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Teaching Prelingustic Communication Skills to School Age Children with Autism

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Teaching Prelinguistic Communication Skills to School Age Children with Autism

by

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For Keith, who started all this.

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Teaching Prelinguistic Communication Skills to School Age Children with Autism

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Abstract: Prelinguistic Milieu Teaching (PMT) is an intervention designed to teach young children to initiate nonverbal communication using vocalizations, gestures, and eye-gaze. Children are taught through social routines in their natural environment. Techniques include contriving an environment in which the children will be motivated to communicate and using a hierarchy of prompting and modeling to evoke the desired communicative behaviors, such as requesting and commenting. PMT has been previously studied in young children (ages 1-5) with developmental delays. In this study, it is implemented with six school-age children with Autism (ages 5-8). A multiple baseline design across participants was used to evaluate the effects of the intervention on the variables of frequency, clarity, and maintenance of the participants' communication. All six participants showed increases in the targeted prelinguistic communication skills

during treatment and maintained the increases during follow-up. Analysis of individual behavioral profiles was helpful for disambiguating individual differences in response to intervention across the three variables. Future research should target generalization of learned behaviors across implementers and settings.

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CHAPTER 1

Introduction

School-age children with autism who never develop the use of symbolic spoken language may have to rely solely on prelinguistic communication modes. However, these children often demonstrate deficits in prelinguistic communication skills as well (Mundy & Crowson, 1997). As a result, they may have ineffective means to consistently communicate their needs and ideas about the world. Intervention targeting their capacities for acquiring consistent and mature levels of prelinguistic communication skill can improve these children's overall level of function in social interactions within their environment.

This chapter explores the use of Prelinguistic Milieu Teaching (PMT) to facilitate consistency in using recognizable prelinguistic communication means for school age children diagnosed with autism. PMT (Yoder & Warren, 1998) is a teaching protocol aimed at facilitating early communication development. It has been studied with younger, developmentally delayed children. It has not been evaluated for efficacy with older children diagnosed with autism who may potentially persist in use of prelinguistic levels of communication across their lifespan. Research-based evidence is needed before this intervention can be validly applied to this group of children.

AUTISTIC DISORDER

To provide a framework for this study, autistic disorders must first be defined. The term "autism" is used when a child under 3 years of age begins to display marked

deficits in several behavioral domains, including communication, social interaction, and adaptive behavior (American Psychological Association, 1994). Within these developmental domains, the severity of behavioral abnormalities varies across children, representing a spectrum of expression for patterns of disorder considered as definitive for an autism diagnosis. Thus, an autistic disorder is often referred to as autism spectrum disorder (ASD). Individual children with ASD differ in intelligence level and in use of symbolic language. However, all ASD children exhibit abnormalities in relating to other persons (Trevarthen, Aitken, Papoudi, & Robarts, 1996). It is estimated that autism affects at least 1 of 500 children worldwide, regardless of culture, race, socioeconomic status, or parental characteristics (National Research Council, 2001).

The majority of children diagnosed with autism demonstrate a severe and pervasive level of disorder throughout their lifespan (Harris, 2000). Predictors such as an IQ below 50 and absence of communicative speech by age 5-6 are indicative of poor long-term outcome, including severe restriction of social and adaptive functioning in adulthood (Nordin & Gillberg, 1998). Recent estimates suggest that as many as one half of all children with autism remain nonverbal after age 5 (National Research Council, 2001). These children are also at risk for failure to develop purposeful nonverbal communication skills (Whalen & Schreibman, 2003).

Intervention to develop a consistent and intelligible means of functional communication is a priority for educators of children with autism. However, providing communication intervention for children with autism is a challenging task. For older children who remain nonverbal, slower progress is likely and few methods have been

evaluated carefully for their efficacy in supporting the autistic child's development of a maximally functional communication system relative to their cognitive and social impairment level (Goldstein, 2002). To make decisions about appropriate interventions for children who have little to no means of functional communication, clinicians must consider the basic nature of communication acts. Such considerations would include: (a) understanding of typical prelinguistic development**,** (b) the effectiveness of the child's communication in terms of recognition and interpretation of the communication attempts by communication partners, and (c) presence of research-based evidence to support the use of an intervention technique or program relative to the unique needs of children with autism who are functioning at a prelinguistic communication level.

DEVELOPMENT OF MEANINGFUL PRELINGUISTIC COMMUNICATION

As a context for understanding the importance of prelinguistic communication to later emergence of language capacities, the nature of language development will be examined. Three broad areas of communication develop during the first several years of life: behavior regulation, social interaction, and joint attention (Bruner, 1981). *Behavioral regulation* involves requesting objects and actions to get another person to respond to perceived needs. For example, a child may simultaneously give a toy and look at another person in hopes of getting that person to activate the toy. *Social interaction* involves gaining or sharing another's attention. A child might engage with another person in a turn-taking game, such as passing a ball back and forth. Finally, *joint attention* is communication that directs another person's attention to an item or event. A child may point to a dog across the street and look at an adult to draw their attention to the dog.

Each of these communicative functions emerges prior to the development of intentional, linguistic communication, which involves use of recognizable words for referring to objects, persons or events (Bruner, 1981).

Caregiver Responsiveness

Beginning at birth, infants and caregivers engage in face-to-face interactions that create an initial means for development of communication. During the first 6 months of life, a typically developing infant begins to produce sounds, gestures, and facial expressions during these face-to-face episodes (Mundy & Willoughby, 1998). Initially, the infant's behaviors are non-symbolic or preintentional, indicating that they are not part of a symbolic communication system in which a specific behavior corresponds to an explicit meaning (Siegel-Causey & Guess, 1989). The child does not intend to communicate. Nonetheless, caregivers often recognize these behaviors and respond with attention and interaction. Parent responsiveness has been found to be a critical factor in children's early language development (Brady, Marquis, Fleming, & McLean, 2004; Calendrella & Wilcox, 2000). Around 6 months, children begin to use these nonverbal communicative behaviors purposefully for behavioral regulation (Mundy & Willoughby, 1998). They may begin purposefully vocalizing, gesturing or making eye-contact with adults to non-verbally request something they desire.

Gestures

Gestures most generally involve actions produced with the arms, hands, and fingers (Iverson & Thal, 1998). Three basic types of gestures develop between 8-24 months: deictic, representational, and conventional. *Deictic* gestures involve actions used

to direct attention to an object or event (Crais, Douglas, & Campbell, 2004; Goldin-Meadow, 2003). *Representational* gestures are in some way symbolic of the object or event of interest (Acredolo & Goodwyn, 1988, 1996; Capirci, Iverson, Pizzuto, & Volterra, 1996). For example, a child may put his fingers to his mouth to indicate that he wants to eat a cookie. Finally, *conventional* gestures represent a social action rather than an object. They include actions such as waving bye, blowing a kiss, or placing a quiet finger to the mouth (McNeill, 1998).

Vocalizations

As children develop motor movements for gestures, they simultaneously develop motor coordination to support production of sounds. Before children produce spoken words, they produce various sounds and sound combinations (see Oller, 2000, for a review of early vocal development). By 6 months of age, children typically produce a variety of consonants and combine consonants with vowels. Early vocalizations may include both repetition of a consonant-vowel syllable sequence, often with sounds such as "buh-buh-buh" and strings of varied sounds and syllables such as "didadidijaja" (Davis & MacNeilage, 1995; Mitchell & Kent, 1990). These vocalization strings will likely contain variable intonation patterns and resemble meaningful words; yet specific vocal means are not yet attached to precise lexical meanings (Nathani, Ertmer, & Stark, 2006). Over the next 6 months, between 12-18 months of age, the children begin to develop specific vocalizations to indicate particular communicative intent (Watt, Wetherby, & Shumway, 2006).

Eye Contact

The use of vocalizations and gestures is frequently coupled with the use of eye-contact, or the connection of the child's eye-gaze with another person's. Direct eye-contact and facial expressions such as smiling may be the first behaviors used to indicate that the child wants more interaction with an adult. From birth to about 3 months, eye-gaze is primarily dyadic and involves prolonged gaze between the infant and another (Levelli & Fogel, 2002). Around 3-4 months, infants begin to turn attention and eye gaze away from their mother and toward objects and events in the environment (Lohaus, Keller, Kissmann, Ball, Borke, & Lamm, 2006). Around 9-12 months, infants begin to use eye-gaze to initiate reference of the objects and events to adults (Mundy, Block, Delgado, Parmares, Van Hecke, & Parlade, 2007). The child may look toward an object and then toward an adult. Eye-contact can also be used to initiate a social interaction or routine such as requesting a toy. Social interaction often develops through social games involving the presence and absence of eye-gaze, such as peek-a-boo, where a child and parent are involved in a series of turns. In the case of the peek-a-boo game, for example, these turns may involve a series of non-verbal behaviors such as: 1) making eye-contact, 2) covering the face with hands, (3) removal of the hands from the face to reproduce the eye-contact.

RATIONALE FOR TEACHING PRELINGUISTIC COMMUNICATION

The use of prelingustic communication means, such as vocalizations, gestures and eye-contact, establishes an important foundation for future development of linguistic communication, or the use of words with consistent referents (Watt, Wetherby, &

Shumway, 2006; Brady, Steeples, & Fleming, 2005; Calendrella & Wilcox, 2000; Smith, Mirenda, & Zaidman-Zait, 2007; Brady, Marquis, Fleming, & McLean, 2004; McCathren, Yoder, & Warren, 1999; Acredolo & Goodwyn, 1988; Iverson & Goldin-Meadow, 2005). Several studies have suggested that prelinguistic communication might form an important link to development of spoken language skills for many children with typical development as well as those with developmental disabilities.

Calandrella and Wilcox (2000) observed 25 toddlers with global developmental delays ages 17-59 months. They found that rate of intentional nonverbal communication, such as use of gesture, was a predictor of spontaneous word productions 12 months later. McCathren, Yoder, & Warren (1999) examined rate of non-word vocalizations in 58 toddlers with developmental delays, ages 17-34 months. They found that rate of vocalizations was positively correlated with expressive vocabulary 12 months later. Similarly, Brady, Marquis, Fleming, and McLean (2004) found that rate of gestures was also correlated with future expressive language outcomes on standardized testing in children ages 3-6 with developmental delays. Initiating joint attention through eye gaze was also found to predict expressive language outcomes in typically developing children (Mundy & Gomes, 1998). These studies suggest that development of prelingustic communication means means a first step in the continuum toward acquisition of symbolic language. Their presence in children determined to have developmental delays appears to be predictive of later level of function. Development of nonverbal communication skills, such as gestures and vocalizations, represents a potentially important step associated with development of meaning-based verbal language.

Children with autism often experience persistence of severe to profound delay in the onset of language skills (Paul, 2006). These children may not develop the social, motor, cognitive, or perceptual abilities to develop symbolic spoken language. Thus, prelinguistic communication may represent the end state of their communication capacities. As a result, they must continue to rely on prelinguistic means to communicate across their lifespan. Achievement of consistent prelinguistic communication capacities may enable a wider range of overall functional interactions within the child's social environment. With a consistent set of communication skills that are readable by individuals in the environment, children who operate at a prelinguistic communication skill level will have a means to communicate consistently in absence of symbolically based linguistic ability. Importantly, establishing a broad range of communicative means may allow an individual to increase the clarity of communicative intentions. For example, the combination of a vocalization with a gesture and eye-contact may create a more consistent and recognizable means of communication for getting an adult to support communication about need for using the toilet. The more consistently the child communicates, the more easily caregivers will be able to interpret and respond to those communication attempts (Keen, Sigafoos, & Woodyatt, 2001).

When children begin to communicate to achieve important functions in the environment, caregivers can, in turn, begin to attend and respond to the child's communication attempts. Thus, caregiver responsivity plays a crucial role in further development of communication skills. In the case of an older, nonverbal child who is not likely to develop spoken words, an increase in "communication skills" might be

quantified by the frequency of initiated communication acts with an adult caregiver. Over time, the child's increase in clear and readable means of communication and the parent or caregiver's increasing responsiveness interact to mutually create more complex and consistent interactions (Skinner, 1957; Sameroff, 1975; Tomasello, 2003).

INTERVENTIONS FOR TEACHING PRELINGUISTIC COMMUNICATION SKILLS

Several contemporary intervention approaches focus on teaching nonlinguistic communication acts will be discussed to understand the range of contemporary interventions targeting prelinguistic communication skills. These include Hanen Parent Training Program (Hanen; Girolametto, 1988), Picture Exchange Communication Systems (PECS; Bondy & Frost, 1994), and Prelinguistic Milieu Therapy (PMT, Yoder & Warren, 1998). All of these interventions are focused on populations of young children with developmental delays who are not yet demonstrating verbal or symbolic language based communication skills. For older children and adults with severe disabilities, communication intervention more frequently focuses on communication repair (Brady, McLean, McLean, & Lee, 1995; Halle, Brady, & Drasgow, 2004) or functional communication training (FCT; Carr & Durand, 1985).

The goal of the Hanen parent training program (Girolametto, 1988) is to train parents to respond to their child's communication acts. Parents are taught techniques such as following the child's lead, imitating the child, and simplifying language models (Girolametto, Pearce, & Weitzman, 1996).

Picture Exchange Communication Systems (PECS; Bondy & Frost, 1994) focuses on teaching the use of pictures or symbols to support emergence of the pragmatic

intention of "requesting" or "commenting". The child is taught to select pictures for initiating a request in a highly structured sequence of levels and stages. PECS has been supported empirically in a number of studies (see Lancioni, O'Reilly, Cuvo, Singh, Sigafoos, & Didden, 2006, for a review of PECS literature). Available studies have been conducted primarily on children with autism spectrum disorders (ASD) and have targeted only a small range of prelinguistic skills (e.g., requesting).

The goal of communication repair (Brady, McLean, McLean, & Lee, 1995) is to teach strategies to repair failed communication attempts (i.e., "breakdowns") by teaching the individual to modify a request (Halle, Brady, & Drasgow, 2004). A communication breakdown occurs when an individual makes a request, but caregivers fail to recognize or respond to the communication act consistently (Brady & Halle, 2002). With communication repair, the individual is taught two or more means of the same communication response to enable a variety of means to communicate. Communication repair is a relatively new intervention in the beginning stages of developing empirical support.

The goal of Functional Communication Training (FCT; Carr & Durand, 1985) is to teach appropriate communicative responses to use in lieu of challenging behaviors such as aggression or screaming, which are thought to be functioning as communication acts (Durand, 1990). Responses are chosen based on the results of a functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1994), where a specific behavioral consequence maintaining the challenging behavior is identified. While FCT may include the use of prelinguistic means, most FCT studies have been conducted on verbal

individuals or individuals using augmentative communication (see Mancil, 2006, for a review of FCT intervention with children with autism).

Finally, the goal of Prelinguistic Milieu Teaching (PMT; Yoder & Warren, 1998) is to establish intentional communication (e.g., requests and comments), as well as build turn-taking within social routines. Vocalization, eye-gaze, and gestures are included as target behaviors in PMT intervention routines (Warren, Bredin-Oja, Fairchild, Finestack, Fey, & Brady, 2006). Intervention procedures are embedded in social and play activities occurring within the child's natural environment (Fey et al., 2006). A series of studies have been conducted to evaluate PMT with young children diagnosed with developmental language delay (e. g. Yoder & Warren, 1998, 1999, 2001, 2002; Fey et al., 2006; Yoder & Stone, 2006a, 2006b). Studies evaluating PMT have been conducted by the originators of the approach.

These prelinguistic interventions offer diverse methods for teaching differing aspects of prelinguistic skills. Each carries the implication that teaching prelinguistic skills means a necessary pre-requisite for later symbolic language acquisition. Approaches vary in the level of empirical support, commercial availability, and methods employed. They are also diverse in the comprehensiveness of communication behaviors targeted for intervention relative to the spectrum of pre-linguistic communication skills described in theoretical approaches focused on understanding the nature and factors underlying pre-linguistic communication development.

PRELINGUISTIC MILIEU TEACHING

Of the various interventions available, PMT (Yoder & Warren, 1998) has the targets the broadest span of prelinguistic communicative behaviors described as underlying communication development. Further, PMT intervention has a clearly established history of research validation. However, PMT has only been tested on young children under the age of 5 described clinically as "developmentally delayed".

The key component of PMT intervention is to create an "enabling context" for use of prelinguistic behaviors by arranging the environment and using social routines. Social routines implemented are repetitive and intended to model predictable interactions between the child and the adult (Warren et al., 2006). PMT techniques include a hierarchy of *prompts*, *models*, and *natural consequences*. *Prompts* may include physical, verbal, or gestural cues that it is the child's turn to communicate. For example, the adult may ask the child, "What do you want?" *Models* of appropriate gestures and vocalizations at the child's communication level are given during the intervention, such as saying "ba" while giving the child a ball. However, the child is not prompted to directly imitate these behaviors. When the child engages in a target behavior, *natural consequences* such as responding to the request or smiling and nodding are used. Additionally, the adult may use *verbal recasting* to put the child's nonverbal communication into words. If the child points to an item, for example, the adult may model the spoken word for the item. No materials or guidebook are available. Procedures for PMT have been described in a series of studies completed by the researchers who developed the intervention. The researchers describe PMT in terms of the transactional approach to language acquisition (Sameroff, 1975), where child variables such as

communication initiation and environmental variables such as parent responsivity influence each other over time.

POPULATIONS PREVIOUSLY STUDIED USING PMT

Prelinguistic Milieu Teaching as it is presently supported in available research appears to be appropriate for Anglo and African-American children ages 2-5 who are nonverbal and functioning at the 9-15 month level of communication development (Yoder & Warren, 1998, 1999, 2001, 2002; Fey et al., 2006; Yoder & Stone, 2006a, 2006b). While present research on PMT indicates that it is a promising intervention for teaching prelinguistic skills to young children with disabilities, no evidence of this approach is available to help guide clinicians in terms of implementation of PMT in the population of older children who have more severe disabilities. These broader considerations could have an impact on populations with high vulnerability to persistence of function at the pre-linguistic level of communication development. In addition, autistic children being raised within culturally and linguistically diverse groups have not been studied to understand the potential effects of cultural diversity on outcomes of PMT intervention. Evaluation of the efficacy of PMT with differing types of developmental disabilities, different chronological and developmental ages, from different cultural environments is needed to establish the general validity of PMT with children who may persist in use of prelinguistic levels of interaction to meet their basic communication needs in the environment. School-age children with autism who demonstrate persistence of communicative behaviors at a prelinguistic level represent one such sub-population.

Of the various disability categories where prelinguistic communication may be an intervention target, children with autism are consistently described as being at risk for failure to develop functional prelinguistic communication skills (Whalen & Schreibman, 2003). These early skills form relevant intervention goals for these children who may not yet acquire spoken or linguistically-based communication. Prelinguistic communication skills may develop at a later age or fail to emerge at all (Brady, Marquis, Fleming, & McLeon, 2004). Furthermore, such children will likely persist in functioning at a prelinguistic level of communication for a long period. In some cases, prelinguistic function may represent a developmental endpoint for communication (Paul, 2008).

STATEMENT OF PURPOSE

The goal of this study was to evaluate the effectiveness of PMT (Yoder & Warren, 1998) as an intervention for school-age children diagnosed with autism spectrum disorders who exhibit severe and persisting levels of communication disability. PMT intervention techniques were implemented to evaluate efficacy related to increasing overall intentional communication during and following treatment. The children were taught to use gestures, eye-contact, and vocalizations as a means to take turns in functional communicative interchanges and to accomplish the pragmatic intentions of "request", "comment", "negate/protest". The following questions quided the study:

1) What is the effect of PMT on the *frequency* of the child's communication measured by the rate of child-initiated communication acts?
2) What is the effect of PMT on the *clarity* of child's communication measured by consistency of use of combined means of communication?

3) What is the effect of PMT on the *maintenance* of child-adult interactions within an activity measured by the number of child communication turns?

The predicted hypothesis is that implementation of PMT will result in increases in frequency, clarity, and maintenance of communication exchanges.

CHAPTER 2

Review of the Literature

Prelinguistic Milieu Teaching (PMT) is an intervention designed to support teaching communication skills to children operating in the prelinguistic period of communication development (Warren, Bredin-Oja, Fairchild, Finestack, Fey, & Brady, 2006). With PMT, a child is taught specific nonverbal communication skills, such as gestures and eye gaze, through procedures embedded into social interaction within the child's natural environment. Therapists use natural prompts and responses to encourage the child to make requests and comments through nonverbal means (e.g., pointing).

Prelinguistic communication skills form relevant intervention goals for children with a variety of developmental disabilities who have not yet acquired spoken language communication capacities. To make decisions about appropriate interventions, clinicians and teachers must evaluate research-based evidence supporting the use of an intervention technique or program (IDEA, 1997). While PMT is a promising intervention for teaching prelinguistic skills to children with disabilities, no meta-analysis of this approach is available to guide clinicians regarding empirical evidence for PMT. The goal of this synthesis is to critically examine empirical support for the PMT approach to teaching prelinguistic communication skills as well as to consider applications with chronologically older children diagnosed with autism where persistence of prelinguistic level of function across the life span may be expected.

This chapter will provide a review of the development of prelinguistic communication skills in typically developing children, considerations for prelinguistic development in children with autism, and a critique of the current literature on Prelinguistic Milieu Teaching (PMT).

DEVELOPMENT OF PRELINGUSTIC COMMUNICATION

Early communication skills targeted with PMT intervention include skills that typically develop between 9-15 months (Warren, Bredin-Oja, Farichild, Finestack, Fey & Brady, 2006). The focus is the development of intentional communication across multiple pragmatic functions, including requesting and commenting. At this level, intentional communication is typically in the form of vocalizations, gestures, and eye gaze as they are combined to convey meanings to an adult caregiver. Play and daily routines provide the context for learning to use intentional communication, through the development of turn-taking and imitation skills (Bakeman & Adamson, 1984). This section will provide a structure for understanding how these capacities develop during the developmental period of prelinguistic communication in typically developing children.

Intentional Communication

Intentionality is when a child deliberately engages in a behavior meant to communicate with another, knowing that a listener will receive the message and act on it (Westling & Fox, 2004). At some point in the first 12 months, a child's behaviors become purposeful and meaningful. This important transition in language acquisition was first

studied in the 1970's and has continued into current research on early typical language acquisition.

Initially, Bates et al. (1979) suggested a three-stage model of intentionality. In the first stage, the *perlocutionary* stage, a child's behaviors may have an impact on caregiver behaviors, but the child is not actually intending to communicate. For example, a child might cry and a parent may pick him up. However, the child does not cry purposefully in order to get the adult to pick him up. In the second stage, the *illocutionary* stage, a child begins to purposefully use actions such as pointing or vocalizing to communicate meaning to a caregiver. For example, a child may point to a bottle of milk to indicate that he wants a drink. In the final *locutionary* stage, a child begins using symbolic communication, such as spoken words that have learned and arbitrary referents. According to Bates, in order for a behavior to be symbolic, a consistent form must be used to represent an object, event, desire, or condition in meaningful contexts.

In the 1980's, Wetherby and Prizant (1989) expanded the understanding of the development of intentionality with children who have developmental disabilities by describing a developmental continuum rather than three distinct stages. They suggested that many important behaviors occur in the pre-intentional stage that facilitates the development of later intentional behaviors. Examples include the child's ability to turn toward a speaker, babble with varying pitch, and shift gaze between an object and a speaker,

The shift to intentionality, then, is seen as being largely due to adult's contingent responses to these behaviors. For example, a child babbles sounds and looks toward his

father. His father gets excited, picks him up and talks to him. After several instances where the child randomly babbles and looks at his father, receiving a consistent contingent response, he may begin to associate making sounds and looking toward his father with being picked up. Thus, when he wants to be picked up, he may learn to look toward his father and produce sounds. These sounds become even more consistent when the father begins to respond only to certain sounds, such as "dada". Eventually, certain sounds and gestures begin to represent certain actions and objects, and the behaviors become symbolic.

Pragmatic Functions

As intentional communication develops, several distinct purposes for communication emerge. The different purposes for which child communicates are considered different communicative functions. Bruner (1981) categorized communicative functions into three categories as described in Chapter 1 of this paper: (a) behavioral regulation, (b) social interaction, and (c) joint attention. Wetherby and Prizant (1989) developed a coding scheme to apply with children diagnosed with developmental disability to illustrate that many different functions emerge from these three basic communicative functions. Table 1 shows examples of these three communicative functions.

Table 1: Communicative functions proposed by Wetherby and Prizant (1989)

Category	Specific Function
Behavioral Regulation	-requesting action or object -protesting action or object
Social Interaction	-requesting social routine

	-greeting another person -showing off -requesting permission -acknowledging another's action
Joint Attention	-comment on an object or event -clarify another's utterance -request information about an object or event

Other contemporary researchers have continued to explore the range of communicative functions that develop in early intentional communication (e.g., Coggins & Carpenter, 1981; Sigafoos, Woodyatt, Keen, Tait, Tucker, Roberts-Pennell, & Pittendreigh, 2000). For example, Sigafoos et al. (2000) proposed a much broader range of communicative functions based on studies of children with developmental disabilities who have severe language impairments. Table 2 lists ten potential functions as well as more functions falling within the ten major categories.

Table 2: Communicative functions proposed by Sigafoos et al. (2000)

Broad Functions	Examples
Imitation	-Imitating speech, head movements ("yes"/"no"), shrugging, or pointing
Answering	-Reacting when spoken to -Responding "yes" or "no" to a question
Commenting	-Expressing pleasure or enjoyment, sadness or anxiousness, humor, fear or surprise, pain or sickness, anger or frustration, or fatigue
Choice Making	-Choosing between two objects -Choosing an activity or to start or stop an activity
Requesting Information	-Requesting clarification of another's utterance or information about something
Requesting an Action	-Requesting help with dressing, help with a game, to use the toilet, or for someone to come
Requesting an Object	-Requesting a preferred object, something to eat, more of something, TV or music
Reject/Protest	-Protesting a disrupted routine, an action they don't want to

	do, something they don't like, when a preferred toy is taken away, when an adult stops interaction
Attention to Self	-Getting another's attention -Seeking comfort -Requesting cuddling/tickling -Showing off
Social Convention	-Greeting or indicating farewell to others -Responding to their own name

Carpenter, Mastergeorge, and Coggins (1983) investigated the potential sequence of functional development for pragmatic intentions. They studied six infants' development between 8-15 months. Protesting was the first intention to develop between 8-9 months. The children developed requesting for actions and objects between 9-10 months. Between 9-13 months, they began to comment on actions and objects. Finally, between 13-15 months, they began answering.

Means of Communication

Means of achieving pragmatic functions vary from challenging behaviors such as hitting, to idiosyncratic behaviors such as tapping a foot, to symbolic means, such as a manual sign for "cookie". Of the many potential means of communication, three behaviors emerge in early language development and persist as important means of communication even after spoken or linguistic language is achieved: (a) eye-gaze, (b) gestures, and (c) vocalizations. Warren et al. (2006) describe these capacities as the "basic components of prelinguistic requesting and commenting acts" (pp. 61). The development of eye-gaze, gestures, and vocalizations is not exclusive. Development of each variable influences the others (Iverson & Thal, 1998). They are combined to form clearer, more intentional acts of communication over time. Nonetheless, each of these

three variables warrants individual consideration in terms of development of intentional communication. Deficits in the use or coordination in any of the three means may have an impact on the child's level of successful communication in social interactions (Mundy & Willoughby, 1998).

Eye-gaze

Months before infants are able to coordinate gestures or produce vocalizations, they are able to shift their gaze. Beginning at birth, infants have episodes of shared attention through shared eye-gaze with others. At this point, the eye-contact is dyadic, and involves a shared look between the child and caregiver (Levelli & Fogel, 2002; Bakeman & Adamson, 1984). By the second month, infants are able to modulate their visual attention to actions and sounds within the environment. The infant's visual focus remains primarily on social partners (i.e., caregivers) until about 5-6 months (Lohaus, Keller, Kissmann, Ball, Borke, & Lamm, 2006). At this time, the infant begins to shift visual focus to objects in the environment. Within the next three months, between 6-9 months, a typically developing infant will begin to shift gaze back and forth between an object and adult (Striano & Burton, 2005). This gaze shift may involve following the gaze of the adult to see what the adult is referencing. Or, it may involve monitoring whether the adult is looking where the child is attending. By 12 months, the infant clearly uses eye-gaze for various pragmatic functions such as requesting or commenting (Mundy, Block, Delgado, Parmares, Van Hecke, & Parlade, 2007; Adamson & Bakeman, 1991). By 18 months, infants have naturally developed skillful coordination of visual attention to people and objects in the environment (Adamson & Chance, 1998).

Gesture

Gesture development is also important to understanding prelinguistic communication fully, as gestures are one of the earliest indicators of intentionality (Adamson & McArthur, 1995). Early intentional gestures typically develop around 6-7 months and include pushing away an object or reaching with the hand while opening and closing it (Carpenter, Mastergeorge, & Coggins, 1983; Crais, Couglas, Cambell, 2004). Bids for social interaction typically develop around 8-10 months in the form of gestures such as clapping and waving (Iverson & Thal, 1998). By 9 to 12 months, the typically developing child is able to use gestures to engage in joint attention with another person, sharing a focus on a third entity (Tomasello, Carpenter, & Liszkowski, 2007; Scaife & Bruner, 1975). For example, the child may point to an object and look at an adult for the purpose of showing the object to the other person. The child is attempting to share the experience with an object with others. At this stage, gestures typically involve pointing to an object or giving an object to another person. From 12-18 months, gestures typically become more symbolic and representational (Capirci, Iverson, Pizzuto, & Volterra, 1996*;* Craise, Douglas, & Campbell, 2004). Gestures may include nodding head to mean "yes", putting a finger to lips to mean "quiet", or putting a hand to the mouth to indicate "drink". Furthermore, use of symbolic gestures develops parallel to use of symbolic spoken words. In an investigation of the correlation of language and gestures, Thal and Bates (1988) found a strong association between language and gesture at the earliest stage of vocabulary development, typically occurring before 18 months.

Vocalizations

Like eye-gaze and gestures, vocalizations emerge early in life. Oral language is the dominant medium implemented by adults for symbolic communication across the lifespan. Development of vocalizations toward an oral communication system illustrates development of the most complex integrated use of action and knowledge systems accomplished by humans (Davis & Bedore, in press).

Beginning at birth, infants use primarily reflexive vocal behaviors, such as crying, coughing, fussing, and burping (Nathani, Ertmer, & Stark, 2006; Stark, Bernstein, & Demorest, 1993). By 2-3 months, the infant typically begins saying vowel sounds or combining back consonants (such as the "g" and "k" sounds) with vowels in long vocalizations (Oller, 2000). This stage is commonly referred to as "cooing". Between 4-6 months, infants' vocal repertoires begin to include noises such as raspberries (lip trills) and grunts, and combinations of different consonants with vowels (Stoel-Gammon, 1998). By 6-9 months, infant vocalizations begin to resemble adult speech in that they contain rhythmic alternations between consonant-like sounds and vowel-like sounds that sound like syllables in adult speech. For example, the infant may say "dada" or "buhbuh". This phase is termed "canonical babbling" (Davis & MacNeilage, 1995). Furthermore, the consonant-vowel combinations that occur are not random, but occur due to rhythmic jaw movements that are consistently apparent across many languages (Davis, MacNeilage & Matyear, 2002; Kern & Davis, 2008).

In canonical babbling (e.g., "dada"), rhythmic syllable-like vocalizations are not attached to meaning. However, certain vocalizations begin to be used meaningfully between 12 -15 months at the single word stage (Oller, 2000; Davis, MacNeilage &

Matyear, 2002). In this stage, however, infants continue to engage in babbling, using a restricted range of sound combinations and strings of sounds that are not meaningful. Between 12-18 months, children who are developing language typically begin to consistently attach sounds and meanings in ways that are recognizable to adults in their environment and canonical babbling diminishes (see Vihman, 1996, for a review). Accurate production of sounds and sequences in early words is also a gradual process. At first, infants will typically say only part of the word. Often, simple consonant-vowel combinations are used in this early stage (e. g., "ba" for "ball").

Discourse Organization

True intentional communication begins when behaviors such as eye-gaze, vocalizations, and gestures are used consistently in a meaningful context with a communication partner. With a typically developing infant, this process occurs with natural imitation and turn taking between a parent and child. Gros-Louis, West, Goldstein, and King (2006) studied early mother-infant interactions. They found the vocalizations of mother and infant to be largely interspersed rather than simultaneous. Mothers tended to respond to infant vocalizations at least 70% of the time. They tended to respond with another vocalization rather than an action such as smiling. Similarly, eye-gaze is often explored and enhanced through turn-taking games like "peek-a-boo" (Barton & Tomasello, 1991; Bruner, 1983). Gestures develop largely through infant imitation of adult models in the natural environment (Thomasello, 1995; Iverson & Thal, 1998). For example, the infant learns to wave through everyday practice as caregivers demonstrate the physical representation of "bye bye" throughout the day.

In a developing child's world, play and daily routines provide the context for critical early language learning (McCormick, Loeb, & Schiefelbusch, 2003). These activities provide critical "anticipatory sets" in which a sequence of predictable events occur (Paul, 1995). The predictable series of behaviors help the infant organize language and knowledge about the world (Milosky, 1990).

Development in Children with ASD

In studies of the communication development of young children with ASD, overall rates of communication are severely delayed (Wetherby, Watt, Morgan, & Shumway, 2007). In terms of use of communication functions, children with ASD tend to exhibit severe deficits in development of the pragmatic function of "commenting", moderate deficits in development of turn-taking, and minor deficits in development of requesting skills (Mundy & Crowson, 1997). Lack of use of eye gaze and gesture have been found be core deficits in children with ASD. In contrast, rate and types of early vocalizations have not been found to deviate significantly from typical developmental expectations (Mundy, Sigman, & Kasari, 1994; Colgan, Lanter, McCormish, Watson, Crais, & Barek, 2006; Sheinkopf, Mundy, Oller & Steffens, 2000).

In a recent study comparing 50 children with autism to 50 typically developing children and 25 children with developmental delays, Wetherby, Watt, Morgan, and Shumway (2007) found five early communication skills that were more impaired in the children with ASD compared with children who had other developmental delays: (a) rate of communication, (b) use of conventional gestures, (c) following a point or gaze of others, (d) initiation of joint attention, and (e) social referencing. All communication

skills were delayed in children with ASD compared to typically developing children, including inventory of consonants.

Individual Differences

Because each child with autism displays a unique profile of child and family variables, no single intervention approach is appropriate for all children (Pelios & Lund, 2001; Goldstein, 2002). Research of intervention methods for children with autism should include consideration of specific child, family, target behavior and treatment variables (Schreibman, 2000). Understanding of variables that influence treatment may allow for more effective, individualized intervention protocols.

Several predictors have been correlated with development of expressive language in children with autism. For example, Luyster, Kadlec, Carter, Tager-Flusberg (2008) studied the development of 164 toddlers (ages 18-22 months) with ASD. They found that the most significant predictors of expressive language development were non-verbal cognitive ability, gestures, and imitation. Smith, Mirenda, & Zaidman-Zait (2007) tracked the expressive vocabulary development of 35 children (ages of 20-71 months) and found that number of words said, verbal imitation skills, pretend play with objects, use of gestures to initiate joint attention were all correlated with children who demonstrated the most rapid expressive vocabulary growth.

While research regarding response to specific interventions is in its early stages, several studies have examined individual predictors of treatment effectiveness. For example, Sherer and Schriebman (2006) found that high rates of toy play, low rates of avoidant behaviors, and low rates of self-stimulation were correlated with better

responding in children receiving Pivotal Response Training (Koegel et al., 1989). With PMT intervention specifically, high rates of parent responsivity and education, and high rate of child joint attention have been correlated with better response to intervention (Yoder & Warren, 1998; 1999; Yoder & Stone, 2006).

Summary

Children with ASD will characteristically fail to develop intentional communication using intelligible social means (i.e. gestures or words). Intervention for these children should focus on the largest deficits and should be tuned with expectations for typical development (Mundy & Crowson, 1997; Whalen & Schreibman, 2003). Based on present understanding of development for prelinguistic communication skills, children may benefit from learning multiple means of communication across diverse pragmatic functions through play and social routines. These natural formats for communication can allow the child to observe clear, progressive models and consistent, naturally reinforcing consequences. PMT (Yoder & Warren, 1998) is one promising intervention that includes these critical aspects. The remainder of this chapter will focus on review of available research to consider the level of evidence for relevance of implementation of PMT intervention with older ASD children.

EMPIRICAL STUDY OF PMT

Preliminary Efficacy Studies

Efficacy of PMT was examined initially in three studies using a single subject design. Warren, Yoder, and Gazdag (1993) investigated increases in the frequency of

requesting, vocal imitation, commenting, and turn-taking in five children with developmental delays, ages 20-30 months. One of the participants was diagnosed with Down syndrome. The others were described as 'unknown' etiology. All participants scored in the 7-11 month age level on the Receptive-Expressive Emergent Language test (REEL; Bzoch & League, 1971), and the mild-moderate mental retardation level on the Bayley Scales of Infant Development (Bayley, 1993). Results were interpreted by visual analysis of a line graph displaying baseline measures and treatment data across behaviors and participants.

In addition to visual analysis, single subject data can also be evaluated with an effect size calculation. One method is to calculate the percentage of non-overlapping data points (PND; Scruggs & Mastropieri, 1998) or the percentage of intervention data points over the highest data point in the baseline phase. First, the highest baseline data point is determined, and a corresponding line is drawn horizontally over the graph across the intervention data. PND for the intervention data is determined by dividing number of data points that fall above the line by the total number of data points presented in intervention. Scruggs and Mastropieri (1998) suggest that a PND of at least 80% suggests a strong effect size. All participants in Warren, Yoder, and Gazdag's (1993) study demonstrated at least at least 80% of intervention data points over the baseline maximum for frequency of requesting.

Yoder, Warren, Kim, & Gazdag (1994) conducted a follow-up study with four participants, ages 21-27 months. Two participants were diagnosed with Down syndrome and two with developmental delays. Results showed that three of the participants

demonstrated PND over 80% for number of intentional requests, suggesting significant treatment effects for these individuals. In addition to treatment effects, the researchers noted that increases in the children's communication influenced future teacher and parent responses in generalized settings. An increase of 23% was found for percentage of adult responses to child communication acts in the generalization phases compared to the initial treatment phases. Generalization included a teacher interacting with the child in a classroom, and the child's mother in the clinic setting where the initial treatment took place. According to the authors, their results supported the "transactional" model of development (Sameroff, 1975). The transactional model suggests that child and environmental variables are intertwined and influence each other over time in acquisition of knowledge related to language. As children increase their rates of communication, adults become more responsive, which in turn increases the child's communication skills further.

In a third study utilizing a single subject experimental design, McCathren (2000) used teacher-implemented PMT with a 3-year-old child who had severe cognitive and communication delays. The child's primary classroom teacher was taught to implement PMT intervention within the classroom setting. Intervention consisted of 13 sessions (20 minutes each) in which the teacher implemented PMT intervention in small group or one-on-one activities in the classroom. Specific techniques identified included: (a) environmental arrangement, (b) following the child's lead, (c) physical and vocal imitation, (d) modeling, and (e) developing play routines. Following intervention, the child increased his overall intentional communication acts, as demonstrated by a multiple

baseline design across behaviors. He increased eye contact, vocalizations with consonants, and use of conventional gestures during three phases of PMT intervention where these behaviors were specifically targeted. At least 80% PND was obtained for each intervention phase.

Comparative Studies

The group design research that followed (Yoder & Warren, 1998, 1999, 2001) compared PMT to other methods such as Responsive Small Group treatment (RSG; Wilcox, 1992). Responsive Small Group treatment was described as a trainer participating in parallel play with a group of three children. The trainer responded to the children's communication acts, but did not place any demands or prompt them to respond in any precise way.

In the first study, Yoder and Warren (1998) used PMT with 28 children and RSG with 30 children. Participants were included based on the following characteristics: (a) 17-36 months of age, (b) mental developmental index (MDI) between 35-85 on the Bayley Scales (Bayley, 1993), (c) fewer than ten words by parent report and language sample, and (d) demonstration of at least one communication in pretreatment communication samples. Two of the participants were diagnosed with 'Pervasive Developmental Disorder-Not Otherwise Specified', which falls within the range of ASD. Twenty-one of the children were described as African-American and four were Hispanic. Although no significant treatment effects were found for PMT relative to the children's use of intentional communication, researchers found that maternal responsiveness prior to treatment predicted the child's progress with PMT. Using multiple regression analysis,

parent responsiveness was compared to treatment effects for both PMT and RSG groups. High levels of parent responsiveness, defined as parents providing models of communication and natural consequences, were positively correlated with increases in the children's development of proto-imperatives (requests) and proto-declaratives (comments).

In a follow-up study, Yoder and Warren (1999) re-examined data from the 58 children in Yoder & Warren (1998). Multiple regression analysis was used to determine interaction between pre-treatment maternal responsiveness and treatment effects. As an extension, the effects were based on data at the end of treatment and at a 6-month follow-up. Significant interactions were found for the number and rate of self-initiating proto-imperatives (requests) at both the end of treatment and the follow-up period.

In a third study, Warren and Yoder (2001) analyzed additional data for a 12-month follow-up. The authors used hierarchical linear modeling (HLM) to help interpret the growth curve of treatment effects. HLM produces a visual display to allow comparisons of different variables (i.e. maternal responsiveness) across time for each of the treatment groups. HLM analysis showed that children with highly responsive mothers experienced more rapid growth using PMT, with growth continuing to a 12-month follow up. Another factor, parent education, was also found to be a predictor of growth with PMT. Children with parents who had higher levels of education made more progress using PMT than children in the RSG group overall.

Following earlier findings about the importance of parent responsiveness to the success of PMT, the component of responsiveness education (RE) was added as a critical

part of the PMT intervention package. Beginning in 2002, Warren and Yoder (2002) implemented parent training component in all studies of PMT. Responsiveness education involved parent education and support sessions designed to teach parents to respond to their children's communication acts. The RE parent training was described as being similar to the Hanen parent education framework (Manolson, 1992) in which parents attend weekly group trainings paired with specific individual practice and feedback each week. Parents were trained in *linguistic mapping*, *compliance* to child communication, and *imitation* of child vocalizations. *Linguistic mapping* was defined as the adult responding to a child's nonverbal communication act by translating the child's intent into linguistically symbolic words. *Compliance* referred to responding to the communication act by giving the child what he requested. *Imitation* of vocalizations was when the adult responded to any vocalization that the child made by echoing that vocalization. The amount of parent training varied, and there were no qualitative criteria for success enumerated for the parent education phase.

Combination of PMT and RE

The next phase of empirical study focused on the combination of responsiveness education and basic procedures of PMT referred to as RPMT or RE/PMT (Yoder & Warren, 2002, Fey et al., 2006; Yoder & Stone, 2006a, 2006b). After controlling for parent responsivity by adding the parent training component prior to PMT intervention, these studies aimed at investigating how child variables, such as pretreatment characteristics and diagnosis, impacted the efficacy of PMT.

Yoder and Warren (2002) studied 17 children with Down syndrome and 22 children with other developmental disabilities (including William's syndrome and cerebral palsy). One participant was later diagnosed with ASD. The median age of both the control and experimental groups was 22 months. Nineteen of the participants were African-American. Using HLM analysis procedures, the authors found that children with lower pretreatment rates of babbling and "commenting" pragmatic function use made larger gains with PMT. The authors concluded that children with higher rates of babbling and "commenting" would be better served by linguistic communication goals as opposed to prelinguistic intervention.

This finding indicated that there might be a potential cap on the extent to which prelinguistic skills can develop in terms of rate and complexity. Once children reach a certain level of prelinguistic development, the next step is linguistic development. There is no more potential for progress with prelinguistic skills because they have already reached maximum potential, according to the authors. Additionally, children in the "other developmental disabilities" group were found to make greater gains than children with Down syndrome. Children with Down syndrome tended to demonstrate higher rates of "commenting" prior to treatment and thus fell into the higher functioning group that would benefit maximally from linguistic goals. Another possibility is that the dependent variables studied, such as gestures and vocalizations, involved motor movements that presented more difficulty for children with Down syndrome. Children with Down syndrome typically have more motor impairments than children with other developmental disabilities, such as autism (Virji-Babul, Kerns, Zhou, Kapur, & Shiffrar, 2006).

Specific Disorder Categories

Finally, studies of RE/PMT have been implemented within specific diagnostic categories, such as Down syndrome and autism spectrum disorders (ASD). Fey et al. (2006) followed 51 children, ages 24-34 months with Down syndrome using a random group design. Half of the children in each group (control and treatment) had Down syndrome. Five of the children were African-American and four were Hispanic. The treatment group received 6 months of RE/PMT, while the control group received no treatment. Multivariate analysis showed effects for the PMT treatment group on overall intentional acts. Overall intentional acts were defined as any non-imitative communication attempt, including all proto-imperatives (requests), proto-declaratives (comments), greetings, and protests. In contrast to Warren and Yoder (2002), no effects on child outcomes due to the presence or absence of Down syndrome were found.

In a follow-up study with the same Down syndrome participants, Warren, Fey, Finestack, Brady, Bredin-Oja, and Fleming (2008) investigated whether the treatment effects found in Fey et al. (2006) would be maintained or increased following the initial 6 months of intervention. During the first 6 months following commencement of intervention, the children received no therapy. Then, during an additional 6 months, 45 minutes per week of PMT therapy and 6 sessions of RE was provided. No significant treatment effects were found for either follow-up (6 months or 12 month). Thus, no long-term benefits were found for PMT/RE intervention continuing beyond the first 6 months of intervention.

In addition to children with Down syndrome, PMT has been studied in young children with autism spectrum disorders (ASD). Yoder and Stone (2006a) investigated 36 children, ages 2-5, with mild to moderate ASD in a randomized group design. Eight of the children were African-American and three were "other". The control group was taught using PECS. Pretreatment, post-treatment, and follow-up measures were analyzed. Significant effects were found for the frequency and number of non-imitative spoken words for the PECS group at post-treatment, but not at follow-up. The authors again used HLM analysis to examine the impact of object exploration; the amount of time that the child attended to toys and objects in the environment. Results indicated that children who began treatment with low object exploration made larger gains in frequency and number of spoken words with RE/PMT than with PECS.

In a second study with the same group of children, Yoder and Stone (2006b) investigated the effects of child variables, such as pretreatment joint attention, on the pragmatic intentions of requesting, commenting, turn taking (object exchange), and initiating joint attention with the same ASD participants. Turn-taking, commenting, and joint attention were found to be more positively affected by RE/PMT than requesting, which was increased more in the groups receiving PECS training. Additionally, children with at least some joint attention skills, quantified as using at least seven initiative joint attention acts during pre-testing, made the most progress using PMT (Yoder & Stone, 2006b). This finding is also in contrast to Yoder and Warren (2002) where children with lower rates of commenting made larger gains in prelinguistic skills with PMT. In both of the Yoder and Stone studies (2006 a, 2006b), children with ASD made more progress

with turn-taking and initiating joint attention when they had higher rates of commenting pre-intervention.

Summary

Table 3 lists studies evaluating PMT. Between 1993-2008, eleven studies have examined treatment effects. Twelve different authors were involved in the studies. Participant numbers ranged from 1-58, with a mean of 35. The children involved ranged from 18-60 months in age, with the vast majority (80%) under age 32 months. Participants were diagnosed with developmental delays, and included etiologies of Down syndrome, prematurity, failure to thrive, autism spectrum disorders, cerebral palsy, Angelman's syndrome, Fragile X, and fetal alcohol syndrome. Frequently, however, participant etiology was unspecified. Six studies identified minority demographics, including low SES, as well as African-American and Hispanic ethnicity. However, results were never evaluated based on ethnicity. Three studies employed single subject designs and eight used randomized group design. Of the eight group studies, five compared PMT to another intervention, such as PECS (Bondy & Frost, 1994) or RSG (Wilcox, 1992).

Table 3: Summary of PMT studies

Study	N	Age	Disability	Minority	Design	Results
Warren, Yoder, Gazdag (1993)	5	20-30 mo	Down syndrome; Developmental delays	None specified	Multiple Baseline	Increases in requesting for all 5 participants; increase in commenting for 1 participant
Yoder, Warren,	4	21-27	Down syndrome;	Low SES	Multiple Baseline	Increases in requesting for all 4

Kim, & Gazdag (1994)		mo	Developmental delays			participants
McCathren (2000)	1	3 ½ years	Developmental delays	None Specified	Multiple Baseline	Increase in child's intentional communication acts, eye-contact, and vocalizations with consonants
Yoder & Warren (1998)	58	17-32 mo	Developmental delays; Down syndrome, pervasive developmental disorder	36% African American; 7% Hispanic	Random group with comparison	No main effects; high levels of parent responsivity were positively correlated with growth
Yoder & Warren (1999)	58	17-32 mo	Developmental delays; Down syndrome, pervasive developmental disorder	36% African American; 7% Hispanic	Random group with comparison	Increases only for families with high levels of responsivity
Yoder & Warren (2001)	58	17-32 mo	Developmental delays; Down syndrome, pervasive developmental disorder	36% African American; 7% Hispanic	Random group with comparison	Growth rate higher for high levels of parent responsivity and education level
Yoder & Warren (2002)	39	Median of 22 mo	Down syndrome, intellectual disabilities, cerebral palsy, autism	49% African American	Random group	No main effects; higher growth rates with no Down syndrome, low babbling, & low comments
Fey et al. (2006)	51	24-33 mo	Down syndrome, developmental delays	10% African American; 8% Hispanic	Random group	Significant treatment effects for overall intentional acts
Warren et al. (2008)	51	24-33 mo	Down syndrome, developmental delays	10% African American, 8% Hispanic	Random group	No main effects found for long-term, low intensity treatment
Yoder & Stone (2006a)	36	18-60 mo	Autism, Pervasive Developmental Disorder	22% African American; 8% other	Random group with comparison	More increase when have low object exploration

Yoder & Stone (2006b)	36	18-60 mo	Autism, Pervasive Developmental Disorder	22% African American; 8% other	Random group with comparison	Significant effect on turn taking; high joint attention pretreatment had significant effect on initiating joint attention

Available studies have built on one other. The PMT approach has been progressively adapted based on findings of earlier studies. The first two studies utilized single subject designs and reported increases in requesting skills for all nine participants (Warren et al., 1993; Yoder et al., 1994). The second set of studies (Yoder & Warren, 1998, 1999, 2001) found no significant differences between the two intervention groups, suggesting that the children who made the most gains in prelinguistic communication using PMT had parents with high levels of education and responsiveness to their child.

Following these initial results, "responsivity education" was added to PMT. Yoder & Warren (2002) examined the use of RE/PMT with a group of 39 toddlers, half of whom had Down syndrome No significant differences were found between treatment and control groups. However, children with lower pretreatment rates of commenting and babbling made more gains. Children with Down syndrome did not make as much gain in prelinguistic communication as children with other developmental disabilities.

Fey and colleagues (2006), subsequently found that children receiving PMT made more gains in overall communication acts, but not in one specific type of act (i.e. commenting). In contrast to Yoder & Warren (2002), Fey et al's (2006) study did not show a lower effect for children diagnosed with Down syndrome. In a follow-up study

with the same participants, Warren et al. (2008) did not find any addition effects when PMT/RE was continued beyond the initial six months of intervention.

Finally, Yoder and Stone (2006a, 2006b) compared PMT to PECS (Bondy & Frost, 1994) in preschoolers with ASD. They found that PECS was superior for teaching requesting, while PMT resulted in higher rates of commenting, joint attention, and turn-taking. Additionally, children who had higher rates of pretreatment commenting made the most progress with PMT.

DISCUSSION

Overall Quality of Evidence

In summary, the eleven available studies of PMT intervention have indicated that some children between the ages of 2-5 with mild to moderate developmental delays demonstrated significant progress with the development of some types of nonverbal communication skills. In single subject research designs, children increased rates of use of pragmatic functions of requesting and commenting, as well as frequency of turn-taking (Warren et al., 1993; Yoder et al., 1994). Fey et al. (2006) found that children taught using PMT had significantly more overall intentional communication acts compared to a control group who received no treatment. However, treatment effects did not achieve significance levels needed to establish that PMT is superior to other approaches, such as PECS (Yoder & Warren, 1998, 1999, 2001; Yoder & Stone, 2006a, 2006b).

Present findings suggest that both parent and child variables may influence the relative effectiveness of PMT. High rates of parent responsiveness and education level

were correlated with children's progress using PMT (Yoder & Warren, 1998, 1999, 2001). Children with low rates of vocal babbling and commenting (Yoder & Warren, 2002), low object exploration (Yoder & Stone, 2006a), and some joint attention skills (Yoder & Stone, 2006b) developed prelinguistic skills most rapidly with PMT.

Limitations of the Current Research

Several studies of PMT have demonstrated support for implementation with populations of children who have distinct family characteristics and pretreatment skills. Evidence supports PMT for teaching turn-taking to young children, ages 3-5, with autism who have at least some joint attention skills and parents with higher education levels (Yoder & Stone, 2006a, 2006b). Additionally, research supports using PMT for teaching intentional communication acts to young children with Down syndrome who have parents with high levels of responsivity (Fey et al., 2006).

Beyond these two chronologically younger populations, there are considerable limits to understanding the potential for generalizing implementation of PMT to other populations with more severe levels of developmental disability. Limitations of available research on PMT involve participant variables for the children studied. Participants were limited in terms of age ranges, disability categories, and level of severity of impairment.

A narrow age range has been studied. All of the children described were under five years old. The vast majority were under 36 months of age. Many children with severe disabilities function at the prelinguistic level far beyond this chronological age. There is no discussion of how PMT might support increases in communication function for older children who persist at a prelinguistic developmental level. For these children,

there may be no expectation that PMT intervention can lead to later normalization of linguistic capacities. Prelinguistic capacities targeted by PMT may be the highest level of communication achieved. Implementation of PMT with this population of chronologically older children who are developmentally young is important to explore in terms of the potential progress in development of prelinguistic skills. In addition influences of the development of prelinguistic skills on maintaining consistency of communication over time is a critical issue of importance for this population.

Another limitation involves the degree of intellectual and physical impairment of participants. Children in the series of PMT studies were described as having mild to moderate intellectual disabilities. Children with more severe disabilities need study, as this population is most likely to remain at the prelinguistic communication level over prolonged periods (Mundy & Crowson, 1997).

As the potential for individuals with severe to profound disabilities to develop spoken communication may be limited, development of appropriate prelinguistic communication capacities may be paramount to achieving an optimum level of communication function across the lifespan. Learning to use gestures instead of tantrums to communicate a need could improve the lives of not only the individual with disabilities, but also caregivers providing support for the individual. Change in mode of communication from disruptive behavior to intelligible modes of prelinguistic communication might allow for less-restricted educational, vocational, and residential environments (Sigafoos, Arthur-Kelly, & O'Reilly, 2003).

Conclusions

PMT is a relatively new intervention approach available to clinicians through review of empirical studies or textbooks on early intervention. A series of studies have been conducted to examine the effects of PMT, as well as parent and child variables that may influence intervention outcomes. The eleven studies on PMT intervention largely used well-constructed experimental designs, controlled for bias, and treatment protocols that are reasonable in terms of the timeframe and ease of implementation in clinical settings. Available research supports use of PMT with Anglo and African-American children with developmental delays ages 2-5 who are nonverbal and functioning at the 9-15 month level of communication development.

The goal of this study is to investigate efficacy of PMT for chronologically older individuals diagnosed as ASD who have severe levels of communication disability. This broader level of inquiry could have an impact in developing communication interventions targeted in a population of older individuals with ASD who have severe-profound communication disability.

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CHAPTER 3

Methodology

The purpose of the present study was to investigate the effects of Prelinguistic Milieu Teaching (PMT) intervention with school-age children diagnosed with moderate to severe autism spectrum disorders. The goal of PMT intervention is to help children establish or increase the frequency, clarity, and complexity of their nonverbal communication (Warren, Bredin-Oja, Farichild, Finestack, Fey, & Brady, 2006). The following questions were posed in evaluating the efficacy of PMT for intervention with ASD children who are operating at the prelinguistic level of vocal communication.

1. What is the effect of PMT on the *frequency* of the child's communication measured by the rate of child-initiated communication acts?
2. What is the effect of PMT on the *clarity* of child's communication measured by consistency of use of combined means of communication?
3. What is the effect of PMT on the *maintenance* of child-adult interactions within an activity measured by the number of child communication turns?

The predicted hypothesis is that implementation of PMT will result in increases in frequency, clarity, and maintenance of communication exchanges. The children were taught to take turns in social routines and combine gestures, eye-contact, and vocalizations as a means of accomplishing the pragmatic intentions of "requesting", "commenting", and "protesting". This chapter will be organized to reflect the methods in which these questions were evaluated.

PARTICIPANTS

Previous study of PMT intervention has focused on young children ages 2-5 with mild to moderate developmental delays. The purpose of this study was to expand the literature by focusing on a population of older children, diagnosed with autism, who demonstrate severe and persisting delays in communication skills. This section provides details on the participants selected for the study.

Inclusion Criteria

All participants met the following inclusion criteria:

1) *Diagnosis of moderate to severe autism spectrum disorder (ASD)*: All participants had an independent diagnosis of Autistic Disorder. The Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1993) was administered to classify the severity of autism. Further description of the CARS is provided in the "Procedures" section.
2) *Severe impairment in expressive and receptive communication*: To determine the current developmental level of communicative functioning, the Receptive-Expressive Emergent Language Scale, 3rd version (REEL-3, Bzoch, League, & Brown, 2003) was administered. Description of the REEL-3 is provided in the "Procedures" section. All participants had to score below the 18-month chronological age for both receptive and expressive language for inclusion in the study.
3) *Chronological ages of 5-8*: Participants within this chronological age range who function at the prelinguistic level would demonstrate severe and

persistent disabilities in age appropriate language functioning rather than developmental delay in language comprehension or production.

4) *Nonverbal level of communication functioning*: Nonverbal was defined as not using spoken language functionally. Participants were considered nonverbal if they used fewer than ten spoken words, as indicated by parent report and a natural communication sample with a familiar communication partner taken during the assessment portion of the study.
5) *No established evidence of severe visual, hearing, or motor impairment*: Lack of visual, hearing, and motor impairment was established via parent report (see Appendix A). Children with these impairments could present additional obstacles to learning the prelinguistic communication skills taught in this study, confounded the results.
6) *Lack of target prelinguistic communication skills (vocalizations, gestures, and eye gaze)*: Participants could not consistently and functionally use nonverbal means, including pointing, other gestures, vocalizations and/or and eye gaze for communicating. Lack of target prelinguistic communication skills was verified through parent report and a language sample in the child's familiar functional communication environment. The child could use no more than one identified communication act per 10-minute period. Details regarding the parent interview and language sampling are described in the "Procedures" section.

7) *English spoken as primary language in the home and school*; Language exposure was documented on the parent case form relative to dominant language use in the child's home and community. The researcher was not proficient enough in any language other than English to conduct the intervention involved in the current study. As a result, participants were from homes where English was the dominant language spoken to the child, based on parent report. Children from bilingual homes were not disqualified from participation if the parents could successfully communicate with the researcher in English.

Participant Descriptions

Participant demographics as reported in the parent interview are displayed in Table 4. To protect confidentiality, all participants are referred to by a "code name". Of the six participants, five (83%) were male and one (17%) was female. Two (33%) were Hispanic, two (33%) were Asian, one (17%) was White, non-Hispanic, and one (17%) was identified as White - Pacific Islander. Three participants were 5 years of age, two were 7 years of age, and one was age 8. All participants had an independent diagnosis of autism or autism spectrum disorder made by a medical physician. One had a secondary diagnosis of Sensory Integration Disorder. All six participants attended public school. All six participants received speech therapy, five received occupational therapy, and four received ABA therapy.

Table 4: Participant descriptions

Child	Age	Gender	Race/ Ethnicity	Diagnosis	Education Setting and Therapy
Adam	5;9	Male	Asian-American	Autism Spectrum Disorder	Structured learning classroom, private speech therapy, in-home ABA
Cody	5;4	Male	Hispanic	Autism	Structured learning classroom, speech therapy at school, in-home ABA
Ben	5;1	Male	Hispanic	Autism	Autism classroom, private speech and occupational therapy, in-home ABA
Sam	7;5	Male	White, non-Hispanic	Autism	Autism classroom, speech and OT at school
Lily	7;6	Female	Asian-American	Autism	Lifeskills classroom, speech and occupational therapy at school
Chad	8;3	Male	White, Pacific-Islander	Autism, Sensory Integration Disorder	ABA classroom, speech and occupational therapy at school

Participant Test Results

Individual results of the two standardized measures, REEL-3 (Bzoch, League, & Brown, 2003) and CARS (Schopler, Reichler, & Renner, 1988) can be found in Table 5. All participants demonstrated an expressive language score between 5-9 months and a receptive language score between 5-12 months. Additionally, all participants scored in the "severely autistic" range on the CARS, with total scores ranging from 38 to 48.

Table 5: Pre-intervention scores on REEL-3 and CARS

Participant	Expressive Language Age-Equivalent (REEL-3)	Receptive Language Age-Equivalent (REEL-3)	CARS Total Score
Adam	9 months	9 months	40
Cody	7 months	12 months	38
Ben	5 months	6 months	46
Sam	8 months	8 months	40

Lily	8 months	8 months	49
Chad	6 months	5 months	48

Recruitment

Following approval of the study and consent forms, and recruitment flyers by the Institutional Review Board at UT-Austin, participants were recruited via a flyer (see appendix B). Flyers were sent to: (a) members of autism advocacy groups, parent support groups, and internet chat groups in the central Texas area, (b) parents of children attending local private schools and clinics that serve children with autism, and (c) autism specialists in local public school districts. Interested parents or guardians contacted the researcher through information provided on the flyer. The researcher phoned parents to discuss the study and answer any questions. Following the initial phone contact, the researcher met with parents in person to review the documents approved by the University of Texas at Austin's Internal Review Board and obtain written consent. Nine families contacted the researcher about the study, and six participants were enrolled in the study. Two children were disqualified because they did not meet the age requirements and one was disqualified because he did not have a diagnosis of ASD.

Every attempt was made to ensure that the participant pool matched the range of demographics of Texas. According to the US census bureau (2007), the following demographics are represented in Texas: 50% White, non-Hispanic, 35% Hispanic or Latino, 12% African-American, and 3% Asian.

SETTING

Previous studies of PMT intervention has shown that children with parents who demonstrate high levels of parent responsivity make stronger gains during treatment (Yoder & Warren, 1998; 1999; 2001). Thus, the home setting was chosen for intervention to ensure that parents were able to observe sessions and to help facilitate generalization of skill use to the family. All study sessions were conducted in the participant's home with a parent or guardian present. Although parents were not formerly trained in PMT intervention, they were present during the intervention. The researcher discussed the goals, procedures, and activities with parents after intervention was begun. Communication development at this stage is facilitated by frequent interactions with caregivers (Brady, Marquis, Fleming, & McLean, 2004; Calendrella & Wilcox, 2000). The goal of interactions during the intervention was to support parents in developing potential strategies to improve their child's communication during daily routines as well as in the social routines developed during the intervention. Toys, materials, and activities that were part of the child's natural home or school environment were utilized to support interactions based on PMT techniques employed in the study. Activities were selected based on recommendations by the parents obtained during the parent interview and observations of the child's play during baseline sessions.

TARGET BEHAVIORS

Child target behaviors or dependent variables for PMT intervention included (1) frequency of intentional communication and (2) clarity of intentional communication,

and (3) maintenance of intentional communication. An act was considered intentional if the child purposefully and clearly attempted to communicate with the adult communication partner (for the purposes of this study, the communication partner was the researcher).

Frequency of the child's communication was assessed by counting the number of times the child initiated intentional communication during each session. An act was considered intentional if the child purposefully and clearly attempted to communicate with the adult communication partner (for the purposes of this study, the communication partner was the researcher). The intentional communication act could be in the form of a pragmatic "request", "protest", "comment", or "other", as described in the following table 6.

Table 6: Description of pragmatic functions

Function	Definition	Example
Requesting	The child communicates for the purpose of requesting an item, action, or event.	Child points to a desired toy and looks at adult.
Protest	The child communicates for the purpose of rejecting an item or protesting an activity.	Child pushes cup away when it is offered.
Commenting	The child directs the adult's attention to an object or event for the purpose of sharing knowledge.	Child says "buh" while popping bubbles.
Other	The child communicates in a way that is not considered a comment, protest, or a request.	Child may use a social greeting, such as "hi" or fill in words to a song..

Clarity of the communication acts was evaluated in terms of the child's ability to combine means of communication to create a clear message. While many different means of prelinguistic communication are possible, three clear and developmentally appropriate

means of communication that are also supportive of functional communication for non-verbal children were targeted in this study. Specific communication means that the child could use for communicating included:

- "Gesture" when a child pointed by extending his finger toward an object or event or used a representational or conventional action, such as a head nod, wave, or upturned palm. For a complete list of potential gestures, see Appendix C.
- "Vocalization" when the child produced any speech sound, word, or word approximation.
- "Eye gaze" when the child made direct eye-contact with the adult for at least 2 seconds.

Maintenance of the child's communication was evaluated by counting the number of turns a child took within a social interaction. Within each social routine or activity, the child could communicate only once and move on to another activity or he or she could take multiple turns within the same activity. The number of child turns reflected his or her ability to maintain focus on the same interaction with the adult for an extended period of time.

PROCEDURES

Four distinct phases were included in this study in order to control for extraneous variables and evaluate treatment effects. First, a pre-baseline assessment was conducted to verify participant qualifications for the study and determine specific behavioral and communication profiles of the participants. Secondly, a baseline condition was conducted

with each participant to evaluate the participants' performance within each of the specific dependent variables (frequency, clarity, and maintenance of communication) prior to intervention. Next, an intervention phase was completed for each participant, in which each participant received fourteen sessions of PMT intervention. Finally, a follow-up phase was conducted following a 4-6 week "break" after the intervention phase to evaluate whether the communication skills gained during intervention persisted even without continued intervention.

Prior to recruitment of participants, IRB approval was obtained from the University of Texas. Prior to the assessment phase, the study was explained to the parents and proper consent was obtained based on IRB approved consent forms. The initial evaluation, baseline sessions, and treatment sessions were conducted by the study author, a licensed Speech-Language Pathologist (CCC-SLP) and Board Certified Behavior Analyst (BCBA). In the following descriptions of the study, the author will be referred to as "the researcher".

Assessment (pre-baseline)

To verify that participants met selection criteria for the study, all participants took part in an initial evaluation. Four sources of information were utilized: (a) parent interview (see Appendix A), (b) REEL-3 (Bzoch, League, & Brown, 2003), (c) CARS (Schopler, Reichler, & Renner 1988), and (d) a 10-minute spontaneous communication sample in a familiar setting with a familiar communication partner. The initial evaluation took approximately two hours. Following evaluation, the researcher scored the REEL-3 and the CARS and coded the communication sample in order to assess if the child

qualified for the study. If the participant met all of the identified inclusion criteria during assessment, the researcher contacted the child's parents and scheduled the first baseline session. If the participant failed to meet one of the inclusion criteria during the assessment phase, then the researcher contacted parents to explain why he or she was not allowed to continue in the study.

Parent Interview

In order to obtain participant variable information and determine qualification for the study, parents of participants were interviewed. Parents were asked a series of questions regarding their child's communication skills in order to verify that their child did not already communicate frequently and clearly using either verbal or prelinguistic communication. The questions asked in the interview can be found in Appendix A. First, the interview included questions regarding the families' ethnic and linguistic status, such as the language spoken in the home, as well as background information on the child, such as age, and medical history, such as potential physical or sensory impairments. Secondly, they included questions about the participant's communication skills. The interview was conducted in a semi-structured format, with the researcher explaining questions as needed.

Receptive Expressive Emergent Language Scale-3rd Edition (REEL-3)

In order to evaluate participants communication skills and verify a severe impairment in receptive and expressive communication, the REEL-3 (Bzoch, League, & Brown, 2003) was administered. The REEL-3 is a developmental checklist employed to determine each participant's developmental level for both expressive and receptive

language skills in the birth-3 developmental range. The two sections (receptive language and expressive language) of the REEL-3 each contain a developmental hierarchy of skills, with 132 total test items. Test items were developed through compilation of transcripts obtained during clinical sessions with infants and toddlers at the University of Florida, as well as review of text and research reports on early language acquisition. Each skill that the child currently demonstrates is scored, and the most advanced skill observed in each area determines an approximate development age. Subtests include: Receptive Language Age, Receptive Quotient, Expressive Language Age, Expressive Quotient, Combined Language Age and Language Quotient. The demographic characteristics of the normative sample roughly match the US population, including: 12% African American, 12% Hispanic American, 3% Asian American, and 2% Native American. Additionally, the sample was equally distributed across geographic region, family income, and gender. Because the assessment was standardized only for children up to age 3, the standard scores and percentile ranks could not be determined. However, age equivalents were determined by scoring all test items and converting the raw scores to age equivalents. This was considered an appropriate measure because of the severity of the language impairments in participants in the present study. Currently, no standardized instruments exist for assessing prelinguistic language skills in older children.

Childhood Autism Rating Scale (CARS)

In order to verify a moderate to severe level of autism, the CARS (Schopler, Reichler, & Renner, 1993) was administered. The CARS is a rating scale that determines a level of autism ranging from "non-autistic" to "severely autistic". The CARS was

initially developed as an administrative and research tool for the TEACCH program in North Carolina. The items on the CARS were derived from criteria on the Diagnostic Statistical Manual, 3rd Edition, Revised (DSM-III-R; American Psychiatric Association, 1987) as well as clinical experience. The child is given a severity rating of 1-4 in 15 different areas associated with autism. See Appendix D for a list of areas. The total summed score of all 15 areas is used to determine the level of severity of autism. A total score of 15-29 suggests non-autistic. A score of 30-37 suggests that the individual is mildly-moderately autistic. Finally, a score of 38-60 suggests that the individual is moderately-severely autistic.

Communication Sample

In order to verify participant criterion, such as rate of intentional communication (maximum of 1 act per 10-minute sample) and nonverbal status (maximum of 10 spoken words), the researcher gathered a communication sample during a 10-minute direct observation period. The researcher video-taped the child interacting naturally with the parent during typical daily routines, such as snack or play.

First, the researcher took frequency data of the child's naturally occurring communication acts. Communication acts included spoken words or vocalizations, gestures, eye gaze, or pointing for the purpose of requesting, commenting, negating or turn-taking as defined previously. The communication acts were recorded and coded as described in the "Data Collection" section. As previously discussed, this set of information gathered from the communication sample was only used to verify qualification for the study.

Additionally, parent variables were investigated during the communication sample in order to examine parent input behaviors described as influencing results of previous studies on PMT. This information was included because parent variables have been found to influence the relative success of PMT intervention. Higher rates of parent responsivity (providing models of communication and natural consequences) were correlated with larger increases in target child behaviors (commenting, requesting, and turn-taking) in children receiving PMT intervention (Yoder & Warren, 1998 1999, 2001, 2002). Specifically, the parent's initiation of an interaction and response to child's communication attempts was recorded. Parent initiation was coded as any instance where the parent commented on the child's focus item or activity, presenting a model or cue for the child to interact. Parent initiations could *not* be in the form of a request or demand of the child. These types of demands were recorded as parent directives. Parent response was any time the parent acknowledged the child's communication attempt. Parent response could be in the form of imitation, expansion, or compliance. Imitation was when the parent directly imitated the child's exact behaviors. Expansion was when the parent added to the child's communication. For example, the parent said, "ball" when the child pointed to a ball. Compliance was when the parent responded to a request made by the child, such as providing a desired item.

Children were not excluded from the study based on parent responsivity. These measures, quantified in terms of rate of parent initiation and response per session, were used to evaluate results of the study. In particular, if individual differences in response to

PMT intervention occurred, the parent responsiveness variable was included to evaluate potential sources of difference in child participant's response to PMT intervention.

Baseline (pre-treatment)

Baseline or pre-treatment sessions were conducted to establish a measure of the frequency, clarity, and maintenance of the participants' communication prior to intervention. During baseline sessions, the researcher interacted naturally with each child without explicitly teaching the child to use prelinguistic communication tools that would be targeted during intervention.

Intervention (treatment)

During intervention sessions, the independent variable, PMT intervention, was administered. The child was taught to use prelinguistic communication skills through implementation of PMT techniques as described in available research protocols and textbooks on language intervention (e.g. McCauley & Fey, 2006). These techniques as they were implemented in this study are described in the following two sections.

Enabling Context

The key component of PMT is to create an "enabling context" by arranging the environment and using social routines (Warren et al., 2006). Prior to beginning intervention, the researcher arranged the environment to create an "enabling context" such that the child would be more likely to initiate communication. For example, preferred items were placed in sight, but out of the child's reach. Procedures were embedded in social and play activities (Fey et al., 2006). The researcher followed the child's attention and motivation (within the arranged environment), allowing the

activities to be "child led". For example, if the child attended to a blanket, the researcher attempted to play peek-a-boo.

Teaching Episodes

During the intervention, the researcher conducted a series of teaching episodes in which a specific child behavior was targeted and taught using a sequence of prompts, models, and natural consequences, as described in PMT studies. A teaching episode generally began with the adult's creating a situation in which the child was likely to communicate and ended with a natural consequence (Warren et al., 2006). "Natural consequences" included responding accordingly to a request or smiling and nodding when the child commented or took a turn. For example, the adult could deliver a drink when the child pointed to it. Teaching episodes were implemented at an average rate of 1 per minute (Warren, 2005).

Typically, a gestural and/or verbal prompt was given if the child did not attempt communication after an opportunity was created. "Prompts" included verbal or gestural cues that it was the child's turn to communicate. For example, the researcher could act surprised and point to an item.

After a prompt was given, the researcher made a brief pause to allow the child time to respond. If the child did not respond to the prompt within a few seconds, the researcher modeled an appropriate response. "Models" included examples of gestures and vocalizations that the child was not prompted to directly imitate. For example, the adult could say and sign "ball" while playing with the ball.

If the child still did not engage in the target behavior, the researcher continued with the interaction or routine. The researcher attempted to avoid using a directive manner throughout the episode and continued to follow the child's attentional lead.

Descriptions and examples of these techniques are described in Table 7:

Table 7: Description of adult intervention techniques

Procedure	Technique	Examples
Prompts	Verbal cue	Adult asks, "What do you want?"
	Gestural cue	Adult opens and raises hands quizzically when the child attends to a toy nearby.
Models	Gesture model	Adult models a point to a bottle of bubbles on a shelf.
	Vocal model	Adult models the sound "m" while waving a blanket over the child's head.
Natural Consequences	Compliance	Adult delivers a cup that the child indicated by pointing to it.
	Imitation	Adult immediately echoes the sound "b" that the child made during vocal play.
	Recast	Adult says "ball" when the child points to it.

Follow-up (post-treatment)

Four to six weeks after intervention concluded, two or three more intervention sessions were conducted to observe maintenance of the target skills. During the break in intervention, no contact between the therapist and child occurred. Parents were not instructed to use PMT intervention during the break, nor were they formally trained on how to implement PMT techniques. However, because a parent was present during all of the intervention sessions and parent questions regarding the intervention were answered as they occurred, it is anticipated that some of the parents could have utilized some of the treatment techniques.

EXPERIMENTAL DESIGN

The study was designed to allow for evaluation of the effects of the independent variable, PMT intervention, on the dependent variables, frequency, clarity, and maintenance of the participants' communication. A multiple baseline design across participants was used to determine treatment effects (Horner & Baer, 1978).

In a multiple baseline design, each child serves as his or her own control by comparing changes in rates of the dependent variables (child's communication acts and turns within an activity) before and after the introduction of an independent variable (PMT intervention). This study utilized a nonconcurrent multiple baseline design (Watson & Workman, 1981) in which baseline begins as participants are recruited rather than waiting until all participants are recruited and beginning baseline at the same time. This design is often beneficial for research conducted in applied settings, as it allows greater flexibility in participant recruitment. A nonconcurrent multiple baseline design was chosen for this study because it was unclear how long it would take to recruit all six participants. This design allowed participating families to begin the study immediately after they were assessed rather than requiring them to wait for an unknown period of time. Baseline durations of 3-10 sessions were randomly selected for the six participants prior to beginning intervention. The duration of baseline was assigned to each participant recruited based on the order in which they began the study. For example, the first duration randomly selected was "5", so the first participant received five baseline sessions. The sixth and last duration selected was "3", so the 6th participant received three baseline sessions.

All baseline, treatment, and follow-up sessions lasted 25-30 minutes. When a participant completed the previously determined number of baseline sessions, he or she began intervention at the next scheduled session. All participants received 14 treatment sessions at the rate of 2 per week. Determination of the number of treatment sessions implemented was based on information from prior studies of PMT using multiple baseline design, in which increases in behaviors across participants were demonstrated within 10-15 sessions (Yoder, Warren, Kim, & Gazdag, 1994). Beginning 4-6 weeks after the final treatment session, two or three additional sessions were conducted during the follow-up phase at the rate of one session per week.

DATA COLLECTION AND ANALYSIS

All assessment, baseline, intervention, and follow-up sessions were videotaped for data collection purposes. All digital video was transferred to a hard drive kept locked in the Speech Production Laboratory in the UT Speech and Hearing clinic at The University of Texas at Austin. Files were marked only with a code name. All video review and data coding was conducted in the same laboratory. For all sessions (baseline, intervention, and follow-up), the researcher: (a) reviewed the video, (b) coded the session, and (d) graphed the data.

Video Review and Coding

Videos were reviewed using Windows Media Player on a laptop computer in the UT Speech Production Laboratory (lab director, Dr. Barbara Davis). A digital timer running within the program was used to track the time. Event recording was utilized in the coding of the data. Each time the child attempted to communicate with the adult was

considered an "event". A datasheet was created using an Excel spreadsheet for data recording (see Appendix E). Each participant had a separate file and each session was recorded on a separate sheet within the file. Immediately after each event, the researcher paused the video and coded the interaction on an Excel spreadsheet on the same computer. The event was listed on the coding sheet according to the time on the timer at the beginning of the interaction. Whenever necessary, the researcher re-watched the event to make decisions about specific codes.

Any attempt the child made to communicate with or interact with the therapist was recorded on the datasheet. Each attempt was considered one event that was further analyzed. The following variables were coded: (1) time of the event, (2) turn number within the activity, (2) child or adult initiation, (3) function of the communication, (4) means of communication used, and (5) prompted or unprompted nature of each mean used. Specific coding guidelines and detailed explanations of these variables are described in Appendix F. Descriptions of how these data coding procedures related to the research questions are discussed in the following sections.

Frequency of Child-initiated Communication

The first research question, "What is the effect of PMT on the frequency of the child's communication" was measured through the rate of child-initiated communication acts during each session. The total number of child-initiated acts was summed at the end of each session. Additionally, several other variables that were not specific research questions were coded because they were of interest in examining the frequency of communication. First, the ratio of the child-initiated acts compared to the adult initiated

acts or the specific pragmatic function the act served was coded. Secondly, the pragmatic function of the communication acts was coded. These additional variables were important to consider because they give us more information about how and why the child initiated communication.

Clarity of Child-initiated Communication

The second research question, "What is the effect of PMT on the clarity of child's communication?" was measured through consistency of use of combined means of communication. Each communication act was comprised of one or more of the following aspects of prelinguistic communication capacities: (a) vocalization, (b) gesture, and/or (c) eye-contact. A communication act could consist of only one of these three means or any combination of the three. At the end of the session, sums were calculated for the total number of acts that contained all three means, total number of acts that contained 2 means, and total number of acts that contained only 1 mode of communication. For this calculation, only capacities that were used independently (without an adult prompt) by the child were counted. Thus, the communicative means were coded as: (a) independent gesture, (b) prompted gesture, (c) independent vocalization, (d) prompted gesture, (e) independent eye gaze, and/or (f) prompted eye gaze. It was possible for the child to independently engage in some of the three, but be prompted for others. For example, if the child independently used a gesture to communicate, but was then additionally prompted to use a vocalization, the act would still be considered child-initiated, but the child would have used only 1 independent use.

Maintenance of Social Interactions

With PMT intervention, children are taught communication skills within social routines and activities. Potential social routines were selected based on child interests reported in the parent interview and observed in the communication sample and baseline sessions. Each child had individualized activities. Descriptions of the activities can be found in Appendix G.

The third research question, "What is the effect of PMT on the maintenance of child-adult interactions within an activity?" was measured by calculating the average number of child communication turns within the various routines and activities. Within each social routine or activity, the child could communicate only once and move on to another activity or he could take multiple turns within the same activity. Turns were counted when the child maintained focus and communication within the same social activity. Each communication act was marked with a number to denote the child's turn number within the activity. For example, the child's first turn within an activity was marked with a "1". If the child maintains focus on the activity, the next event was marked as a "2" and so on. If the child stopped participating in the activity and another activity was begun, then the numbering started again and the new event was marked as a "1" turn. Then, the final numbers of turns within each activity were averaged for the session to determine an average number of turns per social routine.

Child Versus Adult Initiation of the Communication

Because only child-initiated acts were considered in the calculation of frequency and clarity, it was important to code whether the attempt at communication was initiated

by the child or the adult. Furthermore, this calculation allowed for an understanding of the percentage of overall communication that was initiated by the child versus the adult. An act was considered child-initiated if the child spontaneously initiated the interaction with the researcher without any prompting or models from the adult. The act was considered adult-initiated if the researcher initiated the interaction by asking a question, such as "what do you want", giving a direction, such as "come play with me", or giving the child a prompt or model, such as a saying the name of the activity at hand (e. g., "swing"). The percentage of child-initiation was calculated for each individual session. Average percentage of initiation was calculated by dividing the sum of individual session averages by 14, the total number of intervention sessions for each participant.

Pragmatic Function of the Communication

Recording the pragmatic function of each act supported the measurement of frequency by providing an understanding of why the child attempted the communication. Each communication attempt was coded as one of the following: (a) request, (b) comment, (c) protest, or (d) other. This coding identified the pragmatic function of each intentional act. The percentage of communication attempts for each pragmatic function was calculated for each individual session. Comparison of the functions used in individual sessions can be found in Appendix F. Average percentage of the use of each function was calculated by dividing the sum of individual session averages by 14, the total number of intervention sessions for each participant.

Graphing

After coding was complete, calculated quantities (either frequency or average) for each session were graphed using a line graph to allow for visual analysis. A separate multiple-baseline graph was used to analyze each of the three research questions. Visual analysis, as opposed to statistical analysis, is typically used in single subject research because it: (a) allows behavior change to be evaluated continuously, (b) does not require the data to conform to certain mathematical properties, and (c) identifies weak or unstable effects (Cooper, Heron & Heward, 1987).

Determination of intervention effect on each variable (frequency, clarity, and maintenance) was based on the change in variability, trend, and level of the data (Kazdin, 1986) between phases. Data "trends" describe the direction of the data points across time. Trend describes whether the behaviors are stable, increasing, or decreasing. "Variability" describes the variance in the data points in terms of the measurement. Finally, "level" describes the average measurement of the data points in each phase. In this study, an effect would be noted if the data show: 1) low, stable rates of the behavior in baseline, and 2) an increasing trend and overall increase in the level of the data after the introduction of the independent variable (intervention).

Frequency totals of variables that were coded, but were not primary research questions (such as child versus adult initiation and pragmatic function of the communication acts) were compared in tables rather than line graphs.

METHODOLOGICAL SUPPORTS

In addition to analysis involved with answering the research questions, several measures were taken to support the reliability and validity of the study: (a) interobserver agreement, (b) treatment fidelity, and (c) social validity. This section explains how these measures were collected and analyzed.

Interobserver Agreement

Interobserver agreement or reliability involved double coding sessions to calculate a level of agreement in the frequency count. This type of data is essential in single subject research (Kazdin, 2006). Interobserver agreement (IOA) was calculated by comparing the total number of target behaviors recorded by each coder. The lower total was divided by the larger total and then multiplied by 100%. For example, if the researcher coded 13 child-initiated communication acts and the graduate assistant coded 18 acts, then IOA would be calculated at 72% (13/18 X 100). Reliability of at least 75% would suggest an acceptable level of accuracy in the simultaneous data collection of several different behaviors (Cooper, Heron, & Heward, 1987).

Rather than conducting reliability on each individual event, each session was treated as a whole. The final totals or averages obtained by the researcher and the reliability coder were compared and IOA was calculated as previously described. Reliability was calculated for the total number of child initiated turns and the average number of child turns per session.

Reliability coding was completed by masters- and doctoral-level graduate student research assistants in Special Education. The research assistants were trained by the

researcher in implementation of the techniques associated with PMT intervention and identification of the target prelingustic behaviors for each participant. This training included reading a chapter on PMT intervention by Warren et al. (2006) and reviewing the coding procedures described by the researcher. After training, the graduate research assistant coded a series of practice sessions simultaneously with the researcher until she demonstrated 80% agreement with the researcher's data on two consecutive practice sessions. These practice sessions were not included in reliability calculations presented in the results.

After training, reliability coding was conducted on approximately 30% of the sessions for each participant. Typically, inter-observer agreement should be reported for a minimum of 20% of the total sessions (Cooper, Heron, & Heward, 1987). The researcher randomly selected sessions from the hard drive files stored in the laboratory and burned them onto a DVD. The only exceptions to the random selection were that one session was disqualified from use for reliability because the participant removed all of his clothing at one point during the session and another session was disqualified because the participant had a seizure at the end of the session. The assistants were blind to the hypothesis of the study and were not told whether the session was baseline or intervention. The DVD was labeled only with the participant's code name. The session files were labeled with numerical order on the DVD rather than actual session numbers.

Treatment Fidelity

Treatment fidelity data involves determination of the accuracy of the implementation of the intervention. Correct implementation was considered when the

adult created a teaching episode by: 1) contriving a situation in which the child will be likely to communicate, 2) using a specific technique (prompt or model) if necessary, and 3) responding to the child's communication attempt (compliance, initiation, or recast). The research assistants recorded correct or incorrect implementation of each communication event on the same datasheet used for reliability coding. They recorded treatment fidelity data on the same sessions used to code IOA. Each graduate research assistant was trained to record fidelity data as previously described in the review of PMT chapter, review of coding guidelines which included fidelity, and practice recording to match researcher's coding at an 80% level.

Each research assistant recorded whether the researcher demonstrated correct or incorrect implementation of (a) creating an enabling context, (b) prompting or modeling, (c) response to communication. Directions for determining fidelity of treatment can be found in Appendix F. Treatment fidelity was calculated for each of the three variables by dividing the number of episodes with correct implementation by the total number of episodes and multiplying by 100%.

Social Validity

Social validity is a means of evaluating whether behavior changes achieved during treatment are clinically important. Behavior changes can be viewed as clinically important if the intervention has brought the participant's behaviors toward a socially acceptable level or if others subjectively judge the participant's behavior to reflect a qualitative improvement on global ratings (Kazdin, 1977). Social validity data was measured by comparing the scaled rating between baseline and intervention for seven

items that were not dependent variables measured in the study. Specifically, the raters answered the following questions adapted from a social validation assessment used by Lancioni, O'Reilly, Singh, Oliva, Marziani, and Groeneweg (2002):

1) Do you think the child finds the interaction pleasant?
2) Do you think the child can benefit from the interaction?
3) Do you think that parents/ caregivers find the interaction pleasant?
4. Do you think the interaction has practical benefits for the parents/caregivers?
5. Do you think the interaction represents a form of rehabilitation?
6. Do you think that the interaction could be transferred to other settings?
7. How much would you like to be involved in this interaction?

These questions were selected based on previous implementation in a study of social validity of interventions for children with disabilities (Lancioni et al., 2002; Lancioni et al., 2006). They represent a both social-emotional and practical aspects of intervention.

Twenty-four masters-level graduate students in the Special Education department at the University of Texas at Austin conducted social validity measures. All raters were between the ages of 22-55, with a mean age of 28. Twenty-two were women and two were men. They were shown a 4-minute video of both a baseline and a treatment session for each participant and asked to rate the child in each of these areas. All video clips started at minute 5:00 of each session in order to control for bias and consistency. All videos were presented in a random order. Following each video, they scored each variable with a rating of 1-5. The rating sheet used can be found in Appendix H.

The raters were blind to the hypothesis of the study and were not told whether the session was baseline or intervention. During a brief training prior to viewing the first video, raters were given simple procedures for the ratings. They were told that they would be watching a 4-minute clip of an adult and a child interacting and that there would be 2 clips for each of 6 children. They were instructed to rate the "interaction" and were not given information about any potential intervention being implemented. The researcher also explained the rating scale and how to record their ratings on the data sheet. Raters were asked to read through the seven questions and ask for clarification if one of the questions was not understood. Rater inquiries about the questions were answered. Finally, they were reminded about confidentiality of the information observed.

Social validity was assessed by examining the change in ratings for each item before and during treatment (baseline ratings versus treatment ratings). A T-test for matched pairs was conducted using SPSS to evaluate statistical significance of the difference in ratings. First, raters' scores were averaged for each item for both baseline and intervention sessions across all six participants. Then, the mean baseline and intervention ratings were compared for each of the seven items. Effect size was calculated for all comparisons in which mean differences were found to be significant.

POST-HOC ANALYSIS

To evaluate differences in response to treatment, certain participant characteristics were examined based on results of previous studies of behavioral profiles of children with autism. Previous studies of the influence of behavioral profiles on the response of children with autism to pivotal response training (PRT, Koegel et al., 1989) found that

children with high rates of toy play demonstrated higher rates of responding to treatment, and children with high rates of avoidant behaviors or high rates of nonverbal stimulation demonstrated lower rates of response to intervention (Sherer & Schreibman, 2006).

Table 8 lists the behaviors and definitions examined. Ten-minute clips of a baseline session for each participant were analyzed to examine pre-treatment profiles. To control for bias, all analyses began at minute 5:00 of a randomly selected baseline session for each participant. Behaviors were coded using 30-second partial interval recording. The 10-minute video was divided into twenty 30-second increments or intervals. For each interval, the researcher coded whether or not each behavior occurred during that 30-second time period.

Table 8: Behavioral profile definitions

Behavior Examined	Definition
Toy contact/object manipulation	Child interacted with a toy appropriately for at least 5 consecutive seconds.
Avoidant behaviors	Child physically moved away from the adult out of arm's reach, avoided eye contact with the adult, or covered ears.
Approach behaviors	Child moved to within arms reach of the adult or closer, took an item from the adult, reached to the adult, or looked at the adult's face.
Nonverbal stimulation	The child engaged in self-stimulatory behaviors, such as (but not limited to) hand flapping, rocking, facial grimacing, head shaking, and jumping up and down.
Verbal stimulation	Child made nonsensical sounding utterances or repetitive sounds that were non-communicative.

CHAPTER 4

Results

This study investigated the effects of Prelinguistic Milieu Teaching with six children diagnosed previously with moderate-severe autism, ages 5-8, whose receptive and expressive communication skills fell within the 6-12 month developmental age range. A single subject experimental design across participants was utilized to analyze changes in the participants' frequency, clarity, and maintenance of communication before, during, and after the PMT intervention. These indices have been shown to be integrally related to development of language based communication capacities in children developing typically. In addition, they are core features of PMT intervention protocols evaluated previously with younger less severely impaired populations of children. This chapter describes the outcomes of the study and the methodological supports used to enhance the design.

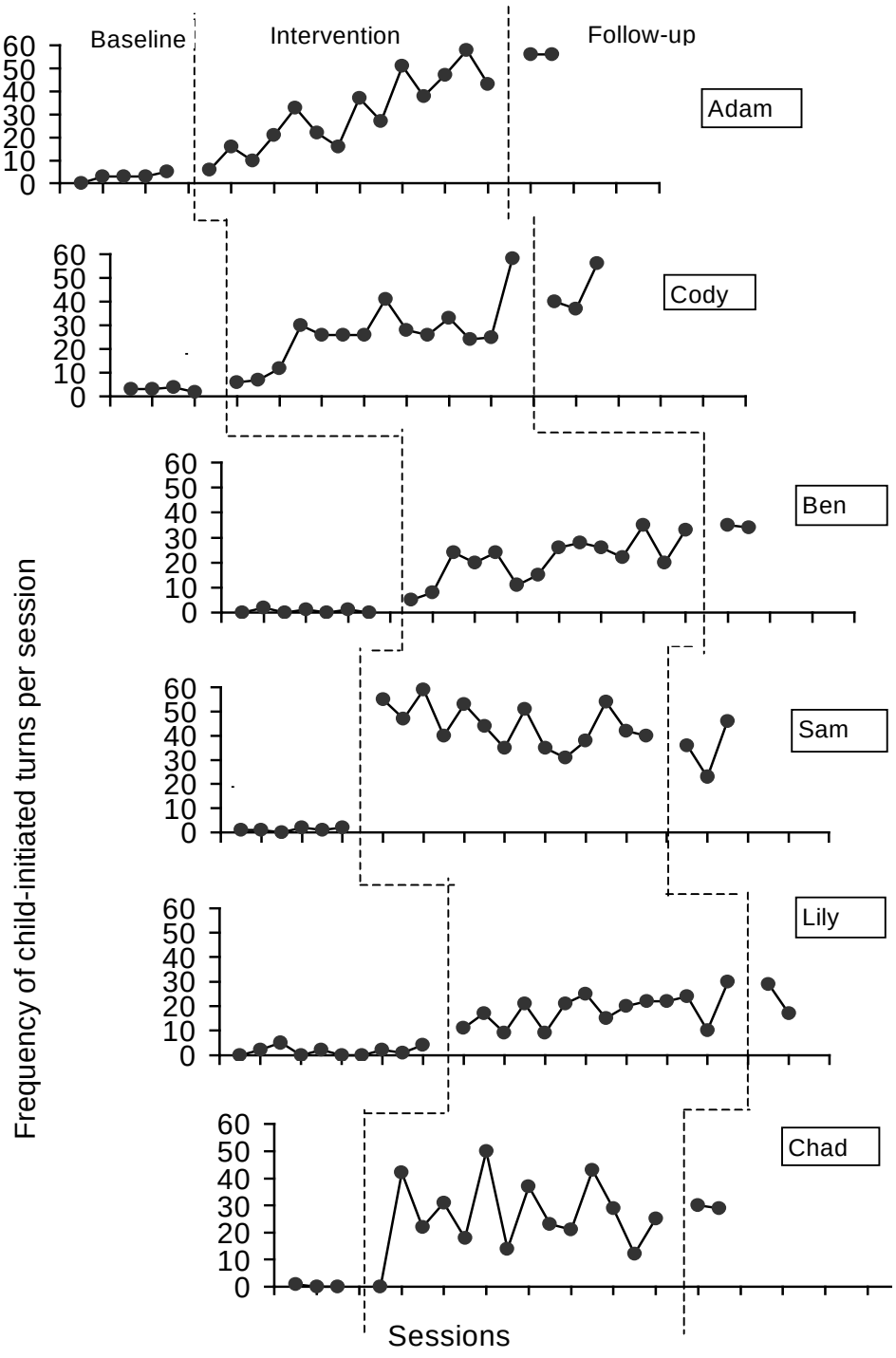
FREQUENCY OF CHILD-INITIATED COMMUNICATION ACTS

Question 1 related to frequency, the number of times the child initiated communication with the adult during each session. Figure 1 displays the frequency of child-initiated communication acts per session across all participants. A data point was displayed for each baseline, intervention, and follow-up session. Phase change lines, the dotted vertical lines, designate changes in phases. The trend for all six participants was stable in baseline, with almost no attempted communication during baseline sessions, an increased rate in independent communication acts during intervention, and maintained

higher rates of communication during follow-up. Adam demonstrated an average of 3 initiated acts per session in baseline, 30 in intervention and 56 in follow-up. Cody demonstrated an average of 3 initiated acts per session in baseline, 26 in intervention and 44 in follow-up. Ben demonstrated an average of 1 initiated act per session in baseline, 21 in intervention and 35 in follow-up. Sam demonstrated an average of 1 initiated act per session in baseline, 45 in intervention and 35 in follow-up. Lily demonstrated an average of 1 initiated act per session in baseline, 18 in intervention and 23 in follow-up. Chad demonstrated an average of 2 initiated acts per session in baseline, 18 in intervention and 23 in follow-up.

All participants demonstrated increases in initiation of communication acts during PMT intervention compared to baseline. There were individual differences in the pace of change across sessions. The ultimate goal for child-initiated communication would be 1-2 communication attempts per minute (Warren et al., 2006). Because the intervention sessions in this study lasted 30 minutes, each session maintained a goal of 30 child-initiated acts. Three participants, Ben, Lily and Chad, achieved the goal frequency of approximately 1 communication act per minute, with maximum intervention rates between 30 and 43 (sessions were 30 minutes each). Three participants, Adam, Cody, and Sam, exceed the estimated frequency of communication, reaching a maximum between 58 and 59 communication acts. Adam and Lily demonstrated a gradual increase in communication acts, while the other 4 participants all demonstrated abrupt increases in level within three sessions.

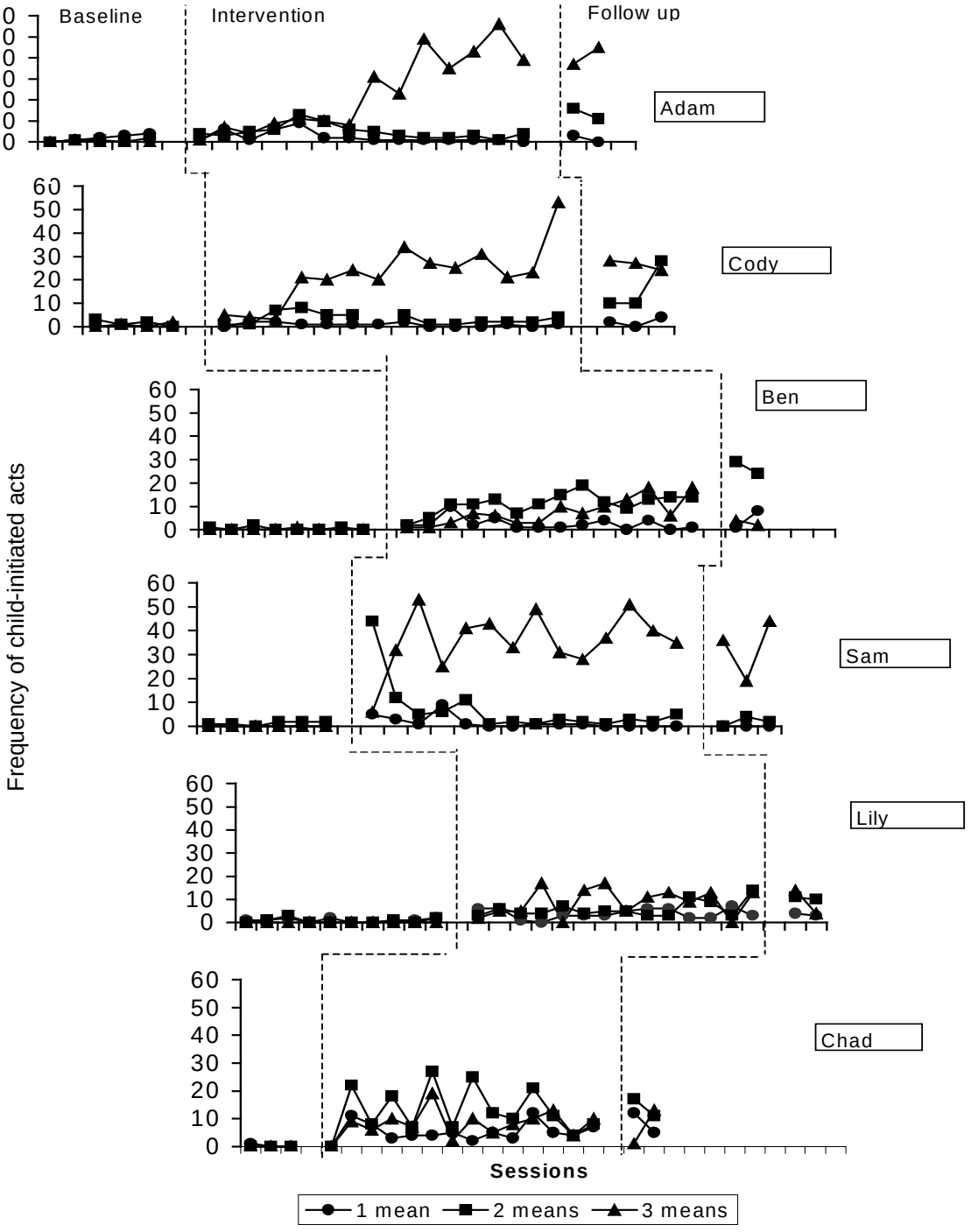
Figure 1: Frequency of child initiated communication acts per session



CLARITY OF CHILD-INITIATED COMMUNICATION ACTS

Question 2 for the study focused on clarity of the children's communication acts. Clarity was the number of communicative means the child used during each communication attempts. The three potential means of prelinguistic communication were: vocalizations, gestures, and eye-gaze. Figure 2 displays each participant's frequency of communication acts containing 1, 2, and 3 means during each session. All 6 participants increased their use of combined means during intervention. Again, there were individual differences across the children in terms of the optimal intervention target of using 3 communication means in acts they initiated. Three participants, Adam, Cody, and Sam, rapidly established the combination of 3 means of communication in their communication acts. Lily also tended to combine all 3 means, but not as consistently as the other 3 children. Ben consistently combined at least 2 means of communication, occasionally combining all 3 means. Chad demonstrated highly variable data, but most frequently used 2 means.

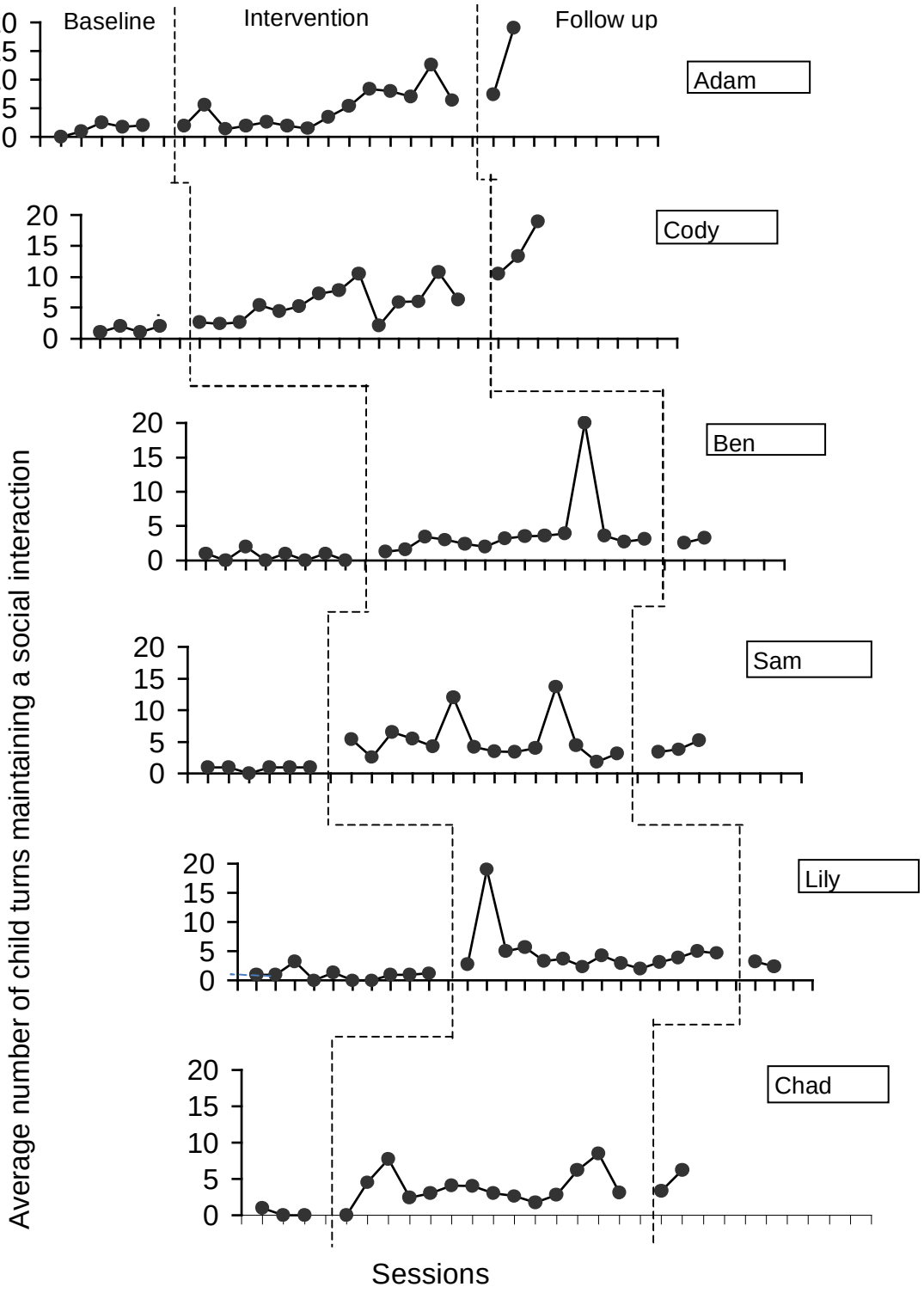
Figure 2: Comparison of frequency of child-initiated communication acts using one, two, or three unprompted communicative means



MAINTENANCE OF COMMUNICATION WITHIN SOCIAL INTERACTIONS

Question 3 related to maintenance of communication was the average number of turns that the child took within each social interaction or routine. Figure 3 displays the average rate of child-turns per social routine for all sessions. All 6 participants increased their maintenance of communication during intervention. However, Adam, Cody, and Sam increased their average rate of turns per session almost twice as much as Lily, Ben, and Chad. Adam averaged 1.4 turns in baseline, 4.9 turns in treatment, and 13.2 in follow-up. Cody averaged 1.5 turns in baseline, 5.7 turns in treatment, and 14.2 turns in follow-up. Sam averaged 0.8 turns in baseline, 5.3 turns in treatment, and 4.1 in follow-up. Lily and Ben moderately increased their overall rates of average turns, but both had random intervention sessions where drastically increased turn-taking was observed. Lily increased from 1.0 turns in baseline to 4.9 turns in intervention, and 2.9 turns in follow-up. Ben averaged 0.6 turns in baseline, 4.1 turns in intervention, and 3.0 turns in follow-up. Chad initially demonstrated an upward trend, but then his turn-taking leveled off and he only moderately increased his turn-taking overall. He averaged 0.3 turns in baseline, 3.8 turns in intervention, and 4.8 in follow-up.

Figure 3: Average number of child turns per social routine or interaction



ADDITIONAL STUDY VARIABLES

In addition to the three main dependent variables addressed in the research questions, two other variables were coded during data analysis that related to the frequency of communication. First, each act was recorded as initiated by the adult or the child. Only child-initiated acts were considered in calculation of the frequency of communication. Yet, it was important to consider the ratio of adult-initiated acts in order to understand what percentage of the data was being analyzed. Additionally, each act was coded by pragmatic function as: "request", "comment", "protest" or "other". This was important in order to get a better understanding of why the participant was communicating. Pragmatic function may be related to the overall frequency of the child's communication attempts. This section describes the comparisons of the initiation and the function of all of the communication acts.

Child Versus Adult Initiation

The number of adult-initiated versus child-initiated acts are compared in Table 9. Results for individual sessions can be found in Appendix I. All six children initiated the majority of acts across all intervention sessions. The average percentage of child-initiated acts ranged from 69-90%. The average percentage of adult-initiated acts ranged from 10-31%.

Table 9: Comparison of child-initiated versus adult-initiated communication acts during intervention sessions

Participant	Average # of Communication Acts Per Session	Average % Initiated By Child Per Session	Average % Initiated by Adult Per Session
Adam	36 (range 15-63)	80% (range 35-100%)	20% (range 0-65%)

Cody	37 (range 19-63)	69% (range 29-100%)	31% (range 0-71%)
Ben	24 (range 8-36)	89% (range 31-100%)	11% (range 0-69%)
Sam	50 (range 32-78)	90% (range 70-100%)	11% (range 0-30%)
Lily	20 (range 10-33)	90% (range 65-100%)	10% (range 0-35%)
Chad	30 (range 17-45)	87% (range 45-100%)	13% (range 0-55%)

Pragmatic Functions

Average percentages of the four pragmatic communication functions analyzed across the fifteen intervention sessions are displayed in Table 10. Comparison of the functions used for individual sessions can be found in Appendix J. Requesting was the most frequent pragmatic function used by all participants, accounting for 68% to 98% of the acts. Commenting was the second highest function used by all participants occurring in 1% to 24% of the acts coded. No participant demonstrated average percentages of protests or other (greetings, fill-ins, etc.) over 10%.

Table 10: Comparison of communicative functions during intervention sessions

Participant	Average % Requests	Average % Comment	Average % Protests	Average % Other
Adam	66% (range 29-96%)	27% (range 0-69%)	5% (range 0-24%)	3% (range 0-12%)
Cody	71% (range 52-96)	18% (range 0-29%)	2% (range 0-5%)	10% (range 0-26%)
Ben	95% (range 81-100%)	4% (range 0-19%)	2% (range 0-10%)	0% (range 0-0%)
Sam	98% (range 66-100%)	1% (range 0-5%)	0% (range 0-2%)	0% (range 0-4%)
Lily	86% (range 61-100%)	9% (range 0-36%)	5% (range 0-14%)	0% (range 0-0%)
Chad	98% (range 91-100%)	2% (range 0-7%)	1% (range 0-5%)	0% (range 0-0%)

INDIVIDUAL DIFFERENCES

Several variables were examined to evaluate potential reasons for differences in the participants' response to intervention. Specifically, the child's pretreatment communication skills, parent variables, and behavior profiles were analyzed. This section describes the results of those analyses.

Communication Skills Prior to Treatment

Individual descriptions of participants' baseline communication skills as reported in the parent interview at study onset can be found in Table 11. All participants were reported to demonstrate some communication for the purpose of requesting items and one was reported to attempt labeling when directly asked to do so. Means of communication included handing items to adults or leading persons to the location of the item for all participants. Two participants were also reported to employ occasional use of sounds or word approximations. One participant was reported to occasionally use manual signs. None of the parents reported eye-gaze as a form of communication. All participants were reported as attempting communication with others fewer than 5 times per day. The range of frequency for communication was "hourly" to "several times per day".

Table 11: Participant's communication skills prior to implementation of study as reported in parent interview.

Participant	Communication Functions	Communication Means	Communication Frequency
Adam	Request food or tangible items; label item when asked	Hand leading, sounds or parts of words	Daily
Cody	Request food or tangible items	Hand leading, manual signs, sounds	Daily
Ben	Request food or	Pulling/hand leading	Several times per day

	tangible items		
Sam	Request food	Pulling/hand leading or handing items to adult	Several times per day
Lily	Request food or to be carried	Pulling/hand leading	Hourly
Chad	Request food or drink	Handing leading or handing items to adult	Several times per day

Parent Variables

Results of parent responsiveness obtained from the 10 min communication sample are reported in Table 12. For every participant except Lily, the parent involved was the mother. Lily's father was the parent involved during her parent-child interaction. Adam, Cody, Sam, and Chad's mothers all demonstrated low rates of both initiation and response (less than 1 per minute). Ben's mother and Lily's father demonstrated high rates of both initiation and response (over 1 per minute).

Table 12: Frequency of parent behaviors during 10 minute communication sample

Participant	Initiation	Imitation	Expansion	Compliance
Adam	1	3	0	1
Cody	5	1	0	3
Ben	17	0	11	9
Sam	0	0	0	0
Lily	20	3	13	10
Chad	0	0	0	0

Post-hoc Analysis of Behavior Profiles

Behavioral profiles were analyzed in a post-hoc analysis in order to examine predictors of response to intervention because they have been shown to influence results in previous autism intervention studies. Five behaviors were analyzed during baseline

sessions for all participants. Average percentages of intervals in which each behavior occurred are displayed in table 13.

Table 13: Mean percentage of interval occurrence of potential predictive behaviors during baseline

Participant	Toy Play	Avoidant	Approach	Nonverbal Stimulation	Verbal Stimulation
Adam	70%	45%	50%	50%	30%
Cody	100%	0%	0%	30	0%
Ben	30%	25%	15%	15%	30%
Sam	0%	0%	75%	35%	0%
Lily	0%	25%	25%	25%	35%
Chad	30%	80%	3%	90%	70%

METHODOLOGICAL SUPPORTS

In order to improve the study's integrity, several measures were taken to support reliability and validity. This section describes the results of interobserver agreement, treatment fidelity, and social validity measures.

Interobserver Agreement

Interobserver agreement (IOA) was calculated for 25-40% of baseline sessions (1-3 sessions) and 29% of intervention sessions (4 sessions) for all participants. Variation in baseline percentage was due to the fact that each participant had a different number of baseline sessions. Average IOA for individual participants is listed in Table 14. All participants demonstrated an average of 100% for IOA for baseline. For intervention, average IOA across participants was 87% for turns and 89% for frequency of child-initiated communication acts. These percentages suggest high levels of agreement between the researcher's and the graduate assistant's coding.

Table 14: Average percentage of interobserver agreement

Participant	Baseline		Intervention	
	Child-initiated Acts	Average Turns	Child-initiated Acts	Average Turns
Adam	100%	100%	89%	88%
Cody	100%	100%	86%	87%
Ben	100%	100%	87%	82%
Sam	100%	100%	93%	88%
Lily	100%	100%	87%	89%
Chad	100%	100%	92%	85%

Treatment Fidelity

Treatment fidelity was calculated for 27% of intervention sessions (4 sessions) for all participants. Average treatment fidelity for the researcher creating an enabling context was 100% for all participants. Average treatment fidelity for the researcher's use of appropriate prompting was 100% for all participants. Average treatment fidelity for researcher response to child communication was 98% overall and ranged from 94%-100% across participants. This high percentage suggests that the researcher conducted the intervention appropriately and accurately.

Table 15: Average treatment fidelity percentages

Participant	Context	Prompting	Response
Adam	100%	100%	99%
Cody	100%	100%	94%
Ben	100%	100%	97%
Sam	100%	100%	100%
Lily	100%	100%	97%
Chad	100%	100%	99%

Social Validity

Social validity was examined by comparing ratings of baseline with intervention for seven items related to the social importance of the intervention. Tables 16 and 17 display the results of the group comparison using a T-test for matched pairs to examine statistical significance and the results of an effect size calculation to examine practical significance. Results of T-test calculations for individual participants can be found in Appendix K.

Table 16: Number of raters, means, and standard deviations for each calculation

Item		N	Mean	Std. Dev.
Item 1	Baseline	128	3.2813	1.19670
	Intervention	128	4.2891	.83385
Item 2	Baseline	128	3.1719	1.31682
	Intervention	128	4.2500	.85112
Item 3	Baseline	128	3.2813	1.17679
	Intervention	128	4.1563	.90873
Item 4	Baseline	128	2.8516	1.20426
	Intervention	128	3.8984	1.07102
Item 5	Baseline	128	2.9922	1.12590
	Intervention	128	4.1016	.99479
Item 6	Baseline	128	3.4297	1.22753
	Intervention	128	4.0234	1.00757
Item 7	Baseline	128	2.7969	1.18627
	Intervention	128	3.8125	1.09221

Table 17: Significance and effect size of each calculation

Item	t	Sig. (2-tailed)	Effect Size	Confidence Interval (95%)
Item 1	-8.111	.000*	.98	.72-1.23
Item 2	-7.947	.000*	.97	.71-1.23
Item 3	-7.000	.000*	.84	.58-1.09
Item 4	-7.952	.000*	.92	.66-1.18

Item 5	-9.317	.000*	.98	.72-1.24
Item 6	-4.294	.000*	.52	.27-.77
Item 7	-8.000	.000*	.89	.63-1.14

*Statistically significant

Overall group comparisons between baseline and treatment were found to be statistically significant for each of the seven items that examined the practicality of the intervention. Effect size calculations also showed large effect sizes for six of the seven rated items. Only one item (item 6: "Do you think that the interaction could be transferred to other settings?") had a moderate effect size. This might suggest that PMT intervention could not be transferred to other settings, such as the child's school. However, since the effect size was based on comparison with baseline, it more likely means that some raters felt the "interaction" in the baseline session could be transferred to school as well. Overall, raters felt that the PMT intervention was more "pleasant" (items 1 & 3), "beneficial" (item 2), "rehabilitative" (item 5), "practical" (item 4), and that they would rather be involved in the PMT intervention (item 7).

CHAPTER 5

Discussion

Two primary purposes for teaching intentional prelingustic communication were discussed in the rationale for this study. The first and basic premise was that prelinguistic communication can provides a foundation for the development of future linguistic communication (e. g., Watt, Wetherby, & Shumway, 2006; Brady, Steeples, & Fleming, 2005; Calendrella & Wilcox, 2000; Smith, Mirenda, & Zaidman-Zait, 2007; Iverson & Goldin-Meadow, 2005). However, it has been suggested that older children who continue to demonstrate severe communication deficits may not have the potential to develop linguistic communication. These children would demonstrate truly "disordered" communication rather than a "delay" in the typical order of development. In this case, the primary purpose of teaching intentional communication using prelinguistic means would be to achieve a consistent and clear means of communication and intent. At this point, one might consider these communication skills to be "nonlinguistic" rather than "prelinguistic".

Research on the course of typical development, indicates that intentional communication develops between 6-12 months. Based on pre-intervention assessment results, this was the developmental age of participants in this study. However, these participants have persisted at this developmental communication level for several years rather than advancing to symbolic and linguistic communication that typically develops after 12 months of age. These participants also demonstrated severe levels of autism based on educational records and pre-study testing.

Review of autistic development suggested that children with ASD have core deficits in the use of eye-gaze and gestures for communication and moderate deficits in turn-taking skills. These aspects of early development typically facilitate development of communication and social skills (Mundy, Sigman, & Kasari, 1994; Colgan, et al., 2006; Sheinkopf, Mundy, Oller & Steffens, 2000). According to parent report of these participants' communication skills prior to intervention, none of the children used eye-gaze to communicate and only one participant (Cody) used gestures. Parents further reported that their children communicated infrequently, often communicated only to request food or objects, and did not engage in turn-taking social activities. Thus, these participants represented a specific population of children for whom "intentional prelinguistic communication" would be an appropriate intervention goal. However, it was not known whether they would be part of the "delayed" group of children who would eventually develop more symbolic forms of communication or the "disordered" group might persist at a nonlinguistic level of communication function.

Prelingustic Milieu Teaching (PMT, Yoder & Warren, 1998) was selected as the primary intervention or independent variable for this study due to the potential to target a variety of communicative means and pragmatic functions. Previous study of PMT intervention has focused exclusively on young children (ages 2-5) with mild to moderate developmental delays. This study expanded evaluation of PMT intervention by examining a unique population of children not previously studied. Participants receiving PMT intervention were ages 5-8, diagnosed with moderate to severe autism and severe communication delays (functioning at the 6-12 developmental level). Additionally,

participants with Hispanic and Asian ethnicity were included. Previous studies of PMT intervention have focused primarily on Anglo- and African-American children.

SUMMARY OF RESULTS

In this study, participants were taught to use gestures, eye-contact, and vocalizations as a means to take turns in functional communicative interchanges and to accomplish the pragmatic intentions of "request", "comment", and "protest". The following questions were examined:

1) What is the effect of PMT on the *frequency* of the child's communication measured by the rate of child-initiated communication acts?

2) What is the effect of PMT on the *clarity* of child's communication measured by consistency of use of combined means of communication?

3) What is the effect of PMT on the *maintenance* of child-adult interactions within an activity measured by the number of child communication turns?

The study hypothesis was that implementation of PMT would result in increases in frequency, clarity, and maintenance of communication exchanges.

Frequency

The first study question centered on increase in frequency of the children's communication acts via implementation of PMT techniques. Previous studies of PMT on younger children found increases in frequency of overall intentional communication acts after intervention (Warren, Yoder, Gazdag, 1993; Yoder, Warren, Kim, & Gazdag, 1994; McCathren, 2000; Fey et al., 2006). This study sought to replicate those results with older children.

All six participants demonstrated increases in frequency of overall communication attempts during the intervention and maintained these increases during follow-up. However, three participants, Adam, Cody, and Sam made larger increases. They reached a maximum frequency of around 2 attempts per minute compared to the frequency of 1 attempt per minute reached by the other three participants, Lily, Ben, and Chad. Authors of the main body of PMT research suggest an ultimate goal of at least 2 acts per minute, at which time the child would be ready to advance to linguistic means of communication (Warren et al., 2006). Thus, based on their high frequency of communication, Sam, Adam, and Cody might be ready for more linguistically oriented approaches to communication intervention. Future intervention should target the use of "real" consistent words rather than prelinguistic vocalizations.

Lily, Ben, and Chad reached a goal of 1 act per minute, but their increases in frequency occurred with much more variability and at a much slower pace. They did not show the steep trend obvious for Adam, Cody, and Sam. They might represent the group of children who will never advance to symbolic, linguistic communication. This issue should be investigated in further longitudinal research into PMT intervention with this population. Potentially, these children could benefit from alternative means of communication (i.e. PECS) or more focus on development of one of two means of communication (i.e. vocal only) at a time.

Clarity

The second study question focused on analysis of increase in clarity of communication. Clarity was examined in terms of the child's tendency to combine the

three potential means of prelinguistic communication (vocalization, gesture, or eye-gaze). Review of typical development suggests that these communication capacities develop simultaneously and interactively (Iverson & Thal, 1998). Furthermore, the importance of developing clear means of communication reflects recent trends in the literature on communication intervention for older children with severe autism and developmental disorders (Keen, Woodyatt, & Sigafoos, 2002). Clarity of communication is described by Warren et al. (2006) as part of the overall goal of PMT intervention, yet previous studies have not examined this variable explicitly.

There were two distinct trajectories among the six participants relative to this variable. Three participants, Adam, Cody, and Sam, developed high levels of clarity in their communication attempts by consistently combining vocalization, gesture, and eye gaze. Chad, Lily, and Ben did not consistently demonstrate the ability to combine all three means of communication. Their profiles of change are worthy of further consideration. Lily and Chad demonstrated communication acts that were not clearly recognizable when they sometimes used isolated acts of eye gaze or vocalization to communicate. However, they both increased frequency of attempted communication during PMT intervention and both demonstrated the ability to combine all three forms. Thus, they might benefit from an intervention such as communication repair, where individuals are taught to attempt different means of communication when one breaks down or is not recognized by the listener (Brady, McLean, McLean, & Lee, 1995). Ben did not develop consistent combination of three means. However, he more consistently combined two means: gesture and eye gaze. His failure to use vocalization, the third form

supporting maximal clarity, might have been related to results on the parent report of the REEL (Bzoch, League, & Brown, 2003). He was not reported to say a variety of sounds or demonstrate any vocal imitation skills. Accordingly, Ben might benefit from a specific training designed to increase his repertoire of sounds or vocal imitation skills. Initially, sound productions might be paired with gestures in situations where he is showing joint attention through gaze, thus using his stronger means to support emergence of vocalizations.

Maintenance

The third study questions targeted maintenance of communication via PMT techniques. Maintenance was defined as the number of turns the child took to maintain a social interaction with the adult. Previous studies of PMT intervention have found increases in turn-taking skills (Yoder & Stone, 2006b). However, the measure of "turn-taking" was not clearly defined. In this study, turn-taking skills were measured by calculating the average number of turns the child took per social interaction or routine during each session.

When considering mean differences between baseline and intervention, all six participants demonstrated increases in maintenance during intervention by doubling their average number of turns per social interaction. However, trends and changes in level for maintenance were quite variable. Only Adam and Cody demonstrated a steady upward trend in average number of turns during intervention. Ben, Sam, and Lily each had at least one session in which they demonstrated high rates of maintained interaction during intervention, but each demonstrated a relatively stable trend during intervention overall.

Chad had the most variable data, with slight upward and downward trends throughout intervention.

Maintenance of social interaction was targeted for intervention as social routines create a basis for learning communication skills. Familiar social routines provide predictable events in which a child may learn to communicate. However, several behavioral characteristics common in children with ASD may impede the development and maintenance of social play routines within their intervention process. Such behaviors may include: self-stimulatory and/or self-injurious behaviors, hyper- or hypo- activity levels, attention deficits, and abnormal visual and auditory responses to stimuli.

As an example, Chad engaged in high rates of self-injurious head-hitting behaviors. These behaviors clearly disrupted the flow of social routines. The behavioral intervention plan for responding to his self-injurious behaviors (explained to the researcher by his parents) involved a period of ignoring or turning away from him. Thus, on days when Chad engaged in high rates of head-hitting, it was difficult to "follow his lead" and engage him in social interaction. Additionally, some children with autism exhibit resistance to change, which may make it difficult to enhance or build on steps within social routines. For example, one child, Sam, sometimes became rigid about completing all of the potential routines he had learned in a particular order. Instead of continuing one routine for multiple turns, he wanted to take one turn within the first routine (e.g. peek-a-boo), then go to the second routine, (e.g. jumping on the bed), and then onto the third routine (e.g. catch a ball).

Summary

Each participant demonstrated unique profiles in terms of how they responded to PMT intervention designed to evaluate the hypothesis that there would be an increase the frequency, clarity, and maintenance of communication skills following PMT. When comparing baseline to intervention data, an increase was seen for all six participants across all three dependent variables. However, the size of the increase for each participant varied greatly. One way to evaluate the effect size is to consider the difference between the mean of baseline and mean of intervention data points (mean difference). For frequency of child-initiated communication attempts, the participants fell in the following order from best response to least response to intervention (based on mean difference between baseline and intervention): Sam, Adam, Cody, Chad, Ben, and Lily. For clarity of child-initiated communication attempts, the participants fell in a similar order from greatest response to least response: Sam, Adam, Cody, Ben, Chad, and Lily. Finally, for maintenance of turns, the participants fell in the following order from greatest to least response to intervention: Adam, Cody, Sam, Chad, Ben, and Lily. When considering all three variables, Adam had the best response to treatment, followed by Sam, then Cody, and then Chad, Ben, and Lily respectively.

Three participants, Adam, Cody, and Sam, demonstrated almost twice the frequency of child-initiated communication acts compared to the other participants. These three participants were also the only three participants to develop obvious levels of clarity in their communication by consistently combining all three means in their communication attempts (vocal, gesture, and eye gaze). Furthermore, Adam and Cody, and Sam developed much higher averages of turn-taking rates compared to the other

participants. They were also the only two participants to develop some commenting skills (over 15% of all communication attempts during intervention were comments). Thus, there appears to be some consistency of the children's performances across the three measures. This finding supports the previous implication that Adam, Cody, and Sam may be following a more "typical" order of delayed development, in which prelinguistic communication skills develop simultaneously and lead to future linguistic forms of communication. Similarly, Lily, Chad, and Ben consistently demonstrated the lowest level of performance across all three dependent variables. However, their increases in frequency of communication were greater than their increases in clarity or maintenance. Because they each demonstrated only slight upward trends, it is not likely that they would continue to demonstrate increases in the dependent variables. This finding suggests that these three participants may be following a more "disordered" development.

PMT intervention is based on the premise that prelinguistic communication is a necessary, although not sufficient prerequisite for linguistic development. However, in this study, two different trajectories were observed. During PMT intervention, three participants developed prelinguistic communication in such a way that future linguistic communication was probable. The other three participants did not develop prelinguistic communication along the proposed continuum of typical development. This diversity of outcomes across six children has potential implications for treatment planning for children with severe communication delays. When children persist at a pre-linguistic level of communication function or do not develop consistent use of prelinguistic means of communication at chronlogical ages where they should be communicating

linguistically, interventionists and educators face the question of whether to use a functional or developmental approach to communication intervention. With a developmental approach, intervention would follow the order of typical development, targeting the skills that develop first in typical language acquisition. With a functional approach, intervention would target skills that would be most functional for that child's environment. In the case of early communication intervention, a developmental approach would target prelinguistic communication skills before linguistic communication. A functional approach might target the use of a symbolic form, such as manual sign. If the child has potential to eventually develop future linguistic forms of communication, teaching the child to use prelinguistic means of connecting with communication partners, including initiating communication (*rate*), using readable means (*clarity)*, and maintaining interchanges (*maintenance*) may pave the way for symbolic language. Alternatively, initial teaching of words may accomplish functional communication outcomes and give the child some semantically appropriate labels for function-based interactions with the environment. How, then, do interventionists make this decision? The answer may lie in examination of individual differences associated with the best response to intervention. This dichotomy of approaches could fruitfully be addressed in future studies where groups of children receive function based interventions versus developmentally based interventions based on the prelinguistic means targeted in this study. Such contrastive studies could address the lack of present consensus on the most beneficial approach to intervention with children with severe compromise in development of symbolic language who have been diagnosed with autism.

INDIVIDUAL DIFFERENCES

Several variables may account for the differences seen in individual participants' results in this study. First, comparisons of individual demographic factors such as chronological age, developmental age in expressive and expressive language, and severity of autism taken prior to implementation of PMT can be examined in terms of potential influence on the outcomes. Additionally, parent responsivity measures were taken during assessments to potentially examine individual results. This analysis was completed because previous study of PMT showed that certain parent variables might influence overall results of the intervention (Yoder & Warren, 1998; 1999; 2001). Finally, a post-hoc analysis examined individual behavioral profiles that may be associated with positive outcomes based on findings of other intervention studies with children with autism (Sherer & Schreibman, 2006).

Chronological Age

In this study, chronological age did not appear to be associated with response to intervention. The best three responders, Adam, Sam, and Cody, were ages 5, 7, and 5, respectively. The lower three responders, Chad, Ben, and Lily, were ages 8, 5, and 7, respectively. However, the age variable did not provide a wide age spread for robust evaluation of this issue. Future studies should include more diverse age cohorts.

Previous study of PMT has focused exclusively on young children ages 2-5. This is the first study to include older children with more severe disabilities. Given the positive results, especially for three of the participants, PMT may be an appropriate intervention for some chronologically older children. However, this study included a

limited number of participants. Future research and replication is needed with a larger sample of children ages 5-8 and at older chronological ages to establish the level of success with this population. Additionally,

Language Skills

In contrast to chronological age, an analysis of developmental age relative to response to PMT intervention suggested that there may be an association between developmental age and response to intervention for these children. Developmental age equivalents were measured using the Receptive-Expressive Emergent Language Scale, 3rd version (REEL-3, Bzoch, League, & Brown, 2003). Comparing the overall age equivalent (average of Receptive and Expressive scores), the two best responders to PMT, Adam and Cody, also had the highest age-equivalents. They scored at 9 months and 9.5 months respectively. Sam, the second highest performer demonstrated an age-equivalent of 8 months. Two of the lowest performers, Ben and Chad, showed the lowest age equivalents, both averaging 5.5 months. This developmental age related finding supports recent studies of PMT on young children with autism in which some language skills were found to be correlated with treatment outcomes.

Lily's performance provided the exception to this for language skills. Lily demonstrated the lowest overall performance across participants for all three measures (frequency, clarity, and maintenance), yet she had the same developmental language score as Sam, 8 months. What issues might help to understand this discrepancy? One potential explanation for this discrepancy was that Lily experienced seizures throughout the course of intervention. Her parents reported daily seizures and on-going medical

interventions, such as chelation, a controversial metal-reducing treatment, throughout the intervention phase. Lily had seizures during two intervention sessions. Future research should investigate the influence of on-going medical factors, such as seizure activity, and medical interventions, such as chelation and pharmaceuticals, on treatment outcomes.

Autism Severity

Autism severity was measured using the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1993). Notably, the three highest performers (Adam, Sam, and Cody) had the lowest autism severity rating on the CARS. Their scores on the CARS ranged from 38-40 while Chad, Ben, and Lily's scores ranged from 46-49. This finding supports suggestions in the literature that autism severity is related to outcomes on early behavioral and communication intervention. In particular, Smith, Mirenda, and Zaidman-Zait (2007) found that children with the most severe autism severity have made the least progress with expressive language development. Autism severity also has been shown to be related to development in other domains, including imitation and play skills (Ben-Itzchak & Zachor, 2007). One avenue to be addressed in future research may be to target specific characteristics of autism that are most influential on communication treatment outcomes. For example, scores on the CARS were affected by 15 different categories, including communication, social, and behavioral development. It may be possible that some areas have greater impact on outcomes than others.

Parent Responsivity

Previous studies of PMT suggested that levels of parent responsivity influenced response to treatment (Yoder & Warren, 1998; 1999; 2001). Only children whose

mothers showed high levels of responsivity made significant gains in communication skills. In this study, parent responsivity did not appear to be correlated with results. The participants whose parents demonstrated highest rates of responsivity, Lily and Ben, were the two poorest responders to PMT intervention. This outcome represents a contrast with outcomes in previous research on PMT for younger, less severely impaired children.

Authors of early PMT intervention studies found the impact of parent responsivity so great that they incorporated parent responsivity education as part of their treatment protocol. Parent education was not included as part of this protocol because there was no previous research on this population of older children to indicate that the training would be necessary or beneficial. Indeed, parent responsivity was not found be related to treatment outcomes with this group of older more severely impaired children. This lack of correspondence of response to intervention and parent responsiveness might suggest that parent responsivity has more influence on PMT intervention with younger less severe populations (ages 2-3). However, follow up with a larger group of children might show some effect. Common intervention practices pursued for younger children with disabilities require treatment in a home setting with a focus on parent training. Older children are treated in clinical or school settings. Future research with this age range might examine the responsivity of teachers in the classroom rather than parents.

Behavioral Profiles

Recent trends in autism intervention have strongly considered the influence of specific participant characteristics or behaviors on the response of children with autism treatment (Schreibman, 2000). Previous studies found that children with high rates of toy

play demonstrated higher rates of responding to treatment, and children with high rates of avoidant behaviors or high rates of nonverbal stimulation demonstrated lower rates of response to intervention (Sherer & Schreibman, 2006). Some of the results of the post-hoc analysis supported these findings. Adam and Cody, two of the highest responders, demonstrated high rates of toy play during the sessions. Chad, one of the low responders, demonstrated high rates of avoidance behaviors and of nonverbal stimulatory behaviors. Sam, a high responder, demonstrated high rates of approach behaviors. Lily and Ben, low responders, had low rates for all behaviors.

Summary

While it is not appropriate to calculate or claim a statistically based quantitatively evaluated correlation with six participants, several pre-treatment variables were identified that may have had an impact on the participant's response to intervention. Lower autistic severity ratings, higher developmental language ages, and high rates of toy play or approach behaviors were all characteristic of the best performers. Chronological age and parent responsivity did not appear to be influential in this group of children. Additionally, performance levels were relatively even across the three variables (frequency, clarity and maintenance). The best responders showed the most positive response to PMT intervention across all three variables.

Based on these findings, several avenues for future research have been identified. First, the high responders may show the best potential to transition to symbolic forms of communication. Previous research on PMT found that continuing intervention beyond the initial training to increase communication attempts was not beneficial (Warren et al.,

2008). However, future study could examine the effects of future linguistic interventions, such as enhanced PMT teaching, on children who have previously made gains with PMT. Severity of the population may indicate a need for a longer course of intervention. Secondly, many of the findings related to examination of individual differences among participants warrant more exploration. Specifically, autism severity was found to impact outcomes in these six children. However, it was not clear which specific autistic traits had the most impact on response to intervention. The relationship of communication deficits compared to other deficits in social and adaptive behaviors could be explored in controlled studies. Additionally, parent responsivity did not impact results for these older children. Research into teacher responsivity may be more practical and functional with school age children. Finally, further study of PMT with more children at this 5-8 year age range, and study with older children is needed to further explore the impact of chronological age on response to PMT.

LIMITATIONS OF THE STUDY

This study indicated positive results for PMT intervention on the frequency, clarity, and maintenance of communication of some nonverbal school-age children with autism. However, there are limitations to this study that must be considered before these results can be generalized to this older and more severe population. One way to evaluate the support of PMT intervention provided in this study is to consider the study in terms of evidence-based practice.

Evidence Based Practice

Evidence-based practice (EBP) is the process of consulting various types of information to answer a clinical question (Justice, 2006). Information such as theoretical perspective, clinical experience, and critical analysis of the literature is integrated to form a basis for EBP. Evidence-based practice originated in the medical field as a perspective for making decisions about patient care utilizing the "best available clinical evidence from systematic research" (Sackett, Rosenberg, Gray, Haynes & Richardson, 1996, p. 71). Other allied health fields were quick to adopt the EBP orientation, creating an emphasis on the need to critically examine current practice in the field of communication disorders.

Five common themes have been identified for consideration in examining the literature relative to EBP standards of evidence in communication disorders (ASHA, 2004). First, the evidence should have *independent confirmation and converging evidence*. For example, studies with both summary statistics showing treatment effects, as well as individual data reports would be considered to demonstrate the most evidence. Secondly, the study should demonstrate *experimental control*. Group studies that are randomized and blind would demonstrate the most experimental control. With single subject designs, studies that have clear differentiation and replication of phases would demonstrate the most experimental control. Third, the study must avoid *subjectivity and bias*. This aspect of EBP is measured by the extent to which those involved in the study (i.e. statisticians, participants, and coders) are aware of the hypothesis of the study. The more "blind" the key players are, the stronger the level of independently gained evidence of the intervention targeted. Fourth, *effect sizes and confidence intervals* must be given.

In addition to basic statistical significance, practical significance and confidence intervals should be explained. Finally, the *relevance and feasibility* of the intervention must be determined. This aspect involves the representativeness of the participants in the study compared to the typical patients seen in clinical practice.

Consideration of these study variables allows professionals to evaluate the overall quality of evidence for any given intervention approach. While evaluating the scientific literature is certainly not the only component of EBP, it is a critical aspect in formulating evidence-based practice decisions. The quality of evidence supporting an intervention provides an initial framework for clinical decision-making in communication intervention. Furthermore, it allows the clinician to compare different approaches being considered for intervention. Limitations of this current study of PMT intervention can be evaluated by considering these five variables.

Independent Confirmation and Converging Evidence

Evidence of a positive effect was achieved in this study using visual line graphs that displayed the results of each individual session along with stated ranges and averages for each participant. However, the study was limited in converging evidence as there were only six participants. While positive results were found for these six, the children consisted of a limited group defined by a disorder of autism, an age range of 5-8, developmental ages of 6-12 months for language skills, no sensory or motor impairments, and English as the primary language spoken in the home. Generalization beyond this specific group is limited. Future studies involving more participants and a broader range

of participants on these potentially important variables for considering outcomes will be needed to establish such evidence.

Experimental Control

This study consisted of a single subject, multiple baseline design. Levels of experimental control were demonstrated by establishing changes in the dependent variables between baseline and intervention phases across six participants. All participants had an equal number of intervention sessions that were consistently analyzed. The number of baseline sessions was staggered across participants.

One limitation to this study is that the participants began baseline nonconcurrently instead of at the same time. Nonconcurrent multiple baseline designs offer slightly less experimental control than the traditional multiple baseline design. However, the nonconcurrent multiple baseline design poses very little threat to internal validity and still represents an experimental design (Christ, 2007). This design differs from nonconcurrent AB designs in that the baseline length is randomly selected and determined prior to implementation of baseline for all participants. This study adhered to the a priori requirements outlined by Watson and Workman (1981). Future studies on PMT with this population should represent a diverse range of research designs, including more single subject experimental research and random group designs.

Subjectivity and Bias

Another potential limitation is that the primary researcher also served as the primary coder for all sessions. However, reliability data was collected on approximately 30% of sessions to control for this bias. Reliability coders were blind to the hypothesis of

the study. Additionally, sessions chosen for reliability were randomly selected. The researcher did not know which sessions would be used for reliability when she was coding. High rates of agreement were obtained between the primary and reliability coding results, suggesting that these results are unbiased and accurate. Nonetheless, future research should include implementation of the intervention by persons other than the primary researcher, such as the child's teacher, therapist, or parent.

Effect size and Confidence Intervals

Although effect size is not necessary to analyze single subject data, it can add to the support that an effect of the dependent variable has been clearly demonstrated. For example, the standard mean difference (SMD) could be calculated by comparing the baseline averages with treatment averages. In this particular study, however, changes were obvious with visual analysis. There was essentially no overlap between baseline and treatment data points. All effect sizes were clearly over 1.0 and showed large effects. Additionally, the visual display of data in the figures allowed for more detailed analysis than effect size alone could allow. For example, although all participants made increases in turn taking skills, different profiles were observable in terms of trend and level. Adam and Cody clearly made more progress than the other participants. Lily demonstrated an increase during intervention, but her overall change in level was not as great and she demonstrated no upward trend. Thus, the lack of "effect sizes and confidence intervals" is not a limitation in single subject experimental designs that conform to highest standards of demonstrating experimental control. If future results are not as clear as these results, calculation of effect size would be warranted.

One variable in particular demonstrates a limitation when interpreting the size of the increase. The measurement used in examining the *frequency* variable may be slightly skewed. For this variable, measurement of child-initiated communication attempts was calculated as the "total number per session". However, sessions ranged slightly from 25-30 minutes. Additionally, if the child moved out of range of the video camera, there may have been some time that the child's communication was not counted in the total. Thus, the actual time that the child's communication attempts were measured may have been less than 30 minutes. A better, more accurate, calculation would have been to measure the rate of occurrence of communications per minute. Time when the child was off camera or the session ended a minute or two early could have been removed from the calculation in this way.

Relevance and Feasibility

This study demonstrated both strengths and weaknesses in the area of relevance and feasibility. . In the review of PMT literature, participant pools in previous studies of PMT intervention were found to under-represent Hispanic and Asian backgrounds. Thus, the participant pool was a strength in that participants from a variety of ethnic backgrounds were included. Five out of the six participants had minority ethnic backgrounds. While the ethnic demographics did not exactly match that of Texas, because no African-American participants were recruited, the inclusion of two Hispanics, two Asians, and one Pacific Islander added value to the results of the study. Additionally, there is an overall lack of multicultural research within the area of severe disabilities (Sorrells, Webb-Johnson, & Townsend, 2004). However, this study did not focus

specifically on children's cultural characteristics and thus cannot explicitly advance this knowledge base. Future research should purposefully select children from diverse linguistic and cultural backgrounds and study the effects of cultural variables on the use of PMT with these populations and their impact on intervention outcomes.

Conducting the study in the children's homes was a limitation. Typically, intervention for school-age children is conducted in the school setting. In some cases, intervention might be conducted in a clinical setting. Intervention with children in this age range is not conducted in their home. This study was conducted exclusively in the home setting with the researcher conducting all intervention sessions. Thus, results cannot be generalized to educational settings or to other implementers, such as parents or teachers.

Future study of PMT with this population should investigate whether parents or teachers could successfully implement PMT. Additionally, future study should investigate whether the intervention would be applicable in other settings, such as the child's classroom or other educational setting. Furthermore, future studies should investigate whether the communicative behaviors learned during PMT generalized to different settings and persons without specific intervention applied in those settings and persons. If a generalization session was conducted with the child's parent, would the child demonstrate the same levels of communication with his or her parents as he or she did with the researcher?

Summary

Only a few limitations of this study were noted when considering results. First, the study was limited by implementation with only a small number of participants. Future research is needed with more participants and a broader age range of school-age children from diverse cultural groups. Future research is also needed across a variety of study designs, including some with calculation of effect size. Secondly, the study was limited in that it was conducted only in the child's home precluding evaluation of generalization across settings or communication partners. Future research should focus on implementation by teachers or parents, delivery of PMT within the classroom setting, and generalization of communication skills gained across settings and communicative partners. Finally, the evaluation of "frequency" of child initiated communication acts was limited by the fact that the calculation of rate involved a total number per session, when the session length may have varied somewhat. Rate per minute would be a better calculation of child initiation in future studies.

CONCLUSIONS

The goal of this study was to evaluate PMT relative to a hypothesis that it would result in increased in the frequency, clarity, and maintenance of prelinguistic communication in school-age children with autism. Two months of prelinguistic milieu teaching (PMT) were implemented in each participant's home. Three questions were posed for evaluation of PMT that examined whether intervention would increase the participants' frequency, clarity, and maintenance of the communication. The answer to all three of these questions was "yes". PMT was an appropriate intervention for increasing

frequency, clarity, and maintenance of communication attempts of older children with ASD who remain nonverbal into the early school-age years.

All participants increased their *frequency* of communication to at least a rate of 1 initiated act per minute during treatment. Three participants increased their rate to 2 initiated acts per minute, indicating readiness for more linguistic means of communication. Although the other three participants made increases, they may have reached their maximum potential for frequency of communication. Secondly, all participants increased the *clarity* of their communication by consistently combining at least 2 different means in their communication attempts. Three participants learned to combine all three targeted means of communication in over 80% of their overall attempts at communication, again suggesting a readiness to advance to linguistic forms of communication. The other three participants may benefit more from additional interventions targeting other means of communication, such as picture selection. Finally, all six participants demonstrated an increase in topic *maintenance* (turn-taking) during intervention. However, increases in maintenance were the most variable of the three measures. Autistic behaviors that often vary from day to day, such as self-stimulatory behaviors, may have influenced these results.

Although all participants made gains during intervention, there were variations in the overall trends and levels of increases across participants. Several individual differences in these six children have been identified that appeared to impact response to PMT. Individual consideration of the children's profiles showed that pre-treatment variables such as lower autistic severity, higher developmental language age, higher rates

of toy play, and higher rates of approach behaviors may be associated with the "best" response to PMT intervention for the three study questions within this small cohort of six children. These findings support previous research on expressive language development in children with autism that found language and social skills, toy play, and autism severity impact treatment. However, they contrast with previous research on PMT suggesting that parent responsivity has a positive impact on the effectiveness of the intervention. A stronger understanding of the influence of these diverse aspects of development is critical to future evaluation of PMT intervention for enhancing communication skills in children with autism.

In summary, this study demonstrated that direct communication intervention was extremely successful in teaching children with low levels of developmental functioning to communicate more effectively. The selected intervention, Prelinguistic Milieu Teaching, offered productive techniques for increasing frequency, clarity, and maintenance of early intentional communication. The intervention was relatively easy to implement and required no pre-planning since it relies on naturally occurring materials and routines. However, implementers must be skilled in the ability to facilitate communication in the natural environment while following the child's lead. Arranging the environment to create an enabling context for communication is a key to PMT intervention. However, this requires steps such as placing preferred items out of reach and removing materials such as sensory toys that might increase the probability of self-stimulation rather than facilitate interaction. This may be especially difficult in settings such as a classroom, where the environment tends to be academically geared. If the

intervention was to be implemented in the school, for example, teachers might need to create a specific space within their classroom where the intervention could take place without having to rearrange the entire classroom.

The prelinguistic communication skills targeted in this study and taught with PMT techniques may allow children with severe autism who persist at a prelinguistic level of function to develop skills in other domains, including social interaction and adaptive behaviors. In particulare, these skills may provide a pathway for at least three of the six participants to advance to linguistic forms of communication. The final conclusion of this study is that PMT based communication intervention for school-age children with severe autism accompanied by severe and persisting communication disabilities may provide an avenue toward improved overall social functioning.

APPENDIX A:

Parent Interview Questions

1. How old is your child?
2. What languages are spoken to your child? If more than one, what is the primary language used with the child?
3. What race or ethnicity is your child?
4. What medical diagnoses does your child have?
5. What types of therapy or educational services does your child receive?
6. Does your child have any sensory impairment? If so, what?
7. Does your child have any physical impairment? If so, what?
8. What are your child's favorite activities?
9. How does your child request his/her favorite activities?
10. Why does your child communicate with you (to request, to tell you about something, to ask you a question, etc.)?
11. How frequently does your child communicate with you?
12. What types of communication does your child use (words, pictures, leading, etc.)?
13. Does your child use spoken words? If so, what words?
14. Does your child use vocalization to communicate? If so, what sounds?
15. Does your child use any gestures that you recognize consistently to communicate? If so, could you describe them?
16. Does your child use any other ways to communicate with you that are unique (looking, facial expressions, etc.)? If so, please explain.

APPENDIX B

APPENDIX B

Recruitment Flyer

Research Study Participants Needed

Do you have a nonverbal child with an autism spectrum disorder (ASD)?

Are you interested in allowing your child to participate in scientific research to understand how to teach communication skills effectively?

The purpose of this study is to evaluate the effectiveness of a treatment approach designed teach vocalizations, gestures, and eye-contact as a reliable means of communication. The goal is for participants to learn to communicate clearly and effectively.

Participants must be between the ages 5-18 and speak English as their primary language.

There is no monetary compensation for participation.

For more information please contact Jessica Franco.
Send an email to: jessicahetlingerfranco@hotmail.com
OR call (512) 626-8305.

APPENDIX C

Examples of Gestures

a. Distal point

b. “Shh” gesture

c. Head nod or shake

d. Wave

e. Shoulder shrug

f. Pantomime or depictive sign

g. Tapping with fingers

h. Moving object toward adult

i. Clap

j. Reaching

k. Proximal point

l. Upturned palm

m. Giving object to adult

n. Showing object to adult

APPENDIX D

CARS Categories

I. Relating to people

II. Imitation

III. Emotional response

IV. Body use

V. Object Use

VI. Adaptation to change

VII. Visual response

VIII. Listening response

IX. Taste, smell, and touch response and use

X. Fear or nervousness

XI. Verbal communication

XII. Nonverbal communication

XIII. Activity level

XIV. Level and consistency of intellectual response

XV. General Impressions

APPENDIX E

Coding Sheet

TIME	TURNS	INITIATED BY		FUNCTION OF THE COMMUNICATION				FORM OF THE COMMUNICATION						TREATMENT FIDELITY		
Clock	Turn #	Child	Adult	Request	Comment	Protest	Other	vocal-I	vocal-P	gesture-I	gesture-P	eye-I	eye-P	Context	Prompting	Response
	0	0	0	0	0	0	0	0	0	0	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!
Sums			**0**													
Averages		**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**									

APPENDIX F

Coding Guidelines

DIRECTIONS FOR IMPLEMENTATION OF CODING:

- Begin coding immediately with the onset of the video. Each video will start with a 0:00 time count. End coding at 30:00 or when video ends.
- Record any attempt the child makes to communicate with or interact with the therapist. Each attempt is considered one event that will be analyzed. Sometimes, one event will take 15-20 seconds. The child may repeat a gesture or vocalization within the event, but it is still considered only one episode.
- Within the episode, AFTER a child attempts to communicate, the therapist may model a better approximation of a vocalization or gesture and the child may imitate the model. If the child's initial communication attempt was independent, then the behaviors should still be coded as "independent". The model in these cases would not be considered a prompt because they occurred after the child initially used the communicative form.
- The time of the event should be recorded in the left hand column. The remaining columns list variables that should be coded as explained below.
- There may be times when the child is not observable in the video. No communication episodes should be coded during any period when the child's head is out of view of the video.

DIRECTIONS FOR DETERMINING THE NUMBER OF TURNS:

Within each social routine or activity, the child may communicate only once and move on to another activity or he may take multiple turns within the same activity. Each event should be marked with a number to denote the (child's) turn number within the activity. For example, the child's first turn within an activity should be marked with a "1". If the child maintains focus on the activity, the next event should be marked as a "2" and so on. If the child stops participating in the activity and another activity is begun, then start the numbering again and mark the new event as a "1" turn.

DIRECTIONS FOR DETERMINING WHETHER ACT WHO INITIATED THE ACT:

The communication attempt should be coded as initiated by either the **adult** or the **child.** Mark a "1" in the appropriate column and leave the other column blank.

> **Child**: The child spontaneously initiated the interaction with the adult without any prompting or models from the adult.
> **Adult**: The adult initiated the interaction by asking a question, giving a direction, or giving the child a prompt or model.

DIRECTIONS FOR DETERMINING THE PRAGMATIC FUNCTION OF THE ACT:
The function of the communication should be recorded as one of the following: **request**, **comment**, **protest**, or **other**. Mark a "1" in the appropriate column and leave the other columns blank.

> **Request:** The child communicates for the purpose of requesting an item, action, or event. For example, the child may request something to drink.
> **Comment:** The child directs the adult's attention to an object or event for the purpose of sharing knowledge. For example, the child may identify a character in a book.
> **Protest:** The child communicates for the purpose of rejecting an item or protesting an activity.
> **Other:** The child communicates in a way that is not considered a comment or a request. For example, the child may use a social greeting, such as "hi" or fill in words to a song.

DIRECTIONS FOR DETERMINING THE FORM OF COMMUNICATION:
Record the form(s) of the communication. The form should be coded as **vocalization**, **gesture**, and/or **eyegaze**. The behavior must be meant to convey meaning and cannot be stimulatory in nature. Do NOT code stimulatory behaviors such as vocalizations that are repetitive and non-communicative, or stereotypic gestures such as handflapping or clapping that are repetitive and not meant to be communicative. The child may use one, two, or all three of these communication means. Mark a "1" in the columns that list the means the child used during that event. Leave the other columns blank.

> **Vocalization:** The child says any speech sound, word, or word approximations.
> **Gesture:** The child points by extending his finger toward an object or event or uses a representational or conventional action, such as a head nod, wave, or upturned palm. (For a more complete list of gestures, see appendix c).
> **Eyegaze:** The child makes direct eye-contact with the adult.

DIRECTIONS FOR DETERMINING INDEPENDENT USE OF THE FORM:
For each of these means, you should code whether it was prompted in some way or if it was an independent and spontaneous use of the form. Each form should be considered separately and recorded as prompted or independent.

> **Prompted (P):** The response was prompted with a vocal, gesture, or physical prompt or the adult modeled the correct response immediately prior (within 3 seconds) to the child's production.
> **Independent (I):** No model or prompt was given by the adult for that form.

Note that the child may independently engage in one of the means, but be prompted for others!

DIRECTIONS FOR DETERMINING FIDELITY OF TREATMENT:

Record whether the therapist correctly implemented PMT techniques. Each of the three techniques has a separate column. Record a "1" if the technique was implemented correctly. Record a "0" if the technique was not implemented correctly.

Enabling context: The therapist created a situation in which the participant was likely to communicate and waited for the child to make a communication attempt. The therapist followed the child's lead for motivation of activities.

Prompting: If the child did not initiate interaction, the therapist used appropriate prompts to attempt to get the child to communicate in the desired way. The therapist used no more than 2 discrete prompts before moving on with the interaction. If the child initiated the communication, then no prompts were used.

Response to communication: The therapist responded in an appropriate way to the child's attempt to communication. The potential appropriate responses include: imitating the child, giving the child a desired item/activity, or recasting the child's attempt with an appropriate word for what he was trying to communicate.

APPENDIX G

Participant Social Routines

Participant	Social Routines/Activities Used
Adam	Cart rides Blanket- peek-a-boo game Slide Tumbling on mat Books Piggy-back rides Chair spins Ball-catch
Cody	Toy figurines Cars Chase Tickles Squish game
Ben	Swing Tumbling on mats/pillows Ball-bounce game Squish game Chase Spin games 5-little-pigs Blanket-pull game Blanket- peek-a-boo game
Sam	Squish game Tickles Dancing Ring-around-the-Rosie Ball-catch Trampoline
Lily	Hammock Ball-bounce Blanket-cover game Tumbling in mats/pillows Brushing Cart rides 5-little-pigs Slide
Chad	Blanket- peek-a-boo game Ball-bounce Squish game Chase Musical toys

APPENDIX H

Social Validity Rating Sheet

Session Code:_____

Instructions: After viewing each video clip, please rate the following items by circling the number that represents your response. For each item, you may select a rating of 1-5. A rating of 1 represents the most negative or unfavorable response, while a rating of 5 represents the most positive or favorable response.

1. **Do you think the child finds the interaction pleasant?**

1 2 3 4 5
Negative……..…Neutral……..Positive

2. **Do you think the child can benefit from the interaction?**

1 2 3 4 5
Negative……..…Neutral……..Positive

3. **Do you think that parents/caregivers find the interaction pleasant?**

1 2 3 4 5
Negative……..…Neutral……..Positive

4. **Do you think the interaction has practical benefits for parents/caregivers?**

1 2 3 4 5
Negative……..…Neutral……..Positive

5. **Do you think the interaction represents a form of rehabilitation?**

1 2 3 4 5
Negative……..…Neutral……..Positive

6. **Do you think that the interaction could be transferred to other settings?**

1 2 3 4 5
Negative……..…Neutral……..Positive

7. **How much would you like to be involved in this interaction?**

1 2 3 4 5
Negative……..…Neutral……..Positive

APPENDIX I

Individual Session Results for Initiation

Adam	Total	% Child	% Adult
1	17	35	65
2	28	57	43
3	15	67	33
4	33	64	36
5	37	89	11
6	23	96	4
7	21	76	24
8	45	82	18
9	37	73	27
10	58	88	12
11	38	100	0
12	48	98	2
13	63	97	3
14	45	96	4
Cody	Total	% Child	% Adult
1	21	29	71
2	19	37	63
3	37	32	68
4	43	70	30
5	48	54	46
6	31	84	16
7	28	93	7
8	52	79	21
9	28	100	0
10	35	74	26
11	41	80	20
12	36	67	33
13	32	78	22
14	63	92	8
Ben	Total	% Child	% Adult
1	16	31	69
2	8	100	0
3	31	77	23
4	21	95	5
5	29	83	17
6	12	92	8
7	16	94	6
8	28	93	7

9	29	97	3
10	27	96	4
11	23	96	4
12	36	97	3
13	22	91	9
14	33	100	0
Sam	Total	% Child	% Adult
1	59	93	**7**
2	67	70	30
3	78	76	24
4	44	91	9
5	60	88	12
6	48	92	8
7	42	83	17
8	53	96	4
9	41	85	15
10	32	97	3
11	41	93	7
12	54	100	0
13	43	98	2
14	44	91	9
Lily	Total	% Child	% Adult
1	17	65	35
2	19	89	11
3	10	90	10
4	23	91	9
5	10	90	10
6	26	81	19
7	26	96	4
8	17	88	12
9	21	95	5
10	22	100	0
11	25	88	12
12	27	89	11
13	10	100	0
14	33	91	9
Chad	Total	% Child	% Adult
1	31	45	55
2	45	93	7
3	23	96	4
4	33	94	6
5	18	100	0
6	33	97	3

7	18	78	22
8	38	97	3
9	36	64	36
10	24	88	13
11	44	98	2
12	30	97	3
13	17	71	29
14	26	96	4

APPENDIX J

Individual Session Results for Pragmatic Function

Adam	Total	% request	% comment	% protest	% other
1	17	71	0	24	0
2	28	75	14	7	6
3	15	73	13	7	4
4	33	55	30	3	7
5	37	95	8	0	12
6	23	96	0	4	0
7	21	71	24	5	0
8	45	87	7	2	0
9	37	76	11	11	0
10	58	29	69	0	2
11	38	47	53	0	0
12	48	52	48	0	2
13	63	59	37	2	3
14	45	40	60	0	0
Cody	Total	% request	% comment	% protest	% other
1	21	86	5	0	10
2	19	68	26	5	0
3	37	84	16	0	0
4	43	56	16	2	26
5	48	52	21	2	25
6	31	81	10	0	10
7	28	64	11	0	25
8	52	69	23	4	4
9	28	96	0	0	4
10	35	69	23	3	6
11	41	61	29	2	7
12	36	61	28	3	8
13	32	72	25	3	0
14	63	76	14	0	10
Ben	Total	% request	% comment	% protest	% other
1	16	94	0	6	0
2	8	88	13	0	0
3	31	81	19	0	0
4	21	95	5	0	0
5	29	97	3	0	0
6	12	100	0	0	0
7	16	100	0	0	0
8	28	93	4	4	0

9	29	83	7	10	0
10	27	96	0	4	0
11	23	100	0	0	0
12	36	100	0	0	0
13	22	100	0	0	0
14	33	100	0	0	0
Sam	Total	% request	% comment	% protest	% other
1	59	93	5	0	2
2	67	100	0	0	0
3	78	96	0	0	4
4	44	98	2	0	0
5	60	98	0	2	0
6	48	98	2	0	0
7	42	100	0	0	0
8	53	98	2	0	0
9	41	95	0	0	0
10	32	97	3	0	0
11	41	100	0	0	0
12	54	100	0	0	0
13	43	100	0	0	0
14	44	100	0	0	0
Lily	Total	% request	% comment	% protest	% other
1	17	88	6	6	0
2	19	89	11	0	0
3	10	100	0	0	0
4	23	96	4	0	0
5	10	90	0	10	0
6	26	62	31	8	0
7	26	85	12	4	0
8	17	94	0	6	0
9	21	71	14	14	0
10	22	68	13	9	0
11	25	100	0	0	0
12	27	93	0	7	0
13	10	100	0	0	0
14	33	61	36	3	0
Chad	Total	% request	% comment	% protest	% other
1	31	100	0	0	0
2	45	100	0	0	0
3	23	100	0	0	0
4	33	100	0	0	0
5	18	94	6	0	0
6	33	100	0	0	0

7	18	100	0	0	0
8	38	100	0	0	0
9	36	100	0	0	0
10	24	100	0	0	0
11	44	91	5	5	0
12	30	97	7	0	0
13	17	100	0	0	0
14	26	92	4	4	0

APPENDIX K

Paired Samples Test and Statistics for Individual Participants

Adam	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Item 1	20	-2.1	1.23	-7.5	19	.000*
Item 2	20	-2.2	1.24	-7.9	19	.000*
Item 3	20	-1.7	.98	-7.8	19	.000*
Item 4	20	-2.3	1.08	-9.5	19	.000*
Item 5	20	-1.9	1.1	-7.6	19	.000*
Item 6	20	-1.5	1.36	-4.9	19	.000*
Item 7	20	-1.85	.81	-10.2	19	.000*

Cody	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Item 1	24	-.21	.77	-1.3	23	.203
Item 2	24	-.04	1.04	-.2	23	.846
Item 3	24	-.42	1.44	-1.4	23	.170
Item 4	24	-.33	1.05	-1.6	23	.133
Item 5	24	-.54	1.02	-2.6	23	.016*
Item 6	24	-.46	1.14	-2.0	23	.061
Item 7	24	-.42	1.18	-1.7	23	.096

Ben	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Item 1	20	-1.5	1.32	-5.9	19	.000*
Item 2	20	-.90	1.17	-3.4	19	.003*
Item 3	20	-.70	1.45	-2.2	19	.044*
Item 4	20	-.45	1.32	-2.5	19	.143
Item 5	20	-.70	.92	-3.4	19	.003*
Item 6	20	-.60	1.31	-2.0	19	.055
Item 7	20	-1.00	1.30	-3.4	19	.003*

Sam	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Item 1	23	-.91	1.00	-4.4	22	.000*
Item 2	23	-1.35	1.40	-4.6	22	.000*
Item 3	23	-1.1	.92	-5.9	22	.000*
Item 4	23	-1.39	1.34	-5.0	22	.000*
Item 5	23	-1.61	1.23	-6.3	22	.000*
Item 6	23	-.87	1.32	-3.1	22	.000*
Item 7	23	-1.35	1.37	-4.7	22	.000*

Lily	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Item 1	20	.25	1.29	.86	19	.40
Item 2	20	-.30	1.62	-.82	19	.42
Item 3	20	.05	1.43	.15	19	.88
Item 4	20	-.45	1.64	-1.2	19	.23
Item 5	20	-.60	1.50	-1.8	19	.09
Item 6	20	-.20	1.85	-.48	19	.64
Item 7	20	-.15	1.76	-.38	19	.70

Chad	N	Mean	Std. Dev.	t	df	Sig. (2-tailed)
Item 1	21	-1.7	1.31	-6.0	20	.000*
Item 2	21	-1.8	1.57	-5.3	20	.000*
Item 3	21	-1.4	.53	-4.1	20	.001*
Item 4	21	-1.4	1.54	-4.3	20	.000*
Item 5	21	-1.3	1.65	-3.7	20	.001*
Item 6	21	-1.0	1.70	-2.7	20	.014*
Item 7	21	-1.4	1.47	-4.3	20	.000*

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