and joint engagement, it is possible to improve the trajectory of language development in children with ASD to reach the goal of developing speech by age 5. JASPER is one targeted joint attention intervention that is naturally implemented, developmentally informed, individualized, and based on learning theory (Kasari, Freeman, & Paparella, 2006). A naturalistic developmental behavioral intervention (NDBI), JASPER is delivered in the context of play. JASPER has been shown to improve joint attention skills, joint engagement, and verbal language development (Kasari et al., 2006; Kasari et al., 2008; Kasari, Gulsrud, Kwon, & Locke, 2010). JASPER has also been adapted for caregivers of children with ASD, who are able to implement the strategies effectively and at high rates of fidelity to affect time spent jointly engaged (Kasari, et al., 2010; Kasari et al., 2014).

Why Teach Parents to Implement Evidence-Based Strategies?

Caregivers are powerful agents of change because they spend the most time with their child and are often the most reinforcing social partner for the child (National Research Council, 2001). Boyd (2011) concludes that parent-implemented interventions allow the caregiver to use

evidence-based strategies to support their child's development throughout the lifespan. This presents the opportunity to deliver an intervention at a high dosage versus what would be possible via a community agency or a child's school program alone. Whereas an insurance company may deem only 10 hours per week of intervention necessary, a caregiver could potentially deliver core components of an intervention throughout the week continuously. Caregivers can integrate strategies throughout multiple daily activities to accelerate learning and permanence of skill acquisition.

Evidence indicates that parents can be trained to deliver targeted interventions effectively. Oono, Honey, and McConachie (2013) found strong and significant evidence for positive change in parent-child interaction as a result of parent-mediated intervention. In focusing on active ingredients and core strategies, parents can use an intervention at high rates of fidelity (above 80%) to improve their child's social communication, adaptive functioning, and language acquisition (e.g. Green et al., 2010; Kasari, et al., 2014). Kasari, et al., (2014) found that parents used targeted strategies with low-resourced children age 2-5 to improve their child's joint engagement and increase initiations of joint attention. Caregiver-delivered intervention is particularly effective at increasing generalization of a learned skill. Kasari, Gulsrud, Paparella, Hellemann, & Berry (2015) found that caregiver-delivered intervention for children age 22-36 months improved joint engagement, and additionally found that initiations of joint attention were generalized to the classroom setting. After receiving training in Pivotal Response Training (PRT), parents generalized use of intervention strategies from the context of learning the intervention in a clinic setting to using intervention strategies at mealtimes in the home (Schriebman & Koegel, 1996). Parent generalization of strategies across activities has not yet been examined for caregiver-mediated joint attention interventions.

Shortcomings of the Current State of ASD Intervention

The development of interventions for ASD has blossomed over the previous 20 years. Both comprehensive and targeted interventions have been developed, with varying levels of rigorous testing and methodology (Virues-Ortega, 2010). Whereas comprehensive interventions target broad developmental outcomes across multiple domains, targeted interventions focus on just one domain or skill, such as social skills or repetitive behaviors. A promising target of more focused interventions is joint attention, with early intervention joint attention gains improving language outcomes for children with ASD (Kasari, 2008). While interventions for ASD have been found to be effective, they are not without their shortcomings. Indeed, is estimated to take 20 years for rigorously developed evidence-based interventions to be implemented in the community educational setting (Walker, 2004).

Dingfelder and Mandell (2010) apply the diffusion of innovation model as described in Rogers (2003) to explain that a poor fit between an intervention and the needs and context of a community setting may be at the heart of the problem. The model proposes four stages of evaluation for adoption of an intervention for a service provider: dissemination, adoption, implementation, and maintenance. Schools are required to adopt evidence-based practices, but these practices are not always disseminated clearly to the community. Practices that are disseminated are developed in a clinic with research participants and therefore administrators may not see their applicability in a school setting, with a diverse sample of students. Additionally, most intervention efficacy studies for ASD use IQ or ASD symptomology as a primary outcome, which may not relate to administrators' outcome of interest. Community service providers have the added consideration of cost, training staff, and the need for acceptance by key stakeholders. Selection and appropriate measurement of a target outcome, homogenous

sample populations, focus on a researcher as the interventionist, and clinic-based interventions are common themes of limitations in ASD intervention research (Kasari and Smith, 2016).

Homogenous participant samples in ASD research. A commonly held notion about ASD prevalence was that it only occurred in families who were well-educated and high to middle SES (Kanner, 1943; Treffert, 1970). This notion was not unfounded at the time, as the ASD population represented in research studies was predominantly male, from a well-educated family, and advantaged, and this persists today (e.g. Dawson, et al., 2010). Furthermore, while the ASD spectrum is highly heterogeneous in terms of symptom presentation and cognitive functioning, study samples tend to exclude participants with lower cognitive scores or expressive verbal language (e.g. Dawson, et al., 2010; Lovaas, 1987). ASD is not restricted to particular racial or social classes, and recent work has made an attempt to include a more representative sample (e.g. Kasari, 2014).

Unfortunately, race matters at all stages of ASD diagnosis and intervention. Racial or ethnic minority children are diagnosed later, given more restrictive education placements in school, and receive less early intervention as compared to their peers (Mandell, Listeud, Levey, & Pinto-Martin, 2002). Once diagnosed, racial or ethnic minority parents report that their children exhibit more severe symptomology (Tek & Landa, 2012). Furthermore, minority students with ASD generally have poorer academic outcomes, graduation rates, and poorer rates of independence at the postsecondary stage (Liptak, et al., 2008). Decreasing the research-to-practice gap for ASD intervention requires that study samples are representative of the local community and make an effort to include participants of diverse racial, ethnic, and SES backgrounds.

Agents of intervention. Intervention packages are generally developed and tested with well-trained research assistants or clinicians as the agents of delivery. However, most families with a child with ASD receive their services in the community or at their child's school, never setting foot in a university-based research clinic (Kasari & Smith, 2016). This is limiting because the effectiveness of clinic-based interventions does not necessarily carry over when implemented in the general population of families with ASD and these interventions are not always tested in the community setting before adoption by service providers.

Community providers report also commonly report using both evidence-based and non-evidence-based strategies and may combine the strategies in nonsystematic and unstudied ways (Stahmer, Collings, & Palinkas, 2005). This is also problematic because it becomes unclear what a strategy is teaching and whether it is having the intended effect. An increasing number caregiver-delivered interventions have been developed and implemented to address this issue (McConachie & Diggle, 2007). Caregivers can be trained directly to implement evidence-based strategies that improve the outcomes of their child, thereby decreasing the research-to-practice divide.

Location of intervention. Although the need for autism interventions are in the community setting, existing evidence-based interventions are generally developed and refined in the academic or clinic setting. When interventions are implemented in the community, they are often done without the proper evidence base or fidelity (Stahmer & Ingersoll, 2011). Many of the readily available community-based interventions for children with ASD are backed by research of a limited scope and questionable quality (Kasari & Smith, 2016). The most common design used to establish the evidence for interventions for ASD is a single-subject experimental design,

where a few participants are observed and each serve as his or her own control (Machalicek et al., 2008; Bailey & Burch, 2002).

Established evidence-based interventions face the additional obstacle of fidelity when implemented in the community setting. Interventions are developed for a specific purpose and are designed to be implemented in a particular way to achieve that purpose. Fidelity refers to how strongly intervention procedures are adhered to (Schoenwald, et al., 2011). When moved into the community, interventions may be implemented with a lower fidelity than the clinical intervention (e.g. Mandell et al, 2013). Lower fidelity of implementation makes it difficult to know what causes changes in outcomes and may diminish potential improvements in child outcome. When developed in the isolation of a clinic setting, it is not clear which aspects of an intervention may be difficult for community providers to implement reliably. Developing interventions in the local community early in the investigative process is essential to ensuring an optimal fit between the intervention and the needs of the local population.

Choice of Outcome Measure. The choice of outcome is essential for the measurement of an intervention's effectiveness. Outcomes of intervention for children with ASD are generally adaptive functioning, cognitive functioning, or ASD symptomatology. However, these targets are limited in their applicability as outcome measures since they are weakly related to social communication, a core deficit of ASD, and may be poorly suited to the duration and targets of ASD intervention (Kasari, 2002; Kasari & Smith, 2016). Global assessments cannot detect small, meaningful change and in the case of ASD, appropriate measurement of small and meaningful change is essential to recording gains in areas of core deficits. Small changes in these core deficits are better detected by a third party via behavioral coding of videotaped behavior and interactions. A coder notes when certain behaviors occur via observations throughout an

intervention. Small but meaningful changes in joint attention skills have been linked to meaningful gains in verbal language. (Kasari, Gulsrud, Freeman, Paparella, & Helleman, 2012). Additionally, parent and self-report questionnaires are frequently used as main sources for outcome measurement (Lord, et al., 2005). To avoid the bias that this data source presents, it is necessary to have a neutral third party as the primary source of outcome measure or at the minimum to bolster outcomes that rely on parent or self-report alone. Tailoring unbiased outcomes of interventions to reflect meaningful changes can ensure their successful adoption by community stakeholders.

Generalization. Generalization is infrequently included as an outcome measure for ASD interventions and therefore has been noted as a challenge in early intervention (Smith & Iadarola, 2015). Generalization refers to applying a skill or idea in a context other than the specific context in which it was learned and indicates learning. Parents are particularly powerful in solidifying learned skills. Parents can be mentored to use both naturalistic (PRT) and more structured (DTT) intervention strategies at home and in the community to foster their child's acquisition of a skill (Koegel, Bimbella, & Schreibman, 1996; Crockett, Fleming, Doepke, & Stevens, 2007). Some studies have included measures of generalization to find that JA skills may generalize to other people, other settings and over time (Kaale et al, 2014; Kasari et al., 2015; Kasari et al, 2008). Parents can consistently use teaching strategies to create continued learning opportunities and ensure that their child's skills are maintained after intervention support ends (e.g. Kaiser, Hancock, & Nietfeld, 2000; Kasari, et al., 2015). However, it has not been yet investigated whether gains in engagement during a parent-mediated joint attention intervention generalize across type of activity, from play to daily routine activities. Establishing generalization across

natural contexts and daily activities is needed to investigate the efficacy of parent-mediated interventions.

Original Parent-Mediated Intervention RCT

In this secondary data analysis, 30-minute tapes of caregiver-child interactions collected before, immediately after, and at 3-month follow up were examined to determine how effectively caregivers use targeted joint attention intervention strategies in their homes to maintain joint engagement across various types of activities. The original study targeted low-resourced families to deliver a caregiver-mediated intervention (Kasari, et al., 2014). Preschoolers from five sites (Los Angeles, Seattle, Baltimore, New York City, and Tallahassee) were randomized in an active control design to one of two interventions, either individualized caregiver-mediated intervention (CMM) or group caregiver education (CEM). The CMM group received two 60-minute sessions per week for 12 weeks within their home. During sessions, caregivers were coached with their child by interventionists with the goal to establish engagement in three routines at home: one with play and two with everyday activities. Joint Attention Symbolic Play Engagement and Regulation (JASPER) is a manualized developmental and behavioral intervention that was used to teach caregivers strategies to create a learning environment and teach joint attention and language skills to their child (Kasari, et al., 2006; Kasari, 2008; Gulsrud, Wong, Kwon, & Locke, 2010). The group education condition did not involve the child's presence and instead delivered similar information in weekly 2-hour group caregiver meetings in the community. Study results indicated that joint engagement increased in the CMM group in 10-minute caregiver-child play activities with a standard set of toys (Kasari et al., 2014).

Statement of Purpose

The study is a secondary data analysis that examines duration of joint engagement from entry to exit and follow up across caregiver-mediated interventions in a longer home observation that reflects daily routines and play in a natural context. Observations were made by a videographer blind to child intervention assignment. Home observations were taped as a component of a larger, randomized, controlled trial intervention study that examined two different caregiver-implemented interventions for preschoolers with autism (Kasari, et al., 2014). The intervention condition is defined as either group caregiver education (CEI) or an individually coached caregiver-mediated intervention targeting joint attention and play (CMM). The primary outcome is duration of joint engagement, time when the child and caregiver are engaged with the same activity and are both aware of the roles of the other. Home observation recordings from 28 low-resourced families from the Los Angeles area were coded in intervals for engagement state at entry, exit, and follow-up.

Primary Aim

This secondary data analysis aims to determine if child-initiated joint engagement (JE) increases in parent-child interactions after caregiver coaching during play routines in the family's home. The parent-child interaction under examination is 30 minutes and will be examined for JE in the context of play as well as other activities. The primary outcome is joint engagement duration at entry, exit, and follow-up across intervention groups (CMM and CEM) and activity categories (Play, Meals and Snacks, Caregiving, Family Chores, and Books). It is expected that the CMM group will use the targeted strategies they learn to result in increased duration of periods of time jointly engaged across activities at exit and follow-up.

Secondary Aims

The secondary aims will be to look more closely at the parent's behaviors in the taped interaction. The secondary outcome will be parent strategy codes at entry and exit across both intervention groups, with higher scores indicating more frequent appropriate use. It is expected that parents of the CMM group will adopt strategies more effectively, in particular the mirroring and imitation strategy.

This paper will also identify whether parent behavior plays a role in children's time jointly engaged. An additional aim is to explore whether increases in parent behavior are associated with increases in the period of time spent jointly engaged, and which strategies may be related to increases in child-initiated joint engagement. It is hypothesized that increased strategy use will be related to longer periods of joint engagement, and that the mirrored pacing strategy will be most closely related to joint engagement gains as was found in a previous parent mediated intervention study with toddlers using JASPER (Gulsrud et al., 2016).

Method

Study Design

After meeting inclusion criteria, participants were randomized to either the Caregiver-Mediated Module (CMM) or the Caregiver Education Module (CEM). The intervention period lasted three months with two hours of individualized (CMM group) or group (CEM) instruction per week. The follow-up period occurred for three months after completion of the intervention. Pre-, post-, and follow-up videotapes were filmed by examiners blind to group assignment. An independent data coordinating center conducted the randomization.

Participants

Recruitment. Twenty-eight child-caregiver dyads were recruited from the Los Angeles area as part of a larger multisite study. Four criteria were used to determine study eligibility. The first required that the child's age be between 2-5 years. The second required that the child's mental age be above 12 months. Mental age was assessed by administration of the Mullen Scales of Early Learning (MSEL) (Mullen, 1997) at screening. Third, autism diagnosis was necessary and was confirmed via administration of the Autism Diagnostic Observation Schedule (ADOS) (Lord, et al., 1989). The final criterion was family identification as "low-resourced". "Low-resourced," for the purposes of this study, was defined as meeting one of the following criteria: 1) low-income as defined by the US Department of Housing and Urban Development for reported family income, number of family members, and state of residence, or 2) either the mother held a high school degree or lower, the primary caregiver was unemployed, or the household received government assistance. Children with a known genetic comorbidity (i.e. Down's Syndrome) were excluded from participation.

Recruitment occurred from August 2009 through July 2011, over 23 months. A total of 37 families were screened for participation. Five were ineligible and three participants declined to continue participation, with a final sample of 28. Fourteen participants were randomized to the CMM group and 14 participants were randomized to the CEM group.

Child Characteristics. The children had an average age of 41.89 (SD 9.38) months, with a range of 24-58 months. Five (17.85%) of the participants were female and 23 (82.14%) were male, consistent with the gender ratios found in the ASD literature. Overall, 4 (14.28%) identified a race/ethnicity of white, 3 (10.71%) identified as Asian, 5 (17.85%) identified as African American, 10 (35.71%) identified as Hispanic, 1 (3.57%) identified as Pacific Islander,

and 4 (14.28%) identified as Mixed or Other. The overall sample was 14.28% white and 85.72% non-white in ethnicity identification. 19 (67.85%) of the sample was reported as hearing English as the primary language at home, with 3 (10.71%) primarily hearing Spanish, 4 (14.28%) hearing Korean and 2 (7.14%) hearing another language at home.

Of the participants, 19 (67.85%) reported receiving early intervention services, and 8 (28.57%) of the participants did not receive early intervention services. Of those that received intervention services and provided information about hours of services received per week, 7 (36.84%) received 1-5 hours of services, 1 (5.26%) received 6-10 hours, 2 (10.52%) received 10-15 hours, 2 (10.52%) received 15-30 hours, and 1 (5.26%) received over 30 hours of intervention per week.

Twenty-six of 28 completed a module 1 of the ADOS, with an average severity score of 6.03 (SD 1.63). One participant in CMM completed a module 2 of the ADOS with a severity score of 6 and one participant in CEM completed a module 3 of the ADOS with a severity score of 9. Average mental age equivalency, in months, as scored by the Mullen was 24.46 (SD 9.63). Participants on average, had a Visual Reception mental age of 27.67 (SD 10.59), a Fine Motor mental age of 26.39 (SD 8.20), a Receptive Language mental age of 22.57 (SD 11.49), an Expressive Language mental age of 21.00 (SD 11.68).

Parent Characteristics. Each family identified a primary caregiver to participate throughout the duration of the study period, but demographic information was requested for both parents, if available. Nine (32.14%) mothers report having an education of a High School GED or less. One (3.57%) reports completing vocational school, 13 (46.42%) report completing some college or finishing their college degree, and 5 (17.85%) report completing some graduate education or their graduate degree. Six (21.42%) fathers report having an education of a High

School GED or less, 16 (57.14%) report completing some college or finishing their college degree, and 4 (14.28%) report completing some graduate education or their graduate degree.

Four (14.28%) families report earning less than $10,000 annual income, 4 (14.28%) report earning between $10-20,000, 4 (14.28%) report earning $20-30,000, 2 (7.14%) report earning $30-40,000, 4 (14.28%) report $40-50,000, and 6 (21.42%) report earning over $60,000. 22 (78.57%) report receiving government assistance, with 11 (50.00%) reporting use of one type of assistance, 9 (40.90%) reporting using two types of assistance, and 3 (13.63%) reporting using three types of government assistance.

Measures

Autism Diagnostic Observation Schedule (ADOS). The Autism Diagnostics Observation Schedule (ADOS) is a semi-structured observational assessment used in this study for the purpose of eligibility (Lord, Rutter, DiLavore, & Risi, 1999). A standard set of materials and probes are used to observe a child's social behavior, communication, and repetitive behavior. These observations are translated to scores and are used to determine whether the behaviors are significant enough to warrant an autism classification based on established cutoffs. The ADOS was used to confirm autism diagnosis.

Mullen Scales of Early Learning (MSEL). The Mullen Scales of Early Learning (MSEL) is a standardized test of visual reception, fine motor, gross motor, expressive language, and receptive language skills in infants and young children (Mullen, 1997). MSEL scores are translated into age equivalents for each of these areas. Mullen raw scores are used to compute child mental age. In this study, the MSEL was administered before randomization by blind, trained assessors and scaled mental age equivalent scores were used for eligibility to establish a child's mental age as being equal to or greater than 12 months.

Demographic Form. A demographic questionnaire was used to obtain descriptive information about child and family characteristics. Demographic information pertaining to household income and size, parent employment, parent education, and government assistance received by the family was used to confirm "low-income" classification for eligibility purposes.

Home Observation. The home observation is used to observe parent-child interactions at entry, exit, and follow-up. An assessor blinded to treatment condition and time point video recorded parent-child interactions in the family's home for 30 minutes. The parent was instructed to interact as they normally would, with the only requirement being to include some play with toys. No materials were provided by the assessor, and all materials used were those in the child's home and in the context of their everyday activities.

Coding. Ratings of child-parent engagement states, child characteristics and behaviors, and parent behavior and strategy use were based on the scale described in Adamson, et al., 2012.

Joint engagement, the primary outcome for this secondary analysis, was measured by continuously coding the parent-child interaction of the home observation using engagement state classifications as described by Bakeman and Adamson (1984). Engagement states refer to a child's attention during an activity with a social partner. These states are referred to as unengaged, object engagement, person engagement, supported joint engagement, or coordinated joint engagement. Unengaged refers to periods of time when the child's attention is on neither their social partner nor the activity or object, object engagement refers to periods of time when the child's attention is solely on an object and not at all on their social partner, person engagement refers to periods of time when the child's attention is solely on their social partner with no reference to the object or activity, and joint engagement refers to periods of time when the child's attention is on both the activity and their social partner. Supported joint engagement

refers to periods of joint engagement where the social partner scaffolds the interaction so that the child coordinates their attention between both the activity and their social partner, while coordinated joint engagement refers to periods of time when the child is actively and independently coordinating their attention with little support. Engagement state was coded in 30-second intervals with rating assigned based on the mutually exclusive state present for the majority of the interval. Engagement state was coded as child-initiated if the child spontaneously initiated the beginning of the engagement state and as adult-initiated if the adult strongly directed the action without following the child's lead. Analysis was based on durations of child-directed joint engagement across types of activities, as these periods represent spontaneous coordination of attention.

In addition to coding each 30-second interval for engagement state, each interval was majority coded for activity type. As the only instructions given were to play as they typically would, many activities reflecting the daily interactions between caregiver and child were present in the home observations. To better understand engagement during play and non-play activities, intervals were assigned a code for the activity present for the majority of 30 seconds. Activity type was coded as either play, reading books, mealtime, family chores, caregiving, other, or outside play.

Child characteristics and behavior as well as parent behavior and strategy use were coded on a seven-point likert scale, for each 10-minute segment of the 30-minute home observation. These codes were based on Adamson's 2012 rating system, with modifications to clarify the scale benchmarks and items to apply to the intervention under study. The total original scale consists of 17 items: Items 1-4 referred to engagement state, items 5-9 referred to qualities of the child's behavior, and items 10-17 referred to parent behavior. For the purposes of this study,

engagement state items were expanded to a total of 7, items 1-7 in the adapted system, to capture all engagement states. Child behavior items were not modified and consisted of items 8-12 in the altered rating system. Parent behavior items were interpreted to apply directly to the primary strategies of JASPER, but remained as a total of 8 items, in the adapted system items 13-20. For a full comparison of original and adapted items, see table 3. The parent strategy items—11- symbol highlighting, 14- elaboration of shared topic, 15- sustainability of shared topic, 16- scope of shared topic, and 17- fluency and connectedness of conversation were adapted for the strategies that have been identified as active ingredients of the Joint Attention, Symbolic Play, and Emotion Regulation (JASPER) intervention by Gulsrud, Hellemann, Shire, and Kasari (2016). The adaptation was made because the children in the videos had infrequent fluid conversations and more detailed items were necessary to capture the nuances of parent strategies. These core JASPER strategies are environmental arrangement, mirroring, routine building, directiveness, and communication. The likert scale items 1-7 for parent behavior were defined as behavior that was increasingly frequent and appropriate, witb a rating of 1 for no appropriate use, a rating of 4 for appropriate use of a strategy 36-50% of the time, and a rating of 7 for appropriate use of a strategy 81-100% of the time.

The rating system falls into three subscales: engagement, child behavior, and parent behavior. Ultimately, the interval coding was used instead of the 1-7 system for engagement state analysis to capture small but meaningful change. Child behavior scores were not used in the present investigation. Parent behavior scores were averaged to give an overall score per item for each video as a whole. Parent items were summed to provide a parent strategy score for each video.

Reliability. Coding procedures were drafted into a codebook. Two coders reached over 80% reliability on the coding scheme before videos are coded. Reliability was calculated with intraclass correlations. 20% of videos were double-coded and compared for reliability to ensure continuity of coding.

Results

Analysis

Prior to conducting analyses, descriptive analyses to examine outliers and assumptions of normality and sphericity were done for parent strategy use and for engagement state intervals. No potential outliers were identified. Joint engagement data was non-normally distributed with a skewness of 2.46 (SE=0.597) and kurtosis of 6.707. As a result, log transformations were applied to joint engagement data in preparation for analysis. Parent behavior data were normally distributed. Although group assignment in this study was random, potential group differences in demographic variables could still exist. Prior to conducting analyses, demographic characteristics at baseline such as ethnicity, income level, and parent education level were analyzed for group differences with paired t-tests. Systematic missingness may have been present if those who are actively coached in the play intervention decided to spend more time playing and less time doing other activities at exit and follow-up timepoints, but this was not the case. Zero inflation was not an issue, but as joint engagement is a core deficit of ASD, parent-child interactions had particularly small percentages of time spent jointly engaged, resulting in a positively skewed distribution of child-initiated joint engagement intervals.

Two-way repeated measures ANOVA were planned to be used to examine group differences in the primary outcome, joint engagement. However, due to the nonnormal distribution of the data, log transformation followed by linear mixed effects models with main

effects of treatment (CMM or CEM), time (entry, exit, follow-up), and treatment by time interactions were used. Group and time were the main effects used in the linear models, with mental age as measured on the Mullen as a covariate. Every 30 seconds was interval coded for the majority of time spent in one of four engagement states. Child-directed joint engagement durations were compared across timepoints and groups to determine whether increases in joint engagement are present in a generalized context. Child-directed joint engagement was investigated through linear mixed effects models a of 1) overall duration of joint engagement across all activities of the entire video, 2) duration of joint engagement in only intervals of play activities, and 3) duration of joint engagement in only intervals of other activities. Listwise deletion was used for missing engagement data and corrections were made for posthoc analyses. Bonferroni adjustment was used for posthoc models of child-initiated joint engagement in play intervals and child-initiated joint engagement in other activity intervals. It was hypothesized that the active coaching group would have improved engagement as a whole across the entire interaction, in play intervals, and in other activity intervals.

A two-way repeated measures ANOVA was initially going to be used to look at group differences in parent strategy use. However, a linear mixed effects model with main effects of treatment (CMM or CEM) and time (entry, exit, follow-up), and treatment by time interactions was a more appropriate statistical approach. Treatment effect was defined as an effect of group on the primary outcome across time from entry to exit. Maintenance effect was defined as a significant increase over time from entry to follow-up for the treatment group. Parent strategy scores were compared across group and across time with a repeated measures ANOVA to determine whether increased effective strategy use is present in the individualized CMM group. The linear model examined group and time effects on parent behavior, with mental age as a

covariate. It was anticipated that the active coaching group will have more effective parent strategy use.

A linear mixed effects regression model was used to look at the potential influence of parent strategy on the primary outcome, joint engagement. Strategies were added to a linear mixed effects model to determine whether parent behavior changes are related to joint engagement gains. It was anticipated that effective use of the mirrored pacing strategy would have the largest effect on joint engagement gains.

Descriptive Analyses

Group randomization was successful and there were no significant group differences in child or parent characteristics at baseline characteristics (see Tables 1 and 2). The unadjusted means for each timepoint for the primary (percent of intervals in child-initiated joint engagement and mean parent behavior scores) are presented in Table 4. Figure 1 displays unadjusted group means for total CIJE intervals, and Figure 2 displays unadjusted group means for parent behavior scores.

Primary Aim: CIJE

Normality. Of the six total groups of joint engagement (entry, exit, and follow-up for CMM and CEM groups), two groups had positively skewed joint engagement data with kurtosis values of 6.7 and 2.2, and one group had a skewness of 2.47. Log transformations were used to normalize the data and linear models were run with both log-transformed engagement data and raw engagement data. Upon inspection of the model residual histograms, the raw residual data was determined to follow a normal distribution, so the raw percentages of child-initiated joint engagement were used in analyses and are reported here. Shapiro tests were used to confirm normality of the residuals.

Child-initiated joint engagement. Linear mixed models were used to analyze percentage of time spent in child-initiated joint engagement in the home observation videos. There was a significant treatment effect for the CMM group for increases in joint engagement across all types of activity intervals (B=0.18, *df*=49, *p*=0.002), controlling for Mullen Mental Age ($\chi^2(1)= 16.189$, *p*=0.000). Mullen Mental Age was a significant predictor in the model as well (B=0.01, *df*=49, *p*=0.015). The treatment effect of increases in JE for the CMM group held for CIJE in intervals of only play (B=0.17, *df*=44, *p*=0.015), controlling for Mullen Mental Age ($\chi^2(1)= 5.89$, *p*=0.015) as well. The treatment effect was not significant for CIJE in intervals of other activities only (B=0.06, *df*=43, *p*=0.261), controlling for Mullen Mental Age ($\chi^2(1)= 1.258$, *p*=0.261). Full model details are presented in Table 5. All effects survived Bonferroni correction, with an adjusted p-value of 0.016. The CMM group maintained treatment CIJE gains from entry to follow-up, in all activity intervals (B=0.087, $\chi^2(1)= 11.368$, *p*=0.001), and in play intervals (B= 0.092, $\chi^2(1)= 6.7174$, *p*=0.009).

Secondary Aim: Parent Behavior Ratings

Parent Behavior. Parent behavior data was normally distributed. Linear mixed models were used to analyze parent behavior scores across time and group, with the scores uniformly representing increased frequency and appropriateness with ratings of 1-7. There was a significant treatment effect for the CMM group for increases in parent behavior ratings (B=9.38, *df*=49 *p*=0.000), controlling for Mullen Mental Age ($\chi^2(1)= 16.189$, *p*=0.000). Mullen Mental Age was not a significant predictor in the model (B=0.03, *df*=49, *p*=0.722). The treatment effect of increases in parent behavior for the CMM group maintained for parent behavior (B=4.5, *df*=49, *p*=0.000), controlling for Mullen Mental Age ($\chi^2(1)= 12.412$, *p*=0.000) as well. Full model details are presented in Table 5.

Parent behavior and child-initiated joint engagement. Parent behavior was added to linear mixed models of CIJE to determine whether increases in parent behavior were related to increases in CIJE. Increases in parent behavior mediated the relationship between group CIJE gains across time. Parent behavior was a significant predictor for CIJE gains across activities (B=0.01, *df*=49, *p*=0.000), in only intervals of play activities (B=0.02, *df*=49, *p*=0.000), and in only intervals of other activities (B=0.01, *df*=49, *p*=0.007). The addition of parent behavior scores in the linear mixed models for total CIJE and play intervals of CIJE resulted in a treatment effect that was no longer significant ($\chi^2(1)= 0.791$, *p*=0.373; $\chi^2(1)= 0.360$, *p*=0.548).

Discussion

The present study examined the effect of an individualized caregiver coaching intervention on caregiver-child interactions in the family's home. This is one of the first investigations of the effects of JASPER coaching on a 30-minute caregiver-child interaction across multiple activities. Specifically, this investigation looked at whether gains in engagement in a short (10-minute) play interaction with provided toys would extend to a more natural context- a 30 minute interaction with no materials provided. Additionally, the present study looked at whether caregiver behavior in this context changed as a result of the coaching intervention, and if so, whether caregiver behavior was related to child engagement. As a short 10-minute play interaction only reflects engagement in one activity and may not reflect the difficulties parents experience in sustaining engagement in their homes, the videos under investigation represent a realistic look at what a family's everyday interactions and activities may be. Results indicate that a short targeted caregiver coaching intervention can lead to improvements in the appropriateness and frequency of caregiver behavior and to improvements in child engagement in the context of everyday at-home activities. Overall, those caregivers who

received active coaching did improve their child's engagement, particularly in play activities. Caregivers did have more frequent and appropriate behavior in the home observations. Importantly, caregiver behavior improvements did drive the increases in child-initiated joint engagement.

Joint Engagement in the Natural Setting

The CIJE findings of an 18% increase in joint engagement due to the intervention suggest that parents can improve their engagement with their children with ASD, in the natural home environment. Although previous studies have found that parent-mediated interventions can lead to gains in child-initiated joint engagement in a brief, structured observation (e.g. Kasari, et al., 2014), the present study is one of the first to look closely at parent-child engagement in a context that more closely approximates a family's day-to-day experience. Although both groups saw improved engagement over time, the persistence of a treatment effect in this more natural setting is more closely reflective of changes that may occur in a family's daily experience. Increases in engagement in the home setting suggest that parent-child interactions are of a higher quality and increased durations of joint engagement provide an opportunity for the parent to provide increased learning opportunities throughout the child's day. The treatment effect for total intervals in the observation is promising. 30 minutes is a long time for a young child with ASD to interact with their parent, and it can be difficult to manage the multiple factors at play in the home environment.

The treatment effect was maintained for total intervals 12 weeks later at follow up. A brief parent-mediated coached intervention (2 hours per week, for 12 weeks) can therefore have significant and durable effects. It lends support to the notion that caregiver-mediated interventions can have effects in the child's daily life beyond the duration of the intervention

itself. Improvements in engagement that persist beyond outside support have the potential to lead to verbal language improvements which then can affect child outcome (Adamson, et al., 2009; Howlin, et al., 2000). Community providers looking to maximize resources to improve parent-child interactions may benefit from the approach of a brief, targeted caregiver-mediated intervention.

The effect of play is also promising. The intervention has a play focus, so it is effectively helping parents to maintain the engagement of their young children in play activities with materials from the everyday environment. Parents in the treatment group are improving their child's engagement in play and therefore are able to infuse their play with more learning opportunities and encouraging their child's joint attention and communication development.

The CMM group was coached in both play and home activities during the active treatment period. The original intervention was developed with a focus on play and those in the treatment group may have chosen to spend more of their time at exit and follow-up engaged in play activities with their child. Furthermore, a larger sample may be necessary to detect the change in joint engagement in other activities. In the present examination, all activities other than play were put into an "other" category and engagement in play was then separated from engagement in other activities. A larger sample size will allow more careful examination of individual other activities, as engagement in home routines or chores may be different than engagement in outside play or reading books.

Changes in Parent Behavior

The parent behavior findings suggest that parents can effectively learn and use targeted intervention strategies within the home environment and with their everyday materials. Parent behavior does change in this context after a coaching period of two hours a week for three

months. Furthermore, these changes in behavior are maintained 3 months later. A crucial assumption of many parent-mediated early intervention studies is that parents use the strategies that they learn with their child throughout their child's day to improve their child's outcomes via increased dosage of targeted strategies (e.g. Rogers, et al., 2010). Despite making this assumption, parent-mediated interventions may rely on parent report rather than the use of in-home measures to determine whether parents are using the strategies they are taught in their child's everyday experience (Lord, et al., 2005). The finding that parents are changing their behavior in their homes with the materials they already have lends support to this assumption. Although community providers report offering parent involvement opportunities, they frequently offer parent education and infrequently offer parent coaching of targeted strategies (Stahmer, 2006). The effect of targeted caregiver coaching on caregiver behavior encourages a potential restructuring of the approach to parent involvement in the community.

The present examination found a treatment effect for parent behavior that was maintained at follow-up, with the targeted intervention group effectively improving their behavior during intervention and then maintaining these improvements at the follow-up visit 12 weeks later. Again, this suggests that 1:1 coaching, as opposed to delivery of information alone, is necessary to teach parents to effectively implement targeted strategies with their children with lasting effects. The implementation of a brief coaching intervention may be a powerful use of resources, particularly for community providers, as caregivers continue to adopt more frequent and appropriate behavior after the coach has ceased active support.

Parent Behavior as Mediator

The mediating role of parent behavior lends support to the idea of caregiver-mediated interventions that parents can improve their child's engagement through learning targeted

strategies. This provides direct support for the importance of parent-mediated interventions that are tailored to a family's needs. 1:1 coaching effectively teaches parents the strategies they need to more effectively engage their child in activities throughout the home context and therefore should more carefully be considered to be a part of a child's intervention plan. Although caregiver-mediated interventions frequently assume that parents learn the strategies to change their child's outcomes, using home observations shows that parents are learning the behavior they are coached on and they are improving their child's coordination of attention between activity and social partner. This engagement with a parent is crucial for a child's learning, and parents can take advantage of periods of joint engagement to teach their children joint attention skills (Adamson, et al., 2009).

The importance of parent behavior in the child's outcome of intervention is a critical aspect of early intervention for ASD. Parents used targeted behavior to improve a core deficit of ASD, joint engagement. As children with ASD have delayed trajectories in joint engagement, parents are an essential, but often overlooked, aspect of their child's intervention (Mundy et al., 1990). Verbal language is an important downstream effect of joint engagement and verbal speech by age 5 is predictive of adaptive functioning (Stahmer, et al., 2011). The finding of parent behavior as a mediator of child-initiated joint engagement gains warrants further investigation.

Conclusion

Limitation and Future Directions

The primary limitation of this present examination is the small sample size. With only 14 participants per group, findings should be interpreted with caution. A larger sample is needed to more definitively conclude the role that parent behavior can play in the home context to improve the joint engagement of their children. Additionally, the extension of treatment gains to other

activities may be limited as the intervention is primarily play-based, and those who participated in the targeted intervention group may have been more likely to spend the observation period engaging in play as opposed to non-play activities with their child after participation in the intervention.

Future directions should address these limitations with a larger sample and a potentially slightly structured observation period to ensure that each participant spends at least a small amount of time in a non-play home activity. The addition of a cap on time spent playing will ensure that all participants have a representation of other activities in their observations. A larger sample will allow for more in-depth analyses. In the present analysis, all activities were combined into two categories: play and other. It may be valuable to investigate further engagement in individual activities in the other category to determine if engagement is improving in specific activities such as book reading. Additionally, in the present study all parent behavior items were averaged and summed to yield a single score for analysis. A lager sample will allow investigation of the specific parent behavior items to determine if certain strategies are more or less adopted by parents in the everyday context. Investigation can also occur into whether certain parent behaviors are most related to engagement gains. Knowledge of which strategies are more or less difficult for caregivers to implement and which may be more or less related to engagement gains can be used to tailor intervention programs to a family's unique needs.

Significance and Implications

The current findings underscore the importance of including parents in intervention plans and of using multiple outcome measures to get representations of behavior both in the clinic and in the home context. Few studies have looked at the role of generalization parent-mediated

interventions, particularly in the natural home context. Although not without its limitation, the current examination represents an important step in the direction of developing naturally valid interventions and outcome measures.

Appendix

Table 1
Child characteristics at baseline

Child Characteristics, *N*(%)	CEM *n*=14	CMM *n*=14
Chronological age, in months		
Mean (SD)	44.07 (8.91)	38.06 (14.75)
Gender		
Male	11 (78.6%)	12 (85.71%)
Female	3 (21.4%)	2 (14.28%)
Race/Ethnicity		
White	2 (14.3%)	2 (14.28%)
Asian	2 (14.3%)	1 (7.14%)
African American	3 (21.4%)	2 (14.28%)
Hispanic	4 (28.6%)	6 (42.85%)
Multi-ethnic/other	3 (21.4%)	2 (14.28%)
Language heard most in home		
English	11 (78.6%)	8 (57.14%)
Non- English	3 (21.4%)	5 (38.46%)
Early intervention services		
Yes	10 71.4	9 (67.85%)
No	4 (28.6%)	4 (28.57%)
Missing	0	1 (7.14%)
Mullen age equivalency, mo: Mean (SD)		
Mental age	24.50 (7.50)	24.42 (11.67)
Receptive language	22.20 (7.70)	22.85 (14.65)
Expressive language	21.78 (8.55)	20.21 (14.46)
Visual reception	27.64 (9.64)	27.71 (11.83)
Fine motor	25.57 (7.05)	27.21 (9.40)
ADOS Severity Score:		
Mean (SD)		
Module 1, n=26	6.53 (1.50)	5.53 (1.66)
Module 2, n=1	6	0
Module 3, n=1	0	9

Table 2
Caregiver characteristics at baseline

Variables (Percent)	CEM *n*=14	CMM *n*=14
Mother's Education		
Less than 12th grade	2 (14.3%)	1 (7.1%)
High school diploma/ GED	3 (21.4%)	3 (21.4%)
Some college/ college degree	6 (42.8%)	8 (42.8%)
Some graduate school/ graduate degree	3 (21.4%)	2 (14.2%)
Income		
<30k	6 (42.8%)	6 (42.8%)
>30k	7 (7.1%)	5 (6.7%)
Unknown	1 (7.1%)	3 (21.42%)
Assistance Services		
Yes	10 (71.43)	12 (85.71%)
No	4 (28.6%)	2 (14.28%)

Table 3
Rating items

Adamson (2012)	Adapted scale
1. Child's total joint engagement	1. Child's total joint engagement
2. Child's supported joint engagement	2. Child's supported joint engagement
3. Child's coordinated joint engagement	3. Child's coordinated joint engagement
4. Child's symbol-infused joint engagement	4. Child's symbol-infused joint engagement
	5. Child's person engagement
	6. Child's object engagement
	7. Child's time unengaged
5. Child's initiation of communication	8. Child's initiation of communication
6. Child's responsiveness	9. Child's responsiveness
7. Child's expressive language level and use	10. Child's expressive language level and use
8. Child's quality of behavior patterns	11. Child's quality of behavior patterns
9. Child's affect	12. Child's affect
10. Parent's scaffolding	13. Parent's scaffolding
11. Parent's symbol highlighting	14. Parent's communication
12. Parent's following in on child focus	15. Parent's following in on child focus
13. Parent's affect	16. Parent's affect
14. Parent's elaboration of shared topic	17. Environmental Strategies
15. Parent's sustainability of shared topic	18. Routine Building
16. Scope of shared topic	19. Appropriate Directiveness
17. Fluency and connectedness of conversation	20. Mirrored Pacing

Table 4
Unadjusted child outcomes at baseline, exit (12wks), and follow-up (24wks)

Outcome	CEM *n*=14	CMM *n*=14
	Mean (SD)	Mean (SD)
Child-Initiated Joint Engagement (% of time)		
CIJE in all interval types		
Entry	13.55 (12.46)	11.82 (12.59)
Exit	13.64 (14.09)	29.44 (17.75)
Follow-up	20.64 (18.87)	29.31 (13.35)
CIJE in play intervals		
Entry	13.34 (14.42)	11.44 (12.64)
Exit	17.31 (15.80)	29.48 (18.67)
Follow-up	23.65 (20.19)	29.28 (22.22)
CIJE in other activity intervals		
Entry	11.06 (12.03)	13.06 (17.12)
Exit	11.88 (13.88)	18.66 (19.98)
Follow-up	15.90 (21.54)	45.42 (69.60)
Parent Behavior Rating		
Entry	19.30 (4.08)	21.64 (4.60)
Exit	21.47 (4.54)	33.19 (7.31)
Follow-up	21.33 (6.85	30.64 (7.07)

Table 5
Model results for treatment effect of child-initiated joint engagement (CIJE) and parent behavior

Fixed Effect	Estimate	Standard Error	df	t-value	p-value
CIJE across all intervals					
Intercept	0.39	0.15	49	2.57	
Time	0.35	0.08	49	4.23	
Group	0.19	0.09	49	2.16	0.09
Group*Time	0.18	0.05	49	3.33	0.002**
Mullen Mental Age	0.01	0.002	49	0.00	0.015*
Parent Behavior Score	0.01	0.04	48	4.90	0.000***
CIJE in play intervals					
Intercept	0.46	0.18	44	2.51	
Time	0.37	0.10	44	3.64	
Group	0.21	0.10	44	1.96	0.266
Group*Time	0.17	0.00	44	2.64	0.015*
Mullen Mental Age	0.01	0.06	44	2.65	0.011*
Parent Behavior Score	0.02	0.06	43	0.60	0.000 ***
CIJE in other activity intervals					
Intercept	0.08	0.17	43	0.50	
Time	0.12	0.09	43	1.39	
Group	0.05	0.09	43	0.53	0.42
Group*Time	0.06	0.05	43	1.47	0.261
Mullen Mental Age	0.004	0.002	43	1.13	0.172
Parent Behavior Score	0.01	0.003	42	3.87	0.007**
Parent behavior rating					
Intercept	3.79	5.81	49	0.065	
Time	20.92	3.19	49	6.606	
Group	7.05	3.43	49	2.058	0.001***
Group*Time	9.38	2.00	49	4.682	0.000***
Mullen Mental Age	0.03	0.09	49	0.355	0.722

*p<0.05, **p<0.01, ***p<0.001

Figure 1

Child-initiated joint engagement in all interval types

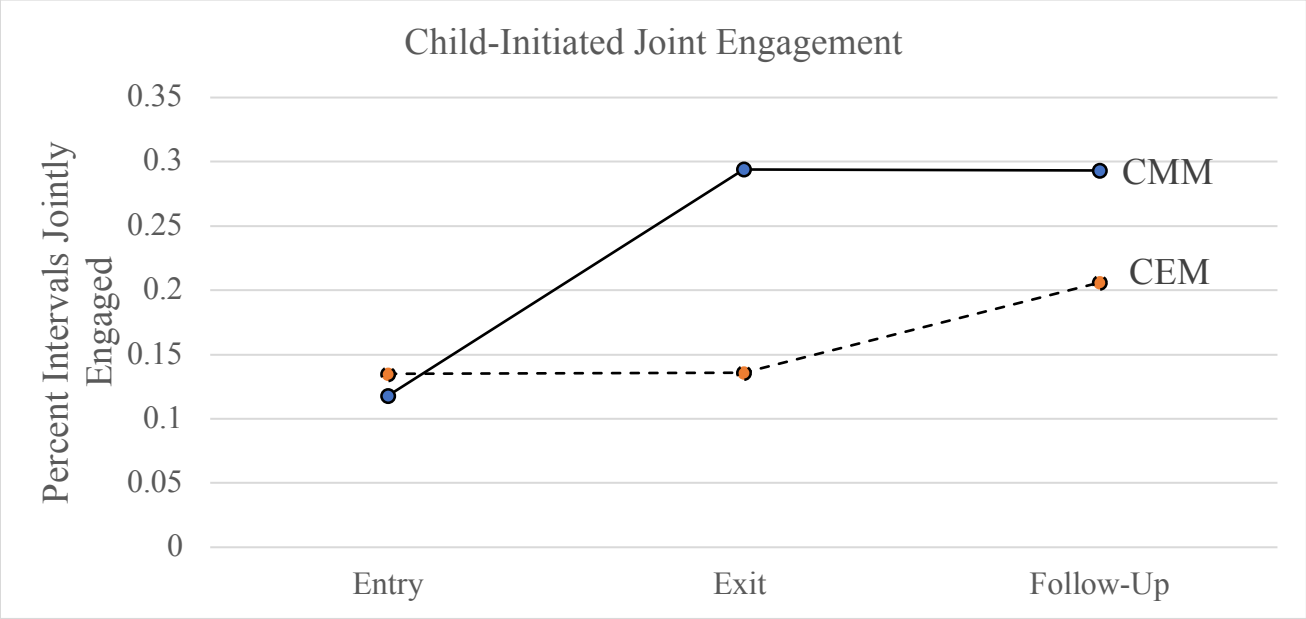
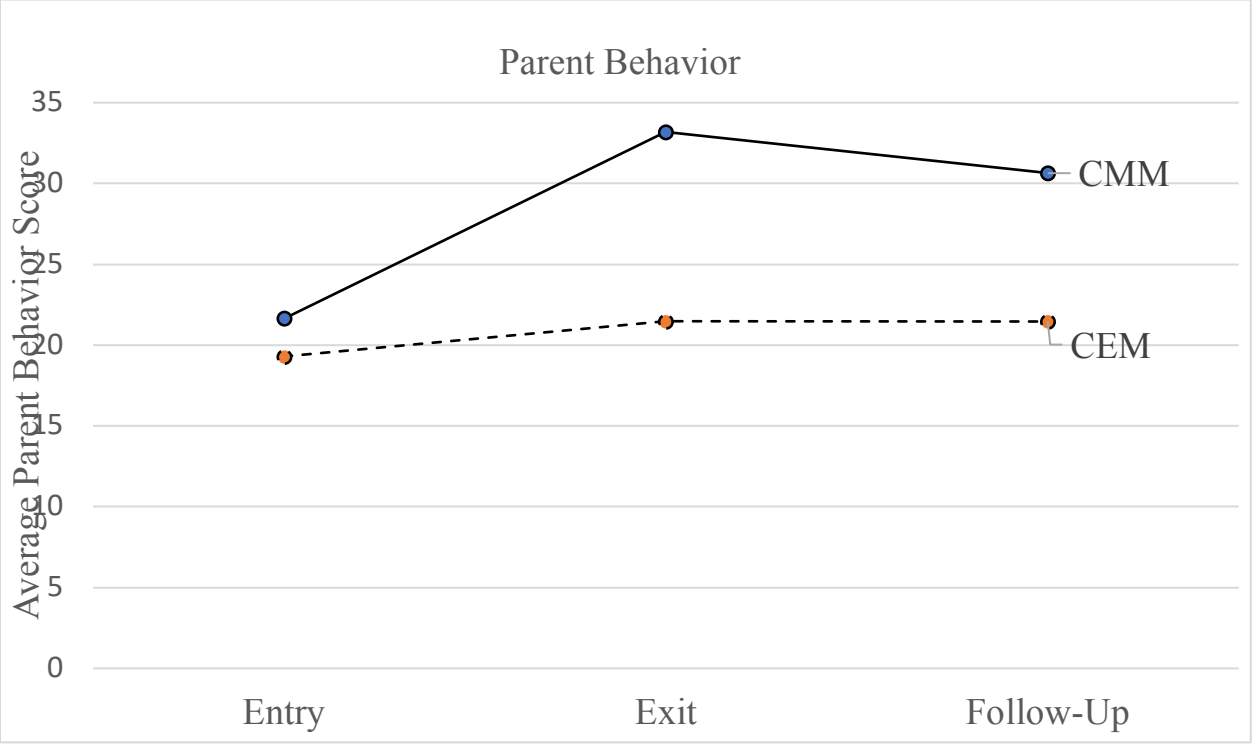


Figure 2

Parent Behavior Rating



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