EFFECTS OF A PARENT-MEDIATED INTERVENTION ON OBJECT PLAY AND PLAY'S ASSOCIATION WITH COMMUNICATION IN YOUNG CHILDREN WITH AUTISM SPECTRUM DISORDER

By

Rebecca G. Lieberman

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Approved:

Professor Paul J. Yoder

Professor Evon Batey Lee

Professor Ann Kaiser

Professor Mark Wolery

To my loving parents Alan and Beth-Ann, and my beautiful sister Kate - I would not be where I am today without their unending love, support, and encouragement

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To David, for his love and support, and his reminder to me of the importance of communication and play in all of our lives

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CHAPTER I

INTRODUCTION

Play and intentional communication are important constructs in the development of typically developing children and children with disabilities. Young children spend much of their time engaged in play, highlighting its prominence in the activity of children, and potentially indicating an important role in development. Additionally, young children exhibit communicative behaviors before they are able to use verbal speech to express themselves, emphasizing the role of children's intentional communication in getting needs met and in becoming a part of a social community from very early in life. Although conceptually separable, object play and intentional communication are related areas of development in early childhood. The association between object play and communication has been described by developmental theorists, and also has a basis in the empirical literature for children with typical development (e.g., Tamis-LeMonda & Bornstein, 1994) and children with disabilities, such as autism spectrum disorders (ASD) (e.g., Yoder, 2006). Understanding the association between object play and intentional communication, as well as possible causal mechanisms, has implications for development and implementation of treatments for young children with ASD.

Theoretical Foundations of Play and Intentional Communication

Play has been conceptualized as demonstrating both functional and symbolic properties by developmental theorists, including Jean Piaget and Lev Vygotsky. Jean

Piaget viewed play as a process whereby children attempt to fit new experiences and observations of their environment into already existing mental representations (Thomas, 2000). Piaget described practice play, which involves learning about the functional use of objects through manipulation, and symbolic play, which requires the child to use and/or perceive one object as representing another (Rubin, Fein, & Vandenberg, 1983). Both types of play involve the use of objects; however, symbolic play tends to be more social in its origins, requiring the child to allocate attention to an object as well as the adult acting on the object. Lev Vygotsky emphasized the semiotic function of play, placing particular importance on the role of signs. "Vygotsky's insight is that pretend substitutions serve a designative function and prepare the child to understand that words, too, can serve such a function" (Fein, 1979, p. 5). Vygotsky's theory of play, and the parallels he drew with the development of language, provides a theoretical basis for empirical examination of associations between play and intentional communication in young children.

Language theories of Jerome Bruner and Lois Bloom also contribute to a theoretical framework for an empirical examination of the association between object play and intentional communication in young children. Bruner viewed the function of communication, and a child's intent to have that function fulfilled by another, as one of the driving forces of language acquisition (Bruner, 1983). According to Bruner, a complex interactive process between child and caregiver requires the support of early routines and familiar contexts to support the child's processing of social and communicative information. Furthermore, establishment of familiar routines provides a context in which the adult can introduce objects into the interaction (Bruner, 1983).

These familiar routines and exchanges during which children learn the early functions of language (i.e., social interaction, requesting, and declaring) often involve playful interactions with objects. Bruner's work demonstrates how interest and interactions around toys and objects relate to early communicative behaviors and later language acquisition, and how an early ability to coordinate attention to an object and person may impact development of expressive communication.

Similarly, communicative intent is central to the theory of language development described by Bloom (1993). According to Bloom, children acquire language so they can express their internal states and thoughts to others, as well as share in others' expression of thoughts. Often the source of such desires, beliefs, and feelings are objects in the child's immediate environment. Like Bruner (1983), context figured prominently in Bloom's theory of children's construction of "mental meanings" of objects and events in their environment.

The theories of Piaget, Vygotsky, Bruner, and Bloom suggest an interrelatedness, and potential interdependence, of object play and communication in the development of young children. Central to these theories is the context objects provide for interactions and language-learning experiences. One important requisite for such interactions and language-learning opportunities is the child's ability to coordinate attention to object and person – an ability which typically develops between the ages of 6 and 18 months.

Coordinated Attention to Object and Person

Central to children's communication with others is their ability to direct their attention to an object of interest *and* to their communicative partner. Within the first 6 months of life, children begin to develop the ability to engage in coordinated attention behaviors with their caregivers (Mundy, Block, Delgado, Pomares, & Van Hecke, 2007). The first instances of coordinated attention between object and person often occur because adults insert objects into their familiar interactive games and routines (Adamson & Chance, 1998; Bruner, 1983). During such social interactions involving objects, children may follow the attention of their caregiver by shifting their gaze or turning their head towards the object or event of their caregiver's focus in an act that is referred to as responding to joint attention (RJA). Instances of coordinated attention where the infant successfully follows the adult's focus of attention are thought to facilitate development of language because the infant can accurately map on linguistic information provided by the adult to the appropriate referent (Morales, Mundy, Delgado, Yale, Messinger, Neal, & Schwartz, 2000).

Responding to joint attention has been associated with expressive language in typical samples (e.g., Mundy et al., 2007), and samples of children with ASD (e.g., Bono, Daley, & Sigman, 2004). According to Bruner (1983), language-learning experiences often occur during play routines involving objects. It may be argued that if a young child plays with objects or toys in many different ways (i.e., demonstrates knowledge about those objects or toys) while socially engaged with another, adult play partners are afforded opportunities to use more and varied language to interact with and describe what the child is doing. These strategies have been found to be associated with later language development. Such a model would bring together two elements of what is currently believed by theorists and researchers (i.e., that children's coordinated attention to object and person is facilitative of later language, and that social interactions involving objects play an important role in this area of early development [Morales et al., 2000]).

Within such a framework, children who are interested in many objects and toys are provided with more opportunities to engage in coordinated attention to object and person, and are also provided more varied linguistic information regarding their diverse interests. The child with high interest in objects early in life has more language learning opportunities, and these opportunities are richer in the variety of language input as compared to a child who is interested in a limited number of objects (Yoder & McDuffie, 2006). Additionally, a child who acts on objects in many different ways (demonstrating varied nonsymbolic and symbolic play acts) may be provided with increasingly complex language and play interactions by responsive adults. This notion becomes particularly salient for intervention planning for individuals with delayed or disordered play and communication skills, such as children with autism spectrum disorders.

Play and Communication Deficits in Children with Autism Spectrum Disorders

It has been established in the extant literature that children with ASD differ from typically developing children in their early play and communication skills, and that these differences can persist past the early childhood years. Additionally, in some studies comparing children with ASD to children with other developmental disabilities, differences in play and communication have been found to be specific to the disorder, as opposed to a more general developmental delay associated with IQ or verbal abilities (e.g., Sigman & Ungerer, 1984; Wetherby, Watt, Morgan, & Shumway, 2007).

Object play. Children with ASD have been found to demonstrate differences in their nonsymbolic play and symbolic play as compared to typically developing children and children with other developmental disabilities. The functional (i.e., nonsymbolic) play of children with ASD has been found to differ significantly from mental age (MA)-

matched controls in its complexity, variation, and integration (Williams, Reddy, & Costal, 2001). Stone, Lemanek, Fishel, Fernandez, and Altemeier (1990) found children with ASD engaged in less functional play as compared to children with other developmental disabilities, including children with intellectual disabilities (ID), and children with typical development. Children with ASD and children with ID did not differ significantly on IQ in this study. Additionally, Stone et al. (1990) reported children with ASD spent less time in total play and less time in appropriate play with toys as compared to controls with and without developmental disabilities matched on chronological age.

Children with ASD have also been found to have deficits in symbolic play when assessed in spontaneous, free-play contexts and in more structured measurement procedures (Charman, 1997). Sigman and Ungerer (1984) found children with ASD performed fewer symbolic acts in free play and structured contexts as compared to MA-matched controls with typical development and MA-matched controls with intellectual disabilities. Additionally, Wetherby, Watt, Morgan, and Shumway (2007) reported group differences on the pretend play subscale of the *Communication and Symbolic Behavior Scales* (CSBS; Wetherby & Prizant, 2002) for gender and chronological age (CA)-matched typical controls and controls with developmental disabilities matched on CA and developmental level. Although an underlying reason for the deficit in play abilities has not been agreed upon among researchers, it seems clear that functional and symbolic engagement with objects is disrupted for many young children with ASD.

Intentional communication. In addition to impairments in object play, children with ASD also demonstrate differences in nonverbal communication and expressive language development. Children with ASD have been found to respond less to others' bids for attention as compared to children with developmental delays and typically developing children, matched on mental age (e.g., Dawson, Toth, Abbott, Osterling, Munson, Estes et al., 2004). Additionally, children with ASD have been found to demonstrate fewer instances of intentional communication using coordinated attention to object and person as compared to typically developing children matched on mental age (Mundy, Sigman, Ungerer, & Sherman, 1986), as well as children with other developmental delays (Mundy et al., 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby et al., 2007). Such findings provide evidence that deficits in gaze-related communication and conventional communication may be particularly difficult for children with ASD.

One of the core characteristics of ASD is delay or absence of language before three years of age (American Psychiatric Association [*DSM-IV-TR*], 2000). A delay in language production is one of the greatest concerns for parents of children with ASD (Paul, 2008). One study found that 36% of children with ASD exhibited no language production over two years of age (Paul, 2008). Additional patterns of language development in children with ASD include use of words that are eventually dropped from the child's lexicon, or lack of progression of expressive vocabulary after a child has acquired several words (Paul, 2008). Children with ASD also have difficulty moving towards use of multiword utterances. For children with ASD who do develop expressive language, differences in use persist (Paul, 2008).

Implications for play and communication deficits in children with ASD. The above studies demonstrate a deficit in play and communication skills in young children with autism spectrum disorders. Although the nature and extent of the deficits vary across children, it is clear they have implications for later functioning for individuals with ASD. Responding to joint attention and nonverbal intentional communication have been found to be related to later language development (e.g., Mundy, Sigman, & Kasari, 1990; Siller & Sigman, 2002). Additionally, it has been demonstrated that development of expressive language predicts positive long term outcomes in individuals with ASD (Howlin, Goode, Hutton, & Rutter, 2004; Lord, Risi, & Pickles, 2004). Finally, many early intervention strategies occur within the context of play (e.g., Dawson, Rogers, Munson, Smith, Winter, Greenson et al., 2010). It therefore seems logical that children who are better able to participate in play routines may have greater access to the strategies employed by early interventionists. An understanding of the association between object play and intentional communication may lead to more effective intervention strategies, improving developmental and learning outcomes of individuals with ASD.

Empirical Support for an Association Between Play and Intentional Communication

In addition to a theoretical basis for an association between object play and intentional communication, there is a body of empirical work suggesting an association between these two constructs in early development. Several correlational studies have examined this relation in typically developing children (e.g., Bates, Benigni, Camaioni, &Volterra, 1979; Casby & Della Corte, 1987; Watt, Wetherby, & Shumway, 2006) and children with autism spectrum disorders (e.g., Sigman & Ruskin, 1999; Stone & Yoder, 2001; Wetherby et al., 2007). Additionally, a recent meta-analysis found positive concurrent correlations between object play (an aggregate of nonsymbolic and symbolic play) and intentional communication (an aggregate of nonverbal and expressive language) in typically developing children (*r* = .32, 95% CI [.20, .44]) and children with autism spectrum disorders (*r* = .39, 95% CI [.26, .51]) (Lieberman & Yoder, under review). The same meta-analysis found positive longitudinal correlations with object play predicting later intentional communication in children with typical development (*r* = .19, 95% CI [.065, .31]) and children with ASD (*r* = .37, 95% CI [.23, .50]) (Lieberman & Yoder, under review). Although few studies have examined intentional communication as a predictor of later object play, it is possible that the longitudinal association between play and communication is bi-directional. Logically, a child who is able to communicate with an interactive partner about his or her interest in an object or toy may elicit an adult response whereby the adult demonstrates for the child functional characteristics of the object or toy.

Although the meta-analysis conducted by Lieberman and Yoder (under review) revealed significant concurrent associations and a uni-directional longitudinal association between object play and intentional communication in typically developing children and children with ASD, it was limited in its ability to determine causality or directionality of the association. This was due to limits of the design of the studies included in the meta-analysis (i.e., correlational) and to the limited number of studies available in the extant literature examining intentional communication as a predictor of later play. However, a single randomized controlled trial (RCT) does provide initial evidence of a bi-directional, causal association between object play and intentional communication in young children with ASD (Kasari, Paparella, Freeman, & Jahromi, 2008). Relative to a control group, Kasari, Paparella, Freeman, and Jahromi (2008) found that a *symbolic play intervention* led to increases in *nonverbal intentional communication* at the 12-month follow-up period (d = .98), and a *joint attention intervention* (a type of nonverbal intentional communication) led to increases in *symbolic play* at the 12-month follow-up period (d = .65). However, it could not be determined from the information provided in the study whether one variable acted as a significantly stronger causal agent of the other in this preschool-aged sample of children with autism spectrum disorder.

The available empirical evidence suggests concurrent associations between object play and intentional communication in children with typical development and children with ASD, as well as a bi-directional causal relation between these two developmental constructs in children with ASD. However, the latter finding requires replication to increase confidence in the existence of such an association between object play and intentional communication in the population of young children with ASD. Identification and understanding of underlying mechanisms of such an association may have implications for development and implementation of treatments in young children experiencing play and communication deficits, specifically young children with ASD.

Evidence of Object Play as a Moderator of Treatment in Children with ASD

In addition to the evidence of a correlation between object play and intentional communication, there is also evidence suggesting object interest and object knowledge, variables that are highly related to object play, moderate the efficacy of treatments on social-communication outcomes in young children with autism spectrum disorders. Two separate studies found that the number of toys acted upon (object interest) at the pretreatment measurement period moderated differential effects between two different social-communication interventions. Yoder and Stone (2006a), a randomized treatment comparison study, found that preschoolers with ASD exhibiting low levels of object interest prior to intervention, made greater gains in communication outcomes when assigned to the Responsive Education and Prelinguistic Milieu Teaching (RPMT) condition as compared to the Picture Exchange Communication System (PECS). A possible explanation is that RPMT, a treatment that establishes and uses play routines as a context for facilitation of communication skills, taught play skills to children who started intervention with little interest in objects. Indeed, this hypothesis was tested in a follow-up study that identified main effects of treatment on object interest. McDuffie, Lieberman, and Yoder (in press) reported children assigned to the RPMT condition made greater generalized gains in object interest as compared to children assigned to the PECS condition (t = 1.72, p = .045, d = .45). Together, these studies suggest an intervention teaching play, as well as communication, may be more effective in increasing targeted social-communication skills in children with fewer play skills before treatment than a treatment than only teaches communication.

A recent randomized controlled trial suggests results similar to the Yoder and Stone (2006a) findings. Carter, Messinger, Stone, Celimli, Nahmias, and Yoder (in press) reported object interest moderated effects of Hanen More Than Words (HMTW) (a parent-mediated social-communication treatment) on communication outcomes in very young children with ASD. The authors reported that participants with low levels of pretreatment object interest made greater gains in requesting ($t(45) = -3.41$, $p < .01$, $\Delta R^2 = .21$) and declarative behaviors ($t(45) = -3.38$, $p = .002$, $\Delta R^2 = .20$), weighted intentional communication ($t(29) = -3.39$, $p = .003$, $\Delta R^2 = .29$), and parent-reported general nonverbal communication ($t(42) = -2.39$, $p = .02$, $\Delta R^2 = .13$) when assigned to the treatment condition as compared to children assigned to the business-as-usual control group (Carter, Messinger, Stone, Celimli, Nahmias, & Yoder, in press). An additional analysis from this same sample found Time 1 object knowledge (i.e., the number of different actions demonstrated by the child) moderated the effects of treatment on follow-up responding to joint attention, such that children with low object knowledge pretreatment made greater gains in RJA by the follow-up period as compared to children assigned to the control condition ($t(45) = -2.60$, $p = .013$, $\Delta R^2 = .14$) (Lieberman, Nahmias, Celimli, Messinger, Stone, Carter et al., 2011).

Research Questions

Based on what is currently reported in the literature regarding treatment effects on object play and the association between object play and communication in young children with ASD, the current study addresses the following research questions:

I. Are there treatment group differences at Time 3 in (a) the weighted number of different play acts (weighted object knowledge), and (b) the number of objects acted upon (object interest) by very young children displaying characteristics of ASD, controlling for Time 1 play variables?

II. Is the magnitude of the association (a) between Time 2 play variables and Time 3 intentional communication and (b) between Time 2 intentional communication and Time 3 play variables conditional upon treatment group membership?

III. In the pooled sample, (a) does Time 2 weighted object knowledge and object interest positively predict Time 3 intentional communication and (b) does

Time 2 intentional communication positively predict Time 3 weighted object knowledge and object interest?

Additional exploratory analyses examined the longitudinal associations between object play and responding to joint attention skills, as well as a mediation model examining the association between pretreatment RJA and follow-up expressive language by way of immediate posttreatment object play.

CHAPTER II

METHOD

Participants

Sixty-two children with a diagnosis of ASD (or characteristics suggestive of the presence of an ASD) and their caregivers participated in the study. To determine eligibility, 165 caregivers across three urban regions of the north- and southeastern United States participated in a phone screening to determine whether their children could be scheduled for an eligibility evaluation for study entry. Ninety-seven children met age criteria and did not have a diagnosed genetic disorder. Additionally, parents of the 97 children answered positively to three questions on the *Modified Checklist for Autism in Toddlers* (MCHAT; Robins, Fein, Barton, & Green, 2001) indicating elevated risk for characteristics of children with ASD. Clinic evaluations were conducted for children meeting criteria of the phone screening. The *Screening Tool for Autism in Two-Year-Olds* (STAT; Stone et al. 2000, 2004, 2008) was administered during the clinic visit. Children who scored "at-risk" on the STAT were eligible for study entry.

Sixty-two children met all criteria, and were randomized to the treatment or a business-as-usual control condition. The study sample was made up of 51 males and 11 females with a mean age of 20.3(2.6) months at study entry. Thirty-two children were randomized to the Hanen More Than Words (HMTW) treatment, and 30 were randomized to the control group (Carter et al., in press). The sample was diverse, with 47.4% of children identified as Caucasian by their parents, and the remaining percentage of children (52.6%) identified by their parents as Hispanic/Latino (38.6%), African American (3.5%), Asian/White (5.3%), American Indian/Alaskan Native/White (3.5%), or American Indian/Alaskan Native/Hispanic (1.8%) (Carter et al., in press). Fourteen caregivers in the control group and 15 caregivers in the treatment group reported having an undergraduate or advanced degree. Four parents in the control group and 1 parent in the treatment group did not report formal education status. Table 1 provides child characteristics at the Time 1 measurement period.

Table 1. *Child Characteristics at the Pretreatment Measurement Period*

	HMTW (n = 32)		Control (n = 30)	
	25 males; 7 females		26 males; 4 females	
	M	SD	M	SD
Chronological age (mos)	21.1	2.7	21.5	2.8
Mullen receptive language age equivalent	8.4	5.4	8.2	4.4
Mullen expressive language age equivalent	8.2	6.0	7.3	3.7
Total STAT raw score	3.04	.56	3.13	.54
DPA object interest	4.0	1.7	3.7	1.4
DPA object knowledge	5.7	2.6	5.8	2.7

Note. There were no significant between-group differences on the pretreatment child characteristics. HMTW = Hanen More Than Words; n = sample size; M = mean; SD = standard deviation; mos = months; STAT = Screening Tool for Autism in Two-year-olds; DPA = Developmental Play Assessment.

Description of Conditions

The Hanen More Than Words (Sussman, 1999) intervention is a manualized parent-mediated intervention focused on improving the social-communication skills of very young children with ASD, including their ability to engage in reciprocal interactions, use communicative behaviors for various pragmatic functions, and understand others' communication (Carter et al., in press). Strategies taught to parents during group and individual sessions draw from current understanding of recommended practices in working with very young children with ASD.

Parents randomized to the treatment condition were offered eight group sessions lasting three hours each, during which they learned how to characterize their child's stage of communication, how to select appropriate communication goals for their child, and how to use responsive play and interaction strategies to help their child achieve these communication goals. Strategies included following the child's lead, imitating the child, modeling behavior, and using visual cues to support language understanding and use. HMTW teaches parents to use play and routine activities to structure joint interactions and create opportunities for communication and language learning; these play and routine activities often involve use of objects and toys. Seventy-eight percent of parents attended six or more of the group sessions.

In addition to the eight group sessions, each family in the treatment group was offered three one-on-one visits with the speech language therapist. The one-on-one sessions occurred in the family's home and lasted approximately 1.5 hours. Over the course of the home visit, the SLP reviewed the parent's progress on homework activities, videotaped parent-child interactions, and provided immediate feedback. Seventy-eight percent of parents participated in at least two of the offered home visits. Speech language pathologists completed fidelity checklists for 97% of group sessions and 78% of one-on-one home visits. Fidelity checklists for group sessions and one-on-one home visits indexed the therapist's delivery of content, quality of teaching, and group size (Carter et al., in press).

Children assigned to the treatment condition continued with any additional intervention services provided by local agencies. Children in the control group received intervention as provided by community agencies and programs, and therefore constituted a business-as-usual control condition. Families in both the treatment and control conditions reported the amount of services they were currently receiving from their local early intervention service provider(s) at each time period, as well as the types of services provided to their children (e.g., speech language therapy, applied behavior analysis [ABA], occupational therapy, etc.) (see Table 2).

Table 2. *Amount of Non-Project Treatment and Parent Level of Involvement at Each Measurement Period*

Non-project treatment variable (hours per month)	Treatment Group	Control Group
	Mean(SD)	Mean(SD)
Speech/language therapy, OT, and ABA across locations at Time 1	8.78(15.57)	11.30(24.48)
Speech/language therapy across locations at Time 1	2.78(4.47)	1.41(2.36)
Parental level of involvement in speech/language therapy, OT, and ABA at Time 1	2.06(1.89)	3.00(1.50)
Speech/language therapy, OT, and ABA across locations at Time 2	32.00(43.58)	18.51(25.10)
Speech/language therapy across locations at Time 2	4.36(5.73)	4.45(3.43)
Parental level of involvement in speech/language therapy, OT, and ABA at Time 2	2.04(1.63)	2.47(1.70)
Speech/language therapy, OT, and ABA across locations at Time 3	25.52(28.02)	38.00(37.63)
Speech/language therapy across locations at Time 3	4.38(2.24)	5.83(4.99)
Parental level of involvement in speech/language therapy, OT, and ABA at Time 3	2.27(1.70)	2.57(1.66)

Notes. Independent samples t-tests were conducted to examine between-group differences in amount of non-project intervention, and none were detected.

Design and Procedures

Children and parents were randomized to the Hanen More Than Words treatment, or a business-as-usual control group. Children's play and communication were measured at 3 measurement periods separated by 4 and 5 months, respectively. This study was approved by the Institutional Review Boards of the three university sites involved in the study.

Design components. Analyses addressing the research questions in the current study used a group experimental design (research question I), a group experimental design with a longitudinal component (research question II), and a longitudinal correlational design (research question III). Exploratory analyses were conducted using a longitudinal correlational design.

Procedures. Measurement of play and communication variables took place at the pretreatment (Time 1), immediate posttreatment (Time 2), and at a 5-month posttreatment follow-up period (Time 3) in a clinic setting (see Table 3). Trained examiners were equally unfamiliar to children assigned to the treatment and control groups, and were blind to group assignment.

Adapted Developmental Play Assessment. A shortened version of the *Developmental Play Assessment* (DPA; Lifter, 2000) was conducted at the pretreatment measurement period and consisted of a 7-minute free-play session with an examiner. The child and examiner were seated at a child-sized table with the child and toys in clear view for the purposes of video recording and later coding. The examiner presented the child with one toy set for 3.5 minutes, and a second toy set for another 3.5 minutes. The child was able to interact with any of the toys on the table in whatever way he or she chose. The trained examiner imitated child actions on objects and used language to describe the child’s activities to keep the child engaged, but did not model new actions, or prompt new play acts physically or verbally. The first toy set consisted of (a) a ring-stack toy, (b) nesting cups, (c) a baby doll, (d) a spoon, (e) a blanket, and (f) a comb and mirror.

The second toy set consisted of (a) farm animal figures, (b) a 3-part train, (c) a boy figure, (d) a cup, saucer, and pitcher, and (e) nuts and bolts in a bowl. Observers coded when a child performed a predetermined action on one of the toys from digitally-recorded files.

All variables were coded using the computer software Playcoder (Tapp & Yoder, 2003). Time 1 play variables measured during the DPA were (a) object interest, defined as the number of different toys on which children demonstrated differentiated play (i.e., actions not including shaking, banging, mouthing, or visual inspection) and (b) object knowledge, defined as the number of different actions used during the procedure, excluding shaking, banging, mouthing, and visual inspection. Variables were coded by a primary observer blind to group assignment. A second observer blind to group assignment independently coded approximately 20% of a randomly selected sample of sessions. The primary observer remained blind to which sessions were coded for reliability. Intraclass correlation coefficients (ICCs) were calculated for object interest (.87) and object knowledge (.86).

Semi-Structured Examiner-Child session. The semi-structured examiner-child session (SSEC) is a 15-minute free play session with an examiner, during which the child was presented with three different toy sets. The SSEC was conducted at immediate posttreatment and 5-month follow-up measurement periods. During the assessment, the examiner and child were seated at a child-sized table, with the child and toys in clear view for video-recording and later coding. Toy set 1 consisted of (a) a schoolhouse and swing, (b) a seesaw, (c) a bike, and (d) Weebles; toy set 2 consisted of (a) a merry-go-round, (b) a bike, and (c) Little People; and toy set 3 consisted of (a) a playhouse, (b) a car, and (c) Little People. A new toy set was introduced when (a) the child did not appear interested in the current toy set and could not be engaged successfully by the examiner, (b) the child communicated that he/she would like something different, or (c) the examiner needed to redirect the child. To maintain the child's engagement, the examiner was permitted to imitate the child's actions, model new actions with the toys when the child was disengaged (with or without securing the child's attention), or expand on the child's actions with a toy when the child was disengaged. However, only child-initiated (i.e., nonimitative) actions were coded and used in calculating the variables for the current study.

Two play variables, object interest and weighted object knowledge, were coded using the computer software Playcoder (Tapp & Yoder, 2003) during the Time 2 and Time 3 measurement periods. Weighted object knowledge was derived by giving a score of 1 to nonsymbolic play acts and a score of 2 to symbolic play acts, and adding them together to create a single variable score. The definition of symbolic play was based on Lifter (2000) and comprised the categories of pretend self (child uses an object in relation to herself while indicating she is pretending), child-as-agent (child extends activities to a doll-like figure), doll-as-agent (child engages doll-like figures as if they are capable of carrying out the actions), and object substitution (child uses one object to stand in for another). A primary observer blind to group assignment for most participants coded play variables. A secondary observer, blind to group assignment, independently coded approximately 20% of randomly selected sessions. The primary observer remained blind to which sessions were coded for reliability. ICCs were calculated for object interest at

Time 2 (.85) and Time 3 (.90), and weighted object knowledge at Time 2 (.95) and Time 3 (.97).

Early Social-Communication Scales-Abridged. The *Early Social-Communication Scales-Abridged* (ESCS; Mundy, Delgado, Block, Venezia, Hogan, & Seibert, 2003) is a structured observational measure of early communicative behaviors in children 8 to 30 months of age. The ESCS was conducted during the pretreatment, immediate posttreatment, and follow-up measurement periods. During this procedure, the child and examiner were seated at a child-sized table with the child and task items in clear view for video-recording and later coding. Through structured interactions with standardized procedures and task items, presses were delivered to elicit child initiations of communication and responses to adult bids for child attention to toys (i.e., responding joint attention). The ESCS pulls for child initiations of joint attention and behavior requests well, and provided a single variable that includes both functions of communication.

Items from the ESCS included several wind-up toys, “hand-operated toys” such as a puppet and balloon, a car, a ball, and colorful posters of familiar early childhood characters hanging up on the walls behind and to the side of the child. Toys were presented one at a time to the child, and remained within view, but out of reach, of the child to elicit communicative behaviors. Examples of strategies used to elicit communication were: (a) verbal and gestural prompts, (b) placing interesting toys in jars to encourage requesting behaviors, (c) activating wind-up toys to encourage commenting and requesting behaviors, and (d) pointing to posters while calling the child’s name to elicit responses to adult bids for coordinated attention.

A single intentional communication variable was measured during the ESCS. Intentional communication was coded if a child used (a) a gesture from a pre-specified list with attention to adult, (b) a gesture from a second pre-specified list with coordinated attention to object and person, (c) non-word vocalizations with coordinated attention to object and person, or (d) referential spoken symbols or signs. Responding to joint attention was also measured during the ESCS and was coded when the child turned their head and/or eyes in the direction of, and beyond, the examiner's point towards a target object. A frequency metric was used for the RJA variable, with a total of eight presses for RJA delivered during the procedure. A trained primary observer blind to treatment assignment of participants coded the ESCS for intentional communication. A trained reliability coder blind to treatment status of participants randomly selected and independently coded 20% of ESCS sessions across all measurement periods. The primary coder remained blind to which sessions were coded for reliability. ICCs were calculated for the intentional communication variable at Time 1 (.96), Time 2 (.98), and Time 3 (.92), as well as RJA at Time 1 (.59), Time 2 (.93), and Time 3 (.90). The ICC for Time 1 RJA may be lower due to reduced variance at the participant level and/or random measurement error, neither of which would lead to increased probability of Type I error (Yoder & Symons, 2010).

Turn-taking task. The turn-taking task is a research measure adapted from Ousley (1997) measuring one of the early pragmatic functions of intentional communication (i.e., social interaction; Yoder & Stone, 2006b). The turn-taking task measured two types of child turns (a) action turns (child imitates adult action on a toy) and (b) give turns (child returns the toy after performing the appropriate action) at the pretreatment, immediate posttreatment, and 5-month posttreatment follow-up measurement periods. During the procedure, the child and examiner were seated at a small table, with the child and task items in clear view for video-recording and later coding. During the assessment, the examiner introduced each task individually. Materials included (a) a drum and drumstick, (b) a basketball hoop and ball, (c) a squeak toy, (d) a pair of sunglasses, (e) a small blanket, (f) a hand puppet, and (g) two blocks. During action turns, the examiner could physically assist the child in performing the action one time, then provide time for the child to complete the task independently. During give turns, the examiner could prompt the child to return the item verbally and by presenting an open hand. The examiner provided contingent verbal praise for action turns and give turns throughout the assessment. Three opportunities were given for each task item for the child to perform action and give turns, for a total possible number of 21 action turns and 21 give turns.

Because children performed action turns significantly more often than give turns, frequencies of action and give turns were transformed into z-scores to give equal weight to each turn type in an aggregated variable, number of child turns. Preliminary analyses revealed strong Time 1 correlations ($r = .58$, $p < .01$) between the separate variables, providing an empirical basis for summing the two types of turns into a single variable. Number of child turns was derived from the Time 2 and Time 3 assessment periods.

The turn-taking variable was derived from media files using the computer software program ProcoderDV (Tapp & Walden, 1993). A primary observer blind to treatment group assignment measured the turn-taking variable at Time 2 and Time 3. A second observer, blind to group assignment, independently coded approximately 20% of randomly selected sessions. The primary observer remained blind to sessions coded for reliability. ICCs for the z-transformed turn-taking variable were calculated at the Time 2 (.99) and Time 3 (.87) measurement periods.

Mullen Scales of Early Learning. The *Mullen Scales of Early Learning* (MSEL; Mullen, 1995) is a standardized assessment measuring early motor, cognitive, and language development in infants and young children. The MSEL was administered at the Time 3 measurement period in the clinic by an examiner blind to treatment group assignment and trained in administration of the assessment by a clinical psychologist. The expressive language age equivalence variable was used in analyses, and provides a measure of developmental level, not developmental impairment.

Table 3. *Operational Definitions for Play and Communication Variables*

Variable	Procedure	Definition
Object interest	SSEC	Number of toys on which children use differentiated play (i.e., anticipated actions that do not include exploratory behaviors such as mouthing, banging, shaking, and visual inspection)
Weighted object knowledge	SSEC	Number of different anticipated actions children use with objects, excluding exploratory behaviors; symbolic play acts are weighted by 2, nonsymbolic acts by 1
Intentional communication	ESCS	Child uses (a) a conventional gesture with attention to adult, (b) a gesture with coordinated attention to object and person, (c) non-word vocalizations with coordinated attention to object and person, or (d) referential spoken symbols or signs
Turn-taking	Turn-taking task	Child fills his/her turn by (a) imitating the adult's action on the toy or (b) giving the toy back to the examiner
Responding to joint attention	ESCS	Child turns his/her head and/or eyes in the direction of, and beyond, the examiner's point towards a target object

Notes. SSEC = Semi-Structured Examiner-Child session; ESCS = Early Social-Communication Scales.

CHAPTER III

RESULTS

Preliminary Analyses

Analyses were conducted using SPSS 19. Normality of distribution of variables was examined, and no transformations were needed for play variables. The time 2 turn-taking variable, time 1 and 2 intentional communication variables, and time 1 and 2 RJA variables were square-root transformed due to non-normality of distributions (Fidell & Tabachnick, 2003). No statistically significant between-group differences were detected for the turn-taking, intentional communication, or play variables at Time 1. Additionally, there were no significant between-group differences on receptive or expressive language, STAT scores, or parent level of formal education at the pretreatment time period. Finally, there was no evidence of significant between group differences on attendance to non-project treatments at any time point (Carter et al., in press) (see Table 2). Analyses were conducted and reported by Carter and colleagues (in press) to determine whether differential attrition could provide alternative explanations for any significant findings. Chi-square analyses revealed the distribution of drop-outs was not significantly different between treatment and control groups.

Concurrent correlations were run at time points 1, 2, and 3 between the intentional communication variable measured in the ESCS and give turns and action turns measured in the turn-taking test to determine whether a single, aggregate communication variable should be created for analysis. An a priori criterion of a correlation of .40 or greater at all time points between the intentional communication and turn-taking variables was set as an indictor that these variables could be aggregated to form a single intentional communication variable. Correlations were above .40 at Time 1 and Time 2 between the intentional communication variable derived from the ESCS and give turns and action turns measured during the turn-taking task, indicating criterion-level intercorrelation among component variables to justify aggregation. However, concurrent correlations between the ESCS communication variable and give turns and action turns fell below .40 at Time 3. Therefore, variables measured during the ESCS and turn-taking task were analyzed separately.

Fidelity of treatment. Speech language pathologists completed fidelity of treatment (FOT) checklists for 97% of group sessions and 78% of one-on-one home visits. Across the three treatment sites, group sessions were implemented with 88% (SD = 4.7) fidelity; one-on-one visits were implemented with 90% (SD = 7.9) fidelity. Twenty-three percent of group sessions and 35% of one-on-one home visits were randomly selected and coded for reliability by trained independent observers using point-by-point agreement. Average point-by-point agreement was 92% (SD = 10) for group sessions and 92% (SD = 11) for one-on-one home visits across the three study sites (Carter et al., in press).

Primary Analyses

Research question I. The first research question examined main effects of treatment on Time 3 object interest and weighted object knowledge. It was hypothesized there would be a main effect of treatment such that children assigned to the HMTW intervention would increase their object interest and weighted object knowledge from

Time 1 to Time 3 more than children assigned to the control condition. Analysis of covariance (ANCOVA) revealed no statistically significant between-group differences at Time 3 on object interest controlling for Time 1 object interest ($F(1, 43) = 1.67$, $p = .203$, Hedges $g = .38$), and no significant between-group differences at Time 3 on weighted object knowledge controlling for Time 1 object knowledge ($F(1, 43) = .015$, $p = .902$, Hedges $g = .04$) (see Table 4).

Table 4. *Analysis of Covariance for Treatment Group Assignment Predicting Time 3 Play Outcomes*

Dependent Variable	Predictor Variable	df	MS	F	p
Time 3 object interest	Treatment group	1	1.671	1.674	.203
	Time 1 object interest	1	.173	.173	.679
Time 3 weighted object knowledge	Treatment group	1	1.00	.015	.902
	Time 1 object knowledge	1	56.543	.866	.357

Note. df = degrees of freedom; MS = mean square; F = F statistic from ANCOVA; p = probability of Type I error rate.

Moderator analyses were conducted to determine whether initial object play variables interacted with treatment group assignment to predict Time 3 play scores. A significant interaction between Time 1 play variables and treatment group assignment would indicate that treatment was beneficial for some, but not all, children assigned to HMTW. Multiple linear regression analyses were conducted with Time 1 object interest (or object knowledge), treatment group assignment, and an interaction term between object interest (or object knowledge) and treatment group assignment entered as predictor variables of Time 3 object interest (or weighted object knowledge). Analyses revealed there was no interaction between Time 1 object interest and treatment group assignment predicting Time 3 object interest ($t(45) = .65$, $p = .52$, $\Delta R^2 = .010$) or Time 3 weighted object knowledge ($t(45) = -.68$, $p = .50$, $\Delta R^2 = .011$). Additionally, there was no interaction between Time 1 object knowledge and treatment group assignment predicting Time 3 object interest ($t(45) = .70$, $p = .49$, $\Delta R^2 = .011$) or Time 3 weighted object knowledge ($t(45) = -.45$, $p = .65$, $\Delta R^2 = .005$) (see Table 5).

Table 5. *Multiple Linear Regressions Examining Moderated Effects on Time 3 Play Variables*

	Dependent Variable (Moderator)											
Predictor Variable	Time 3 OI (Time1 OI)			Time 3 OI (Time 1 OK)			Time 3 WOK (Time 1 OI)			Time 3 WOK (Time 1 OK)		
	B (SE)	β	p	B (SE)	β	p	B (SE)	β	p	B (SE)	β	p
Treatment group	.389 (.305)	.041	.209	.396 (.296)	.042	.188	-.524 (2.465)	-.017	.833	-.332 (2.438)	-.011	.892
Moderator	-.118 (.155)	-.027	.450	-.104 (.079)	-.041	.195	1.361 (1.251)	.094	.283	.627 (.646)	.076	.337
Treatment group by moderator interaction	.131 (.202)	.023	.520	.078 (.110)	.022	.486	-1.107 (1.631)	-.059	.501	-.412 (.908)	-.036	.652

Note. OI = object interest; OK = object knowledge; B = unstandardized beta; β = standardized beta; p = probability of Type I error; SE = standard error.

Research question II. The second research question examined whether the longitudinal correlations between Time 2 object play and Time 3 intentional communication, as well as Time 2 intentional communication and Time 3 object play, varied by group assignment. Although it was hypothesized there would not be a significant interaction between the Time 2 predictor variable and treatment group assignment predicting the Time 3 criterion variable, this was tested to address the unexpected possibility that treatment may influence Time 2 to Time 3 associations. Multiple linear regression analyses were run with the Time 2 predictor variable (communication or play), treatment group assignment, and an interaction term between the Time 2 predictor variable and treatment group assignment entered as predictor variables of the Time 3 criterion variable (communication or play). Analyses revealed there was no interaction between Time 2 object interest and treatment group assignment predicting Time 3 intentional communication ($t(42) = -.49$, $p = .626$, $\Delta R^2 = .006$) or Time 3 turn-taking ($t(25) = -1.04$, $p = .310$, $\Delta R^2 = .046$) and no interaction between Time 2 weighted object knowledge and treatment group assignment predicting Time 3 intentional communication ($t(42) = .10$, $p = .919$, $\Delta R^2 = .000$) or Time 3 turn-taking ($t(25) = -1.075$, $p = .294$, $\Delta R^2 = .046$). Additionally, there was no interaction between Time 2 intentional communication and treatment group assignment predicting Time 3 object interest ($t(41) = .042$, $p = .967$, $\Delta R^2 = .000$) or Time 3 weighted object knowledge ($t(41) = -.54$, $p = .597$, $\Delta R^2 = .016$), and no interaction between Time 2 turn-taking and treatment group assignment predicting Time 3 object interest ($t(29) = .70$, $p = .491$, $\Delta R^2 = .018$) or Time 3 weighted object knowledge ($t(29) = .29$, $p = .777$, $\Delta R^2 = .003$). Therefore, longitudinal correlations were examined in the pooled sample of participants.

Research question III. The third research question examined the bi-directional longitudinal correlations between object play variables and communication variables in the pooled sample. It was hypothesized that Time 2 play variables would significantly predict Time 3 communication variables, and that Time 2 communication variables would significantly predict Time 3 play variables. Simple linear regression analyses revealed no significant longitudinal associations between Time 2 play variables and Time 3 communication variables, or between Time 2 communication variables and Time 3 play variables (see Table 6).

Table 6. *Longitudinal Associations Between Play and Communication Variables*

	Object Interest Time 2	Weighted Object Knowledge Time 2	Object Interest Time 3	Weighted Object Knowledge Time 3
Intentional Communication Time 2	-	-	.11	.17
Turn-taking Time 2	-	-	.13	.16
Intentional Communication Time 3	-.003	.005	-	-
Turn-taking Time 3	.12	.25	-	-

Note. Values entered are standardized Beta coefficients. No associations were significant at the .05 level.

Exploratory Analyses

Hypothesis-generating (i.e., exploratory) analyses were conducted to examine possible associations between play variables and additional communication variables. A pattern of findings emerged involving weighted object knowledge and responding to joint attention.

Longitudinal associations between weighted object knowledge and RJA. Exploratory analyses conducted for the current study examined the bi-directional, longitudinal association between RJA and weighted object knowledge at Time 2 and Time 3. First, multiple linear regression analyses were conducted to confirm that predictor variables did not interact significantly with treatment group assignment to predict Time 3 criterion variables. Time 2 weighted object knowledge did not interact with treatment group assignment to predict Time 3 RJA ($t(43) = -1.634$, $p = .110$, $\Delta R^2 = .050$). Therefore, the longitudinal association was examined in the pooled sample. However, the predictor variable did interact with treatment group assignment when Time 2 RJA was entered into the model as a predictor of Time 3 weighted object knowledge ($t(44) = -2.40$, $p = .021$, $\Delta R^2 = .11$). Therefore, the association between Time 2 RJA and Time 3 weighted object knowledge was examined within each group separately.

In the pooled sample, Time 2 weighted object knowledge predicted Time 3 RJA ($r = .44$, $p = .003$). Within the treatment group, Time 2 RJA did not significantly predict Time 3 weighted object knowledge ($r = .08$, $p = .717$). In contrast, within the control group Time 2 RJA did significantly predict Time 3 weighted object knowledge ($r = .58$, $p = .005$). These findings suggest a pattern of interrelationships between object play and RJA, with some associations varying by group assignment. In addition to the above longitudinal correlational models, examination of mediating associations between play and communication variables could shed further light on the interrelatedness of these early developing skills.

Mediation model involving RJA, weighted object knowledge, and expressive language. A mediation analysis was conducted to determine whether an association between RJA and expressive language might occur through a third, mediating variable – in this instance, weighted object knowledge.

Preliminary analysis. First, it was necessary to test whether the associations between variables in the mediator model varied by treatment group assignment. The longitudinal correlation between Time 1 RJA and Time 2 weighted object knowledge did not vary by treatment group assignment ($t(43) = -.498$, $p = .621$, $\Delta R^2 = .005$), nor did the correlation between Time 2 weighted object knowledge and Time 3 expressive language ($t(44) = -.266$, $p = .791$, $\Delta R^2 = .001$). The longitudinal association between Time 1 RJA and Time 3 expressive language did not significantly vary by treatment group assignment, although there was a trend towards significance, and the effect size is moderate ($t(48) = -1.759$, $p = .085$, $\Delta R^2 = .063$). In the pooled sample, Time 1 RJA positively predicts Time 2 weighted object knowledge ($r = .38$, $p < .05$) and Time 2 weighted object knowledge positively predicts Time 3 expressive language ($r = .55$, $p < .01$). In the pooled sample, Time 1 RJA does *not* significantly predict Time 3 expressive language ($r = .15$, $p = .274$). However, a significant association between the predictor and the outcome is not required to interpret results of the mediation model (Collins, Graham, & Flaherty, 1998; MacKinnon, Krull, & Lockwood, 2000). Zero order associations are presented in Table 7.

Table 7. *Zero-Order Correlations Between RJA, Weighted Object Knowledge, and Mullen Expressive Language Age Equivalence Scores*

	Time 1 RJA	Time 1 OK	Time 2 RJA	Time 2 WOK	Time 3 RJA	Time 3 WOK	Time 3 Mullen Exp
Time 1 RJA	1.00	.15	.43**	.38*	.47**	.37*	.15
Time 1 OK	-	1.00	.31*	.60**	.15	.14	.23
Time 2 RJA	-	-	1.00	.54**	.70**	.39**	.43**
Time 2 WOK	-	-	-	1.00	.44**	.61**	.55**
Time 3 RJA	-	-	-	-	1.00	.39**	.34*
Time 3 WOK	-	-	-	-	-	1.00	.41**
Time 3 Mullen Exp	-	-	-	-	-	-	1.00

Note. RJA = responding to joint attention; OK = object knowledge; WOK = weighted object knowledge; Exp = expressive language.
* .05 level
** .01 level

Primary mediation analysis. Figure 1 depicts the three pathways of this model: (a) pathway "a" represents the association between the predictor variable (RJA) and the mediator (weighted object knowledge); (b) pathway “b” represents the association between the mediator (weighted object knowledge) and the criterion variable (expressive language); and (c) pathway “c” represents the direct effect of the predictor variable on the criterion variable. The coefficients in the figure are standardized coefficients to aid interpretation. To further examine the interrelationships between RJA, weighted object knowledge, and expressive language, a simple mediation analysis was conducted using the PRODCLIN software (MacKinnon, Fritz, Williams, & Lockwood, 2007) downloaded from http://www.public.asu.edu ~davidpm/ripl/Prodclin/. This software provides the confidence interval for the product of the a and b pathway coefficients.

Ordinary least squares regression analyses were conducted to derive unstandardized coefficients (i.e., the typical coefficients used to test the significance of the indirect effect) and standard errors for pathways a, b, and c in the model (MacKinnon, 2008). To obtain the coefficient for path a, Time 2 weighted object knowledge was entered into a regression as the criterion variable, and Time 1 RJA was entered as the predictor variable (B = 7.41, SE = 2.959, $p = .016$). To derive the coefficients for pathways b and c, Time 3 Mullen expressive language age equivalence score was entered as the criterion variable, and Time 2 weighted object knowledge and Time 1 RJA were entered as the predictor variables (B = .536, SE = .132, $p < .001$ and B = -1.097, SE = 2.72, $p = .703$, respectively). One way to test for mediation is to multiply the unstandardized coefficients for the a and b pathways, and compute a confidence interval around the product term. This product term indicates how much a 1-unit change in the predictor variable affects the criterion variable by way of the mediator (MacKinnon, 2008).

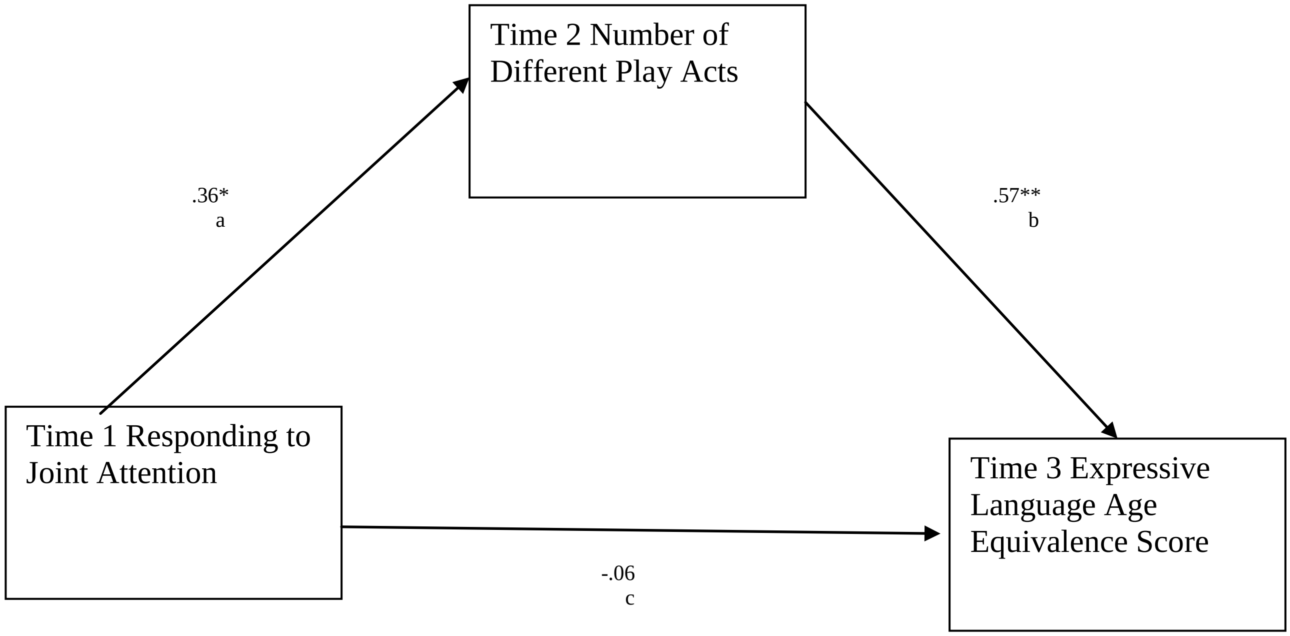

Figure 1. Path diagram for mediation analysis where responding to joint attention at Time 1 predicts weighted object knowledge at Time 2, which subsequently predicts expressive language age score at Time 3. The standardized Beta coefficients are indicated for each path in the model. A 95% confidence interval was used to find the lower and upper limits around the product term of the a and b path coefficients [.82, 8.08].

*p <. 05

**p < .01.

Results indicate responding to joint attention at Time 1 predicts weighted object knowledge at Time 2, which then predicts the Mullen expressive language age equivalence score at Time 3 (see Figure 1). Analysis revealed a 95% confidence interval from .82 to 8.08, indicating a statistically significant mediating role of weighted object knowledge in the association between RJA and expressive language in this sample of young children (i.e., the confidence interval did not include zero).

CHAPTER IV

DISCUSSION

Summary of Findings

Primary analyses involved examining the main effects of the Hanen More Than Words treatment (a parent-mediated intervention) on the object play skills of young children with ASD. Additionally, the longitudinal associations between object play and intentional communication were examined. Findings indicated there were no main effects of treatment on the number of toys on which children demonstrated differentiated play, or on the number of different actions children used on objects. Additionally, object play at Time 2 did not significantly predict nonverbal intentional communication variables at Time 3, nor did nonverbal intentional communication at Time 2 significantly predict object play at Time 3. These findings were unexpected, as initial hypotheses based on prior theory and empirical findings predicted main effects of treatment on play, as well as significant, bi-directional longitudinal correlations between play and communication variables.

Although we cannot know with certainty the reasons for null findings, the following provides some possible explanations for these results. First, Hanen More Than Words is a parent-mediated treatment, and although we have FOT data on the clinicians' implementation of group and individual sessions with caregivers, we do not have data on parents' implementation of learned strategies. It is possible, therefore, that some parents did not implement strategies consistently or with fidelity, which may have affected detection of main effects of treatment on object play. Additionally, there is no information on parents' attendance to specific sessions. We could therefore not run analyses examining whether effects of treatment on object play co-varied with parents' attendance to those sessions focused specifically on play. Also, the participants in the current study were younger than children involved in the Yoder and Stone (2006a) study, which did demonstrate main effects of a similar, clinician-implemented treatment on object play (McDuffie et al., in press). It is possible that the younger age of the current sample contributed to the non-significant findings of this study.

Next, there may be some unmeasured or unanticipated variable which interacted with treatment to predict effects on children's play skills. Moderator analyses were run for initial object interest and object knowledge, with no significant interaction with treatment group detected. Additional exploratory analyses examined other possible pretreatment child (i.e., STAT score, receptive language, social-communication skills) and family (i.e., parent formal education level, parent responsivity, parent stress and depression) characteristics which may have interacted with treatment group assignment to predict outcomes. However, there were no significant interpretable findings. It remains possible that some other unmeasured pretreatment variable interacted with treatment group assignment to affect child outcomes. Also, there was little variability in the object interest variable at Time 3, which could have decreased our ability to detect change from Time 1 to Time 3, as well as our ability to detect significant correlations with communication variables. Finally, the SSEC may not have been a sensitive enough measure to detect change in children's object play skills at the Time 3 measurement period. Materials for the assessment were selected based upon the perception they would be fun and engaging for young children, and would afford opportunities for many different play actions. Materials were not necessarily selected based on cognitive level of play. Therefore, the materials used during the SSEC may not have adequately captured change in children's play skills over time.

Exploratory (i.e., hypothesis-generating) analyses were conducted examining a possible association between RJA and object play, as well as a mediation model involving RJA, object play, and expressive language. Significant, bi-directional longitudinal correlations were found between RJA and weighted object knowledge measured at Time 2 and Time 3 in the control group, while Time 2 RJA did not predict Time 3 weighted object knowledge in the treatment group. It is not completely understood why there were group differences in the longitudinal association between Time 2 RJA and Time 3 weighted object knowledge. Although there was a mean difference in Time 2 RJA favoring the control group, this was not statistically significant. However, these findings suggest there was some disruption of the expected association between RJA and weighted object knowledge for children assigned to the treatment condition, but it is unclear why this might be so. Finally, a mediation analysis revealed a significant single-mediator model whereby Time 2 weighted object knowledge mediated the association between Time 1 RJA and Time 3 expressive language.

Several assumptions underlying the mediation analysis were tested and met for the current model including normality of distribution of the variables, lack of interactions between variables included in the model, and reliability of measurement (MacKinnon, 2008). The Time 1 ICC for the RJA variable was somewhat low (.59), and may have contributed some error to the model. This lower ICC is not a likely explanation for the significant relation between RJA at Time 1 and object knowledge at Time 2, but it could attenuate the magnitude of the association (Yoder & Symons, 2010). Additionally, an assumption of temporal precedence was met (i.e., the predictor variable was measured four months prior to the mediator, which was measured 5 months prior to the criterion variable) (MacKinnon, 2008). Also, the mediation model was built upon logic derived from prior theoretical and empirical findings (MacKinnon, 2008), increasing likelihood of replication in future samples of young children with ASD. A final assumption of mediation analysis is that all relevant variables are included in the model (MacKinnon, 2008; Pedhazur, 1973). This assumption provides a very stringent guideline for analysis, as it may never be possible to know and include all relevant variables. Therefore, it is acknowledged here that all relevant variables may not have been included in this first exploratory mediation model. However, the logic model used to produce the model presented has a sound basis in theory and current research, which increases validity of the findings.

Old mediation analysis methods required significant associations between all variables present in the mediation model (e.g., Baron & Kenny, 1986). However, it has since been established that a significant association between the independent and dependent variables is not required for mediation to be present (Collins et al., 1998; MacKinnon et al., 2000). Therefore, the non-significant direct effect between Time 1 RJA and Time 3 expressive language is not problematic for interpretation of results.

It should be reiterated that the model examined in the above analysis is the result of an exploratory study, and that findings need to be confirmed with additional analyses using other samples of young children with ASD. Also, the above analysis cannot be used to infer causality between included variables because the levels of the predictor variable were not manipulated in the context of an internally valid experiment. That is, this mediation analysis is correlational in nature (MacKinnon, 2008). Nevertheless, the mediation model described above provides information regarding the relations between RJA, object play, and expressive language in young children with ASD that could inform future studies, and if replicated, treatment models for children with ASD.

Limitations

The present study has several limitations. First, as previously discussed, no fidelity of treatment data were collected on parents' use of intervention strategies when the HMTW speech-language pathologist was not present. Future studies should include a measure of parent fidelity of implementation. Although such data are challenging to collect, recent studies have collected and reported on parent FOT in the absence of research staff that trained the parents (e.g., Kaiser, Hancock, & Nietfeld, 2000; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010). Second, although we have general information regarding attendance to group and individual sessions, we have no information on how many parents assigned to the treatment condition attended group and individual sessions targeting object play specifically. We therefore do not know whether play outcomes varied based on parent attendance to the sessions that taught strategies to increase their children's play. Third, detailed information about what specific interventions were implemented in the business-as-usual control condition is not available. It is possible children in the control group were also exposed to strategies targeting play variables, leading to no detectable effects of treatment on object play because both groups made gains in their play skills.

Finally, all significant findings in the current study were the result of exploratory analyses. Multiple significance testing increases likelihood of Type I errors, leading to detection of significant associations between variables when such associations are absent in the population. Although significant findings were in expected directions based on current knowledge, it is important that additional confirmatory studies with a priori predictions be conducted. Significant results in the current paper, including the mediation model, that replicate are more likely to be representative of population associations, and could inform future research studies and early intervention for young children with ASD.

Interrelatedness of RJA, Object Play, and Expressive Language

Responding to joint attention is one component of a socially-mediated joint attentional system facilitative of early learning across developmental domains, including expressive language. Mundy, Sullivan, and Mastergeorge (2009) describe responding to joint attention development as involving a "learning to do" phase and a "learning from" phase. Once infants are efficient in coordinating their attention to object and person, they are able to use such interactions to learn about their environment from their adult interactional partners. RJA is defined as the infant's ability to direct their attention to a shared target based on another's gaze, head posture, or gesture (Mundy et al., 2009). Inherent in this definition is the presence of an object or event to which the adult is trying to draw the child's attention. In the natural environment, the adult frequently demonstrates an action on the referent subsequent to successful directing of the child's attention. Some of these actions will be new to the young child. Over time, such play models may provide the basis for learning to play with objects in new ways. We therefore can see how a bi-directional, longitudinal association between RJA and object knowledge may be supported early in development, and how such processes might be disrupted in young children with ASD.

One possibility for explaining the association between object knowledge and RJA is a common requisite skill of disengaging visual attention. Play diversity (i.e., performance of different actions on an object or toy), may depend upon the ability to shift attention between different components or aspects of an object or toy and its relation to the environment. For example, a child demonstrating limited object knowledge may enjoy spinning the wheels of a car, but is unable to disengage his/her attention from the wheels to other areas of the car, such as the doors, to manipulate or act on the object in a new way. Similarly, responding to another's bid for joint attention necessitates disengagement from one focus of attention to engage with another target.

Interestingly, current research points to difficulty with disengagement of attention for children with ASD, supporting the hypothesis of a common attentional component impacting object play and RJA. Landry and Bryson (2004) found children with ASD had more difficulty disengaging attention from one stimulus to attend to a competing stimulus as compared to children with Down syndrome and typically developing children matched on verbal and nonverbal mental age. Additionally, Zwaigenbaum, Bryson, Rogers, Roberts, Brian, and Szatmari (2005) found that the ability of infant siblings of children with ASD to disengage from a central stimulus to attend to a competing, peripheral stimulus at 12 months predicted ADOS scores at 24 months. Interestingly, typically developing infants demonstrate such obligatory or "sticky" attention around 2 months of age, and develop the ability to disengage attention around 3 to 4 months of age

(Zwaigenbaum, Bryson, Rogers, Roberts, Brian, & Szatmari, 2005). Disruption of this early emerging ability in children with ASD could impact development of many subsequent skills, including responding to joint attention and object play.

In addition to the associations between RJA and weighted object knowledge, a significant mediation model was demonstrated, where weighted object knowledge at Time 2 mediated the association between Time 1 RJA and Time 3 expressive language. Consideration of parent-child interactions involving objects may provide some insight as to how such a model may be present early in development for young children with ASD. First, a parent who engages with their child around an object or toy may use play models or expansions to show their child how to play with an object in many different ways, and may use verbal or gestural cues to draw their child's attention to the information they are trying to convey. A child who is able to respond to such bids for joint attention has increased opportunities to benefit from these play models and expansions, and may acquire new knowledge about how to play with objects through these strategies. In turn, children able to play with toys in many different ways provide increased opportunities for language learning in the form of descriptive talk, or what has been referred to as "synchronous talk" (Siller & Sigman, 2002). These teaching strategies, which have been shown to be associated with language learning (e.g., Siller & Sigman, 2002), may lead to subsequent increases in children's expressive language. Although the analysis presented in the results section cannot determine causality within the proposed mediation model, the findings lead to testable hypotheses regarding the interrelatedness of RJA, object play, and expressive language.

Implications for Practice

Recent studies have examined treatment of responding to joint attention skills in young children with ASD. Both clinician- (Jones, Carr, & Feeley, 2006; Martins & Harris, 2006; Whalen & Schreibman, 2003) and parent- (Kasari et al., 2010; Rocha, Schreibman, & Stahmer, 2007; Schertz & Odom, 2007) mediated interventions have been examined. Some results suggest a functional relation between the independent and dependent variables in the treatment context (Kasari et al., 2010; Martins & Harris, 2006; Rocha et al., 2007; Schertz & Odom, 2007). Although the majority of interventions used preferred objects as stimuli and reinforcers for correct responses, only one study used *routines* around objects and toys to target RJA skills (Kasari et al., 2010). Increased understanding of how early communication and play skills are related in young children with ASD may have implications for development and implementation of more effective practices in early intervention.

Targeting RJA skills. As noted previously, young children with ASD may have difficulties coordinating their attention between a person and an object or event in response to another's bid for attention. This may be due to the fact that (a) the child is not reinforced by social exchanges with adults or (b) the child may not have the ability to disengage from their current focus due to persistence of sticky attention. Under either circumstance, using routines around objects as the intervention context could be facilitative of development of RJA. However, approaches to treatment would vary based on the reason for the disruption of RJA. If a child was not reinforced or motivated by social interaction with another, intervention might focus on making such social exchanges reinforcing by pairing smiles, hugs, and exaggerated verbal responses with routines around objects about which the child has prior knowledge. For example, if a child knows how to play with bubbles, the play partner may use bubbles to provide contexts for reinforcing social engagement and RJA (Yoder & Lieberman, 2008). Evidence for efficacy of a paired-reinforcement approach is limited (e.g., Solberg, Hanley, Layer, & Ingvarsson, 2007), but could be tested in future studies. Alternatively, if a child is motivated to interact socially, but is unable to shift their attention from their current focus to attend to what an adult play partner is doing with a similar object, the focus of treatment may be on helping the child learn to disengage attention effectively in order to learn from others in their environment. This may be facilitated by using objects and toys about which the child has much prior knowledge, ensuring more cognitive resources for the shift in attention required to demonstrate RJA. Although empirical evidence of this approach is limited, it is theoretically plausible, and testable. In both cases, increasing the child's RJA skills would use an approach that focused on creating contexts which involved objects and toys about which the child demonstrated prior knowledge, and which provided multiple opportunities to target RJA.

Targeting object play. Similarly, explanations for disruption in object play skills may be motivation-based or knowledge-based. A child with ASD may have fewer object play skills because object play is not reinforcing. This could be due to negative attributes associated with many objects or toys, such as aversive sounds, textures, or other physical properties. For instance, it has been reported that some children with ASD demonstrate hyperresponsiveness to the sensory properties of objects or toys compared to typically developing children, with aversion to sensory stimuli demonstrating a decline with increasing mental age (e.g., Baranek, Boyd, Poe, David, & Watson, 2007). Additionally, some preliminary research has shown that avoidance of multisensory toys is negatively related to duration of play with new objects in children with Fragile X syndrome (Baranek, Chin, Greiss Hess, Yankee, Hatton, & Hooper, 2002). One could reason that very young children with ASD who experience such aversion to objects or toys may likewise limit their early exploratory and manipulative behaviors with objects. Alternatively, some children with ASD may be interested in playing with objects, but may not acquire knowledge about objects through typical means (i.e., exploration, manipulation, and observation). Again, intervention may vary based on the reason for disruption in development of object play skills, but could effectively be implemented in a context involving social routines around objects with a play partner demonstrating properties of the objects through models and expansions.

Individualization of intervention. Understanding the child's strengths and areas of need, and how one skill might influence another, allows clinicians and parents to develop appropriate and potentially more effective intervention programs. For instance, Kasari et al. (2010) implemented a parent-mediated intervention whereby clinicians worked with parents to establish play routines that could provide the context for delivering intervention strategies targeting joint attention and expressive language skills. Importantly, Kasari and colleagues (2010) based the joint attention outcomes of toddlers with ASD on their "developmental readiness for learning" (p. 1047) in this recent randomized controlled trial. Here we see how determining a child's current skill level and strengths, and knowing how to use those strengths to target subsequent developmentally appropriate skills, can lead to improved outcomes for young children with ASD.

Findings from Carter et al. (in press), Lieberman et al. (2011), and from the current study suggest this may be so for other samples of young children with ASD. Carter and colleagues and Lieberman et al. found children low on an object play variable at Time 1 benefitted most from the treatment condition as reflected in their Time 3 social-communication outcomes. Although there were no main effects of treatment on object play, this pattern suggests that for developmentally young children with ASD, the highly responsive strategies taught by HMTW may be particularly beneficial for this subgroup of children.

Interventions incorporating both play routines and early communication strategies may be most effective when individualized for a child based on current strengths and needs. Ensuring young children with ASD attain the "learning to do" phase of RJA when needed, and benefit from the "learning from" phases of RJA when developmentally ready, may support acquisition of important object play skills, which may be associated with later expressive language use, and potentially more optimal outcomes in individuals with ASD (Mundy et al., 2009).

Future Directions

Communication remains an important treatment target for individuals with ASD, and skills in this area predict positive outcomes later in life. Because many early intervention strategies for very young children with ASD involve object-focused routines with caregivers, determining how play and early communication relate to one another has implications for development and implementation of efficacious treatments. Future studies should examine single mediator models involving RJA, play, and expressive language to determine whether support for this model replicates. Subsequent experiments will be needed to determine whether the associations are causal. Such rigorous and disciplined studies have the potential to continue to expand the evidence base for intervention for young children with ASD, contributing to the improvement of the lives of children with ASD and their families.

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