TEACHING PARAPROFESSIONALS TO IMPLEMENT A SOCIAL COMMUNICATION INTERVENTION FOR YOUNG CHILDREN WITH ASD

by

Alicia A Mrachko

Bachelor of Science, Case Western Reserve University, 1986

Master of Education, University of Pittsburgh, 2010

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This dissertation was presented

by

Alicia A Mrachko

It was defended on

July 23, 2015

and approved by

Doug Kostewicz, Ph.D., BCBA-D, Associate Professor, Department of Instruction & Learning

Rachel Robertson, Ph.D., BCBA-D, Assistant Professor, Department of Instruction & Learning

Benjamin Handen, Ph.D., BCBA-D, Professor of Psychiatry and Pediatrics, Department of Psychiatry

Christopher Lemons, Ph.D., Assistant Professor, Vanderbilt University

Dissertation Advisor: Louise Kaczmarek, Ph.D., Associate Professor, Department of Instruction & Learning

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Alicia A Mrachko, PhD

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Children diagnosed with Autism Spectrum Disorder (ASD) frequently lack social communication skills and researchers have developed evidence-based practices to address these deficits. More recently, researchers are examining paraprofessional use of these interventions when working directly with children with ASD. The author completed a review examining studies in which paraprofessionals were taught to implement a social communication intervention with young children with ASD. Researchers in the review studied paraprofessional use of naturalistic behavioral interventions with studies reporting an increase in paraprofessional treatment fidelity for the chosen intervention, and most reporting corresponding improved child outcomes. From this review, the author designed and completed research examining adult behavioral skills training for paraprofessionals in a manualized, naturalistic behavioral social pragmatic intervention from Project ImPACT (Ingersoll & Dvortcsak, 2010). Three Therapeutic Support Staff (TSS) were taught with online modules, in-vivo training and ongoing feedback to use interactive strategies to a predetermined frequency criterion with young children with ASD in the child's home setting to improve child spontaneous communication. The TSS increased strategy use to criterion quickly with accuracy and generalized the strategies to snack time or the playground. The TSS also sharply decreased their use of questions and demands during playtime.

Strategy use continued after intervention. Child spontaneous communication increased in frequency and moved from mostly eye gaze and gestures to eye gaze, vocalizations and a few words. The results indicate that a package combining online modules, in-vivo training plus ongoing feedback is effective in teaching TSS to use social communication strategies during playtime. This study furthers the concept of a target frequency for each strategy within a play session.

Keywords: Autism, paraprofessional, social communication, naturalistic behavioral intervention, treatment fidelity, feedback, modeling, coaching

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PREFACE

The author completed this research with a grant from the University of Pittsburgh School of Education. The author thanks Southwestern Human Services, the therapeutic support staff and families who participated in the study. The author also thanks Brea Furman and Brittany Bauerle for their hard work coding videos and assessing implementation fidelity. The Early Intervention team were the biggest cheerleaders one could ever hope for. The dissertation committee all provided their knowledge and encouragement unselfishly and the author appreciates their collegiality. The author can never adequately express her thanks to her advisor, Louise Kaczmarek, for her dedication, mentorship and inspiration. Most importantly, the author wishes to thank her husband John, her children Sarah, Lauren and Daniel, and her mother Delores for their unwavering belief and support.

1.0 INTRODUCTION

Social communication skill development begins early in infancy and continues throughout childhood. During the first year of life a child learns to communicate intentionally through social exchanges such as smiling, coordinating attention between objects and people, and using sound and gestures (Wetherby, 2006). Such early social engagement lays the foundation for more complex social interactions that emerge in early childhood including imitation, imaginary play, and spoken language (Schreibman & Ingersoll, 2005). Spoken language develops to request wants and needs, label items, share attention and obtain information (Sundberg & Michael, 2001). Children with Autism Spectrum Disorder (ASD) often struggle with early social engagement leading to further difficulties with more complex social communication, academic learning and personal interactions (Chiang & Carter, 2008). Researchers have reported that compared with typically developing peers, children with ASD spend more time in apparently purposeless activity, interact less with others, and maintain greater physical distance from peers when in the same area (Goldstein, Lackey, & Schneider, 2014).

Among the deficits related to a lack of social engagement is an absence of social communication, a core deficit in children with ASD (American Psychiatric Association, 2013). Early social communication skills, such as joint attention, imitation, symbolic play, and the ability to understand and express language are skills that are often delayed or impaired in

children with ASD (Ingersoll & Schreibman, 2006). In particular, spontaneous social communication is a typical behavior that children with autism often lack (Duffy & Healy, 2011).

Social communication intervention research for young children began as early as the 1960s (Hart & Risley, 1968) and was extended to children with ASD beginning in the 1970s (Lovaas, Koegel, Simmons, & Long, 1973; McGee, Krantz, Mason, & McClannahan, 1983). Interventions for children with ASD based in the science of Applied Behavior Analysis emerged initially (Lovaas et al., 1973) followed somewhat later by interventions with a foundation in child development (Mahoney & Perales, 2003; 2005). These interventions have ranged from highly structured discrete trial training (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998), to milieu teaching strategies (Charlop, Schreibman, & Thibodeau, 1985) and peer-mediated interventions (Goldstein, Kaczmarek, Pennington, & Shafer, 1992).

Recently interventions combining both behavioral and developmental approaches have shown promising results in increasing social communication behaviors in young children with ASD (Dawson et al., 2010; Ingersoll & Wainer, 2013). These interventions utilize well-developed programs for both parents and professionals as important interventionists (Ingersoll & Dvortcsak, 2010; Rogers & Dawson, 2010). Like parents, paraprofessionals spend a large amount of time directly working with young children with ASD, both in the home and at school (Rispoli, Neely, Lang, & Ganz, 2011).

Paraprofessionals are often the direct interventionists in the home or preschool under the supervision of a specialist. Although paraprofessionals have been reported to hinder a child's interaction with peers and teachers in a school setting (Giangreco & Broer, 2007), in a home setting they can foster interaction between the child with ASD and siblings or parents (Lorimer, Simpson, Smith-Myles, & Ganz, 2002). The cost of intensive behavior in-home therapy can be

costly, up to $30,000 annually or more (Luiselli, Cannon, Ellis, & Sisson, 2000; Sharpe & Baker, 2007), and would be much higher if implemented only by Master's level professional. Jacobson, Mulick and Green (1998) calculated that children with ASD receiving three years of intensive behavioral intervention had improved outcomes that saved from $652,000-$1,082,000 during the child's lifetime. Paraprofessionals would seem to be a cost-effective way to provide the large number of hours of direct intervention recommended for children with ASD (Hughes & Valle-Riestra, 2008).

A paraprofessional is defined as an adult working under the supervision of a lead teacher or a Master's level clinician, often directly with a child with disabilities in a school or home setting (Boomer, 1994; Giangreco et al., 2010; Kohler, 1999). These adults have education levels ranging from a high school diploma to a Bachelor's degree and frequently spend the most time with the child other than family caregivers. Paraprofessionals hired to assist in schools with preschool-aged children are primarily high school graduates (73%) with associate degreed (11%) and bachelor degreed (13%) personnel less common (Killoran, Templeman, Peters & Udell, 2001). In school, the paraprofessional provides behavioral, academic, and life skill support (Boomer, 1994). Giangreco and colleagues (2010) have determined that in schools paraprofessionals lack basic and specific training for the interventions they are required to implement with individual students. Despite lack of training, schools are often over-reliant on paraprofessionals to provide intervention to children with disabilities (Giangreco & Broer, 2007). In the home, the paraprofessional is often a Bachelor's level therapist with the title Therapeutic Support Staff (TSS), who provides direct behavioral service to a child with autism or developmental disabilities (Kohler, 1999). These paraprofessionals are typically provided some training in autism-specific interventions that will be a part of the programming for their clients

(Community Care Behavioral Health Organization, 2012). Early research on modern wraparound services, where the majority of intervention is carried out by in-home paraprofessionals, found that children receiving services had significant and improved behavioral, academic, communication, and placement outcomes (Bruns, Burchard, & Yoe, 1995; Clark, Schaefer, Burchard, & Welkowitz, 1992; Eber, Osuch & Reddit, 1996; Toffalo, 2000; VanDenBerg, 1993). While not all the children in these studies had a diagnosis of autism, autism services were included in the population studied. Whether in home or school paraprofessionals require effective training to successfully carry out evidence-based interventions for children with ASD.

Treatment fidelity is a key characteristic of implementing evidence-based practices (Halle, Metz, & Martinez-Beck, 2013). When establishing an intervention as evidence-based, the researcher must adhere to the treatment with fidelity (Halle et al., 2013). Treatment fidelity is defined as the degree to which interventionists implement a program as originally intended (Dunst, Trivette, & Raab, 2013). Treatment fidelity helps the researcher create internal validity in a study; when the independent variable (the intervention) is implemented with fidelity, the dependent variable change can be attributed to the intervention if other variables are controlled (Wolery, 2011). Implementation fidelity measures the degree to which the training and coaching of the participant is provided as intended and is consistent across participants, a further step toward ensuring treatment fidelity (Dunst et al., 2013). Treatment fidelity is important in practice as well as research. If a practitioner wishes to replicate the results of research, they must also replicate the procedure of the intervention with fidelity (Wolery, 2011). Killoran, Templeman, Peters and Udell (2001) suggested that paraprofessionals master treatment fidelity in service delivery to young children with disabilities by demonstrating knowledge of Early Intervention/Early Childhood Special Education best practice and the ability to teach and

implement programs. Research on training paraprofessionals has reported treatment fidelity outcomes in the form of adherence to an intervention protocol thus measuring the effect of the training (Rispoli et al., 2011). The purpose of increasing treatment fidelity by training paraprofessionals is to improve outcomes for the children with ASD who are the recipients of the intervention (Schepis, Reid, Ownbey, & Parsons, 2001).

1.1 STATEMENT OF THE PROBLEM

In light of the critical nature of social communication interventions for children with ASD and the prevalence of paraprofessionals in service delivery to these young children, there is a need for research examining paraprofessional training to improve social communication in young children with ASD. Although social communication interventions for children with ASD have demonstrated evidence of effectiveness (Goldstein et al., 2014; McConnell, 2002), studies determining effective use of approaches combining developmental and behavioral theory are still emerging. Researchers have begun to study professional and parent use of combination strategies with improved child outcomes (Ingersoll & Wainer, 2013; Dawson et al., 2010). No studies have been found examining methods to teach paraprofessionals to use a combination approach.

Little research is available on teaching paraprofessionals to implement social communication interventions. The few studies that examine paraprofessionals implementing social communication strategies for children with ASD have occurred in a preschool or clinic setting. Given that paraprofessionals implement interventions for young children with ASD in home settings daily as part of behavioral wraparound services, researchers need to examine home settings as part of paraprofessional research. The following study evaluates teaching

paraprofessionals to implement a combination social communication intervention for young children with ASD in their homes.

2.0 LITERATURE REVIEW

The literature review in this chapter covers three essential areas of research: (1) Social communication interventions for children with ASD, (2) Adult behavior skills training of paraprofessionals (3) Training of paraprofessionals to implement social communication interventions for children with ASD. The first review represents an overview of the theoretical foundations of social communicative interventions for this population, including selected studies documenting their effectiveness. The second review represents an overview of adult learning models and research on paraprofessional interventions. The third review represents a systematic comprehensive research synthesis of the research devoted to training paraprofessionals to implement social communication interventions for children with ASD

2.1 SOCIAL COMMUNICATION INTERVENTIONS FOR CHILDREN WITH ASD

In 2002, two researchers reviewed the available evidence for social interaction and communication interventions for children with ASD (Goldstein, 2002; McConnell, 2002). Both reviews indicated that some interventions to improve social communication have evidence of effectiveness. Based on the data provided in the reviews, few studies targeted increasing spontaneous communication without some form of prompting from adults or peers. Both McConnell (2002) and Goldstein (2002) pointed to vague intervention descriptions as a major

limiting factor in establishing an evidence base for practice. McConnell described the need for increased research in home and community settings, since a vast majority of the work to that date had been in classrooms. Along with home settings, McConnell advocated for research with a younger population (preschool and younger) to establish practice for early intervention. Goldstein advocated for an increase in social validity measures and good dependent variable measurement.

In the ensuing 12 years many of these recommendations have come to fruition. Intensive early intervention for young children with ASD has been established as a principal method for improvement in long-term functioning (National Research Council, 2001). Researchers have developed interventions targeting younger children with ASD (e.g., Dawson et al., 2010), home and parent interventions (e.g., Vernon, Koegel, Dauterman & Stolen, 2012), and manualized treatments (e.g., Ingersoll & Dvortcsak, 2010). Goldstein and colleagues (2014) recently conducted an updated review of the social skills literature, including 20 studies that specifically targeted social communication or requesting. They found satisfactory replications of interventions with measureable treatment effects, stating that social interaction treatment should be considered an evidence-based practice for preschool children with ASD (Goldstein et al., 2014). Research still divides into several paths of inquiry as to the best method to teach children with ASD social communication skills. The literature generally divides along two lines, behavioral and developmental theories (Ingersoll, 2010).

2.1.1 Developmental Social Pragmatic Interventions

Developmental Social Pragmatic (DSP) interventions were derived from Piaget's constructionist psychology and social-pragmatic language acquisition theory (Ingersoll, 2010).

Very early in infancy the child organizes his/her experience adaptively in a predetermined sequence (Greenspan & Lourie, 1981). Piaget labeled the cognitive developmental trajectory in three stages: Sensorimotor, Concrete Operational and Formal Operational (Piaget, 1954). These stages develop as the child interacts with the environment, including caregivers. Symbolic language is believed to emerge as one signal that a child is moving from the sensorimotor stage into the concrete operational stage (Piaget, 1954). Social-pragmatic language acquisition theory parallels cognitive development theory by stating that children learn language only after they have acquired knowledge of the world around them and that their language will always have intent (Bruner, 1981). Three prelinguistic skills emerge in sequence before a child begins to develop symbolic language: sharing attention, sharing affect and sharing intentions (Stern, 1985). A desire to signal intent (e.g. request, show) and the beginning of imitation skills with repetitive actions produce the start of symbolic social communication in a young child (Stern, 1985). Social communication interventions applying DSP theory make use of typical cognitive and language development trajectories.

Researchers using a DSP theoretical model believe that all children, regardless of ability, learn skills, including language, in a developmental sequence (Gerber, 2003). A child with ASD may learn social communication skills more slowly but he will learn those skills in the same order as a typically developing child. Through assessment and intervention, an interventionist identifies and targets the cognitive developmental stage (e.g. sensimotor, concrete operational) and language developmental stage (e.g. prelinguistic) of the child (Gerber, 2003). Intervention goals are derived from the outcomes of the assessment (Vismara & Rogers, 2010). Critical factors considered common to all DSP interventions include responsiveness of the adult caregiver (i.e., matching affect, interests, and developmental level of the child), reciprocity, and

contingency (Ingersoll, 2010). Ingersoll (2010) described other frequent features of a DSP intervention such as following the child's lead or interest and responding to all communicative attempts as purposeful. Several interventions for young children with ASD have originated from the DSP model.

The SCERTS model is a comprehensive treatment package based on DSP theory that emphasizes social communication, emotional regulation, and transactional support for children with ASD and their families and schools (Prizant, Wetherby, Rubin, & Laurent, 2003). The goals developed for social communication in SCERTS follow the typical developmental trajectory beginning with the prelinguistic development of joint attention and then proceeding to understanding and using symbols (words) to intentionally communicate (Prizant et al., 2003). Prizant and colleagues (2003) believe joint attention accelerates and expands the acquisition of symbolic use. The SCERTS model also recognizes the need for generalization of skill development. An essential element of the SCERTS model comprises addressing goals through interaction with multiple communication partners in multiple natural environments (Prizant et al., 2003).

Responsive teaching is a DSP approach based on the idea that maternal or caregiver responsiveness facilitates development of a child's motivation, and cognitive, socio-emotional, and communication skills (Vismara & Rogers, 2010). Mahoney and Perales (2003; 2005) developed the responsive teaching protocol in which assessment yields individual developmental goals, and parents or caregivers are taught responsive techniques to address those goals. Responsive teaching has been shown to increase parental response to the child with ASD and improve the child's social-emotional and communicative functioning based on pre-post standardized assessments (Mahoney & Perales, 2003, 2005). Aldred and colleagues (2004) used

a responsive teaching approach called Child's Talk in a randomized controlled trial (RCT) of 40 children with ASD. The parent learned to change their interaction with their child to increase the child's communication in six stages: establishing joint attention, synchrony, sameness, variation, communicative teasers, and modeling (Aldred, Pollard, Phillips, & Adams, 2001). The RCT demonstrated through pre-post diagnostic testing that the children in treatment made higher gains in communication and a significant change in Autism Diagnostic Observation Schedule (ADOS) scores relative to the control group (Aldred, Green, & Adams, 2004).

A widely known DSP approach similar to responsive teaching is the developmental, individual-differences, relationship-based (DIR) model (also known as Floortime) developed by Greenspan and Wiedner (2006). This model takes into account inherent individual differences of the child, and the family and culture surrounding the child to increase the child's socio-emotional abilities by caregiver-child interactive engagement (Greenspan & Wiedner, 2006). Research on DIR/Floortime included a large case study with limited 10-15 year follow-up (Greenspan & Wiedner, 1997; Wiedner & Greenspan, 2005). A pilot experimental study of DIR/Floortime called the PLAY Project Home Consultation Program studied 68 children ages 2-6 years in an 8-12 month parent training intervention (Solomon, Necheles, Ferch, & Bruckman, 2007). This study found that the children significantly increased their developmental functioning as measured by the Functional Emotional Assessment Scale (FEAS) (Solomon et al., 2007). The authors conceded that more rigorous controlled studies, targeting specific outcomes including communication were necessary. Most recently a RCT study of 51 children with ASD and their caregivers (Casenhiser, Shanker, & Stieben, 2013) examined a DIR-based intervention (MEHRIT) based on the work of Greenspan and Wieder (2006). The MEHRIT intervention

demonstrated significant gains in social interaction components over control as measured by the Child Behavior Rating Scale (Casenhiser et al., 2013).

2.1.2 Naturalistic Behavioral Interventions

Behavioral theory assumes that operant behaviors, such as social interaction and communication, are learned (Ingersoll, 2010). Antecedents and consequences directly affect behaviors (Cooper, Heron & Heward, 2007). In other words, what happens before and after a behavior will affect the behavior, especially the future frequency and topography of the behavior. Motivating operations make the power of the consequence stronger. For example, if a child is hungry, he is more likely to ask for a cookie when he arrives home from school and sees the cookie jar on the counter. Behavioral interventions manipulate antecedents to teach new behaviors and systematically reinforce to increase those behaviors (Cooper et al., 2007; Ingersoll, 2010). Behavioral interventions also apply strategies such as prompting (providing a cue to increase the likelihood of a correct response), shaping (systematically reinforcing closer and closer approximations of the target behavior), chaining (linking behaviors together) and fading (decreasing prompts until independent responding occurs).

Early behavioral therapy for children with ASD are highly structured, adult-directed interventions (Lovaas, 1987). Discrete trial training (DTT) provided intensive treatment of massed trials at a table, achieving gains in language including verbal and nonverbal social interactions, "mands" or requests, and descriptions of objects and pictures (Krantz, Zalenski, Hall, Fenske, & McClannahan, 1981; Lovaas, 1987; Lovaas et al., 1973). DTT is still used today as a behavioral intervention for social communication. Two three year-old children mastered spontaneous responses to stimuli commonly found in a preschool classroom (e.g. saying "bless

you" when someone sneezed or "what?" if someone whispered) after three to seven sessions (Jones, Feeley, & Takacs, 2007). Thomas, Lafasakis, and Sturmey (2010) taught three nonverbal 3 year-old boys to vocally mand for desired objects through a 4-step prompt fading sequence with continued high levels of independent mands and generalization for two of the boys at two- and four-month follow-up.

Verbal behavior interventions (VB) based on Skinner's Analysis of Verbal behavior (1957) increased after Sundberg and Michael's (2001) landmark article. Verbal behavior intervention uses direct intensive teaching sessions in a format similar to discrete trial training. Instead of massed trials, verbal behavior intersperses mastered and targeted behaviors to increase behavioral momentum when learning new skills. Unlike DTT, verbal behavior also incorporates manding sessions where a child learns to appropriately request desired items. Natural environment teaching (NET) provides generalization training of skills already acquired through manding and intensive teaching sessions. Although VB is still highly structured, it provides more natural environment training and recognizes the motivation of child choice to teach manding using vocalization, manual sign, or picture symbols (Sundberg & Michael, 2001). Three nonvocal preschool boys who used sign language to mand for motivating objects were taught to use vocal mands, and two of the three were independently vocalizing mands after intervention (Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010).

Other researchers have also recognized the power of natural reinforcement to teach spontaneous requesting, but incorporated more naturalistic behavioral methods. Incidental teaching, an intervention to help children develop language by means of natural interactions with adults in a natural setting, was introduced in the late 1960s (Hart & Risley, 1968). Critical antecedent components of incidental teaching are natural environment, child choice or initiation,

environmental arrangement, and using a graduated prompt sequence (Hart & Risley, 1975; Ingersoll, 2010; Vismara & Rogers, 2010). Behavior and consequence strategies require a target vocalization that the child can produce. Natural reinforcement contingencies (i.e., when the child requests he receives the object requested) are paired with adult praise and attention, and the interaction is short and comfortable for the child (Hart & Risley, 1975; Ingersoll, 2010; Vismara & Rogers, 2010). One advantage to naturalistic behavioral interventions lies in the ability to generalize to new settings with new adults or peers (Vismara & Rogers, 2010). Two adolescent youths with ASD were taught to correctly label items for making lunches using incidental teaching (McGee et al., 1983). Koegel and colleagues (1998) demonstrated increases in sound intelligibility for five children with ASD using incidental teaching methods. The study compared the incidental teaching with analog (i.e., DTT) and found the analog condition had limited effects, with functional use occurring only during the incidental teaching sessions (Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998).

Several variants of the naturalistic behavior teaching method employ similar techniques, such as time-delay, mand-model, milieu teaching, interrupted behavior chain, and natural language paradigm or pivotal response teaching (Ingersoll, 2010). Seven elementary school boys with ASD who previously had no spontaneous manding repertoire demonstrated high levels of spontaneous verbal manding after a time-delay prompting procedure (Charlop, Schreibman, & Thibodeau, 1985). In the mand-model technique, the teacher or caregiver mands for the child to describe or request. Rogers-Warren and Warren (1980) demonstrated the mand-model technique with three preschoolers. Although the results were variable, all three children increased their appropriate verbalizations and generalized to new, untaught words and phrases (Rogers-Warren & Warren, 1980). Milieu teaching expands on naturalistic behavioral teaching by combining

incidental teaching techniques with time-delay and mand-model techniques (Alpert & Kaiser, 1992). Alpert and Kaiser (1992) demonstrated an increase in child requesting for six preschool boys with ASD after training mothers to use milieu techniques, although no functional relation was established. Parents of three preschool boys with no vocal communication and high problem behavior were taught to use milieu teaching to increase independent communication and decrease problem behavior (Mancil, Conroy, & Haydon, 2009). Mancil and colleagues (2009) also demonstrated that the boys generalized communication from home to preschool with their teacher. Interrupted behavior chains uses existing routines in the child's life to prompt new spontaneous requesting (Hunt & Goetz, 1988). Unlike the mand-model technique that requires the teacher or parent to ask the child "What do you want?" the interrupted chain does not use any verbal prompting. The teacher or parent interrupts the child from completing a behavior chain (e.g. entering a classroom, finishing a puzzle) by either blocking access or withholding a necessary object. Modeling and physical guidance provide error correction when the child fails to appropriately ask for the interruption to be removed (Hunt & Goetz, 1988). Albert and colleagues (2012) determined that once successful mand training was implemented, an interruption behavior chain procedure increased the spontaneous manding of missing objects for three children with ASD.

The single naturalistic behavioral intervention that has received the most attention and empirical support (National Autism Center, 2009) is known as natural language paradigm (NLP) and Pivotal Response Treatment (PRT; Ingersoll, 2010). The premise of NLP is to teach language, including requesting, using whatever is motivating to the child (Koegel, Koegel, & Surratt, 1992). Spontaneous requesting results when the child is naturally motivated to gain the object or activity. Since incidental teaching requires some type of child-initiation to begin the

teaching trial, the child may not contact contingent reinforcement or remediation with high frequency. NLP uses prompts to begin the teaching sequence for higher practice frequency (Koegel, Carter, & Koegel, 2003). Koegel and colleagues (1992) compared NLP to DTT and reported not only an increase in word attempts and number of words in a phrase, but a marked decrease in disruptive behavior as well. When Gillett and LeBlanc (2007) measured three preschoolers' response to NLP teaching, they found a level increase in the frequency of spontaneous vocalizations at preschool with generalization to the home for one student. Spontaneous communication was specifically targeted in a British study involving six 4-5 year-old children with ASD using NLP techniques (Kossyvaki, Jones, & Guldberg, 2012). Significant improvements in spontaneous initiations were demonstrated across children and settings.

Koegel, Koegel, and Mcnerney (2001) incorporated NLP as part of a more comprehensive intervention, called Pivotal Response Treatment, which has facilitated widespread improvement in all domains for children with ASD. Pivotal Response Treatment (PRT) addresses language in the same manner as NLP using child motivation, prompting and generalization. Two children aged six and four years participated in a study of PRT for self-initiations and increased their number of questions asked, and the amount, diversity, and correct tense of verbs after six to seven sessions of PRT (Koegel et al., 2003). Both children also demonstrated generalization by using the targeted verb tense with other verbs. Although this does not demonstrate a functional relation with only 2 replications, Koegel and colleagues (2014) completed a similar study and found all three preschoolers increased the frequency of spontaneous questions from 0-2 in baseline to 4-15 in intervention. In a comparison study of PRT and VB interventions researchers found no significant difference in cognitive functioning, language or problem behavior improvements between the two techniques (Stock, Mirenda, &

Smith, 2013). PRT joins incidental teaching and other naturalistic behavioral techniques as an effective evidence-based intervention (National Autism Center, 2009).

2.1.3 Combination approaches

When the practical implementation of the DSP and naturalistic behavioral theoretical models are examined, striking similarities appear. Both DSP and naturalistic behavioral interventions focus on social communication and both use natural environments, often the home with the caregiver as interventionist (Ingersoll, 2010; Vismara & Rogers, 2010). Both approaches also emphasize child choice or child initiation, with natural reinforcement as the primary consequence (Ingersoll, 2010; Vismara & Rogers, 2010). The primary difference in application of the theories is that naturalistic behavioral intervention uses direct prompting to evoke child behavior, whereas DSP emphasizes adult responsiveness to the child to evoke behavior (Ingersoll, 2010; Vismara & Rogers, 2010). While the DSP approach does not have the same amount of empirical support that naturalistic behavioral intervention research has demonstrated, both applications have been shown to increase social communication in children with ASD (National Autism Center, 2009). A combination of the two approaches utilizes the similarities while capitalizing on the differences.

Work by Kasari and colleagues targeted joint attention and symbolic play in a developmental sequence to increase social communication outcomes in preschool and home settings (Kasari, Freeman, & Paparella, 2006; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Kasari, Paparella, Freeman, & Jahromi, 2008; Lawton & Kasari, 2012). The Joint Attention and Symbolic Play/Engagement and Regulation intervention (JASP/ER) taught joint attention and symbolic play skills by combining discrete trial training and milieu teaching (Kasari et al., 2006;

Kasari et al., 2010; Kasari et al., 2008; Lawton & Kasari, 2012). First, assessments identified unmastered skills for each individual child based on the developmental sequence. The intervention began with a short period (5-8 minutes) of discrete trial priming for the desired skill, followed by 20 minutes of floor play using milieu teaching principles. Early studies of the intervention involved either joint attention or symbolic play as the dependent variable. In a randomized controlled trial (RCT) of 58 children with autism, the participants were assigned to one of three conditions: joint attention intervention, symbolic play intervention, or control with existing services (Kasari et al., 2006). In a 12-month follow-up of the above RCT study, Kasari and colleagues (2008) demonstrated significant gains in social communication over the control group. In later studies Kasari et al. (2010) and Lawton and Kasari (2012) considered the JASP/ER intervention's effect on joint attention and engagement in a home and a preschool setting demonstrating gains in both settings. Researchers at the University of North Carolina, Chapel Hill (Dykstra, Boyd, Watson, Crais, & Baranek, 2012) built on the procedures and strategies from Kasari et al. (2006), developing Advancing Social Communication and Play (ASAP) for implementation by public school staff in one-on-one and small group preschool settings. In a multiple baseline across participants design, the three preschool participants exhibited increases in social interaction, requests and joint attention after participating in ASAP teaching (Dykstra et al., 2012).

Two sets of researchers have combined developmental social-pragmatic and naturalistic behavioral theories, creating manualized, comprehensive social communication interventions (Ingersoll & Dvortcsak, 2010; Rogers & Dawson, 2010). The *Early Start Denver Model* (ESDM; Rogers & Dawson, 2010) and *Teaching Social Communication for Children with Autism* (Ingersoll & Dvortcsak, 2010) or Project ImPACT, combine behavioral and developmental

theories in applications for toddlers with ASD. Both interventions include positive caregiver affect and responsiveness, real-life activities and materials, and a focus on verbal and nonverbal communication. ESDM is intended for a team of professionals to work with young children with ASD and their parents in a center or in intensive home-based therapy. Project ImPACT is intended for professionals to teach parents to work with their children in a clinic, so that the parents can deliver the intervention in the home (Ingersoll & Dvortcsak, 2010; Rogers & Dawson, 2010). Both interventions have emerging evidence of effectiveness for social communication for young children with ASD.

The Early Start Denver Model (Rogers & Dawson, 2010) incorporates teaching strategies from ABA, PRT, and the DSP Denver model for older children. ESDM uses ABA strategies such as securing attention, prompting, ABC contingencies, shaping and chaining, and PRT strategies such reinforcing all attempts, interspersing mastered and new skills, using natural reinforcement, turn-taking, providing clear directions and child choice, and following the child's lead. ESDM also follows the Denver model using strategies such as adult affect, modulation and responsiveness, developmentally appropriate language, and multiple opportunities for communication. Short-term objectives are created after assessing current skill level with the ESDM Curriculum Checklist (Rogers & Dawson, 2010). The interventionist and child play in the natural environment, with the adult creating opportunities for communication and engagement through enjoyable activities chosen by the child. Rogers and Dawson (2010) state that all developmental areas can be addressed in this manner, including receptive and expressive communication. In a longitudinal randomized controlled trial of EDSM, the 24 children in the ESDM group had significantly higher expressive language than the control group as measured by the Mullen Scales of Early Learning (MSEL) and significantly higher communication as

measured by the Vineland Adaptive Behavior Scales (VABS) after 2 years of intervention (Dawson et al., 2010).

Teaching Social Communication to Children with Autism, or Project ImPACT (Ingersoll & Dvortcsak, 2010) focuses on training parents of young children with ASD to implement the intervention throughout the course of typical daily routines and during play time. Before beginning the program the interventionist and caregiver complete assessments and write program goals for the child. The caregiver-training program is divided into interactive teaching techniques and direct teaching techniques. The authors created a pyramid model with four basic interactive techniques at the bottom: Follow Your Child's Lead, Imitate Your Child, Animation, and Modeling and Expanding Language (Ingersoll & Dvortcsak, 2010). As seen by the titles, the techniques focus on DSP concepts of child initiation and adult responsiveness to the child. These are the foundation for the intervention. In the middle of the pyramid are three additional interactive teaching techniques: Playful Obstruction, Balanced Turns, and Communicative Temptations (Ingersoll & Dvortcsak, 2010). The middle techniques also rely on adult responsiveness, but antecedent manipulation occurs as the adult changes the environment to encourage communication from the child. These are techniques common to Naturalistic Behavior Interventions. The top tier of the pyramid holds the direct teaching techniques: teaching expressive and receptive language, imitation, and play (Ingersoll & Dvortcsak, 2010). These are adult-led ABA techniques that use prompt sequences to evoke communication and interaction. The direct teaching techniques are taught only after the caregiver has mastered the interactive techniques. If at any time the child begins to disengage during the direct techniques or the second-tier interactive techniques, the adult moves back to the foundational interactive techniques to re-engage the child before moving forward again. Project ImPACT weaves

together a DSP focus on developmental level and adult responsiveness with the naturalistic behavioral theory of direct prompting for high frequency practice. Child-led activity, natural environments and reinforcement are foundational properties throughout the intervention. The intervention manual provides explicit guidance with accompanying video models, allowing the professional to train the parent with a high degree of fidelity (Ingersoll & Dvortcsak, 2010).

In a pilot study of 24 preschool children with ASD, using Project ImPACT, Ingersoll and Wainer (2013) demonstrated a significant increase in child language use during play and in daily routines, and a significant increase in child language as measured by the Social Communication Checklist, when completed by both the parent and the teacher. They focused not only on child outcomes but also on parent outcomes. Parents significantly increased their implementation accuracy for the intervention, and parental stress was significantly reduced (Ingersoll & Wainer, 2013). The researchers also evaluated the social validity of the intervention for both trainers and parents, with high acceptability, effectiveness, and usability scores for both adult groups (Ingersoll & Wainer, 2013).

In summary, both *Project ImPACT* (Ingersoll & Dvortcsak, 2010) and the *Early Start Denver Model for Young Children with Autism* (Rogers & Dawson, 2010) provide comprehensive plans for increasing social communication skills in young children with ASD. Research on both models suggests that evidence for their efficacy is emerging. Finally, both models include a parent-training component. Parent training is central to the Ingersoll and Dvorcsak (2010) model and an important aspect of the Rogers and Dawson (2010) model.

The components of both Project ImPACT (Ingersoll & Dvortcsak, 2010) and the ESDM are among evidence-based practices for young children with ASD (National Autism Center, 2009). With a current prevalence rate of 1 in 68 children in the United States diagnosed with

ASD (Center for Disease Control, 2014), the need for qualified professionals to help children with ASD is higher than ever. A decade ago Simpson (2005) stated that the special education field needs to create more specific training to those providing services to children with ASD. Although parents and caregivers are participants in Project ImPACT and the ESDM, there still remains a need for qualified educators and therapists to work directly with children and parents. Paraprofessionals are a key component of a child's treatment team, often the primary direct service provider, whether in school or home (Dillenburger, Keenan, Doherty, Byrne, & Gallagher, 2012; Giangreco, Suter, & Doyle, 2010; Hughes & Valle- Riestra, 2008).

2.2 ADULT LEARNING: BEHAVIOR SKILLS TRAINING

Teaching adults to implement an intervention with fidelity and to maintain high performance over time and settings requires a multi-faceted approach (Demchak, 1987; Jahr, 1998; Lang & Fox, 2003; Stormont & Reinke, 2013). A behavioral skills multi-step model of adult learning that has shown to be effective consists of (1) an initial teaching of the material, sometimes referred to as the didactic component, including a rationale for the intervention, (2) modeling of the intervention by the trainer, (3) opportunities for the learner to practice the intervention, and (4) ongoing feedback as the learner implements the intervention with the child until mastery criterion is reached (Jahr, 1998; Stormont & Reinke, 2013; van Oorsouw, Embregts, Bosman, & Jahoda, 2009). Initial teaching can include written or video materials, verbal instruction or both (Jahr, 1998; Lerman, Tetreault, Hovanetz, Strobel, & Garro, 2008). Researchers have compared video versus live training for support staff with both methods found to be effective (Macurik, O'Kane, Malanga, & Reid, 2008). Group instruction has also been

found to be an effective initial training method when paired with continued individual feedback (Lerman, Vorndran, Addison, & Contrucci Kuhn, 2004; Palmen, Didden, & Korzilius, 2010). Feedback can be provided verbally, in writing, graphically or using video of the learner's performance (Arco, 2008; Brown, Gatmaitan, & Harjusola-Webb, 2013; Stormont & Reinke, 2013). Early research on teacher training included the use of video feedback (Dawson, Dawson, & Forness, 1975) and verbal feedback (Koegel, Russo, & Rincover, 1977) for training teachers to implement discrete trial teaching with children with ASD. More recent articles detail graphical, written feedback, and video self-monitoring to improve fidelity of intervention for teachers and paraprofessionals (Dib, Sturmey, & Tiger, 2007; Palmen et al., 2010). The literature supports these training methods for all adults, including professionals, paraprofessionals and caregivers (Ryan, Hemmes, Sturmey, Jacobs, & Grommet, 2008; Shayne & Miltenberger, 2013). In these studies, when evaluating the effectiveness of intervention training for adults, the dependent measure is typically fidelity of intervention.

Recently researchers have begun to more closely focus attention on treatment fidelity and child outcomes. Research examining behavioral skills training packages to increase teacher treatment fidelity in the classroom or caregiver treatment fidelity in the home has yielded evidence of effectiveness. In a review of parent training for young children with disabilities, more than 70% of the 24 studies incorporated modeling, practice and feedback to successfully teach parents to implement interventions in the home setting (Barton & Fettig, 2013). In a randomized control trial Strain and Bovey (2011) compared written manual only and manual with full 2-year training (i.e., didactic training, modeling, and coaching) on adult classroom performance of the LEAP (Learning Experiences and Alternative Program for Preschoolers and their Parents) model. The full model classrooms increased teacher treatment fidelity from 27% to

87%, while the manual-only classrooms increased from 23% to 38% (Strain & Bovey, 2011). The teacher fidelity improvement resulted in all child outcomes in the full model at a significantly higher level than the manual-only classrooms (Strain & Bovey, 2011). Researchers implementing behavioral skills training models appear to increase adult treatment fidelity and child outcomes as well.

While most training methods are studied as in vivo sessions, virtual or online learning models should be considered when looking at behavioral skills training. Virtual or distance-based learning is increasing in popularity due to lower cost and convenience (Kelso, Fiechtl, Olsen, & Rule, 2009), and distance-based learning provides adults who may be in rural areas with limited resources or adults with daytime constraints access to specialized information (Wainer & Ingersoll, 2013). In a randomized control trial of computer-based learning of PRT techniques with 27 families of children with ASD, the treatment families displayed significantly higher treatment fidelity of the PRT strategies, and the children displayed significantly more verbal utterances (Nefdt, Koegel, Singer, & Gerber, 2009). The families also reported increased confidence in their ability to interact with their children, although they noted the quality of video and audio during teleconferencing was sometimes poor. In a study of distance-based training of eight sets of parents to implement certain strategies from the ESDM, researchers reported a significant increase in parent treatment fidelity of the strategies and a significant increase in child spontaneous verbal utterances (Vismara, Young, & Rogers, 2012). The parents in this study reported that computers and web-based learning was not a limitation and that they would recommend this training to other parents. While these studies targeted parents as interventionists, one study of a social-communication intervention targeted pre-service therapists (Wainer & Ingersoll, 2013). Five pre-service therapists increased their treatment fidelity in reciprocal

imitation training (RIT), a piece of the Ingersoll and Dvortcsak (2010) intervention. Five children with ASD and their parents worked with the five therapists and all five increased their imitation (Wainer & Ingersoll, 2013). All the above studies list extending research for parents and therapists (i.e., paraprofessionals) in distance-based learning as a necessary future direction.

2.3 PARAPROFESSIONAL RESEARCH

The rationale for teaching paraprofessionals to implement interventions with fidelity is similar to parents: since they spend a great amount of time directly interacting with children, they have a large impact on children's outcomes (Rispoli et al., 2011). Research has focused limited attention on teaching paraprofessionals to interact appropriately and teach children in home settings, concentrating largely on school-aged children in school settings (Giangreco et al., 2010; Rispoli et al., 2011). Giangreco and colleagues (2010) conducted a review of paraprofessional research in inclusive schools from 2000-2007, finding mostly descriptive articles, with only seven empirical studies. Rispoli (2011) reviewed the literature examining paraprofessionals teaching persons with ASD and found 12 studies, which included a total of 39 paraprofessionals and 40 persons with ASD. Six of the studies included children 5 years or younger, and one article included only preschool-aged children (Schepis, et al., 2001). Nine of the 12 studies were conducted in school settings, and the remaining three were conducted in community and group home settings. The paraprofessionals were taught to implement several different interventions, from activity schedules and social stories to communication and behavioral strategies (Rispoli et al., 2011). Two studies targeted social communication interventions, incidental teaching (Ryan, Hemmes, Sturmey, Jacobs, & Grommet, 2008) and pivotal response training (Robinson, 2011).

Although the literature including paraprofessionals is growing (Giangreco et al., 2010), researchers need to give more attention to this large group of practitioners implementing interventions for children with ASD .

In light of the critical role of paraprofessionals in providing service to children with ASD and the importance of social communication interventions for this population, lead teachers and clinicians need to learn which interventions have been demonstrated to be effective when administered by paraprofessionals, and what strategies have been developed to train and supervise paraprofessionals successfully. The purpose of this review is to answer the following questions:

1. What paraprofessional-implemented social communication interventions for young children with ASD have been studied?
2. What methods were used to train paraprofessionals to provide interventions to children with ASD?
    a. What research designs were used and to what extent did the designs meet quality standards?
    b. What outcomes were measured?
    c. To what extent was maintenance and generalization measured?
3. Which social communication interventions were effective for the children with ASD when implemented by paraprofessionals?
    a. What research designs were used and to what extent did the designs meet quality standards?
    b. What outcomes were measured?
    c. To what extent was generalization and maintenance measured?

2.3.1 Methods

The initial search in February 2014 included three computerized databases (i.e., PsychInfo, PsychArticles and ERIC). Descriptors and all possible variations including *autis*, paraprofessional, teach* assistant, teach* aide, assistant teach*, therapeutic staff support, support staff, tutor,* and *staff* were used in the search. An ancestral search identified additional articles and two literature reviews on staff interventions for children with ASD. An additional step involved a hand search of *Behavioral Interventions,* the journal that has reported the largest number of paraprofessional studies for children with autism.

To meet criteria for the review, an article had to:

1. Appear in an English-language peer-reviewed journal.
2. Include paraprofessional staff as the intervention delivery personnel, rather than studies with certified teachers or Master's level clinicians (e.g., Nigro-Bruzzi & Sturmey, 2010), parents (e.g., Gillet & LeBLanc, 2007) or studies with data that could not be disaggregated (e.g., Dyer & Karp, 2013; Kohler, Steigner, & Hoyson, 2001; Stevens, Williams, & Gaffan, 1999).
3. Include children from birth through 8 years old with a diagnosis of ASD as recipients of intervention.
4. Report directly measuring the effects of an independent variable (i.e., training package that teaches service providers an intervention for children with ASD) on a dependent variable of paraprofessional behavior.
5. Target a social communication outcome for children with ASD such as spontaneous communication, joint attention, play, or reciprocal interaction rather than compliance,

labeling or self-help skills (e.g., LeBlanc, Ricciardi & Luiselli, 2005; Sarakoff & Sturmey, 2008; Toelken & Miltenberger, 2012)

The initial online search generated 130 articles of which five met criteria. An ancestral search of all articles meeting criteria and literature reviews yielded two additional articles, with no additional articles resulting from the hand search. The qualifying articles (Feldman & Matos, 2012; Gianoumis, Seiverling, & Sturmey, 2012; Hall, Grundon, Pope, & Romero, 2010; Madzharova, Sturmey, & Jones, 2012; Robinson, 2011; Seiverling, Pantelides, Ruiz, & Sturmey, 2010; Weinkauf, Zeug, Anderson, & Ala'i-Rosales, 2011) meeting review criteria contained seven studies in four journals.

2.3.2 Results

This review examined research on paraprofessional-implemented social communication interventions for young children ages eight and under with ASD. Twenty-two paraprofessionals participated in the seven studies. The participants ranged from 18-60 years old and worked in three specialized preschool settings, three inclusive preschool settings, and one autism treatment center. A majority of the paraprofessionals were female (21), with only one male included. Education levels ranged from a high school diploma to a bachelor's degree in psychology. In one study (Weinkauf et al., 2011) undergraduate and graduate students in an ABA program acted as paraprofessional participants. A demographic description of the articles is contained in Appendix A. All of the studies examined an approach or approaches to increase some type of social communication in young children with ASD.

2.3.2.1 Social communication intervention descriptions

Researchers studying paraprofessional implementation of programs for social communication focused predominantly on naturalistic behavioral interventions. Two studies (Feldman & Matos, 2012; Robinson, 2011) taught the participants PRT, while two other studies (Gianoumis et al., 2012; Seiverling et al., 2010) taught NLP, an intervention similar to PRT. Gianoumis and colleagues (2012) also taught paraprofessionals to conduct stimulus preference assessments separately before NLP sessions. Hall and colleagues (2010) examined different interventions based on the needs of the two different preschool classrooms and a home setting. One classroom with two paraprofessionals implemented PRT, while the other classroom with three paraprofessionals implemented Incidental Teaching. The paraprofessional in the home setting applied DTT in an early intervention home-based program, but the goals for this intervention were not in the social communication domain, so were not included in this review. The remaining two studies executed more stringent ABA interventions; Madzharova and colleagues (2013) taught the classroom aides to implement mand training, and Weinkauf and colleagues (2011) educated their classroom aides to use 125 different ABA-based techniques to teach the children skills including Functional Communication.

2.3.2.2 Paraprofessional: Design and quality standards.

Study effectiveness is measured by the degree to which a functional relationship is established between an independent (IV) and dependent variable (DV). As in many intervention studies for children with ASD, the researchers in the reviewed articles all used single-subject research designs to examine the selected interventions. Single-subject designs employ within and between subjects comparisons to establish the functional relation between the IV and DV

(Horner et al., 2005). Horner and colleagues (2005) established quality standards for the execution of single subject research.

Five studies implemented single subject research designs that met quality standards (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011; Seiverling et al., 2010; Weinkauf et al., 2011). Four of the reviewed studies employed a multiple baseline design across paraprofessionals to measure their response to training on PRT or NLP strategies (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011; Seiverling et al., 2010). A fifth study (Weinkauf et al., 2011) used a within subjects changing criterion design replicated with four paraprofessionals. All but one of these studies (Weinkauf et al., 2011) repeatedly measured the dependent variable over time, had stable baselines before intervention was introduced, and demonstrated at least three comparisons across phases or between subjects. Although Weinkauf and colleagues (2011) did not establish stable baseline responding, they did measure three comparisons across phases and between subjects. In another study the initial participant did demonstrate an increasing baseline measurement right before intervention, but there was a level jump from 27-57% correct steps in baseline to 91-98% correct after intervention began (Seiverling et al., 2010). The subsequent two participants demonstrated stable baselines before beginning intervention (Seiverling et al., 2010). These five studies met the quality standards of repeated measurement with a minimum of three comparisons needed to provide evidence of a possible functional relation between the IV, i.e., training, and the DV, i.e., paraprofessional outcome (Horner et al., 2005).

The remaining studies (Hall et al., 2010; Madzharova et al., 2012) did not meet quality standards that would allow identification of a functional relationship between the IV and the DV. Madzharova and colleagues (2012) did not make claims of causality, explicitly describing two

case studies, one of which is part of this review. Hall and colleagues (2010) employed a multiple baseline across two settings, repeated with three paraprofessionals for one intervention and two paraprofessionals for the second intervention. Even with five separate participants, only two replications were demonstrated across each subject, with no staggered implementation between subjects (Hall et al., 2010).

Another indicator of poor design was the length of baseline for the participants. Baseline in a single subject design needs to establish stable responding, with at least three to five data points (Cooper, Heron, & Heward, 2007; Kennedy, 2005). Five of the seven studies had baselines of four or more data points with stable responding before entering intervention (Feldman & Matos, 2012; Gianoumis et al., 2012; Hall et al., 2010; Madzharova et al., 2012; Seiverling et al., 2010). Weinkauf and colleagues (2011) only recorded one baseline probe for all four participants. One study (Robinson, 2011) had only two baseline data points for the first participant, but the remaining three participants had 4-9 data points in baseline so three replications still exist with stable baseline.

Operationally defining and describing the independent variable is important for replication (Horner et al., 2005). The studies all used components of adult behavioral skills training: didactic or group training, written materials, modeling, rehearsal and feedback (see Appendix A). Three studies used all training components (Gianoumis et al., 2012; Seiverling et al., 2010; Weinkauf et al., 2011). Hall and colleagues (2010) used all components except modeling and was the only study to use group training and didactic training. Robinson (2011) modeled the desired behavior then provided video feedback. Madzharova and colleagues (2012) used video modeling and video feedback. Feldman and colleagues (2012) provided materials and didactic training, and then gave verbal feedback when the paraprofessionals implemented the

intervention. The common component through all studies was feedback, whether written, graphic, video or verbal.

Four of the studies reported implementation (training) fidelity for the researcher for 27% to 100% of the training sessions (Gianoumis et al., 2012; Madzharova et al., 2012; Seiverling et al., 2010; Weinkauf et al., 2011). The results of implementation fidelity were high: two studies reported 100% fidelity across training sessions (Gianoumis et al., 2012; Weinkauf et al., 2011), and the remaining two reported 94-95% fidelity (Madzharova et al., 2012; Seiverling et al., 2010).

2.3.2.3 Paraprofessional: Outcome measures.

Despite the differences in types of interventions studied, six of the seven studies defined the paraprofessional dependent variable as treatment fidelity, measured as percentage of correct steps or procedures (Feldman & Matos, 2012; Gianoumis et al., 2012; Madzharova et al., 2012; Robinson, 2011; Seiverling et al., 2010; Weinkauf et al., 2011). In contrast, Hall and colleagues (2010) recorded paraprofessional behavior as frequency of one skill; for the paraprofessionals trained in Incidental Teaching the researchers recorded the number of requests for elaboration, and for the paraprofessionals trained in PRT, the researchers recorded the number of descriptors used. Feldman and Matos (2012) and Robinson (2011) added a second paraprofessional outcome described as levels of involvement. Feldman and Matos classified five levels as active hovering, passive hovering, noninvolvement, social facilitation, or monitoring. Robinson described her levels as hovering, implementing, monitoring and uninvolved. In both studies data from baseline and intervention phases demonstrate that the paraprofessionals moved from predominantly hovering or uninvolved in baseline to facilitating or monitoring in intervention.

A measure of internal validity is the inclusion of operational definitions of the dependent measures to allow for experimental control and replicability (Horner et al., 2005). All the studies with the exception of Weinkauf and colleagues (2011) provided operational definitions or descriptions of the dependent measure. Hall and colleagues (2010) provided some description, and the remaining five studies gave detailed definitions and descriptions of all dependent measures (Feldman & Matos, 2012; Gianoumis et al., 2012; Madzharova et al., 2012; Robinson, 2011; Seiverling et al., 2010).

Since the dependent measure for paraprofessionals in six of the seven studies was treatment fidelity, examination of data collection yielded information on how closely researchers were monitoring the implementation of the social communication intervention. Most researchers chose to record data across time intervals, with two high quality studies (Gianoumis et al., 2012; Seiverling et al., 2010) measuring across trials and sessions. The two studies with the most quality indicators of single subject research (Horner et al., 2005) had the most stringent data collection procedures (Feldman & Matos, 2012; Robinson, 2011). Data were scored for each component of PRT individually using 1-minute intervals in a 10-minute session. The number of correct intervals for each component was used to derive percentage for each component (e.g., 6 intervals correct / 10 total intervals = 60% correct). The interval recording used by the two high quality studies (Feldman & Matos, 2012; Robinson, 2011) required the paraprofessional to use the strategies every minute, a higher fluency criteria than across a total session. Weinkauf et al. (2012) used a 10-minute session to assess the overall percentage of total skills performed. Although using trials instead of time as a measurement base, Gianoumis et al. (2012) used a stringent measurement, collecting data for 15 trials in each session with percent correct steps out

of a possible 21 steps for each trial. Seiverling et al. (2010) collected percentage correct data for total session, but did not specify a time interval or number of trials per session.

In addition to data measurement, criteria for exiting training resulted in higher post training and maintenance scores. Six studies, including the four highest quality studies, required the paraprofessionals to achieve treatment fidelity performance criteria before moving into post-intervention (Feldman & Matos, 2012; Gianoumis et al., 2012; Madzharova et al., 2012; Robinson, 2011; Seiverling et al., 2010; Weinkauf et al., 2011). Feldman and Matos (2012) required 80% correct performance across three sessions, and Robinson (2011) required 80% correct performance across two sessions. Three studies required 90% correct performance; Gianoumis and colleagues (2012) demanded criteria across two consecutive sessions, and Seiverling et al. (2010) and Madzharova et al. (2012) demanded criteria across three sessions. Gianoumis et al. (2012) recorded data as percent correct in 15 trials, and Madzharova et al. (2012) recorded data as percent correct for each teaching trial. Seiverling et al. (2010) did not specify the number of trials in a session, reporting only total percentage correct per session. Weinkauf and colleagues (2011) reported a 90-100% correct performance criterion for each cluster of skills before moving on to the next cluster, but to achieve total mastery they reported only that the paraprofessional needed to perform with "a minimal amount of errors" (p. 868). With the exception of Weinkauf et al. (2011), paraprofessionals came to criteria quickly, one to four sessions after beginning training.

Another measure of internal validity is interobserver agreement (IOA), the ability for two people to report the same data across sessions (Horner et al., 2005). All seven studies measured IOA on 20-43% of sessions with mean results ranging from 78-100%. One study reported IOA for each participant in each phase of the study (Seiverling et al., 2010).

Social Validity. Researchers in all seven studies used questionnaires or surveys to assess the social validity of the intervention for the participants. Five studies (Feldman & Matos, 2012; Hall et al., 2010; Madzharova et al., 2012; Robinson, 2011; Weinkauf et al., 2011) rated satisfaction statements (e.g., This intervention was important to me) and skill statements (e.g., I am confident in my ability to do the intervention). All five reported that the participants agreed or strongly agreed with the importance of the intervention and improvement in their skill and the child outcomes. The participants in one study identified the most helpful components of the training as in vivo training, specific feedback, and learning new facilitation strategies (Feldman & Matos, 2012).

Two studies (Gianoumis et al., 2012; Seiverling et al., 2010) administered a skills survey pre- and post-intervention to assess paraprofessional-perceived performance change. All three paraprofessionals in the study by Gianoumis and colleagues (2012) reported that they believed their skill level had increased. Two of the three participants in Seiverling and colleagues (2010) study reported a slight increase in skill, while the third participant felt she was skilled before and after the intervention. Overall in all the studies participants felt the interventions were worthwhile and that they gained skills and confidence.

2.3.2.4 Paraprofessional: Maintenance and generalization.

Only two studies measured maintenance of newly trained paraprofessional skills after intervention ended. Feldman and Matos (2012) had one maintenance probe for each paraprofessional three, five, or seven weeks after intervention ended. Robinson (2011) had one follow-up probe four weeks after intervention ended. In the two studies, six paraprofessionals maintained high levels of fidelity, with one paraprofessional in the study by Robinson dropping

slightly from intervention (80-90% fidelity) to maintenance (70%). The remaining five studies did not measure any maintenance of skills for the paraprofessionals.

A measure of external validity is generalization, the ability to replicate effects across different people, settings, or activities (Horner et al., 2005). Only three studies (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011) measured generalization across activities or students. Interestingly, two were the same studies that measured maintenance (Feldman & Matos, 2012; Robinson, 2011). Feldman and Matos (2012) reported that after the participant attained mastery on the first activity, a probe using a second activity was measured. If the participant did not meet mastery criterion on that activity, they were retrained using that activity. Then, regardless if retraining occurred or not, a third activity for generalization was also measured. Two of the three paraprofessionals needed retraining on the second activity, but all three maintained high fidelity on the third activity (Feldman & Matos, 2012). Gianoumis and colleagues (2012) measured generalization of paraprofessional skills with a second child. Two to four data points for the generalization child, and two to four points for the original child were collected after training ended. All generalization data demonstrated continued high fidelity (Gianoumis et al., 2012). Robinson (2011) collected generalization for children and activities, one probe for each. All paraprofessionals maintained high fidelity when generalizing to a new activity, and three of the four also maintained high fidelity with a new child (Robinson, 2011). For the three studies reporting generalization, the paraprofessionals appeared to be able to transfer the skills to different activities or children.

2.3.2.5 Paraprofessional: Summary

While all seven studies showed an improvement in paraprofessional behavior as a result of the independent variable, only four of the studies met the standards for quality single subject

research design (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011; Seiverling et al., 2010). Thus we can say that they unequivocally demonstrated a functional relationship between the training the paraprofessionals received and the changes in their observed behaviors. These studies applied quality methodology with operationally defined variables, high IOA values, high social validity ratings, and mostly stable baselines. All four studies demonstrated at least three separate strong experimental effects with stable level changes between baseline and intervention. The two studies examining PRT (Feldman & Matos, 2012; Robinson, 2011) had the strongest effect with baseline measures of 0-27% correct steps and intervention measures of 80-100% correct steps. The two studies examining NLP (Gianoumis et al., 2012; Seiverling et al., 2010) had higher baseline values, ranging from 13-70% correct steps, but also maintained higher (89-100%) correct steps during the intervention phase. Feldman and Matos (2012) and Robinson (2011) demonstrated exceptional quality by including both generalization and maintenance of paraprofessional skills.

Two studies provide evidence of effectiveness, but have a lack of at least one quality indicator (Horner et al., 2005) that prevents a definitive statement of effectiveness. Weinkauf and colleagues (2011) did demonstrate three separate experimental effects with stable level changes, since they taught three clusters of skills, but other methodological considerations such as lack of stable baseline data, lack of operational definition of the dependent measure, and lack of generalization and maintenance preclude experimental control and an established functional relation. Although Hall and colleagues provide two replications across settings and repeated with multiple participants (Kennedy, 2005), they neglected to provide a detailed definition of the dependent variables, and in both the PRT and the Incidental Teaching classrooms no functional relation was established between the IV and DV.

The remaining study offers some evidence of intervention effectiveness. Madzharova and colleagues (2013) demonstrated in the reviewed case study that with training the paraprofessional increased her use of the manding techniques from 5-55 percent correctly performed steps in baseline to 60-100 percent correctly performed steps in intervention. This study provides some indication that the intervention should be investigated further for evidence of effectiveness.

2.3.2.6 Child: Design and quality standards.

Five of the seven studies also measured child outcomes as a result of paraprofessional implementation of a social communication intervention (Feldman & Matos, 2012; Gianoumis et al., 2012; Madzharova et al., 2012; Robinson, 2011; Seiverling et al., 2010). Hall and colleagues (2010) and Weinkauf and colleagues (2011) did not provide any data on child outcomes. The four studies meeting quality standards for research design (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011; Seiverling et al., 2010) all included child measures to further describe the outcomes of the interventions.

The child outcomes were also measured by single subject research designs, following the same phase changes as the paraprofessionals in the studies. These researchers used the same observation sessions to collect data on both paraprofessional outcomes and child outcomes, providing a direct comparison between paraprofessional performance and child performance. Three studies used a multiple baseline across children (Feldman & Matos, 2012; Robinson, 2011; Seiverling et al., 2010). Gianoumis and colleagues (2012) executed multiple baselines across pairs of children (the original child and a generalization child for each paraprofessional). Madzharova and colleagues (2012) collected data on two children paired with the paraprofessional in the case study.

Although the child outcome data were graphed in the same manner as the paraprofessional data, one significant difference existed. The children moved into intervention based not upon their stable performance in baseline, but based upon the paraprofessional performance and entrance into intervention. For two studies (Feldman & Matos, 2012; Robinson, 2011) the child participants did have stable baseline performance of zero or near zero prior to the paraprofessional intervention, so a case could be made for a valid research design. In the remaining four studies the child data can be considered corollary information to substantiate the effectiveness of the paraprofessional intervention, but a functional relation between the communication intervention and the child outcome was not established (Kennedy, 2005).

The independent variables for the child measures were the social communications interventions described above. The operational definitions of the interventions were the descriptions or task analysis for the fidelity measurement for the paraprofessionals. All of the studies that measured child outcomes provided detailed descriptions of the interventions used.

2.3.2.7 Child: Outcome Measures.

All dependent measures for the children required a verbal response, initiation, mand or interaction with a peer. Two studies targeted frequency of vocal responding to stimulus items (Gianoumis et al., 2012; Seiverling et al., 2010). Vocal responding included specific target vocalization requirements for each participant. Seiverling and colleagues (2010) graphed the child outcome as cumulative frequency of vocal chains of responding, and Gianoumis and colleagues (2012) graphed child outcome as percentage of trials with appropriate vocalizations. Gianoumis et al. (2012) also measured child maladaptive behavior, including behaviors such as crying, screaming, and lying on the floor. Two studies used peers as communication partners (Feldman & Matos, 2012; Madzharova et al., 2012). Feldman and Matos (2012) collected data

on child to peer interactions using 30-s partial interval recording, and Madzharova and colleagues (2012) recorded the number of independent peer-to-peer mands. Robinson (2011) developed differing dependent measures for each of the four children participating in the study, based on their IEP goals and informal assessment of needs, but all measures involved vocalizations. The dependent measures for the younger participants included verbal interaction with adults; the three year-old participant outcome was vocalizing two or more understandable words, and the six year-old participant outcome was vocalizing one-word mands. The two older participants had measures that included peers. The seven year-old participant was taught to engage in an interaction with a peer that included one initiation and one response, and the eight year-old participant was taught to direct spontaneous verbalizations toward a peer(s). All five studies included detailed descriptions of child dependent measures, including examples and non-examples. Interobserver agreement (IOA) was calculated for 30-35% of sessions for child behavior in all six studies. Mean IOA values ranged from 88-100%.

Social Validity. All researchers included questions relating to the intervention for children with ASD in their social validity surveys. Examples of questions were "they felt their students benefitted from their training" (Robinson, 2011, p112), and "I feel the strategies I learned are effective in promoting peer-to-peer requesting" (Madzharova et al., 2012, p. 227). Gianoumis et al. (2012) and Seiverling et al. (2010) did not question the intervention itself, but rather the paraprofessionals skills before and after the training. In all surveys administered in studies where child data were collected, the participants felt the training was valuable and they were more confident in their skills.

One high quality study took a unique approach to interpret child social validity. Robinson (2011) assessed child affect in baseline and after intervention to gauge intervention acceptability

for the child participants. They reported that two of the children did not have much affect change, since they were neutral to positive in baseline, while two of the children improved and stabilized their affect from negative and neutral to positive.

2.3.2.8 Child: Maintenance and Generalization.

The two high quality studies that measured paraprofessional maintenance (Feldman and Matos, 2012;Robinson, 2011) also evaluated child maintenance with one probe of child behavior at the same time they collected one probe of paraprofessional behavior, three to eight weeks after intervention ended. Feldman and Matos (2012) found that in follow-up all three children maintained improved communication level corresponding to the paraprofessionals high levels of implementation fidelity. Robinson (2011) found that two children did not maintain the level of their communication behavior in follow-up, although the remaining two children increased the level of their communication behavior. The paraprofessional behavior did not closely correspond to the child behavior; both children whose communication behavior dropped were working with paraprofessionals whose fidelity maintained at 90-100%, while one child who increased his communication behavior was working with a paraprofessional whose fidelity dropped below 80% (Robinson, 2011).

Feldman and Matos (2012) and Robinson (2011) were also the only two studies that studied any generalization of skills for the children. Both of these studies had the children generalize the skill with the paraprofessional in other activities after learning in one activity. Robinson did not specify the generalization activity, stating that it was similar but different to the one used in intervention. All four children participants did not generalize their individual communication behaviors to the second activity at the same level as the intervention activity, but they were all higher than baseline (Robinson, 2011). Feldman and Matos used four different

activities, lunch, recess, art, and board games. The researchers trained the paraprofessionals during one activity, and then assessed paraprofessional fidelity and child measures in two of the three additional activities. Two of the three children did not initially perform well in the first generalization activity, corresponding to the paraprofessional's poor fidelity in the same session. The paraprofessionals received additional training in the generalization activity and the treatment fidelity and child measures improved. The children all maintained high levels of reciprocal social behavior in the second generalization activity, even though two of the paraprofessionals dropped their fidelity performance down to 80%.

2.3.2.9 Child: Summary

Two studies demonstrated strong effects of a social communication intervention on child verbal behavior (Feldman & Matos, 2012; Robinson, 2011). The four children in the Robinson (2011) study increased their target verbalizations from 0-5 in baseline to 3-40 during and after intervention. The three children in the Feldman and Matos (2012) study increased their engagement time from 0-30% in baseline (only 1 data point over 10%) to 80-100% during and after intervention. These are the same two studies that also demonstrated the strongest effect for paraprofessional behavior. The children studied by Seiverling and associates (2010) did increase their vocal chaining with NLP, and two of the three children experienced a rate change after intervention, indicating an experimental effect. Similarly, two out of three children in the study of NLP by Gianoumis and colleagues (2012) showed a level change from 0-20% of trials with vocalizations in baseline to 33-100% after intervention. Both children in Madzharova and colleagues' (2012) case study 2 increased their peer-to-peer manding (4-5 times in intervention) with less variability than in baseline (0-5 times), but no experimental effect is demonstrated in a case study.

The five studies with both paraprofessional and child outcomes did demonstrate some relation between increased paraprofessional fidelity of implementation and child improved social communication. Three studies, reported that when paraprofessional intervention fidelity increased with training, child outcomes increased also (Feldman & Matos, 2012; Madzharova et al., 2012; Robinson, 2011). Two of the four studies with demonstrated effectiveness for paraprofessional training demonstrated a relation between paraprofessional performance and child performance (Feldman & Matos, 2012; Robinson, 2011) The remaining two studies (Gianoumis et al., 2012; Seiverling et al., 2010) demonstrated an increase in two of the three child outcomes when the paraprofessionals increased intervention fidelity.

2.3.3 Discussion

This review examines current literature on teaching paraprofessionals to implement social communication interventions to young children with autism seeking avenues for future research. The seven studies reviewed used one or more of the following components to teach the paraprofessionals to implement the intervention with a high degree of treatment fidelity: written instructions, didactic training, modeling, rehearsal, and feedback. Types of feedback included written, oral, graphical, and video. While all studies reported positive outcomes, four of the seven studies provide definitive evidence of effectiveness in teaching paraprofessionals to implement NLP and PRT with fidelity with young children with ASD (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011; Seiverling et al., 2010). Two of these studies also provided evidence that the paraprofessional implementation of the intervention resulted in the desired increased child outcomes (Feldman & Matos, 2012; Robinson, 2011). Gianoumis et al. (2012) and Seiverling et al. (2010) report mixed results for the child outcomes studied. The

remaining three studies offer varying amounts of evidence that paraprofessional training created a change in their implementation of the chosen social communication intervention (Hall et al., 2010; Madzharova et al., 2012; Weinkauf et al., 2011).

The majority of the studies utilized a naturalistic behavioral intervention based on child choice, natural reinforcement, prompting, and responsiveness to the child (Feldman & Matos, 2012; Gianoumis et al., 2012; Hall et al., 2010; Robinson, 2011; Seiverling et al., 2010). This type of approach increased child spontaneous communication in some studies, such as peer interactions (Feldman & Matos, 2012; Robinson, 2011) and unprompted vocal response to a stimulus item (Gianoumis et al., 2012). Spontaneous communication is an important social behavior that occurs without prompts or directions, and children with autism typically have difficulty with this skill (Duffy & Healy, 2011). Although spontaneous communication is not clearly defined in the research literature, some have defined it as communicative behavior under the control of environmental stimuli and/or internal states, representing the most advanced end of a continuum model that starts with physical or verbal guidance (Duffy & Healy, 2011). Many children with ASD rely on verbal or physical prompts to respond to or initiate social communication (Chiang, 2009; Chiang & Carter, 2008). Transferring stimulus control from verbal or physical prompting to a natural environment context (e.g., presence of the object desired) gives the child more control, both over the physical environment and interactions with others (Chiang & Carter, 2008; Kaczmarek, 1990). Communicative control creates choice of when to communicate, with whom, and for what purpose; the child with ASD who develops some form of contextual spontaneous communication will more successfully have wants and needs met (Chiang & Carter, 2008). Given that children with ASD often become prompt

dependent (Duffy & Healy, 2011), increasing the paraprofessionals ability to foster spontaneous communication is important.

The two highest quality studies (Feldman & Matos, 2012; Robinson, 2011) chose to train paraprofessionals to implement PRT. Feldman and Matos (2012) chose to use the out-of-print manual by Koegel and colleagues (1989) as the didactic training. The paraprofessionals were taught six social communication strategies: child choice of activity, clear instructions, appropriate response including prompting and opportunities for initiation, natural reinforcement, specific communication from paraprofessionals, and appropriate physical proximity. Robinson (2011) based the PRT intervention on strategies from the updated Koegel and Koegel (2006) text on PRT and included four strategies that are modifications of the earlier strategies. These naturalistic behavioral strategies combine prompting strategies and responsive strategies to create a cohesive package creating child motivation yet still providing some direct teaching (Koegel & Koegel, 2006). While the strategies are well defined as dependent measures, the text is not a systematic training manual. Fixen, Blasé, Metz, and Van Dyke (2013) describe criteria for defining an effective practitioner program based on extensive literature reviews. The program should have a clear description of the philosophy and values of the program and clear criteria that define the population for whom the program is intended. Essential functions, sometimes called active ingredients, should be operationally defined and clearly described. The description should "allow a program to be teachable, learnable, and doable in practice; and promote consistency among practitioners" (Fixen et al., 2013) (p 219). Finally, a program should have a method for evaluation of the performance of the program by practitioners (treatment fidelity) and evaluation of the effectiveness of the program (data collection). Ingersoll and Dvortcsak (2010) created systematic, reader-friendly manuals to train professionals and parents on a package of

naturalistic behavioral strategies similar to PRT to increase social communication. As the manuals move from the responsive strategies to the direct teaching methods, every chapter includes a rationale for the strategy, step-by-step method for implementing, examples, and homework for practice. The professional manual also includes a DVD with multiple video examples for each strategy depicting children at different language levels (preverbal, single words, simple phrases, complex phrases). Treatment fidelity forms are provided at the back of the manual for practitioner evaluation, as well as a social communication checklist to evaluate the child. The Ingersoll and Dvortcsak manuals meet all of the criteria for an effective program (Fixen et al., 2013).

When training the paraprofessionals to implement the social communication interventions, all reviewed studies included performance feedback as part of the independent variable. Performance feedback consists of written, graphical, verbal or video response when observing an instructor implementing an intervention with the goal of improving performance (Casey & McWilliam, 2010). Feedback has long been viewed as a valuable training tool and typically consists of both praise and correction (Alvero, Bucklin, & Austin, 2001; Arco, 2008). Rispoli and colleagues (2011) described feedback as an important intervention factor to attaining paraprofessional treatment fidelity. The reviewed articles add to the strong literature base demonstrating feedback as a component of effective adult professional development. In a review of the effectiveness of feedback as part of training adults who work with individuals with severe disabilities, Arco (2008) found a functional relation in most studies between supervisory feedback and improved participant performance. In a component analysis of adult training methods, feedback was the only component that individually produced 75-100% correct responses for all participants (Ward-Horner & Sturmey, 2012). When feedback, modeling and

rehearsal were added to a didactic training package, Lang and Fox (2003) reported that effect sizes increased from .35 to 1.25. A meta-analysis of effective methods of training staff for individuals with intellectual disabilities found that feedback was significantly more effective than any other training technique (van Oorsouw et al., 2009). Researchers studying paraprofessionals implementing social communication interventions demonstrated that feedback was an important piece of the intervention. While four of the studies used a combination of didactic, modeling, rehearsal and feedback to train the paraprofessionals (Gianoumis et al., 2012; Hall et al., 2010; Seiverling et al., 2010; Weinkauf et al., 2011), three studies used feedback in combination with only one other strategy, either didactic (Feldman & Matos, 2012) or modeling (Madzharova et al., 2012; Robinson, 2011). Since two of these studies (Feldman & Matos, 2012; Robinson, 2011) demonstrated the highest results with the most experimental control, it is reasonable to conclude that feedback is effective as a training strategy in combination with at least one additional strategy with paraprofessionals working with children with ASD.

A second training strategy that appeared to contribute to paraprofessional treatment fidelity was modeling. The researchers either modeled the strategy in vivo (Gianoumis et al., 2012; Robinson, 2011; Seiverling et al., 2010; Weinkauf et al., 2011) or the participant watched video models (Madzharova et al., 2012). Modeling has been demonstrated to be another effective component in a behavioral skills training model for adults when isolated (Krumhus & Malott, 1980; Sterling-Turner, Watson, Wildmon, Watkins, & Little, 2001; Ward-Horner & Sturmey, 2012) and also as part of a package (Dib et al., 2007; Nigro-Bruzzi & Sturmey, 2010). Modeling and feedback together provide teaching strategies of correct demonstration, reinforcement and error correction. Full adult learning models that include didactic information and discussion, modeling, and feedback are found to be effective means of packaging the

components of behavior skill training for rapid acquisition of a new skill (Jahr, 1998; Lang & Fox, 2003; Sterling-Turner, Watson, Wildmon, Watkins, & Little, 2001; Stormont & Reinke, 2013; van Oorsouw, Embregts, Bosman, & Jahoda, 2009).

One strategy that was not explored in the studies reviewed was distance-based training and coaching of paraprofessionals. Distance-based learning for parents is evolving in the research literature on young children with disabilities (Kelso, Fiechtl, Olsen, & Rule, 2009) and children with ASD (Nefdt, Koegel, Singer, & Gerber, 2009; Vismara, Young, & Rogers, 2012). Distance-based learning involves instruction from DVDs or online sources (Nefdt et al., 2009; Wainer & Ingersoll, 2013) and virtual coaching via a teleconferencing medium such as Skype (Kelso et al., 2009; Vismara et al., 2012). This method could be explored to facilitate training in geographic areas where personnel with expertise is often limited.

A training strategy and research design component that appeared to contribute to effectiveness was treatment fidelity performance criteria for the paraprofessionals to leave intervention. Requiring performance criteria appeared to be an effective way to quickly establish treatment fidelity and provide the child participant with instruction as intended. Although no empirical study establishes an absolute percentage for "high" treatment fidelity, 80% is generally considered the threshold for high fidelity in research (Smith, Daunic, & Taylor, 2007). The six studies all required 80-90% or higher across multiple sessions to leave intervention or move to the next phase. The studies requiring performance criteria mirror the literature base in adult training models (Rispoli et al., 2011; Ward-Horner & Sturmey, 2012). The remaining study measured paraprofessional outcome as frequency of a specific behavior such as elaborations or descriptors (Hall et al., 2010) and did not require any criteria to leave intervention. When using treatment fidelity as a dependent measure, performance criteria appeared to contribute to a

successful intervention. Establishing appropriate criteria appears to be an avenue for fidelity research.

Data measurement also appears to contribute to the effectiveness and quality of the study. Using more direct measures of data collection such as interval recording rather than a post-observation Likert-like scale (e.g., 5= consistently implemented down to 1=never implemented) will more accurately measure the performance of the paraprofessional implementing the social communication intervention. The highest quality studies (Feldman & Matos, 2012; Robinson, 2011) used whole interval recording of paraprofessional treatment fidelity, the most stringent data measures in the review. Whole interval recording is often used to record data on behaviors (e.g., follow the child's lead) that are occurring continuously in a session (Cooper et al., 2007). In whole interval recording the component can only be scored as correct if it was done correctly during the whole interval; this method of data collection can actually underestimate the performance (Cooper et al., 2007). A larger interval will be more likely to underestimate the occurrence of the behavior. Both Feldman and Matos (2012) and Robinson (2011) used a one-minute interval to record behavior. A smaller interval, such as 10 seconds, would be an even more accurate measure of behavior. Further research studying even more direct measures of fidelity, such as frequency of behavior, would contribute to the quantitative evidence in the literature.

Determining if the paraprofessionals can apply the new social communication skills with new children, activities or in new settings is a strong indicator of effectiveness (Horner et al., 2005), yet only three studies measured any type of generalization (Feldman & Matos, 2012; Gianoumis et al., 2012; Robinson, 2011). Generalization was measured across activities in two studies (Feldman & Matos, 2012; Robinson, 2011) and across children participants in two

studies (Gianoumis et al., 2012; Robinson, 2011). All studies in the review were conducted in school or clinic settings with no generalization to home settings. Through behavioral health rehabilitation services, paraprofessionals provide home-based services for children with ASD in Pennsylvania under the supervision of a behavior specialist consultant (Community Care Behavioral Health Organization, 2012; L&M Policy Research, 2014). Given the importance of teaching social communication for young children with ASD (McConnell, 2002), researching paraprofessional intervention in multiple settings, including the home setting seems to be both essential and timely.

Generalization and maintenance were measured as single probes (Feldman & Matos, 2012; Robinson, 2011) or as three to four data points with a generalization child (Gianoumis et al., 2012). Repeated generalization measurement would provide some proof of the external validity of the intervention (Horner et al., 2005). Repeated measurement of maintenance would yield more accurate information about the durability of the intervention (Horner et al., 2005).

Most articles in this review strengthened the evidence for effectiveness of training paraprofessionals in social communication interventions by measuring child outcomes during intervention sessions. Recording child outcomes demonstrated that the paraprofessionals not only implemented the intervention as intended, but that it had the desired effect on child communication. By including more child outcomes the articles in this review increased their support over research training paraprofessionals on other interventions for children with ASD that do not include child outcomes (Dib et al., 2007; Leblanc, Ricciardi, & Luiselli, 2005; Rispoli et al., 2011). However the child outcomes alone are not evidence of the effectiveness of the social communication intervention. The paraprofessional intervention design must demonstrate experimental control by the criteria for moving from baseline to intervention (Kennedy, 2005).

With experimental control established, the addition of the positive child outcome data is strong evidence that the intervention is effective with that group of paraprofessionals and children. Child outcomes provide additional important evidence when studying paraprofessional interventions to increase social communication for children with ASD.

2.3.3.1 Future Directions

Given the importance of social communication interventions for children with ASD and the number of paraprofessionals currently working with children with ASD in school, clinic and home settings, developing models for effective paraprofessional training is critical. Researchers utilizing training models including feedback with at least one other training component have demonstrated that paraprofessionals can meet high treatment fidelity. Future research should target cost effective trainings that include different types of modeling and feedback.

The Ingersoll and Dvortcsak (2010) manual was originally created to teach professionals how to teach parents to implement the strategies. Similar to parents, paraprofessionals spend a large amount of time with children with ASD and often lack training on basic strategies (Rispoli et al., 2011). Video models on the DVD and corresponding online modules provide examples of correct implementation that can be accessed repeatedly to increase paraprofessional understanding. Video modeling has recently been demonstrated to be effective with adults as well as children (Shayne & Miltenberger, 2013; Ward-Horner & Sturmey, 2012). Coaching is also a critical piece of the Ingersoll and Dvortcsak model. This review and other literature (Arco, 2008; Rispoli et al., 2011; Ward-Horner & Sturmey, 2012) have demonstrated the importance of feedback in the adult training. Future research should explore paraprofessional implementation of the Ingersoll and Dvortcsak model.

Including the quality indicators of single subject design (Horner et al., 2005) creates a study that will provide a strong measure of evidence. Researchers should operationally define the independent and dependent variables, use repeated measurement, evaluate implementation fidelity, and establish criteria for entering intervention and leaving intervention. Additionally researchers should measure maintenance and generalization for durability and external validity. Including child outcomes will provide additional evidence of effectiveness.

2.3.3.2 Conclusion

This review examined seven studies of training paraprofessionals to implement social communication interventions with children with ASD. Six of the seven provided some evidence of effectiveness and four demonstrated quality indicators of a strong single subject design. Several conclusions can be drawn from the review. *First*, researchers training paraprofessionals on PRT demonstrated the most evidence of effectiveness of training and child outcomes. Additional research is needed on teaching paraprofessionals to facilitate child spontaneous communication. *Second*, feedback appears to be a successful component when paired with at least one other component of training paraprofessionals. Future research should include adult learning models that provide easy to implement, cost-effective training, and utilize modeling and feedback components. Ingersoll and Dvortcsak (2010) is one such model to examine. *Third*, paraprofessional research in social communication interventions for children with ASD should include rigorous design and experimental control. Data measurement of paraprofessional treatment fidelity should be direct, and research should include child outcome data. *Fourth*, research in home and community should be examined. Researchers need to provide more extensive generalization and maintenance data. *Fifth*, research utilizing distance-based learning methods should be explored. The effects demonstrated in this literature point to the need for

additional research in the area of paraprofessional training in social communication strategies for children with ASD.

3.0 METHODS

Based on the need for furthering the training of paraprofessionals to teach social communication skills to young children with ASD, this study addressed the following questions: (a) What effect does the combination of online training, in-vivo training (discussion, modeling and coaching), and feedback (email and video) have on the accuracy of paraprofessional delivery of the interactive components of the Ingersoll and Dvortcsak (2010) intervention to young children with autism in their homes? (b) Do the children who receive the interactive components of the Ingersoll and Dvortcsak (2010) intervention demonstrate changes in spontaneous communication? The study was submitted and approved by the Institutional Review Board (IRB) for the University of Pittsburgh.

3.1 PARTICIPANTS AND SETTING

Three therapeutic support staff (TSS) employed by a behavioral health agency in the greater Pittsburgh area participated in the study. In the state of Pennsylvania, Behavioral Health Rehabilitation Services (BHRS) are prescribed for children with autism by a licensed psychologist and are provided by a BHRS wraparound agency who bills either private insurance or Medicaid (Community Care Behavioral Health Organization, 2012). These agencies employ Master's degreed Behavioral Specialist Consultants (BSC) who write the programming and

supervise the Therapeutic Support Staff (TSS) who implement the programs. Therapeutic Support Staff have bachelor's degrees and additionally receive some training by their agencies before beginning to provide services to clients. The child's programming occurs in home, school, and community settings. Often all behavioral services for young children with autism are provided in the home. The programming typically includes goals related to socially appropriate behavior, communication, and pre-academic subjects. The TSS implements both structured teaching and play-based services, with the goal of training parents to implement interventions during daily routines when therapists are not present. The TSS is responsible for collecting data related to the goals, and the BSC is responsible for analyzing the data and making corresponding treatment decisions.

Two females and one male TSS participated in the study. All three had Bachelor's degrees. Daniel had a Master's degree in Research Methodology, and Elizabeth was currently a Master's student in Social Work. All three had received the same introductory training at the participating behavioral agency. None of the TSS had been trained on naturalistic behavioral social communication interventions (e.g., Pivotal Response Treatment, Incidental Teaching, Early Start Denver Model) or mand training. Anna and Elizabeth were new TSS on their first cases. Daniel had been a TSS for 15 years. The three TSS participants were between 22-54 years old and all three were Caucasians. One TSS was of Hispanic descent. Demographic information on participants is found in Table 1.

The child participants all had a diagnosis of autism spectrum disorder (ASD) according to the Diagnostic and Statistical Manual – V (2013) or the Diagnostic and Statistical Manual – IV (2000) for Autistic Disorder or Pervasive Developmental Disorder - not otherwise specified. None of the three child participants were diagnosed with a co-morbid medical or sensory

disorder (e.g. Cerebral Palsy, Seizure disorder). The children were between three and six years old, two were male and one was a female. All three were determined to have little or no spontaneous communication as evaluated by the Communication and Symbolic Behavior Scales (CSBS; Prizant & Wetherby, 2002). Demographic information for the three child participants is included in Table 2.

Table 1 Demographic information for adult participants

Adult Participants	Gender	Age range	Education	Race	Years Experience with Children with ASD
01 Daniel	M	40-50	MS	Caucasian	20+
02 Anna	F	50-60	BS	Caucasian	1 yr 1 mo
03 Elizabeth	F	20-30	BS	Caucasian	2 mo

Table 2 Demographic information for child participants

Child	01 Ravi	02 Beni	03 Chloe
Age at start of study	4 yr 3 mo	3 yr 1 mo	6 yr 10 mo
Gender	Male	Male	Female
Race/Ethnicity	Indian	Caucasian/Hispanic	Biracial (Caucasian/African American)
Diagnosis	ASD; ADHD	Autistic Disorder	Autistic Disorder
Age at Diag.	2 yr 3 mo	2 yr 11 mo	2 yr
Time in BHRS	2 weeks	1 yr 1 mo	4 yrs
# hours/week	11	20	9
Related services	OT, SLP	OT, PT, SLP	SLP

Note: BHRS= Behavior Health Rehabilitation Services (Wraparound), OT = Occupational Therapy, PT = Physical Therapy, SLP = Speech Language Pathology

3.1.1 Recruitment Procedures.

An agency in the greater Pittsburgh area providing wraparound behavioral services for children with ASD identified TSS to be contacted as potential participants for the study. The BSC from the agency first contacted the TSS to see if they were interested in the study. When a TSS indicated interest, the researcher contacted them through a phone call to provide additional information with an introductory script and confirmed that they would like to participate in the study. If the TSS continued to indicate interest, an information sheet and consent form was provided to the parents of the child with ASD. If the parents agreed to participate, the researcher

contacted the parents through a phone call, provided any additional information if requested, and scheduled time for the screening. All TSS and parents of the children provided informed consent.

3.1.2 Screening Procedures and Pre-assessment Measure

Screening procedures were conducted prior to baseline to determine if each child met inclusion criteria. Screening procedures included: a) Communication and Symbolic Behavior Scales (CSBS; Prizant & Wetherby, 2002) and b) Childhood Autism Rating Scale (CARS; Schopler, Reichler, DeVellis, & Daly, 1980). The CSBS assesses communication in three domains, social, speech, and symbolic. The assessment is standardized for infants and toddlers up to 24 months so the raw scores were used to evaluate language level and change across the length of the intervention. When screened with the CSBS, all three children had very few initiations, no words, and few consonant sounds. All three had some intentional gestures and gaze shifts. The CARS rates fourteen behaviors for severity of autism symptoms including verbal and nonverbal communication and imitation. A score of 30 or greater indicates the presence of autism, with higher scores indicating increasing severity. All three children fell into the severely autistic range. Both of these assessments were completed with the child and parents. The parents provided a copy of the child's evaluation report. These procedures determined that a) the child had ASD, and b) the child had a low level of spontaneous communication (i.e., 0-3 initiations during assessment and further confirmation by parent report). After the child met inclusion criteria, pre-assessment measures were collected at the same meeting.

The Mullen Scales of Early Learning (MSEL; Mullen, 1995) was used to assess the child's developmental age in gross motor, fine motor, visual reception, expressive language, and receptive language. The MSEL is a standardized assessment for children up to 69 months (5

years 9 months). Since Chloe was over 6 years old the standard scores in the highest age range were used. All three children's standard scores fell below the first percentile (very low) with the exception of the Gross Motor domain that is not standard scored after 34 months. Composite screening and assessment data for each child is found in Table 3.

Table 3 Screening and assessment data for child participants

Child	Chronological	CSBS		MSEL	CARS
		Raw composite		Standard composite	
	Age at Testing	Pre	Post	(developmental age)	
Ravi	4 yr 3 mo	31	35	49 (7-33 mo)	42.5
Beni	3 yr 1 mo	26	45	56 (7-18 mo)	39
Chloe	6 yr 10 mo	34	55	40 (5-33 mo)	41.5

note: CSBS = Communication and Symbolic Behavior Scales (Wetherby & Prizant, 2002); MSEL = Mullen Scales of Early Learning (Mullen, 1995); CARS = Childhood Autism Rating Scale (Schopler, Reichler, & Renner, 1988)

3.2 SETTING/STAFF

The screening, pre-assessment, baseline, intervention and follow-up were conducted in the children's homes. Generalization probes occurred in the family kitchen or dining room for snack, and at least one of the generalization sessions with Anna and Elizabeth occurred at a playground. The TSS completed the online training modules in a location of their choosing prior to the in-vivo training session in the child's home.

3.2.1 Materials

The TSS were provided with *Teaching Social Communication To Children with Autism, A Practioner's Guide to Parent Training* (Ingersoll & Dvortcsak, 2010) which includes a DVD with video models of the strategies and a Samsung Galaxy Tab 4 computer tablet with a protective case and a stand. The manual was comprised of a rationale for the intervention, written instructions with examples, and homework. The authors created a set of accompanying online training modules as part of Project ImPACT (Improving Parents as Communication Teachers) at the Autism Research Lab at Michigan State University (Ingersoll & Dvortcsak, 2010). A link to the online training module(s) was provided to the TSS when intervention began. The intervention used toys already present in the home. The Samsung Galaxy Tab 4 was used to complete the online training modules and to video record sessions when the researcher was not present. The researcher also used a Samsung Galaxy Tab 4 to tape all training and play sessions when she was present. Data sheets were used to collect data from the video recordings on the frequency and accuracy of the TSS implementation of the strategies, TSS questions and demands, and child spontaneous communication during baseline and treatment sessions.

3.3 DEPENDENT AND INDEPENDENT MEASURES

3.3.1 Dependent Measures

Dependent measures collected for the paraprofessional consisted of: (a) frequency of correct use of the three intervention strategies (i.e., imitation, modeling and expanding language,

and communicative temptations); (b) percent correct use of an intervention strategy out of total attempts to use per session; (c) frequency of asking questions or making demands. All measures were collected within a 10-minute play sample. Correct use of a strategy was determined based on a treatment fidelity checklist itemizing the definition of the strategy (Appendix B). All checklist items had to be correct for the occurrence to be scored as correct. The dependent measure for the child was spontaneous communication. Child spontaneous communication included developmentally appropriate initiated communication such as eye gaze, gesture, vocalization or word directed toward the TSS. Inappropriate behavior such as screaming or hitting was not counted as spontaneous communication. Dependent variable definitions are described in Table 3. Child communication levels and expanded levels used in modeling and expanding language are described in Table 4.

Table 4 Dependent Variable definitions and examples

Strategy	Definition	Examples	Non-examples
Imitation	While facing the child, the TSS will move in the same manner using the same body parts as the child is moving within three seconds, manipulate a toy or object in the same manner, and/or use the same facial expression. A movement cycle of imitation includes movement in same direction (whole body, hand, foot, head) from start of motion until the body/part changes direction or stops. The TSS may not give a demand or a question during imitation or provide any physical prompting. Child movement must be socially acceptable in the home (e.g., not screaming, not running away, not hitting).	1. Child pushes car forward on the table, and TSS immediately pushes her car forward on the table. 2. Child jumps up and comes back down one time. TSS immediately jumps up and comes back down one time. EACH JUMP represents one imitation. 3. Child puts arms around adult (hug). TSS immediately puts arms around child. 4. Child frowns, TSS immediately frowns.	1. Child taps drum, TSS taps drum. At the same time TSS says, "Are you tapping?" 2. Child pushes car, TSS pushes car away and says "zoom your car over here." 3. Child taps drum, TSS says, "tap, tap" and picks up stick afterward (delayed).

Table 4 continued

Strategy	Definition	Examples	Non-examples
Modeling and Expanding Language	TSS provides a verbal description of child activity or self-describes own activity during or within three seconds after the activity, or enlarges a verbal comment from the child at one level above current language level. No questions or demands may be used. When the TSS repeats a word up to three times with less than 1 second between words it functions as one instance. Phrases more than one level above the child's current language level do not count as modeling and expanding. Conventions such as bye-bye, or thank-you count as 1 word, and can be paired with a noun for two words. See Table 2 for language levels and expansion.	Preintentional/word approximation level: 1. Child squishes play-doh, TSS says, "Squish, squish, squish!" 2. Child pushes car, says, "zzzzz," TSS says, "Zoom!" 3. Child holds up block, TSS says, "Block!" One-word level: 4. Child says, "Bubbles," TSS says, "Blow bubbles!" 5. Child puts cow toy in bucket. TSS says, "Bye-bye cow." Two-word level: 6. Child says, "Blow bubbles" TSS says, "___ (name) blow bubbles!" Three-word phrase 7. Child says, "Car go zoom!" TSS says, "The green car goes zoom!"	1. Child squishes play-doh, TSS says, "Can I have play-doh?" 2. Child pushes car and says, "zzzzz," TSS says, "Car go zoom!" 3. Preverbal child holds up block, TSS says, "You have a block!" 4. Child says, "Bubbles" TSS says, "You want bubbles?" 5. Child pus cow toy in bucket, TSS says, "Time to clean up!" 6. Child says, "Blow bubbles." TSS says "Blow bubbles!" 7. Child says, "Car go zoom!" TSS says, "Zoom!"

Table 4 continued

Strategy	Definition	Examples	Non-examples
Communicative Temptations (see descriptions below for specific temptations)	1) Arranging the environment as specified by the definition of the CT when the child demonstrates motivation for the toy/object by reaching for the object, looking at the object, other gesture, or searching for the object. 2) Responding within three seconds of child's request for the object by providing access to the object or engaging as requested (e.g., Blowing bubbles). Access is paired with adult modeling and expanding language, positive affect and animation.		
In Sight and Out of Reach	Placing the desired object object where the child can still see it but cannot reach it or access it on his own.	Placing a small toy/edible in a clear plastic jar with a lid.	TSS asks, "What do want?"
Inadequate Portions	Giving child only one piece at a time for a toy or food that has multiple multiple pieces or identical parts.	Puzzle, train track, one cheerio	TSS withholds puzzle pieces then asks, "What do you want?
Assistance	Using toys that require adult assistance, or physical play with the adult.	Balloons, bubbles, mechanical toys, tickles	TSS holds up bubble container, then asks, "Do you want bubbles?"

Table 4 continued

Strategy	Definition	Examples	Non-examples
Questions and Demands	Adult asking the child a question or placing a demand during play	TSS says: 1. "What do you want to do?" 2. "Come here." 3. "Put the doggie over there."	
Child spontaneous communication	Any child initiated eye contact, or vocal, signed or gestural initiation that includes eye contact from the child toward the TSS in the absence of any but contextual prompts in the environment. Inappropriate behavior such as screaming or hitting does not count as spontaneous communication.	1. During play, child looks at TSS and smiles 2. Child looks at TSS and points to toy car. 3. TSS and child are building blocks. Child says "Block!" while looking up at TSS and back at block. 4. Child points to bubble container and says, "I want bubbles."	TSS prompts child response by asking a question. a) "What do you want?" b) "What is this?" c) "You want the puzzle piece?" Child points at an item and screams.

Table 5 Current child language level and expanded level

Child's Communication Level	*Adult Model*
Pre-intentional or nonconventional gestures	Intentional gestures and single words
Word approximations or single words	Single words and two-word phrases
Two-word phrases	Simple phrase speech (i.e., subj-verb-obj)
Simple phrase speech	Phrase speech with descriptors
Phrase speech with descriptors	Complex phrase speech

Ingersoll & Dvortcsak (2010), *Teaching Social Communication to Children with Autism,* p241.

3.3.2 Independent Variables

The independent variable was the training of the TSS to implement the three strategies defined above through an online module, in-vivo training (didactic discussion, modeling and coaching) and feedback (email with selected video samples). Ingersoll and Dvortcsak (2010) created a three-tiered social-communication intervention model representing both developmental and behavior strategies. The first and second tiers, entitled "Interactive Teaching Techniques" are the strategies used in this study. The first tier consists of "Follow the Child's Lead", "Imitate your Child", "Animation", and "Modeling and Expanding Language." These strategies are responsive techniques for creating motivation for the child to engage and interact with the adult. The first strategy measured in this study, imitation, included training in "Follow the Child's Lead", "Animation", and "Imitate Your Child." The second strategy measured in this study included training in "Modeling and Expanding Language." This strategy uses the child's

developmental level to dictate the level used by the TSS to model and expand language. The second tier in the Ingersoll and Dvortcsak model builds on the strategies from the first tier, and includes the "Communicative Temptations." Communicative temptations consist of seven specific strategies (i.e., In Sight and Out-of-Reach, Control Access, Assistance, Inadequate portions, Sabotage, Protest, Silly Situations) that teach the adult to control access to the preferred material in fun ways to evoke requests and initiations from the child without direct prompting. The third strategy measured in this study includes three of the communicative temptations: "Assistance", "In Sight and Out-of-Reach", and "Inadequate Portions". The TSS completed online instruction for each section (1-3 modules) lasting approximately 30-60 minutes. The TSS then received in-vivo training for 30-60 minutes in the next session following completion of the online module. The researcher provided feedback on all video-recorded sessions during intervention through written email with a link included to view video clips. If the TSS did not meet mastery criterion in five-seven sessions, the researcher provided a repeat in-vivo training session.

3.3.3 Research Design

A multiple baseline design across behaviors was used to demonstrate a functional relationship between the independent and dependent variables. The design included: baseline, tier 1 (i.e., imitation), tier 2 (i.e., modeling and expanding language), and tier 3 (i.e., communicative temptations) with generalization probes at the end of training for each tier, and maintenance for all three tiers. Maintenance of all behaviors was measured for four or five sessions randomly selected from all uploaded maintenance sessions from one to five weeks after intervention ended.

Baseline sessions continued for at least five sessions until a TSS exhibited stable responding. The TSS were trained and received feedback until they demonstrated an experimental effect in frequency change of correct use based on goals developed by the researcher and TSS with 80% or greater correct treatment fidelity across three consecutive sessions. After demonstration of experimental effect for each tier a generalization probe was conducted during snack time or at a playground. Then the TSS moved into the next tier of the training. This cycle of training and generalization continued until all three tiers were completed. To measure maintenance after the last generalization probe the TSS continued to video-record and upload sessions conducted in the same manner as baseline. One TSS (Daniel) recorded for two weeks after intervention, a total of seven sessions before the family left the country for an extended time period. Three weeks after intervention ended Anna and Elizabeth recorded for two weeks, representing five sessions for Anna and four sessions for Elizabeth. The researcher collected maintenance data on all sessions recorded by the second and third TSS.

A multiple baseline across behaviors was chosen because the intervention is not reversible. The design was easy to implement and allowed for demonstration of experimental control by replicating the effects across multiple behaviors and time. Varying the length of baseline controlled for maturation. The design was repeated with two additional TSS for external validity.

3.4 PROCEDURE

3.4.1 Baseline condition.

Baseline sessions took place in a designated room in the child's home. This was the same room where the intervention took place. One baseline probe in the generalization setting was also conducted. During the first baseline session the researcher came to the home during the TSS normal shift. After the first session the TSS videotaped and uploaded the video without the researcher present. Before each session the TSS conducted a brief informal preference assessment for up to five toy sets from up to 10 parent-selected toy sets. The researcher taught the TSS to conduct a brief preference assessment during the first session following the steps in Table 6 (Gianounmis, Seiverling & Sturmey, 2012). The researcher told the TSS to play using the child's normal programming with available toys for 10 minutes. The session was videotaped and uploaded to the University of Pittsburgh Box storage or transferred to the researcher via an SD memory card for later scoring. No instruction or coaching occurred during these sessions.

Table 6 Multiple stimulus preference assessment procedure

Instructions
1. Place up to 10 items in a row approximately 1-2 feet in front of the child and no farther than 3 feet to the left or right side of the child. 2. Say, "Pick one" 3. If the child selects a stimulus item within 5-s give the child access to the item for 10-30s. Selection may consist of vocalizations, gestures or eye gaze directed to the item. 4. Reposition the remaining items in a different order. 5. Remove the accessed item out of sight of the child. 6. If the child does not select an item, reposition items and repeat the directions. 7. Block the child's attempt to select more than one item by placing the child's hands in his lap and repeating step 2. 8. Repeat with remaining items until the child has selected up to 5 items.

Gianoumis et al., (2012), p 60.

3.4.2 TSS training condition.

The training condition consisted of online training modules, in-vivo training that included discussion of the strategy, modeling by the researcher and practice with coaching, and finally written and video feedback on video-recorded sessions by email. Before the first training session in a tier the TSS was given the link to the training module(s) (Ingersoll, 2013) and instructed to view the module(s) before the session. The researcher told the TSS to complete an informal preference assessment and then play with the child using the strategies taught in the last session(s) or from the new module. The researcher videotaped the 10-minute play session.

Following the 10-minute play session one of the three training tiers occurred. The first training phase, *imitation*, covered the foundational strategies in the Ingersoll and Dvortcsak (2010) program: follow your child's lead, imitate your child, and animate. The second training

tier, *modeling and expanding language,* reinforced the strategies covered in the previous lesson and added the technique of modeling and expanding the child's language in play. The third training tier, *communicative temptations,* reinforced the previous strategies and taught three communicative temptations.

Each in-vivo session consisted of three sections: *didactic discussion, modeling,* and *coaching.* The purpose of *didactic discussion* was to review the strategies already learned by using the manual and video models as reference, review baseline data and set a goal for strategy frequency. The purpose of *modeling* was to provide in-vivo modeling of the new strategies. The purpose of *coaching* was for the TSS to practice the strategies with the child and receive immediate correction and reinforcement.

3.4.2.1 Online Module

The TSS completed the online module(s) (Ingersoll, 2013) which included watching video models of the strategy. The modules described the strategies with text and provide multiple examples to illustrate. Each module took approximately 15-30 minutes to complete.

3.4.2.2 In-Vivo Training

The in-vivo training session was composed of three sections: didactic discussion, modeling by the researcher, and practice with coaching.

Didactic Discussion

Didactic discussion briefly reviewed the topics discussed above in the online modules using the manual and DVD video models as a reference if necessary. The didactic discussion included the following steps: a) the trainer assessed the TSS understanding with a brief quiz

taken from the online module(s), b) during the first training session for each section the trainer reviewed the TSS baseline performance in graphical form and set a goal for performance based on expected frequency described in data collection procedures below, c) trainer answered any TSS questions, d) trainer reviewed strategies learned to date. This section took between 4-8 minutes.

Modeling

Modeling focused on demonstrating the target strategy covered in the online module(s). The trainer modeled the strategy at least three times with the child participant. The trainer answered any questions from the TSS. This section took approximately 4-6 minutes.

Coaching

Coaching provided time for the TSS to practice with the child and receive immediate feedback. Coaching included an 8-15-minute play period where the TSS practiced the strategies and the trainer provided immediate behavior-specific praise and correction. Following the coaching session the trainer answered any additional questions and reviewed the strategy goal for the upcoming daily sessions.

3.4.2.3 Daily Sessions

The next five days that the TSS worked with the child included a 10-minute videotaped session. The TSS: (a) set up the tablet to videotape, (b) conducted the informal preference assessment, (c) set up the room in the same manner as during the training session, (d) conduct a 10-minute play session. After the TSS finished the session the video was uploaded to a secure

shared University of Pittsburgh site called Box for the trainer to score. The trainer scored the video that evening and provided feedback in an email or text containing total frequency and accuracy data and two statements of behavior-specific praise and one corrective statement. A brief video clip illustrating correct performance was included in the email. A second video clip was sometimes also included for corrective feedback. If the clip could not be included in the email, or a text was used, the clip was placed in the secure Box site and the TSS directed to the site. The TSS was asked to reply indicating they had received the feedback.

3.4.2.4 Generalization probes

When the TSS demonstrated experimental effect change in level and trend by meeting the predetermined goal, and 80% fidelity across three consecutive training and practice sessions, during the next session the TSS video-recorded a generalization probe. During this session the TSS conducted a videotaped 10-minute session during snack time or at the playground using all the strategies taught to date. No feedback was provided either during the session or by email.

Follow-up measures. A post-treatment measure was assessed at the same session as the last generalization probe. The CSBS (Prizant & Wetherby, 2002) was administered to each child.

3.4.2.5 Maintenance condition

Data from five maintenance sessions was collected from two weeks of video recordings beginning one to three weeks after training ended. The TSS conducted a videotaped 10-minute play session and uploaded the video to the University of Pittsburgh Box site. The TSS was told to play using the strategies taught in the training sessions. No feedback was provided after these sessions.

3.4.2.6 Implementation Fidelity

The researcher videotaped all training sessions and a graduate assistant coded for implementation fidelity (training) using an implementation fidelity form customized from the Ingersoll and Dvortcsak (2010) manual. If the researcher fell below a 90% observed rating the graduate assistant reviewed the video with the trainer and provided corrective feedback. See Appendix B for the Implementation Fidelity Form.

3.4.3 Data Collection Procedures

3.4.3.1 TSS and child target behaviors.

The researcher viewed and scored fifteen 10-minute play samples from parent-child sessions of earlier research studies, using the definitions in this study. Based on coding multiple videos from parent-child sessions, the expected frequency of: 1) *imitation* after training should be a minimum of 17 correct instances in a 10-minute session, 2) *modeling and expanding language* after training should be a minimum of 70 correct instances in a 10-minute session, and 3) correct use of one of the three *communicative temptations* should be a minimum of 4 times in a 10-minute session.

All sessions were videotaped. The researcher watched the videos from baseline, training, daily practice, generalization and maintenance sessions and coded the video for TSS and child target behaviors. The researcher recorded the number of attempted instances of a strategy and the number of correct instances of a strategy to calculate percent correct. A correct instance of a strategy was recorded if 100% of the checklist items for that instance of the strategy were correct. Mastery criterion for all three strategies was a level change in correct instances from baseline up to predetermined goals and a minimum of 80% of the instances attempted scored as

correct in three consecutive play sessions. The researcher and TSS set goals for TSS behavior based on baseline performance and expected frequency of behavior after training. If the TSS had a frequency of zero for a strategy in baseline the minimum expected frequency became the goal. If the TSS has greater than zero frequency in baseline, the goal was the minimum expected frequency or double the baseline frequency, whichever was larger. The researcher also scored frequency of TSS questions/demands and child spontaneous communication frequency for the 10-minute session.

3.4.3.2 Interobserver Agreement

A graduate assistant was trained to conduct interobserver agreement (IOA). The researcher and graduate assistant first discussed definitions and examples of the TSS and child target behaviors. Next they watched a sample 10-min video from a parent-training session separate from this study and practiced coding. IOA was scored point to point, meaning that each instance of coded behavior must match to be scored as in agreement. The researcher and assistant continued to code video and compare until they reached 80% IOA or greater across three 10-min samples. For TSS strategy use, point by point included the agreement on the use of each step of a strategy (e.g. Imitation IOA would include all 9 steps of Imitation). To calculate IOA the researcher and assistant's agreement was divided by the agreement plus disagreement and multiplied by 100 to obtain a percentage. The graduate assistant coded IOA on 25-30% of all videotaped play sessions. To reach IOA the assistant was in 80% agreement or greater with the researcher across all conditions. If IOA fell below 80%, the researcher and graduate assistant watched the video together to come to agreement on the scoring.

3.4.4 Social Validity of Outcomes

Each TSS completed a social validity survey during the weeks immediately following the end of training. The questionnaire asked the TSS to rate their experience with the training and using the strategies to facilitate initiations. The TSS were asked nine Likert-like questions (1=not helpful to 5= extremely helpful) about which components of the intervention they felt were the most effective. The nine components were listed as: online module, module review with researcher, modeling by researcher, skill practice, verbal feedback, email feedback, video feedback, manual, and the overall intervention. Open-ended questions asked what the TSS found most helpful and any suggestions for improvement. They were also asked if they used the strategies at any time other than the videotaped sessions and if they taught the parent any of the strategies. Finally the TSS was asked if they would recommend this intervention to other staff in the agency.

The parents were also given a social validity survey asking them to rate their perception of the effectiveness of the intervention with their child. The parents also had a mix of Likert questions (1= strongly disagree to 5= strongly agree) and open-ended questions. Six Likert questions asked if the parents agreed that: the PI interacted well with my child, the TSS interacted better with my child after intervention, my child is communicating more after intervention, I would like to learn more about the intervention, I am satisfied with the outcome of the intervention, and I would recommend this intervention for other paraprofessionals. Five open-ended questions asked what the parent liked best about the interactions between the TSS and child, what was most helpful, and were they taught any of the strategies. If they were taught any of the intervention, they were asked what strategies did they use and any suggestions to improve training or general feedback.

3.5 DATA ANALYSIS

Analysis of the effect of the independent variable on the dependent variables was studied for both the TSS and the child participants. Visual analysis of the TSS and child data was used to determine changes in TSS and child behavior across conditions, and if the training was effective in teaching the TSS to implement the social communication strategies accurately. The data was collected during each session by video, scored and graphed immediately following each session, and analyzed for behavior change. Data was collected and analyzed for the following questions:

a) What effect does the combination of online training, in-vivo training and feedback have on the accuracy of paraprofessional delivery of the interactive components of the Ingersoll and Dvortcsak (2010) intervention to young children with autism in their homes? Frequency of correct strategy use per 10-minute play session was used to study the effect that the training package of: a) online modules, b) in-vivo training of discussion, modeling and coaching, and c) written email and video feedback had on the TSS delivery of the social communication intervention in the home. Treatment fidelity was measured per 10-minute play session as a percentage of the number of correct instances of strategy use over correct use plus incorrect use. Frequency and treatment fidelity data was visually represented on two graphs. The frequency graph had calendar dates on the x-axis and frequency of strategy use on the y-axis. The three tiers of the multiple baseline were imitation strategy use, modeling and expanding language strategy use, and communicative temptation strategy use. The treatment fidelity graph had calendar days across the x-axis and percent correct strategies used on the y-axis. Mastery of a strategy occurred when the TSS demonstrated consistently high levels of correct use of the strategy over time. The TSS demonstrated mastery with both a level change of correct strategy frequency up to the predetermined goal from baseline and 80% correct of the strategies

attempted across three consecutive sessions. Then the TSS moved into a generalization probe and the next tier of training or maintenance. TSS use of strategies in a second environment and activity was analyzed for generalization of skill. TSS use of strategies one to five weeks after intervention ended was analyzed to determine if the effect of training continued after the intervention ended. Frequency of questions or demands was also scored and graphed for each 10-minute play session. On the questions and demands graph the x-axis was calendar days and the y-axis was frequency of questions and demands. In addition, replications of changes across conditions and behaviors were analyzed. The graduate assistant scored and calculated IOA for 25-30% of the sessions. The graduate assistant recorded implementation fidelity for all training sessions.

b) Do the children who receive the interactive components of the Ingersoll and Dvortcsak (2010) intervention demonstrate changes in spontaneous communication? To study change in frequency of child spontaneous communication event recording was used. The data was visually represented on a graph and visual inspection analyzed changes in level, trend and variability both within and across conditions. In addition, replications of changes across conditions and behaviors were analyzed. A Pearson r correlation was analyzed for correlation between all TSS behaviors measured and child spontaneous communication. The graduate assistant scored data and calculated IOA for 25% of the sessions.

4.0 RESULTS

The results sections are organized into three general categories: 1) the frequency and treatment fidelity of TSS intervention behaviors with graphical representation 2) child spontaneous communication, and 3) social validity. The three TSS substantially increased their correct use of each of the three strategies during the play sessions from baseline to training and feedback, and decreased their use of questions and demands. The TSS demonstrated varying levels of maintenance for the different strategies. The child participants all demonstrated increased spontaneous communication to the TSS during the play sessions, mostly in the form of eye gaze, gestures and vocalizations. Finally the TSS and parents stated they felt the intervention was helpful and effective.

4.1 FREQUENCY OF TSS BEHAVIORS

The frequency and treatment fidelity of TSS target behavior during 10-minute play sessions were graphed in accordance with a multiple baseline across behaviors design for the three participants. The results for each TSS were graphed separately with dates reported across the x-axis and frequency of target behaviors or treatment fidelity on the y-axis. Each graph represents behaviors in baseline, the three phases of training (i.e., imitation, modeling and expanding language, and communicative temptations), generalization probes, and maintenance

probes one to five weeks after intervention ended. The criterion goal for frequency of strategy use is the horizontal dotted line in each phase of the frequency graph. The goal for imitation was 17 correct instances; the goal for modeling and expanding language was 70 correct instances for Daniel and Elizabeth and 80 correct instances for Anna; and the goal for communicative temptations was 4 correct instances. To be scored as correct 100% of the steps in the checklist needed to be completed with fidelity. The criterion of 80% correct uses out of attempts is the horizontal dotted line in each phase of the treatment fidelity graph. The frequency of questions and demands is displayed on a separate graph.

4.1.1 Participant 1 Daniel

Figure 1 illustrates Daniel's use of the social communication strategies before, during, and after training. Figure 2 illustrates Daniel's treatment fidelity in the form of percent correct uses over total attempts. Figure 3 represents Daniel's frequency of questions or demands during the session. During baseline, Daniel did not use the imitation or the communicative temptations strategies at all. During eight days in baseline he correctly used modeling and expanding language minimally (1-9 instances per session), mostly after he had been trained in imitation and decreasing questions and demands. By contrast he ranged from 39-140 instances of questions or demands per baseline session. After the online training on the imitation strategy, his use of that strategy remained at zero. Following the in-vivo training and one written feedback his use of the strategy increased to 2 correct instances. After two days of feedback Daniel's use of imitation jumped to 20-24 for the next three sessions. After online training, in-vivo training and one written feedback, his imitation strategy treatment fidelity also jumped from 0 to 50% and after ongoing feedback increased to 86-100%. Daniel demonstrated even more rapid results for

training in modeling and expanding language. After online training, he modeled and expanded the child's language 22 times correctly with 79% treatment fidelity, and after in-vivo training and one written feedback he then jumped to 78-79 instances with 86-100% treatment fidelity. After online training in the communicative temptations, Daniel increased to 1 correct instance of a communicative temptation at 50% treatment fidelity. His performance in this phase was more variable, jumping to 6 correct uses at 100% treatment fidelity after the first in-vivo training, but not achieving consistent strategy use until in-vivo retraining on day 6 of the communicative temptations intervention. He used communicative temptations 6-12 times correctly on days seven through nine with 92-100% treatment fidelity.

In the generalization sessions at the end of each phase Daniel successfully applied the strategies during 10-minute snack sessions at the family table. He demonstrated 43 correct uses of imitation at 72% treatment fidelity for the imitation probe, 67 correct uses of modeling or expanding language at 97% treatment fidelity for the modeling and expanding language probe, and 6 correct uses of communicative temptations at 75% treatment fidelity for the communicative temptations probe. These levels are just below criterion for either frequency or treatment fidelity.

Daniel maintained a high level of imitation strategy use through the modeling and expanding language phase (38-55 correct uses) with the exception of the first day of training when he only imitated 9 times correctly. During the communicative temptation phase, however he decreased imitation strategy use to 1 correct use and continued the lower performance in maintenance (0-7 uses). Daniel increased his use of modeling and expanding language during the communicative temptation phase and after intervention ended (68-102 correct uses) with the exception of the first day in communicative temptations (50 correct uses) and the communicative

temptation generalization probe (49 correct uses). Daniel did not maintain communicative temptation strategy use with only one day over criterion (8 correct uses) in maintenance.

Daniel also showed a marked decrease in his use of questions and demands following training. The first day of intervention after online imitation training he had 59 questions or demands, but after in-vivo training he dropped immediately to 5-27 questions or demands throughout the three phases of the intervention. His questions and demands were also low after all intervention ended, ranging from 7-33 instances.

Overall, Daniel learned the strategies quickly, demonstrating understanding through correct answers on all three quizzes at the end of the online modules. He correctly applied the strategies consistently after in-vivo training and ongoing feedback. Daniel took five days to reach criterion for imitation, four days to reach criterion for modeling and expanding language, and nine days to reach criterion for communicative temptations. He generalized all three strategies in a different setting and activity. He was able to maintain the use of one of the three strategies consistently after the intervention for those strategies ended. He also consistently decreased his use of questions and demands during each phase and even after all intervention ended.

Figure 1 Daniel's frequency of social communication strategy use

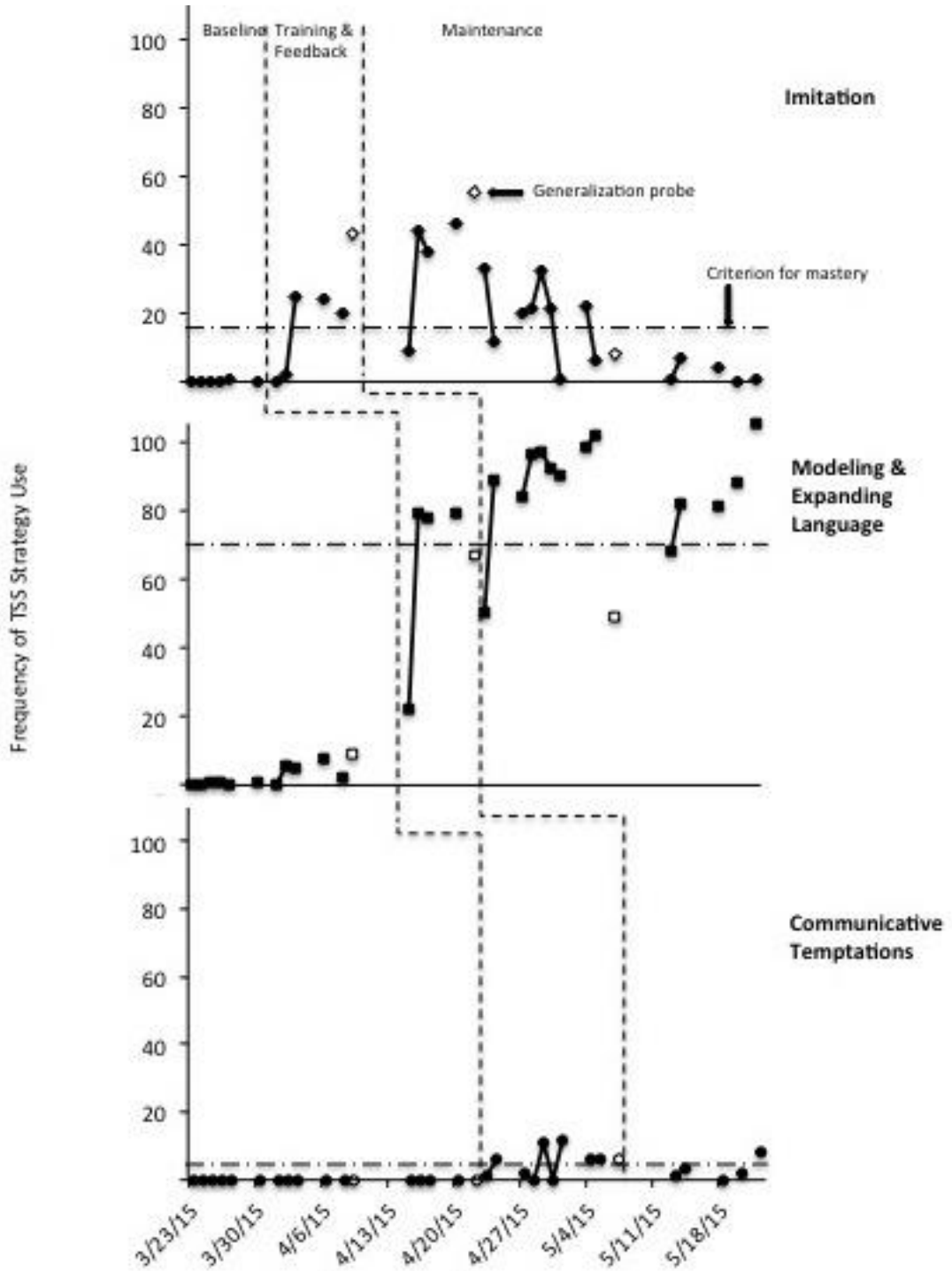


Figure 2 Daniel's treatment fidelity as percentage correct uses of each strategy

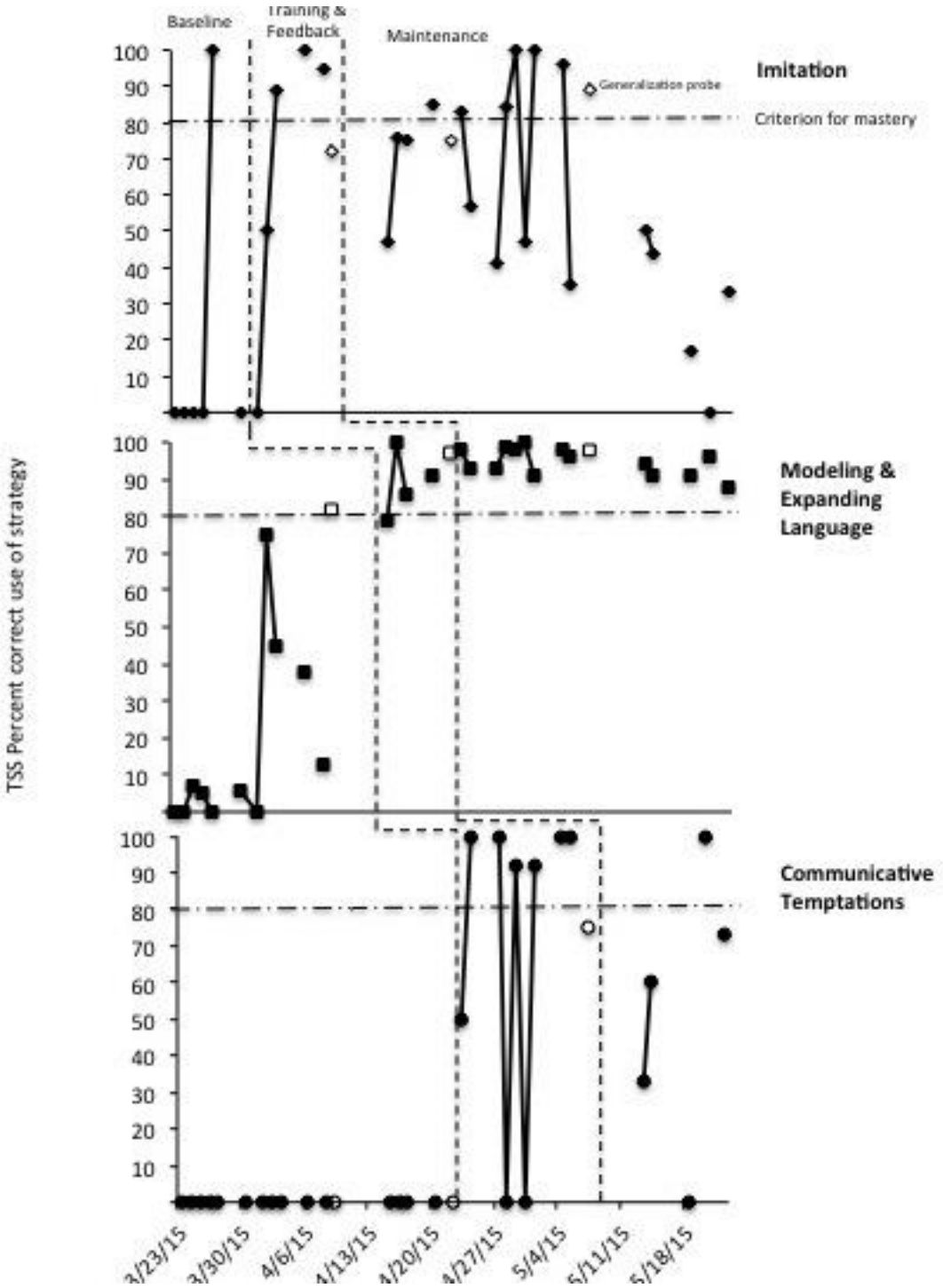
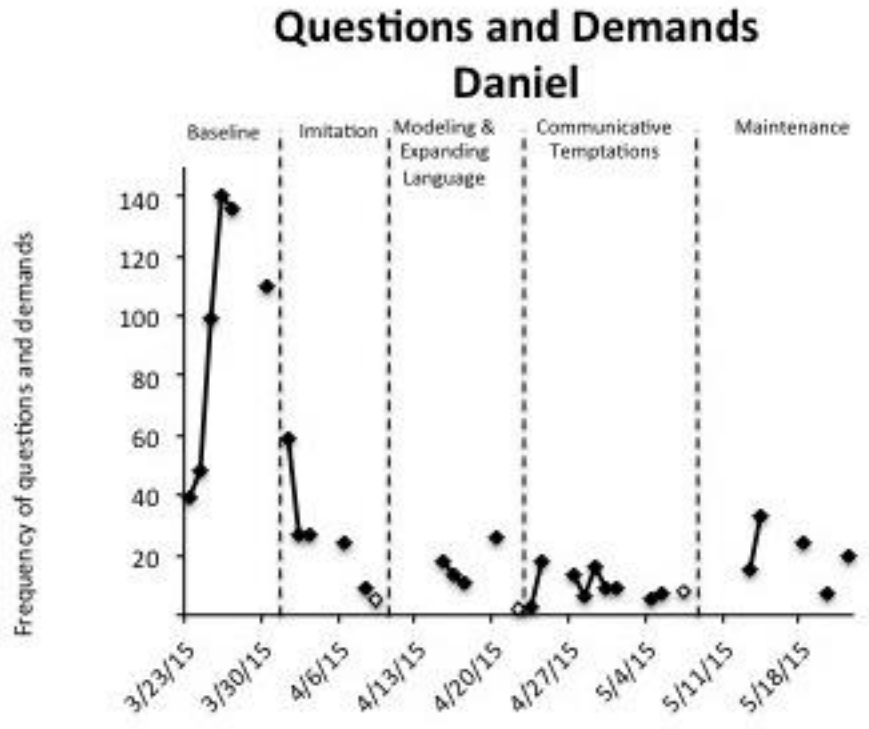


Figure 3 Daniel's frequency of questions and demands



4.1.2 Participant 2 Anna

Figure 4 illustrates Anna's use of the social communication strategies before, during, and after training. Figure 5 illustrates her treatment fidelity of the strategies as percent correct use. Figure 6 illustrates her use of questions and demands during the sessions. During baseline, Anna used neither the imitation nor communicative temptation strategies although she modeled and expanded language correctly 14-41 times per session in baseline. She also demonstrated a high rate of questions and demands with 101-139 instances during the initial baseline sessions. After

online training in imitation Anna increased her imitation strategy use to three correct with 49% treatment fidelity, but after in-vivo training she jumped up to 31 correct occurrences at 89% treatment fidelity. With ongoing feedback in the next two sessions she continued to increase to 62 and 79 correct occurrences with 80-90% treatment fidelity meeting mastery criterion. After online training in modeling and expanding language she demonstrated 58 correct uses of the modeling and expanding language strategy at 97% treatment fidelity. After in-vivo training and ongoing feedback Anna more than doubled her correct uses to 131-157 instances at 96-99% treatment fidelity in the next 3 sessions. After online training in the communicative temptation strategies, Anna did not use any communicative temptation strategies, but after in-vivo training and one feedback email she demonstrated 2 correct uses of communicative temptation strategies with 40% treatment fidelity. With ongoing feedback she consistently demonstrated 9-13 instances of communicative temptation strategies at 90-93% treatment fidelity for the next three sessions.

Anna completed generalization in two different settings. Imitation and communicative temptations generalization took place during a snack time in the dining room, while modeling and expanding language generalization occurred at a nearby playground. Anna demonstrated her highest use of target strategies during the generalization probes. Anna demonstrated 107 correct uses of the imitation strategy at 98% treatment fidelity during the imitation probe, 173 correct uses of the modeling and expanding language strategy at 85% treatment fidelity during the modeling and expanding language generalization probe, and 24 correct uses of the communicative temptation strategy at 92% treatment fidelity during the communicative temptations generalization probe.

Anna maintained a high frequency of the imitation strategy throughout maintenance. During the modeling and expanding language phase she demonstrated 15-43 correct uses per session of the imitation strategy at 60-90% treatment fidelity. During the communicative temptations phase she used the imitation strategy less often with 6-22 correct uses per session but maintained a high level (86-100%) of treatment fidelity. She increased imitation strategy use to 49 correct during the communicative temptations generalization probe with 100% treatment fidelity. In the maintenance probes Anna continued to use the imitation strategy above criterion level (17-47) with the exception of one day when she only used the imitation strategy twice. Her treatment fidelity of the imitation strategy remained high during the maintenance probes at 94-100%. Anna also maintained a high frequency of the modeling and expanding language strategy during the communicative temptations phase demonstrating 90-121 correct uses with 87-94% treatment fidelity. During the maintenance probes her performance of the modeling and expanding language strategy varied with 30-92 correct uses and 48-100% treatment fidelity per session. Anna's demonstration of the communicative temptation strategies during the maintenance probes was highly variable, ranging from 0-8 correct uses with 0-100% treatment fidelity per session. One reason for Anna's variability in maintenance is that two sessions were less than 10 minutes; maintenance probe 2 was only 5:50 minutes and maintenance probe 5 was only 8:14 minutes.

Anna substantially decreased her use of questions and demands down to 37 on the first day of training and maintained an even lower level of use at 0-25 per session for the entire intervention, with only two days above 10 and nine days of 0-2. She continued to use questions and demands at a low level into the maintenance probes with four of the five days at 0-5 and one day at 29.

Overall Anna responded well to in-vivo training and ongoing feedback. Like Daniel she showed a slight improvement after the online modules, but a significant improvement in level with little variability after in-vivo training and ongoing feedback. Anna took four days to reach criterion for the imitation strategy, four days to reach criterion for the modeling and expanding language strategy, and five days to reach criterion for the communicative temptation strategies. She actually increased her use of all three sets of strategies in the generalization probes. Anna maintained use of all three sets of strategies beyond the phase of intervention and into maintenance although with more variability. She demonstrated a decreasing trend in the modeling and expanding language strategy. She also substantially reduced her number of questions and demands and continued to use consistently low levels even during maintenance.

Figure 4 Anna's frequency of social communication strategy use

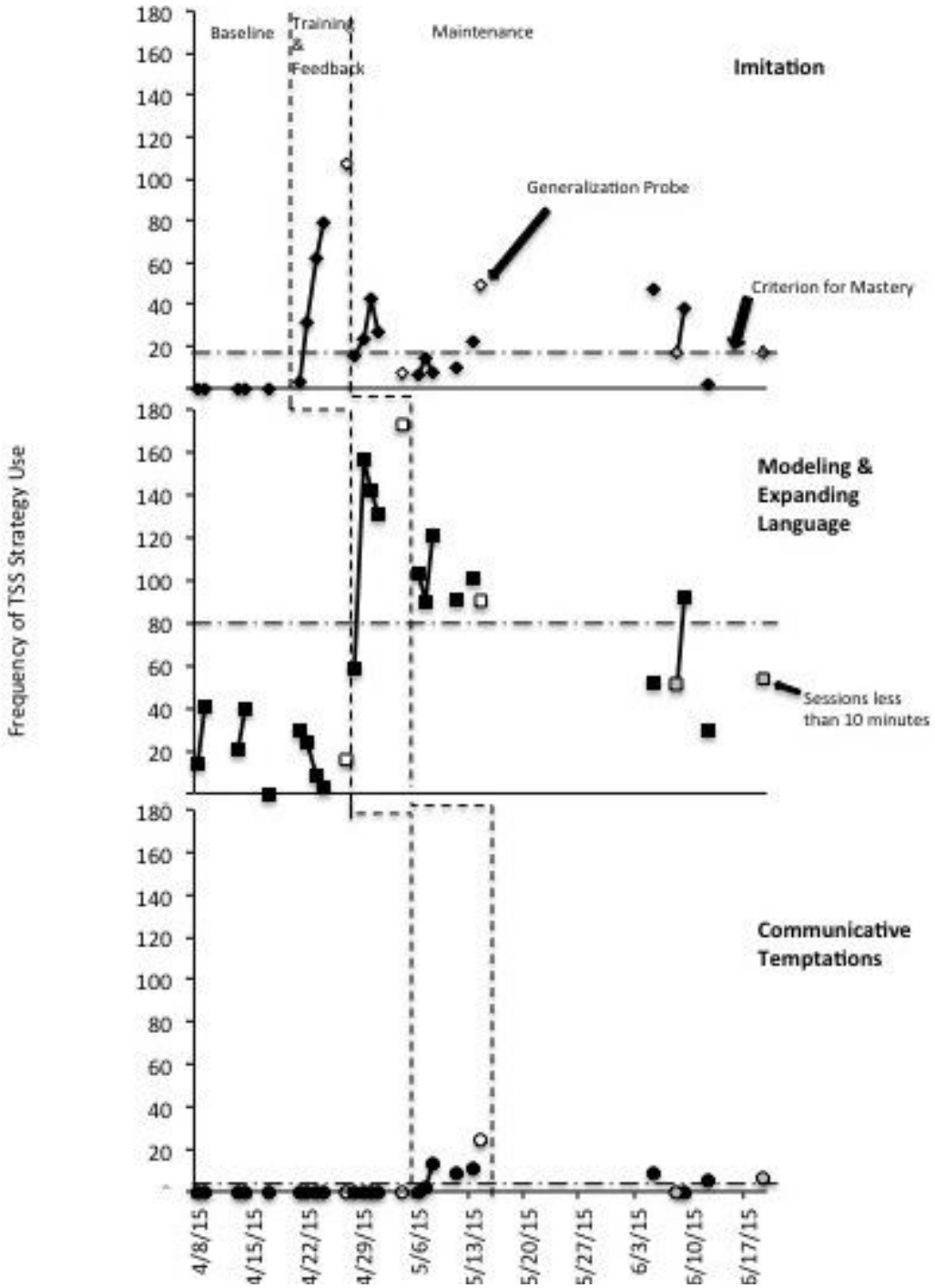


Figure 5 Anna's treatment fidelity as percent correct use of strategies

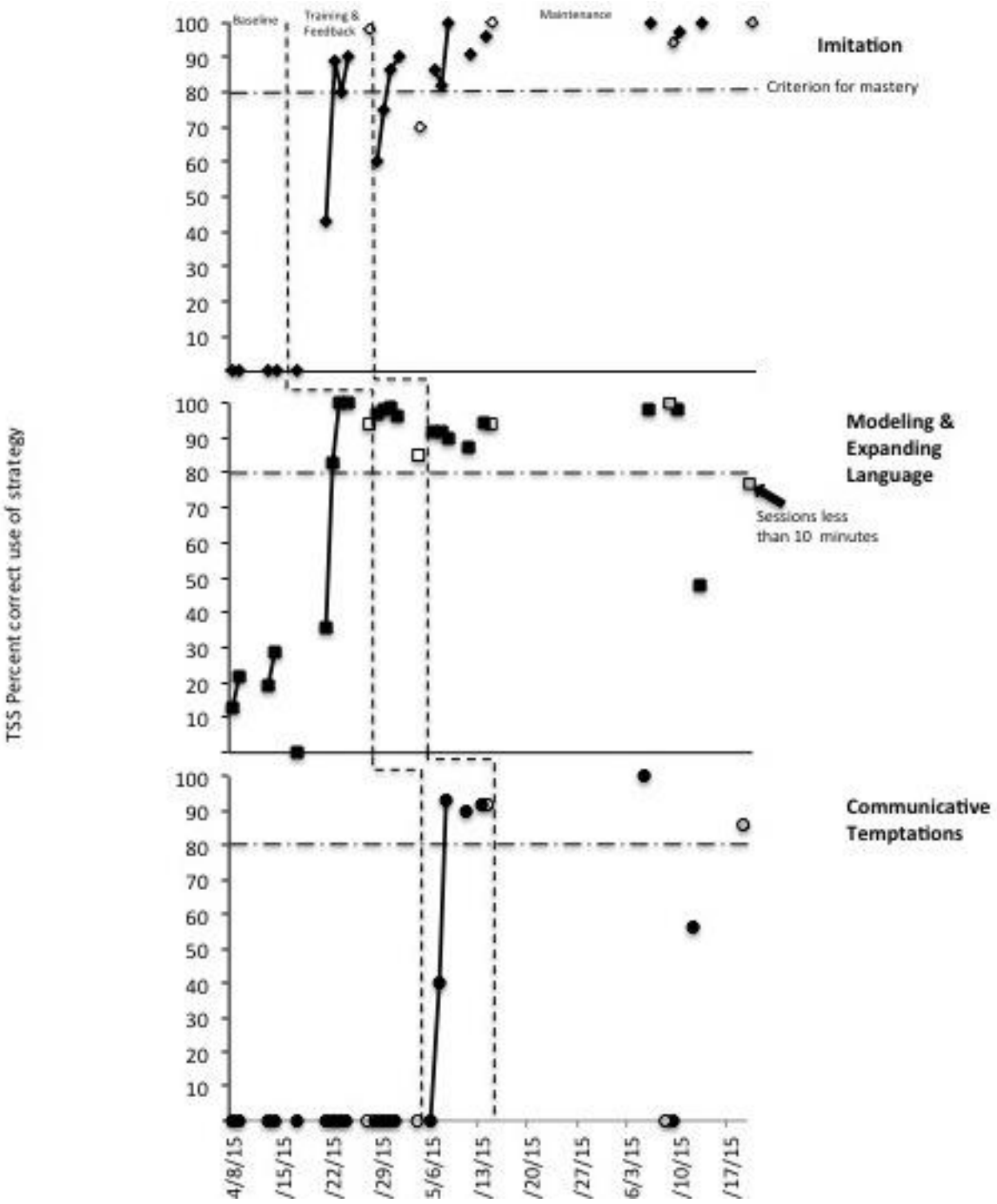
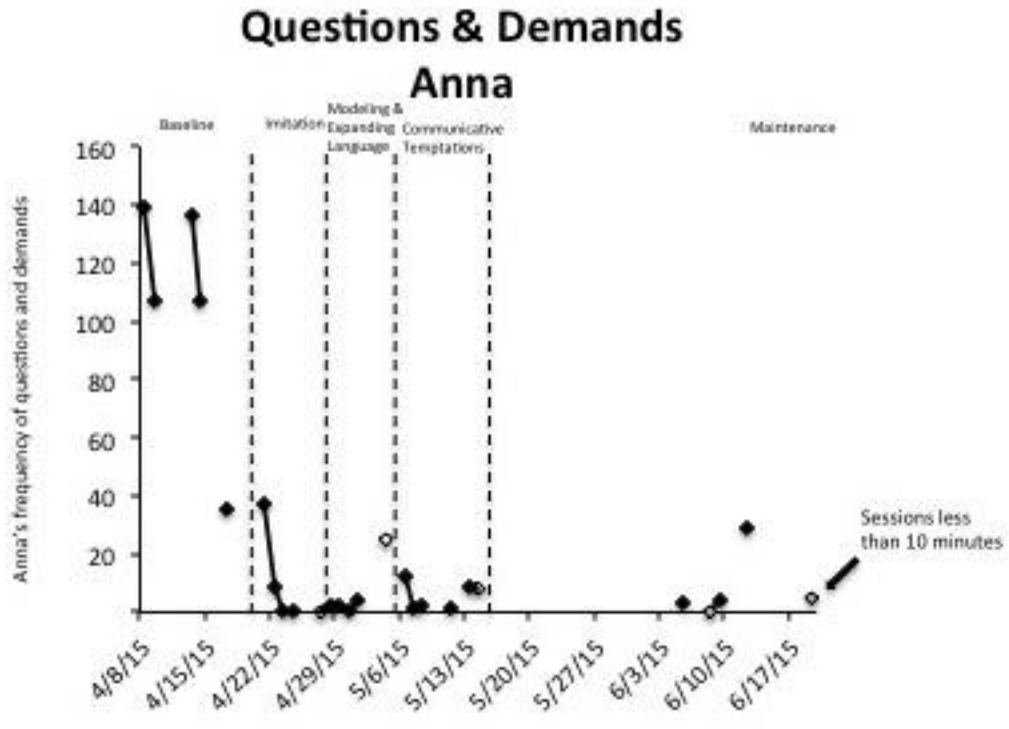


Figure 6 Anna's frequency of questions and demands



4.1.3 Participant 3 Elizabeth

Figure 7 illustrates Elizabeth's correct use of the social communication strategies before, during, and after training. Figure 8 illustrates Elizabeth's treatment fidelity as percent correct uses. Figure 9 represents Elizabeth's use of questions and demands. Elizabeth did not use any imitation or communicative temptation strategies during baseline. She used the modeling and expanding language strategy correctly 2-11 times on nine days during initial baseline with 19-50% treatment fidelity. She also had a high frequency of questions and demands in baseline with 42-85 instances during baseline sessions. After online training, Elizabeth used the imitation

strategy correctly once at 25% treatment fidelity. Similar to Daniel and Anna, she jumped up to 36-71 correct uses at 92-100% treatment fidelity after in-vivo training and ongoing feedback. During the imitation phase Elizabeth increased her use of the modeling and expanding language strategy with 21-37 correct uses at 37-78% treatment fidelity. After the online training module for the modeling and expanding language strategy she increased her use slightly to 35 correct at 81% treatment fidelity. Elizabeth made a substantial jump after in-vivo training and ongoing feedback, more than tripling her modeling and expanding language strategy use to 120-143 correct at 93-100% treatment fidelity. After the online module training she failed to use any communicative temptation strategies. She used the communicative temptation strategies at a high level after in-vivo training and ongoing feedback with 23-37 correct at 94-100% treatment fidelity for the next three sessions. She came to criterion in the communicative temptation strategies after only four sessions.

Elizabeth completed a generalization probe for the imitation phase during a snack time at the kitchen table, and a generalization probe for modeling and expanding language and the communicative temptation phases at the local playground. She demonstrated her highest use of the imitation strategy during the imitation generalization probe with 89 correct at 95% treatment fidelity. She also maintained a high level of the modeling and expanding language strategy use during the modeling and expanding language generalization probe with 96 correct at 98% treatment fidelity. She continued to meet criterion by demonstrating 5 correct uses of the communicative temptation strategy at 100% treatment fidelity during the generalization probe for that strategy.

Elizabeth maintained variable but above criterion imitation strategy use during the modeling and expanding language phase and the communicative temptations phase. She had her

highest level of imitation during the modeling and expanding language phase (111 at 96% treatment fidelity) and one day below criterion use during the communicative temptations phase (10 at 77% treatment fidelity). Her imitation strategy use fell below criterion during the maintenance probes (11-14) although her treatment fidelity was high (100%). Elizabeth also continued to use the modeling and expanding language strategy at a high frequency during the communicative temptations phase and maintenance probes with 100-130 correct at 91-100% treatment fidelity. One exception was during the communicative temptations generalization probe when she only demonstrated 59 occurrences of the modeling and expanding language strategy. Elizabeth maintained a high level of the communicative temptation strategy use during the maintenance probes with 16-21 occurrences per sessions at 95-100% treatment fidelity.

Elizabeth substantially decreased her questions and demands with in-vivo training and feedback. Although she continued a high frequency of 54 questions or demands after online imitation training, on all subsequent days during intervention she dropped to 2-14 questions or demands, and used no questions or demands by the end of the intervention. During the maintenance probes she continued to use only 1-5 questions or demands for each session.

Overall Elizabeth consistently increased her strategy use with intervention and decreased her questions and demands. She showed little change after the online modules but a marked difference after in-vivo training and ongoing feedback. Elizabeth met criterion for imitation strategy use after four days, modeling and expanding language strategy use after four days, and communicative temptation strategy use after four days. She maintained or increased her use of the strategies during the generalization probes. Elizabeth maintained all three sets of strategies above criterion beyond the phase of intervention and into maintenance, although she showed a downward trend in imitation over time. She also substantially reduced her number of questions

and demands during intervention and had stable low levels of questions and demands in maintenance.

Figure 7 Elizabeth's frequency of social communication strategy use

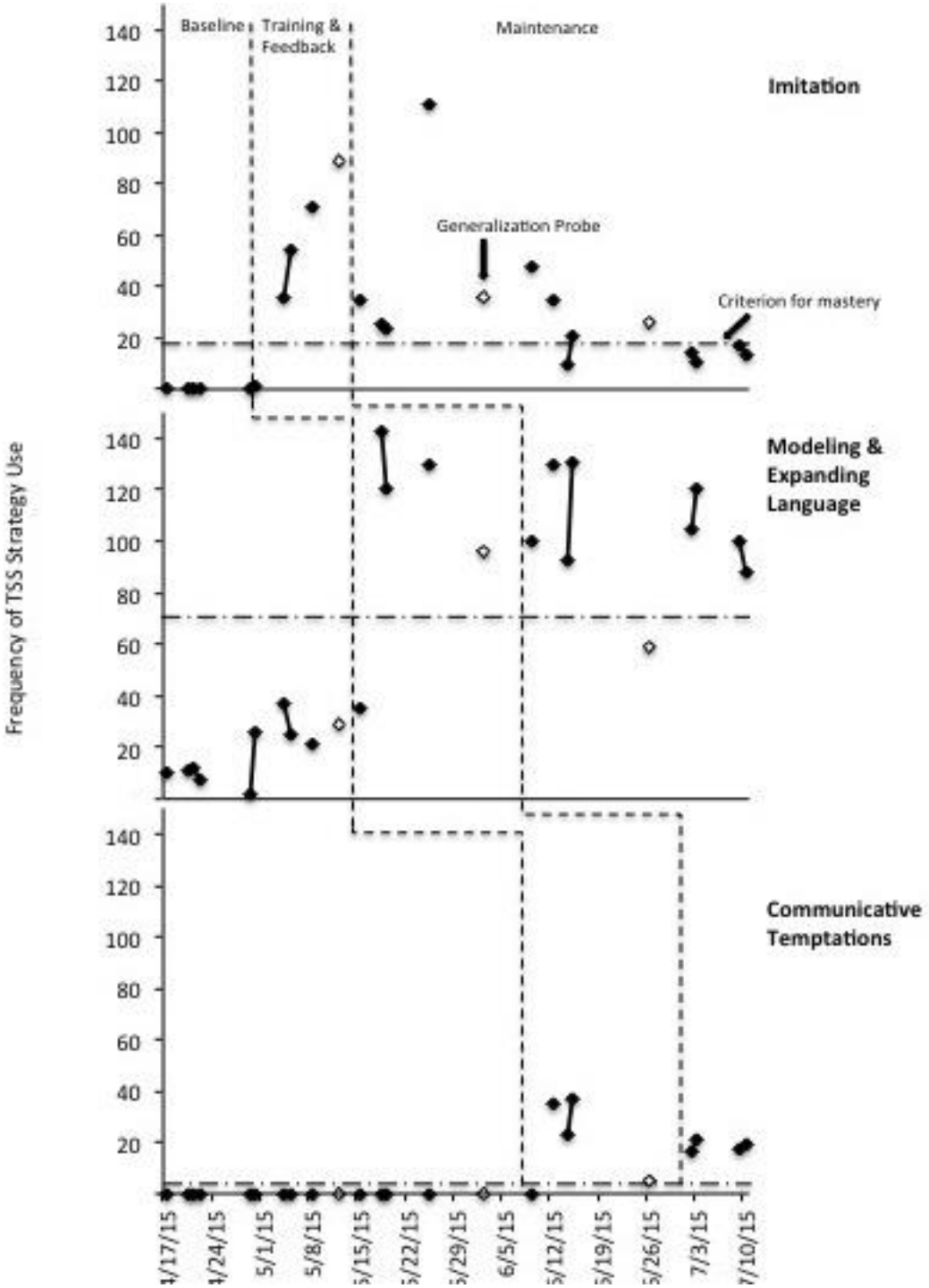


Figure 8 Elizabeth's treatment fidelity as percent correct use of strategies

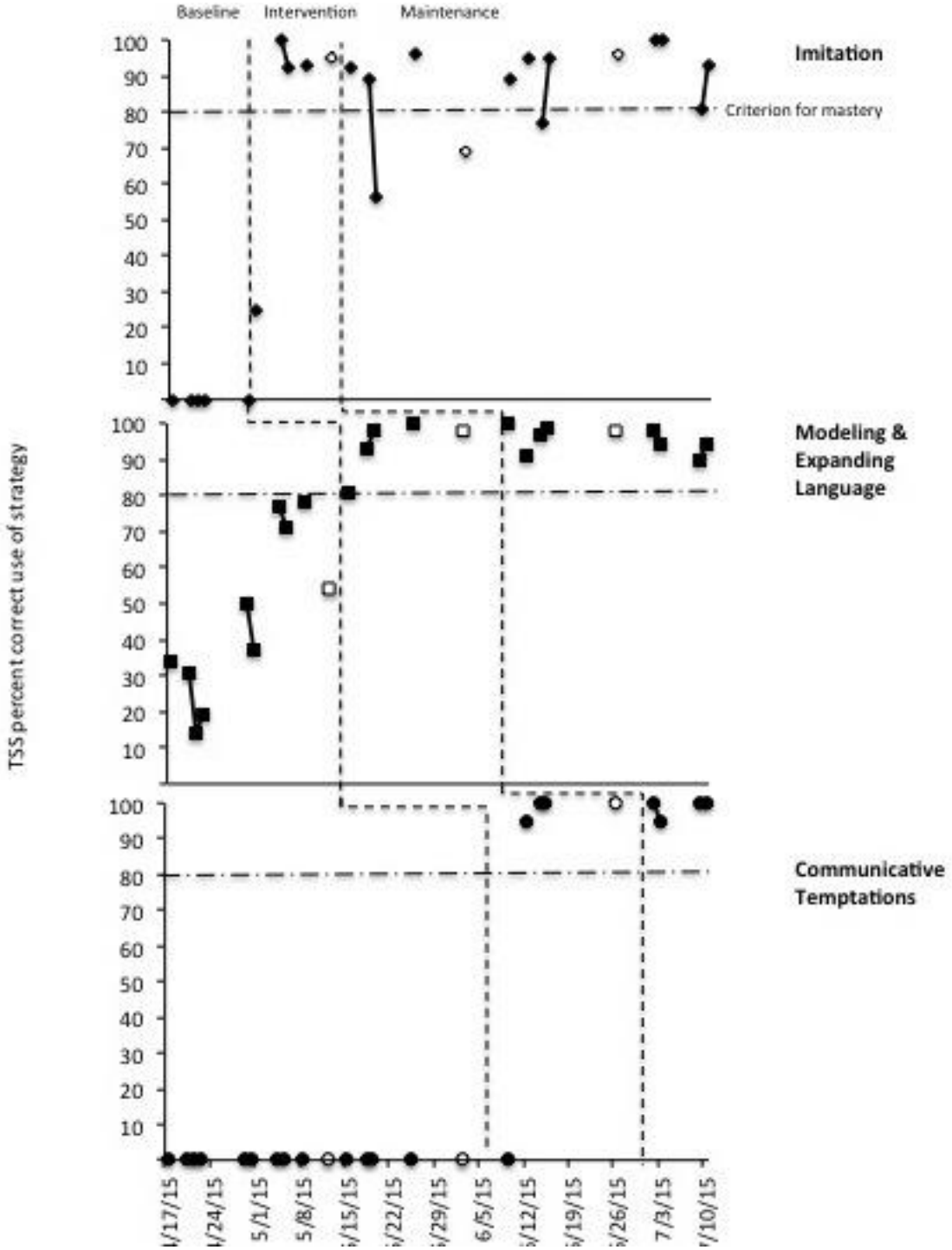
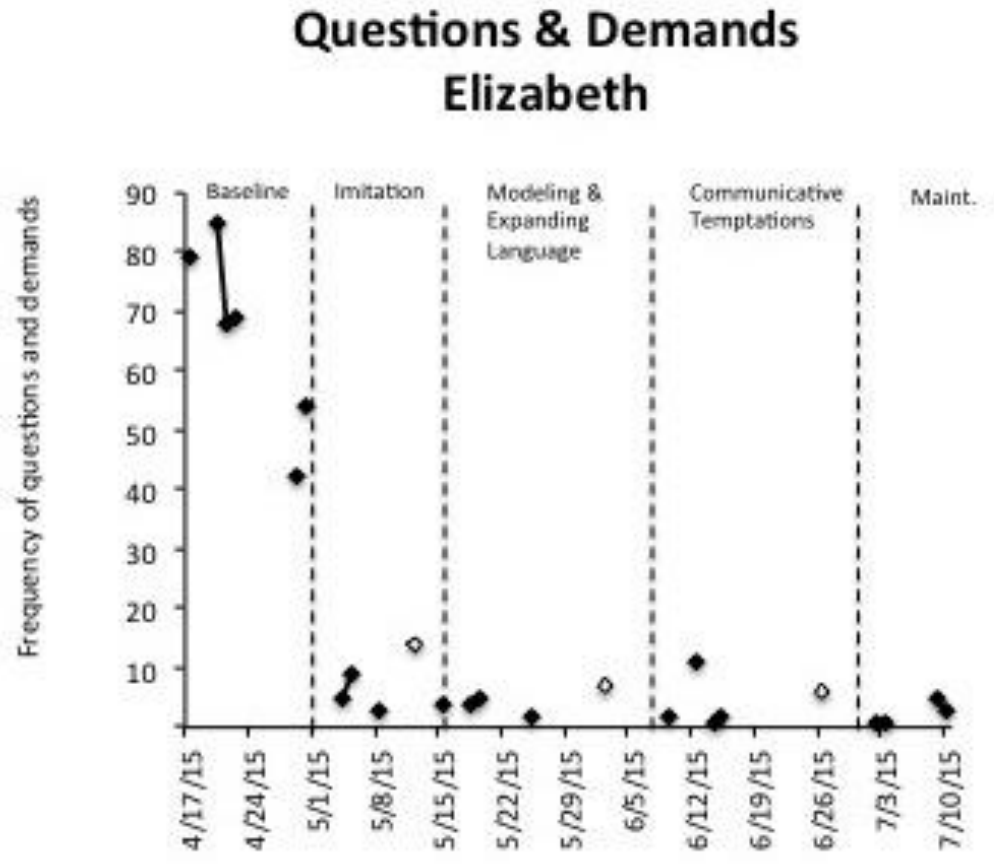


Figure 9 Elizabeth's frequency of questions and demands



4.1.4 Interobserver Agreement (IOA)

Interobserver agreement was collected for 25% of sessions for Daniel, 31% of sessions for Anna, and 27% of sessions for Elizabeth. At least one session from every phase was included. The IOA was scored point-to-point meaning each instance of a strategy was compared for agreement. The mean agreement for Daniel was 93% (range 79-100%) for the target strategy phase (and all strategies in baseline and maintenance). The mean agreement for questions and demands for Daniel was 91% (range 79-100%) and for child spontaneous communication for

Ravi was 92% (range 83-100%). The mean agreement for Anna was 91% (range 63-100%) for the target strategy phase (and all strategies in baseline and maintenance). The mean agreement for questions and demands for Anna was 96% (range 87-100%) and 100% for child spontaneous communication. The mean agreement for Elizabeth was 94% (range 70-100%) for the target strategy phase (and all phases in baseline and maintenance). The mean agreement for questions and demands for Elizabeth was 97% (range 82-100%) and 93% (range 76-100%) for child spontaneous communication.

4.1.5 Implementation Fidelity

100% of the training sessions were coded for implementation, or training fidelity. A graduate assistant was also copied on all feedback texts or emails sent to the participants. Implementation fidelity for training Daniel, Anna Elizabeth was 95-100% for all training sessions.

4.1.6 Summary of TSS behaviors

All three TSS were able to accurately demonstrate the strategies taught. Once the TSS learned a strategy they used the strategy consistently during training. Although variability increased, they also maintained a higher level of strategy use than during baseline after intervention ended. All TSS demonstrated a downward trend in at least one strategy during maintenance probes, but maintained high treatment fidelity. They increased their imitation of the child's movements and vocalizations. They only used language at or one level above the child's level, which means for these children the TSS used single words to describe or label activities.

They used motivating objects or activities in communicative temptation strategies to evoke requests from the child. In addition to increasing their use of the strategies, the TSS dramatically decreased their use of questions and demands during play. The TSS also maintained low levels of questions and demands throughout maintenance.

The TSS had varying levels of success in continuing the strategies with fidelity after reaching criterion for a training phase. Eighty percent treatment fidelity means that 8 out of 10 times that they attempted the strategy they successfully completed all steps. While two of three TSS maintained treatment fidelity of 85% or greater for the modeling and expanding language strategy after reaching criteria, they were not as consistent with imitation or communicative temptation strategies. Anna and Elizabeth maintained at least 80% treatment fidelity for the imitation strategy during the majority of their sessions after the imitation phase, but Daniel had highly variable (0-100%) treatment fidelity for the imitation strategy after his imitation phase. Daniel also had variable results maintaining treatment fidelity for the communicative temptation strategy (0-100%) after reaching criterion. Anna's treatment fidelity fell during maintenance probes for both the modeling and expanding language strategy (48-100%) and the communicative temptation strategy (0-100%). Elizabeth maintained all sessions at greater than 90% treatment fidelity after reaching criterion for the modeling and expanding language and the communicative temptation strategies. Overall the TSS used the strategies more often and one of the TSS were successfully using all three strategies correctly a majority of the time, while the two remaining TSS used at least one of the strategies correctly with consistency.

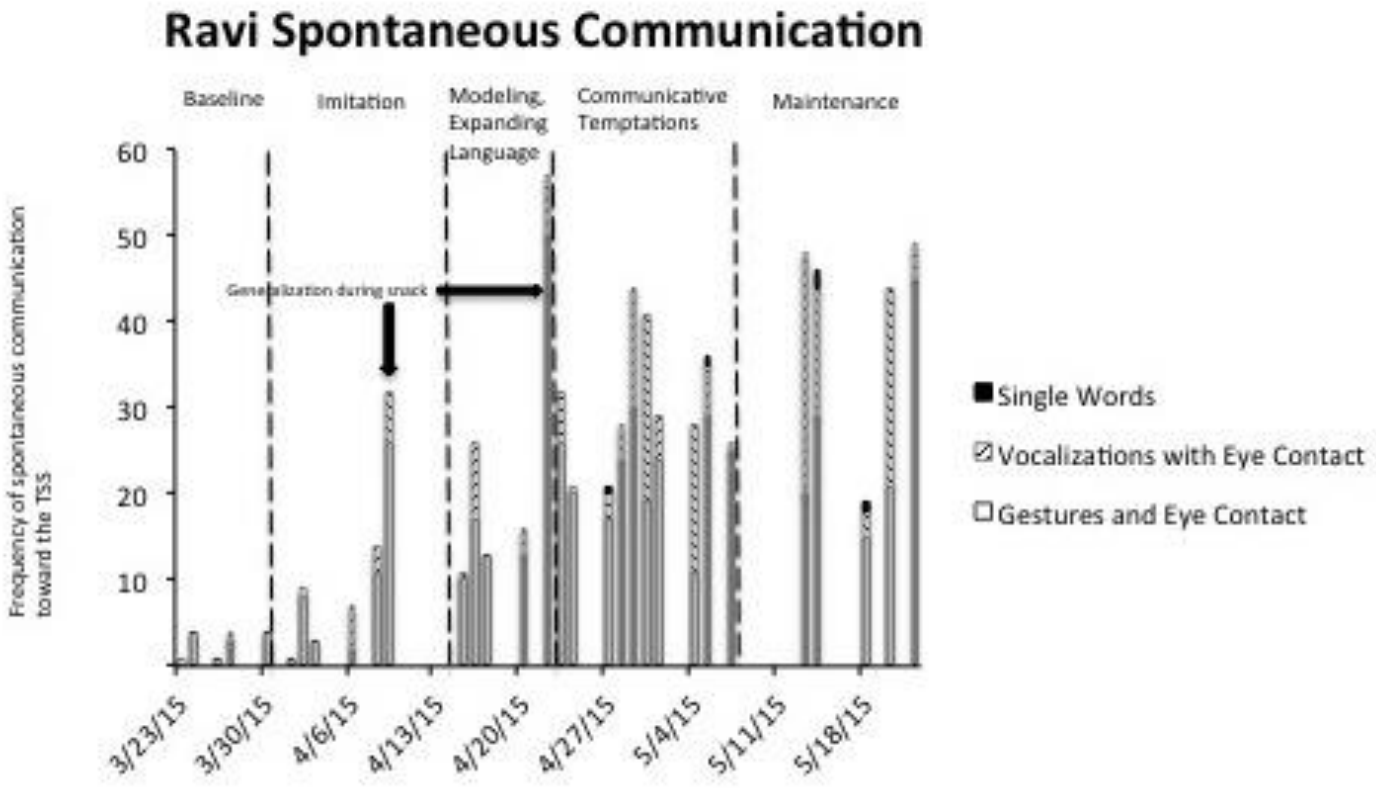
4.2 CHILD SPONTANEOUS COMMUNICATION

All three children had low rates of spontaneous communication prior to the beginning of intervention. Ravi, Beni and Chloe all scored very low on the communication composite of the CSBS (Prizant & Wetherby, 2002) and the expressive language section of the MSEL (Mullen, 1995). Child spontaneous communication during the 10-minute play sessions is shown in Figures 10, 11, and 12. The graphs depict not only the overall frequency of spontaneous communication directed toward the TSS, but also the type of communication used by the child. Each bar in the graph represents one session of data. The bar is divided into the three types of communication used by the children during the intervention: intentional eye contact and gestures directed toward the TSS, vocalizations or word approximations, and single words. All three children's communication development would be considered preintentional or word approximation (Ingersoll & Dvortcsak, 2010).

Ravi (Figure 10) worked with Daniel and had 0-4 instances of spontaneous communication during baseline. His communication increased to 1-14 instances when Daniel entered imitation training and jumped to 32 during the imitation generalization probe. Ravi's communication continued to increase to 12-26 instances per session when Daniel entered the modeling and expanding language training, and spiked again at 57 instances during the modeling and expanding language generalization probe. He had an even higher level of spontaneous communication when Daniel entered the communicative temptations phase, with levels of 21-44 instances of communication per session including 31 instances during the communicative temptations generalization probe. Ravi continued to maintain higher levels of spontaneous communication during maintenance with four of the five days at 44 or above. Ravi demonstrated a clear upward trend in spontaneous communication throughout the intervention.

Ravi's type of communication changed throughout the intervention. During baseline, imitation and modeling and expanding language Ravi used mainly eye contact or gestures to communicate with Daniel. He continued to increase his use of eye contact and gestures throughout the intervention. However during the communicative temptations phase Ravi began to use vocalizations more and more toward Daniel and this trend continued into the maintenance probes. Ravi spoke one or two single words on four different days in the final phase and maintenance. It is clear that Ravi not only increased his communication during and after intervention but he moved into more complex communication as well.

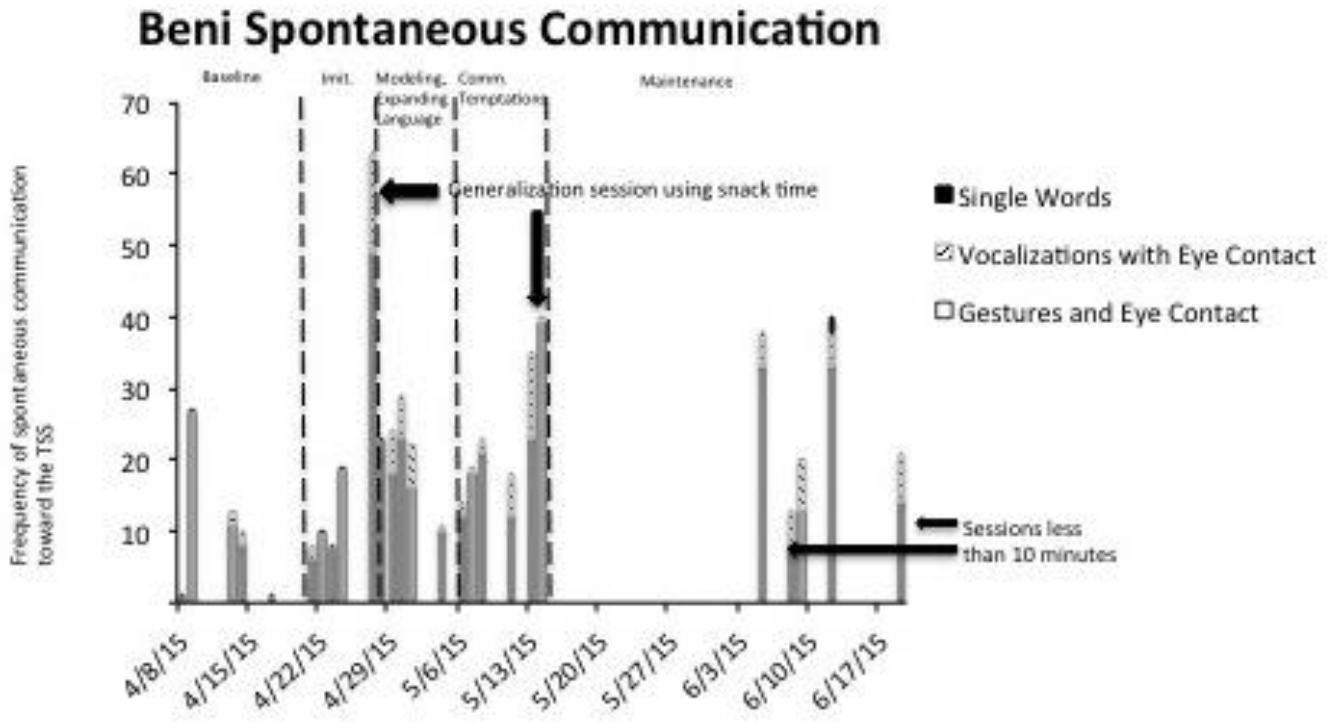
Figure 10 Ravi spontaneous communication



Beni (Figure 11) also increased his spontaneous communication during the sessions with Anna. He communicated 1-13 times per session for all baseline days except on baseline day 2 when he communicated 27 times. After Anna entered the imitation phase Beni increased his communicative acts to 8-19 times per session with a spike of 63 during the imitation generalization probe. He continued an upward trend ranging from 22-29 communicative acts per session when Anna entered the modeling and expanding language phase, with the exception of a drop to 11 communications during the modeling and expanding language generalization probe at the playground. For the first four days of Anna's communicative temptations phase, Beni continued a similar level of 14-23 communications per session, but on day five he jumped to 35 communications and continued that level with 40 communications during the Communicative Temptations generalization probe. Beni continued to communicate between 13-40 times during maintenance. Although Beni's trend is not as clear as Ravi's, he consistently communicated more frequently as the intervention continued.

Beni also changed the nature of his communication throughout the intervention. During baseline he used eye contact or gestures almost exclusively. His shift to more vocalizations occurred during Anna's modeling and expanding language phase. His number of vocalizations continued to increase during communicative temptations and maintenance, and he spoke a word to the TSS for the first time during the fourth maintenance probe. His vocalizations also moved from purely vowel sounds (ahhhh) to include consonants (dadada). Beni increased his communicative complexity during the intervention.

Figure 11 Beni spontaneous communication

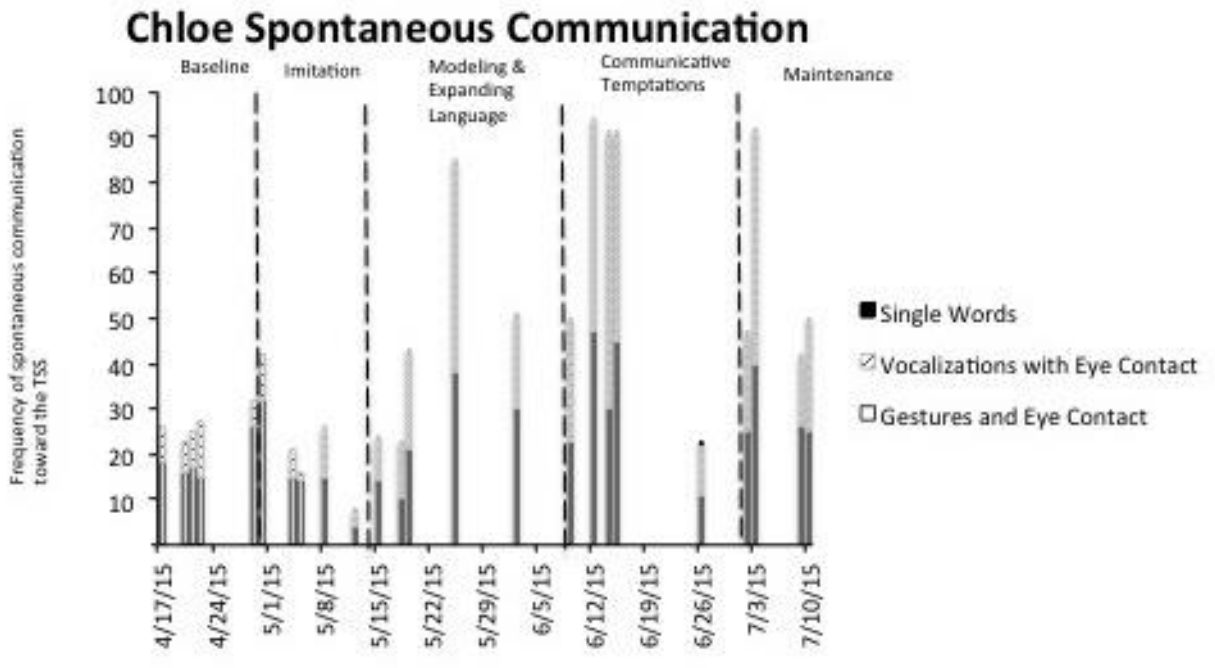


Chloe (Figure 12), who worked with Elizabeth, had an increasing level of communication although more variable, partly due to a prolonged time period in the middle of the intervention when she was sick. During baseline Chloe communicated 23-32 times per session, and this level stayed the same when Elizabeth entered the imitation phase ranging from 16-42 instances of communication per session. During the imitation generalization probe Chloe's communication was at the low level of 9 instances. When Elizabeth entered the modeling and expanding language phase, Chloe's communication frequency rose to 23-85 instances per session including 51 instances during the modeling and expanding language generalization probe. When Elizabeth

entered the communicative temptation phase Chloe's communication frequency increased to 50-94 communications per session with three of the four days over 90 instances. Chloe demonstrated only 23 communications during the communicative temptations generalization probe at the playground, but her communication returned to high levels during maintenance (47-92). Although Chloe demonstrated no increase in communication behaviors during Elizabeth's imitation phase, her data indicates an upward trend in the remainder of the intervention and maintenance. By the end of the study she was emitting approximately triple the amount of communication behaviors that she used during baseline.

Chloe used vocalizations every session from the beginning of the intervention. The family reported that she did use certain words occasionally, but not often and the TSS had never heard her say a word. Her vocalizations often took the form of a word approximation with consonants and vowels blended. She did increase her use of vocalizations substantially beginning in modeling and expanding language until the end of the study. She spoke one word to the TSS during the communicative temptations generalization probe (tickle). Chloe increased her complexity of speech to the TSS as well as the frequency.

Figure 12 Chloe spontaneous communication



Correlations between TSS behaviors and child spontaneous communication computed as Pearson r are shown in Table 6. Significant correlations occurred between more than half of the TSS behaviors and child communication. There was significant correlation between three of Daniel's measured behaviors and Ravi's spontaneous communication. A significant inverse correlation occurred between Daniel's questions and demands and Ravi's communication, indicating that as Daniel decreased his questions and demands Ravi increased his spontaneous communication. The strongest correlation occurred between Elizabeth's modeling and expanding language and Chloe's communication. Chloe's language was also significantly correlated with

Elizabeth's use of the communicative temptations. Beni's communication was significantly correlated with Anna's use of imitation and communicative temptations. TSS use of communicative temptations was the only strategy that was found to have a significant correlation with all three children's spontaneous communication.

Table 7 Pearson r correlation of each TSS behavior to child spontaneous communication

Child Spont. Comm.	Imitation	Model & Expand	Comm. Tempt	Q&D
Ravi (with Daniel)	.298	.752**	.448*	-.609**
Beni (with Anna)	.563**	.124	.407*	-.370
Chloe (with Elizabeth)	.029	.711**	.787**	-.375

*Note: Significant, **p<.01, *p<.05*

The CSBS results changed noticeably for Beni and Chloe from the pretest before baseline to the posttest at the last generalization session (Table 3). Beni's biggest gain was in the social domain. During pretest he only used two gestures (pushes/pulls away, reaches) and in posttest he used five different gestures: pushes/pulls away, reaches, gives, waves, and points. Although Beni did not follow adult point and gaze in pretest he followed the adult point and gaze twice in posttest. His rate of communicating increased from 1-3 occurrences during each sampling opportunity in pretest to 3+ occurrences in all sampling opportunities in posttest. In the speech domain Beni used no consonants during pretest but he used a consonant sound during posttest (/m/). During the pretest in the symbolic domain Beni pretended to feed the Elmo doll. During the posttest in the symbolic domain he knew his own name and pretended to drink from a bottle and put the spoon in the bowl. In the social domain Chloe increased her rate of communicating from pretest scores of 0-2 occurrences per sampling opportunity to posttest scores of 2-3+

occurrences per sampling opportunity. Her only gesture in pretest was reaching but in posttest she reached and gave a toy. In the speech domain at pretest, Chloe used consonants during 2 sampling opportunities then at posttest she used consonants during 4 sampling opportunities. She also increased the variety of consonants used; at pretest she used only /m/ and /n/ but at posttest she used /m/, /n/, /b/, /d/, and /g/. In the symbolic domain Chloe demonstrated comprehension of names for people during pretest, identifying daddy and her self. During posttest she added comprehension of names of objects, identifying bottle, spoon, and mouth in addition to her daddy and her self. Ravi's scores varied from pretest to posttest with little overall gain (Table 3). In the social domain he increased the frequency of sharing positive affect from pretest (2 sampling opportunities) to posttest (4 sampling opportunities). He also increased his use of gestures, reaching during pretest but reaching, pushing/pulling away, and giving in posttest. However, Ravi decreased his use of joint attention from 3 three sampling opportunities at pretest to 1 sampling opportunity at posttest. In the speech domain Ravi decreased his use of consonants, using /d/ and /m/ at pretest but using only /m/ in posttest. In the symbolic domain Ravi increased his ability to stack blocks from no blocks at pretest to 2 blocks at posttest. During pretest Ravi pretended to drink with a bottle, stir and eat with a spoon, and feed the stuffed animal, but at posttest he decreased symbolic use to pretending to drink with a bottle.

4.3 SOCIAL VALIDITY

Both the paraprofessional and the parent of the child were asked to fill out a social validity survey after the intervention had ended. The surveys contained a mix of Likert questions and open-ended questions.

4.3.1 TSS social validity

All three TSS reported that they felt the review and modeling by the researcher, skill practice and verbal feedback were extremely or fairly helpful. One TSS felt the online module, and email and video feedback were a little helpful, and the manual was not helpful. The second and third TSS felt those same components were extremely helpful, with the exception of the manual that was fairly helpful. Overall two TSS felt the intervention was extremely helpful and one felt it was fairly helpful.

Daniel reported that he found that breaking old habits was the best part of the intervention. He was happy that he was stopping and thinking about what he was doing. Anna reported that she has gained a new respect for the child's timing, ability and wishes. She felt it helped her to listen to his voice better. Elizabeth felt that having the researcher come to the home, see her demonstrate the strategies and be able to ask questions was the most helpful. Daniel wished he had received more training at the beginning of the intervention. Elizabeth wished that an alternative generalization session could be planned since Chloe had a feeding intervention during snack and the playground was not a preferred activity for her. All three TSS reported that they use the strategies during every session now. Daniel was the only TSS who did not train the parent to use the strategies. Anna taught the mother to use imitation, eye contact, waiting for a response and body positioning face to face with the child. Elizabeth explained the strategies and modeled them for the father during sessions. All three TSS recommended the intervention for other staff members especially when working with nonverbal children who are new to treatment.

4.3.2 Parent Social Validity

Ravi's mother filled out the survey and reported that she somewhat agreed that: the PI interacted well with Ravi, Ravi is communicating more, she would like to learn more about the intervention, and she would recommend this intervention to other paraprofessionals. She was neutral about the TSS interacting better with Ravi after the intervention and her satisfaction with the outcome of the intervention. In contrast, Beni's mother and Chloe's father strongly agreed that the PI interacted well and the TSS interacted better with the child after the intervention. They strongly agreed that their child is communicating better, and they were strongly satisfied with the intervention. They strongly recommended the intervention for other paraprofessionals.

Ravi's mother felt that Ravi is more attached to Daniel now, and felt the verbal communication and behavioral changes were the most helpful piece of the intervention. She states that Daniel taught her to use the trampoline with Ravi to eliminate inappropriate climbing activities, but this answer indicates that she did not know the components of the intervention or the goals. She wanted to receive more training about his verbal communication and social interaction with better behavioral changes. Chloe's father felt that Elizabeth is able to get Chloe's attention easier now, and that Elizabeth taught him to imitate Chloe to get her attention. He reported that he now imitates her movements and vocalizations to gain her attention and he does this throughout the day. Beni's mother stated that Beni has developed better eye contact and observing skills during the intervention sessions and even when they are not using the strategies. She felt that the TSS imitation of Beni and following the child's lead were the most helpful pieces of the intervention. She reported that Anna had taught her to imitate Beni's actions and sounds, make eye contact, stay in front of him, and expand his sounds to single words. She says

that she uses the strategies all day through all her activities with her son. Clearly Anna and Elizabeth took time to teach Beni's mother and Chloe's father and transfer the skills.

4.3.3 Summary of Social validity

Based on the responses to the surveys, both the TSS and the parents felt the intervention was valuable, and addressed important goals, although one parent was unaware of the scope of the intervention. The TSS felt the in-person pieces of the training including discussion, modeling, skill practice and verbal feedback were the most helpful, although two of the TSS also felt the email and video feedback and the online modules were helpful. The manual appeared to be the least helpful piece of the intervention for the TSS, most likely because it was not the primary source of information during training. Both the parents and the TSS recommend that training be used for other TSS at the agency, and all three parents requested more training.

5.0 DISCUSSION

This study examined a combination package of online teaching modules, in-vivo training sessions, and feedback for teaching home-based TSS. The goal was to increase the frequency and accuracy of TSS delivery of a combination social communication intervention for young children with ASD during service delivery in the home. The research also examined child spontaneous communication change when the paraprofessionals implemented the intervention. The three studies demonstrated clear experimental effect for the paraprofessionals. The combination of the initial online training, the in-vivo training session, and the ongoing email and video feedback increased the paraprofessional accuracy and frequency of the strategies during the play sessions and generalization probes. They continued to use the strategies in maintenance, especially modeling and expanding language. All three children increased their use of spontaneous communication and remarkably their vocalizations toward the TSS. The study furthers the literature base in several important ways. First it contributes to the growing body of literature on teaching adults to implement social communication interventions for children with ASD. Second it adds evidence of a behavioral skills training package to adult training methods literature. Third it extends the current avenue of thought on measurement for training adults to implement interventions, and finally it is the first to explore the correlation between adult questions and demands with child social communication.

5.1 SOCIAL COMMUNICATION INTERVENTIONS

This study adds to the growing body of effectiveness literature for the Ingersoll and Dvortcsak (2010) intervention that currently includes parents and professionals (Ingersoll & Wainer, 2013; Ingersoll & Wainer, 2013). In the initial efficacy single subject study Ingersoll and Wainer (2013) demonstrated that eight parents could learn the strategies with weekly or twice weekly sessions in a twelve-week teaching format. Five of the eight children increased spontaneous communication during the study. Using a group research design, Ingersoll and Wainer (2013) examined parent treatment fidelity of the full intervention package and found that parents significantly increased their treatment fidelity of every major portion of the intervention. This study enlarges the breadth of evidence by studying paraprofessional implementation of the responsive and interactive portions of the intervention in a single subject design demonstrating a positive experimental effect for frequency and treatment fidelity, with strong correlations to child spontaneous communication for two of the three strategies, modeling and expanding language and the communicative temptations.

This study also contributes to the larger body of evidence for training adults in different capacities to implement naturalistic social communication interventions for children with ASD. Most researchers have examined training paraprofessionals in school settings to use naturalistic behavioral interventions (Feldman & Matos, 2012; Hall et al., 2010), or teaching parents to use similar strategies in the home (Mahoney & Perales, 2005; Vernon et al., 2012) with positive outcomes. This study is the first to focus on teaching paraprofessionals social communication strategies in a home setting. Although there are two randomized controlled trials for combination interventions (Dawson & Rogers, 2010; Ingersoll & Wainer, 2012) only one targeted the ability of the professional or parent to learn and apply the intervention. Two single subject studies

examined the combination approaches for parents with equally promising results. Ingersoll and Wainer (2013) taught eight parents the strategies in project ImPACT while Vismara and colleagues (2012) trained nine parents on ESDM and both found that all parents increased their treatment fidelity during intervention. This research demonstrates that paraprofessionals can learn to accurately and frequently implement social communication strategies, adding to the scant single subject literature base on training adults working with children with ASD in combination social communication interventions.

5.2 BEHAVIORAL SKILLS TRAINING PACKAGE

Training packages has been shown to be significantly more effective than single methods alone (Lang & Fox, 2003; van Oorsouw et al., 2009). This study implemented a behavioral skills training package that encompassed all the components found to be effective in teaching adults (van Oorsouw et al., 2009; Ward-Horner et al., 2012). This included an initial information presentation, modeling of the desired behavior, time for practice with immediate feedback and ongoing feedback as the TSS began implementing the strategy.

Feedback, which has been shown in the literature to a particularly effective aspect of adult training, was an integral part of the training package in this study. In a meta-analysis of 55 studies, van Oorsouw and colleagues (2009) examined aspects of staff training and found that training with feedback was more effective than training without feedback. Sanetti and colleagues (2007) demonstrated that graphical and verbal feedback together was more effective than verbal feedback alone for elementary school teachers implementing a behavior support plan. Earlier studies teaching paraprofessionals to implement social communication strategies all provided a

mix of verbal and written or video feedback (Dyer & Karp, 2013; Feldman & Matos, 2012; Gianoumis et al., 2012; Hall et al., 2010; Madzharova et al., 2013; Robinson, 2011; Seiverling et al., 2010; Weinkauf et al., 2011).

In this study, feedback was provided verbally following TSS performance during in-vivo training and in written form accompanied by video segments following the daily sessions. The TSS indicated that they strongly agreed feedback was an effective piece of the intervention, especially the immediate verbal feedback during the in-vivo training. Immediate verbal feedback of the form provided here (i.e., delivering specific praise and corrective feedback) is considered a critical part of the coaching process for transferring the skill to the learner (Trivette et al., 2009). Anna and Elizabeth described the email with accompanying video feedback as extremely helpful and reported that they watched the videos more than once. Video feedback allows the TSS to consider the behavior and review as needed (Brown et al., 2014). At his request, Daniel received the ongoing feedback via text message rather than email. He admitted that he did not watch the videos every day. It is possible that Daniel's sporadic use of the video feedback contributed to his variable communicative temptation performance during intervention. The results indicate that this study adds to the literature demonstrating that a combination of verbal, written and video feedback contributed to a successful training package for paraprofessionals.

This study, like several others focused on social communication or engagement for children with autism (Nefdt et al., 2009; Vismara et al., 2012; Wainer & Ingersoll, 2013), included electronically available didactic material with video models of the strategies being promoted. Two studies (Nefdt et al., 2009; Vismara et al., 2012) created a DVD with written chapters and video models for each chapter, while Wainer and Ingersoll (2013) employed an online site with written modules containing video models, similar to the modules used in this

study. The DVD with written and video information constituted the entire intervention for Nefdt and colleagues (2009). Parents were assessed in play sessions before and after viewing the DVD. While the online modules were the principal intervention, Wainer and Ingersoll provided one in-vivo post intervention training if participants did not come to fidelity within 2 or 3 sessions. Vismara and colleagues (2012) formatted their intervention in a similar manner to this study, requiring the parents to view a chapter on the DVD before each training session with the researcher. Vismara and colleagues reported that all nine parents increased their treatment fidelity of ESDM to between 4 and 5 on a Likert scale (range 1-5) over the twelve weeks with a slight decrease in follow-up. This parallels the results from the current study that demonstrated the TSS increased their frequency and treatment fidelity after the online modules plus the in-vivo training and ongoing feedback but some behaviors did decline in maintenance. Wainer and Ingersoll found that six of nine adults (four professionals and two parents) came to treatment fidelity without the post intervention training. One third of the adults in the study needed additional in-vivo training to master the strategies. In a group design with 27 caregivers, Nefdt and colleagues recorded that the DVD treatment group increased their mean percentage of correct strategy intervals from 16.5% in baseline to 75.35% in intervention with a large standard deviation of 26.61, indicating high variability. This is a higher mean level than the 0-50% treatment fidelity for imitation and communicative temptations strategies in this study after the online module training, but lower than the 79% or greater treatment fidelity for the modeling and expanding language strategy after the online module training. The mean treatment fidelity from Nedft and colleagues is lower than the 80% or greater recorded for this study and for the two remaining studies after full intervention (Vismara et al., 2012; Wainer & Ingersoll, 2013). These results indicate that it did not matter whether the computer-based material was given through a

DVD or an online module but that the addition of in-vivo training was important to achieving higher (>80%) treatment fidelity.

A unique feature of the training model was the inclusion of a targeted mastery level for strategy use. Six of the studies in the literature review also included treatment fidelity criterion of 80-90% or greater over multiple sessions. The remaining study in the literature review (Hall et al., 2010) measured paraprofessional frequency of a single strategy in each intervention (PRT or Incidental teaching) but did not set mastery criterion or measure treatment fidelity. This research extends the concept of mastery criterion further by not only requiring high treatment fidelity levels but also establishing criterion for the frequency of correct implementation of the strategies during a 10-minute play session. The researcher discovered that the paraprofessionals far exceeded these criterion when they began to master each strategy and in some cases leveled out close to criterion in maintenance. In previous literature and in the current study, establishing criterion for mastery appears to promote rapid acquisition of the skill given the few number of sessions that were required for all participants to meet the criterion. Since there is no previous literature discussing appropriate levels of adult responsive behavior in play, this study can contribute to a better understanding of optimal interactive frequencies for adults and young children with ASD.

5.3 MEASUREMENT IN SOCIAL COMMUNICATION RESEARCH

This study established measures that required a two-part criterion to master a strategy. To master a strategy they had to implement it with 100% accuracy at least 80% of the time and they had to increase their use of the strategy to a specified criterion. The two part criterion ensures

both that the adult achieves fluency in implementing the strategy and that the child receives a high percentage dosage of correct uses of the strategy during the session. Traditionally, researchers have measured adult implementation of an intervention for children with ASD as treatment fidelity on a Likert-like scale (1 to 5; Vismara et al., 2012) or percent correct steps performed (Ingersoll & Wainer, 2012; Lawton & Kasari, 2012; Sanetti et al., 2007; Seiverling et al., 2010; Vismara et al., 2012). This may ensure accuracy but does not necessarily ensure fluency or dosage. A few researchers have measured intervention fidelity more directly as was done in the current study. For example, Feldman and Matos (2012) and Robinson (2011) required correct use of the strategy within the interval for the interval to be counted as correct. Vernon et al, (2012) measured parent frequency of strategy use for every session and treatment fidelity for 50% of the sessions. Although this ensures accuracy based on actual measurement rather than ratings, simply counting frequency of correct uses does not necessarily ensure dosage or fluency. The use of the two-part criterion sets a higher standard for adult performance that may contribute to the generalization and maintenance of the strategies as well as child outcomes.

Measurement differed from previous studies for the child dependent measure as well. The roots of spontaneous communication for preverbal children involve engaging with eye contact and joint attention (Aldred et al., 2001). Therefore spontaneous use of eye contact from the child (i.e., not in response to his/her name or some other demand) was counted as spontaneous communication even when not accompanied by a gesture or a vocalization. Kossyvaki and colleagues (2012) developed a table describing levels of child spontaneous communication from pre-symbolic means such as eye contact to symbolic means such as words or signs. The researcher used this same method of classifying spontaneous communication for this study. Child spontaneous communication was displayed as the frequency of each level of

communication adding up to the total number during that session. Research in naturalistic behavioral strategies has often defined child spontaneous communication in terms of vocal communication or PECS only, usually in the form of a request (Gianoumis et al., 2012; Koegel et al., 2003; Mancil et al., 2009; Thomas et al., 2010). Both DSP and naturalistic behavioral studies (Dykstra et al., 2012, Feldman & Matos, 2012) include child engagement or initiations defined by gaining or reciprocating attention and was often measured using eye gaze, gestures, and speech or alternative communication (sign, PECS, AAC). All three children increased their spontaneous eye contact to share attention or accompanied by a gesture to request, and then increased their vocalizations as the intervention progressed. Although the development of language in children with ASD is well documented (Wetherby, 2006), this study adds to the literature in measurement and progression of spontaneous communication in children with ASD.

5.4 DECREASING QUESTIONS AND DEMANDS

One primary teaching point in the first set modules was to decrease the use of questions and demands during play. This component is a robust piece of the intervention, occurring throughout training in all three sets of strategies (Ingersoll & Dvortcsak, 2010). Decreasing questions and demands during a play session gives the child a chance to initiate rather than respond to the adult (Ingersoll & Dvortcsak, 2010). Previous literature on responsive strategies has not fully addressed the decrease of questions and demands during play, instead focusing on increasing the adult description of the activity taking place (Kasari, Freeman, & Paparella, 2006; Mancil, Conroy, & Hayden, 2009) or simplifying adult verbalizations when interacting with a nonverbal child (Aldred et al., 2004; Kossyvaki, Jones, & Guldberg, 2012). All three TSS

substantially decreased their use of questions and demands from baseline to intervention with a continued downward trend. For one participant, Daniel, the decrease in questions and demands moderately correlated with Ravi's increase in spontaneous communication. This research is the first study teaching adults strategies to increase social communication in children with ASD that measured questions and demands as a separate variable. Additional research examining the relation between questions and demands and child spontaneous communication including the addition of appropriate questions and demands during direct instruction would further the line of study.

5.5 LIMITATIONS

Although the results demonstrate experimental control, some limitations exist. All three TSS had a slight upturn of modeling and expanding language during the imitation generalization probe immediately before training for modeling and expanding language. This may have been due to the nature of the generalization probe (snack time). The modeling and expanding language was stable with low frequency and poor accuracy prior to the generalization probe. However stable responding should have been demonstrated before proceeding to the intervention. Maintenance was not collected at the same point after intervention for every participant due to vacations. The maintenance for Daniel was collected in the two weeks immediately post-intervention since Ravi's family was leaving the country for an extended vacation. Both Elizabeth and Anna collected maintenance data two to five weeks after intervention ended as planned. However Elizabeth's final generalization probe occurred 10 days after mastering the communicative temptations due to cancellations.

Second, the researcher encountered challenges to participant access to technology. Technical problems with the accounts for non-university participants meant the secure Box folder for uploading videos did not work for the first few weeks for Daniel and Anna. The researcher was required to meet with the participants daily to exchange memory cards with the videos on them. During intervention the researcher sent the feedback video clips in the feedback email to Anna. Daniel only had Internet access on his phone, which is why he had requested his feedback as a text rather than email. Until Daniel had access to Box the video feedback was played for him during the next morning by the researcher or sent as a very short video (10 sec) in a text. Once he had access to Box he watched the video clips on his phone. However since one of the advantages of video feedback is the ability to watch repeatedly (Brown et al., 2014) this was not the most effective method of video feedback for Daniel. Making sure technology is readily available and easily accessible to all participants is critical for future research (Macurik et al., 2008).

Another challenge with technology was the quality of video. Since the participants used a tablet to record video no wide-angle lens was available to capture the entire room. This led to portions of several videos where the child or TSS was not visible, limiting the accuracy of the data. Ensuring complete video capture of TSS and child behavior is critical for accurate data collection (Blythe & Abdullah, 2005).

Third, Anna and Elizabeth trained the parent in some of the strategies while Daniel did not. The TSS were told the parents would receive some training after intervention, but since Beni's mother was video recording the play sessions it was a natural progression for Anna to explain what she was doing and why. Elizabeth also explained and modeled imitation for Chloe's father during sessions. Daniel did not include the parents in the sessions. Consistent

instruction for training parents during intervention will contribute to reliable results between participants.

Fourth, the educational level of TSS is higher than the typical paraprofessional in a school or residential setting (Giangreco et al., 2010). While all three TSS had a Bachelor's degree, Daniel also had a Master's degree, an unusual level of education for a TSS. Before the effectiveness of the intervention can be extended to paraprofessionals additional research is needed with paraprofessionals in school settings and possibly residential settings as well.

Finally maturation of the children during intervention could potentially account for at least a portion of the gains in spontaneous communication (Whalen et al., 2006). All three TSS had just begun services with each child within 3 weeks of beginning the study. Although the children were not new to services, their comfort level with the TSS and natural maturation could account for a portion of their increase in communication directed to the TSS.

5.6 IMPLICATIONS FOR PRACTICE

The current study demonstrated the effectiveness of teaching home-based paraprofessionals to implement strategies to facilitate social communication with young children with ASD during playtime. Evidence suggests that paraprofessionals in early childhood special education should be competent in creating a variety of appropriate environments and facilitating communication in those environments (Killoran et al., 2001). Researchers have paid little attention to interventions for paraprofessionals during a child's playtime. This study initiates a body of literature that demonstrates that paraprofessionals can learn interactive techniques to create motivation for young children with ASD to spontaneously communicate.

The TSS learned the strategies easily with in-vivo training and feedback. The online component appeared to influence skill level minimally. All TSS in PA are provided supervision weekly by their BSC. Supervision sessions would be an ideal time to teach, model and coach the TSS in the natural environment. Without the time constraints of a research study the BSC could spend time on each strategy or the combination of strategies. The manual and video models provide a consistent basis for training, while the in-vivo modeling and feedback are demonstrated to be effective tools (Ward-Horner & Sturmey, 2012). Video feedback could be incorporated to maintain behavior beyond immediate coaching (Brown et al., 2014). This intervention also serves to pair the TSS with reinforcement during the early days of service delivery for a child. The acts of providing choice, following the child's lead, imitating motor movements and vocalizations serve as social reinforcement for the child (Ingersoll & Dvortcsak, 2010). By pairing themselves with reinforcement, TSS increases the child motivation to engage with the TSS in activities, including instructional activities, in the future (Cooper et al., 2007).

One large consideration for agencies employing TSS in home settings with young children with ASD is transference of skill. This intervention was created to teach to parents; the natural progression is to teach these skills to the caregivers during TSS sessions (Ingersoll & Dvortcsak, 2010). Not only does this increase the time the child receives intervention, it also creates self-efficacy in the parents. Stress and anxiety has been shown to be higher when parenting a child with ASD (Valicenti-McDermott et al., 2015). This intervention gives the parent tools to increase engagement and communication skills in their children, potentially decreasing challenging behavior when the child is able to request needs and wants (Mancil et al., 2009).

5.7 IMPLICATIONS FOR RESEARCH

The literature base for paraprofessional research on social communication interventions for children with ASD is small and limited to mainly PRT or manding interventions (Dyer & Karp, 2013; Feldman & Matos, 2012; Gianoumis et al., 2012; Hall et al., 2010; Madzharova et al., 2013; Robinson, 2011; Seiverling et al., 2010; Weinkauf et al., 2011). All previous studies take place in a school setting. This research represents the first study targeting paraprofessionals in a home environment learning a combination naturalistic behavioral/DSP approach to teaching social communication skills to children with ASD. Further research for paraprofessionals in preschool settings implementing the same approach during free playtime is necessary to generalize the findings to the larger paraprofessional population. One randomized controlled trial (RCT; Rogers & Dawson, 2010) has demonstrated effectiveness for a comprehensive intervention that includes strategies similar to the Ingersoll & Dvortcsak (2010) intervention. A similar longitudinal RCT for paraprofessionals and families in home settings would provide even more definitive evidence of effectiveness.

Further extending the intervention to include the full set of strategies taught in the manual would give the TSS the remaining tools to evoke child communication. Future research should examine the effectiveness of the additional interactive techniques and direct teaching techniques. Extending the research to include paraprofessionals and families would allow the researcher to examine multiple levels of treatment fidelity. Not only would the implementation fidelity of the researcher to the TSS be measured, but the implementation fidelity of the TSS training the parent. Intervention fidelity would be measured for both the TSS and parent. This design adds to the literature on both social communication interventions (Ingersoll, 2010) and treatment fidelity (Dunst, Trivette, & Raab, 2013).

Finally a component analysis of the training package will lead to a better understanding of the change agents when training paraprofessionals (Ward-Horner & Sturmey, 2012). All components of the intervention should be studied separately: online training with video models, in-vivo training with discussion, modeling, and skill practice with immediate verbal feedback, and ongoing written and video feedback. Research on most effective components will create practical applications for schools and agencies looking for cost-effective ways to train their staff.

5.8 CONCLUSION

The combination of initial online training, in-vivo training that included discussion, modeling and coaching, and ongoing written feedback with exemplary video segments quickly increased TSS strategy behaviors and maintained most of those behaviors after the intervention ended. The study demonstrated that a full adult learning model resulted in effective implementation of the intervention (Trivette et al., 2009). This study adds to the literature in several areas of research. The paraprofessional training extends research on adult learning models to include a combination of computer-based and in-vivo training and ongoing feedback (Sterling-Turner et al., 2001). This research also expands on the current literature on paraprofessional research on social communication interventions for children with ASD to include paraprofessionals in home settings implementing a combination intervention. Finally the research adds to the emerging literature on treatment fidelity (Dunst et al., 2013; Smith, Daunic, & Taylor, 2007) by requiring a stringent level of fidelity to meet mastery criterion and measuring fidelity directly as frequency rather than indirectly as interval recording or percentage of steps correct. This study provides a starting point for developing a system of training and supervising

paraprofessionals to implement a combination social communication intervention for children with ASD. Further research will refine the paraprofessional intervention and define an evidence-based practice to improve skill level for a critical population of people delivering service to children with ASD.

APPENDIX A

STUDIES INCLUDING TRAINING PARAPROFESSIONALS IN SOCIAL COMMUNICATION INTERVENTIONS FOR YOUNG CHILDREN WITH ASD

Table 8 Studies including training paraprofessionals in social communication interventions for children with ASD

Article	Participants Adult (Child)	Setting	Adult Dependent Variable	Adult Independent Variable	Child Intrvn.	Child Dependent Variable	General. & Maint.
Feldman & Matos, 2012	3 female paraprofessionals, 23-50 yrs. (3 boys with ASD, 5y 2m-8y9m)	3 public inclusive elementary schools	Fidelity -% correct procedure (6 steps) Level of involvement	Mat, D, OF	PRT	Reciprocal social engagement with peer (% 30-sec intervals)	Generalization across activity, Maintenance probe
Gianoumis, Seiverling & Sturmey (2012)	3 female teaching assistants, 25-34 yrs old. (6 children with ASD, 3-4 yrs old. 3 boys, 3 girls)	Specialized full-day preschool for children with ASD	% correct steps performed Detailed description of steps.	Mat, D, M, R, GF,	NLP	% trials with appropriate vocalization (2nd-Maladaptive behavior)	Generalization across children
Hall, Grundon, Pope & Romero (2010)	5 paraprofessionals, 4 female, 1 male. * (5 preschool-aged boys with ASD)*	2 public preschools	# of elaborations (Incidental teaching) # of descriptors (PRT) Some description.	Mat, G, D, R, OF, WF	Incident. Teaching PRT	No Measures	None
Madzharova, Sturmey & Jones (2012)	1 teacher assistant, female * (5 yr old girl with ASD)*	ABA-based school for children with ASD	% correct steps (19 total) Detailed task analysis included	VM, VF	Mand training	# of independent peer-peer mands	None

Table 8 continued

Article	Participants Adult (Child)	Setting	Adult Dependent Variable	Adult Independent Variable	Child Intrvn.	Child Dependent Variable	General. & Maint.
Robinson (2011)	4 female paraprofessionals, 18-60 yrs old. (4 boys with ASD, 3-8 yrs old)	School classroom and playground	% correct steps (2^{nd} – level of involvement) Detailed description included.	M, VF	PRT	Individual verbal goals for each child (verbalization, spontaneous, verbalization, mands, peer-peer) interaction)	Generalization across 1 activity, 1 student, Maintenance probe
Seiverling, Pantelides, Ruiz & Sturmey (2010)	2 female teaching assistants, 1 male training coordinator, 23-42 yrs. old (3 children with ASD, 40-49 mo., 2 boys, 1 girl)	Specialized preschool for ASD	% correct steps Detailed lists included.	D, M, R, OF	NLP	% opportunities correct vocal responding (3 vocal chains)	None
Weinkauf, Zeug, Anderson & Ala'i-Rosales (2011)	4 females ages 19-56. Students in ABA program (Children with ASD, ages 4-8)	Community Autism center	% skills demonstrated correctly (3 skill clusters). No detailed description.	D, M, R, OF,	125 ABA skills divided into 3 clusters	No measures	None

❖ some participants not included in review – did not fit criteria and results were disaggregated.

Key for Adult Independent Variable: Mat= Written Materials, D=didactic training, G=group training, M=modeling, R=rehearsal or role-playing, GF=graphic feedback, VF=video feedback, OF=oral feedback, WF=written feedback

APPENDIX B

DATA COLLECTION FORMS

Figure 13 Implementation Treatment Fidelity

Trainer _____
Observer _____
Date_____ Strategy _____
Participant_____
Check the appropriate box to indicate if procedure is observed or not observed. Add notes in appropriate box.

Procedure	Observed	Not Observed	N/A
The trainer arranges environment to promote TSS-child interactions (limited distractions)			
The materials for the session are available (Manual, developmentally appropriate toys, implementation fidelity form, intervention fidelity forms, video camera)			
The trainer provides a brief description of the session			
The trainer video-tapes the 10-minute play session (TSS and child)			
The trainer provides brief praise and corrective feedback after play session (1-2 min)			
The trainer reviews online training information in the manual for the current strategy: rationale, key points of technique (3-5 minutes)			
The trainer answers any TSS questions or concerns			
The trainer assesses the TSS understanding of the material			

through questions/discussion (1-2 min)			
The trainer reviews TSS baseline data and sets goal for strategy use (2-3 min)			
The trainer provides a demonstration of the technique(s) at least 3 times with the child while explaining the impact on the child's behavior (4-6 minutes)			
The trainer encourages the TSS to practice the technique with the child (8-12 minutes)			
The trainer provides positive and corrective feedback to the TSS regarding the use of the techniques with the child			
The trainer helps the TSS work through any obstacles in implementing the technique			
The trainer is responsive to the TSS throughout the session			
The trainer addresses unrelated questions or concerns the TSS raises during the session			
The trainer reminds the TSS that she will send an email in the evening with feedback and a video clip.			
The trainer reminds the TSS to video a 10-minute play session every time she is in the home and upload that day to the secure folder			
The trainer send the feedback email to the TSS the same day as the session after watching and scoring the video			
The email contains: total frequency of strategy, % correct strategies, behavior-specific praise (at least 2 examples) corrective feedback (at least 1 example) and a link to at least 1 video clip.			
Total			
Percent Correct: observed/(not observed + observed)			
Notes:			

Figure 14 Imitation treatment fidelity

Imitation Treatment Fidelity

Observer _____ **Day/Intervention #_____ page____**
Date_____
Participant_____
Child no._____

KEY
+ = Observed; (-) = Not Observed; NA = Not Applicable

Time:																								
Strategy Step																								
Attempt #:																								
TSS stays face to face with child																								
TSS is at child's level																								
TSS allows child to choose activity																								
TSS moves in the same manner as the child: same body part, type of toy and/or facial expression within 3 seconds of child movement																								
The TSS looks at child																								
The TSS does not ask any questions or place any demands																								
The TSS does not physically or verbally prompt the child																								
The TSS stops and waits when the child stops																								
The TSS uses animated facial expression																								
The TSS follows the child if they move to a new activity or new location in the room																								
100% Correct Strategy use = +																								

Notes:

Total Correct/Total attempted

% correct

Figure 15 Modeling and expanding treatment fidelity

Modeling and expanding Treatment Fidelity

Observer _____

Date_____ **Day/Intervention #**_____**Page**_____

Participant_____

Child no._____ **Child Current Language Level**_____

KEY
+ = Observed; (-) = Not Observed; NA = Not Applicable

Time: / **Strategy Step**																										
Attempt #																										
TSS allows child to choose activity																										
TSS follows the child's lead and participates with child in activity																										
TSS provides a verbal description of child's activity or self-describes activity																										
TSS uses language at or one level above child's current assessed level																										
TSS expands child's language at one level above child's current assessed level																										
TSS uses animation in facial expression and voice																										
TSS does not use a question or place a demand																										
100% Correct Strategy use = +																										

Notes:

Total Correct/Total attempted

% correct

Figure 16 Communicative temptations treatment fidelity

Communicative Temptations

Observer _____ **Day/Intervention #_____**
Date_____
Participant_____
Child no._____

KEY
+ = Observed; (-) = Not Observed; NA = Not Applicable

Strategy Step: Time:																							
Attempt #																							
TSS allows child to choose activity																							
TSS follows child's lead and participates with child in activity																							
TSS assesses child motivation for an object																							
TSS arranges the environment to promote child initiation: 1. places desired item in sight but out-of-reach (plastic container with lid, high shelf) OR 2. gives only a small piece of desired item to child (puzzle piece, train track, 1 cheerio) OR 3. provides item that needs adult assistance (bubbles, balloon)																							
TSS waits for child to initiate request for item																							
TSS responds (provides object or helps) within 3 seconds of child initiation																							
If no child initiation, TSS follows child's lead in activity																							
TSS models and expands on child's language at or one level above current assessed language level																							
TSS uses animation in facial expression and voice																							
TSS does not use a question or place a demand																							
100% Correct Strategy use = +																							

Notes:

Total Correct/Total attempted

% correct

Figure 17 Frequency of questions and demands

Questions or Demands

Observer _____
Date_____ **Day/Intervention #_____**
Participant_____
Child no._____

KEY:

Q = Questions; D = Demands

TIME	0-:30	:31-1:00	1:01-1:30	1:31-2:00	2:01-2:30	2:31-3:00	3:01-3:30	3:31-4:00	4:01-4:30	4:31-5:00	5:01-5:30	5:31-6:00	6:01-6:30	6:31-7:00	7:01-7:30	7:31-8:00	8:01-8:30	8:31-9:00	9:01-9:30	9:31-10:00
Q																				
D																				
TOTAL																				

Total Questions and Demands =

Notes:

Figure 18 Frequency of child spontaneous communication

Child Spontaneous Communication

Observer _____
Date_____ **Day/Intervention #_____**
Participant_____
Child no._____

KEY:

G=gesture, V=Vocalization, W=Word(s), Phr=Phrase/sentence, I=inappropriate communication

TIME	0-:30	:31-1:00	1:01-1:30	1:31-2:00	2:01-2:30	2:31-3:00	3:01-3:30	3:31-4:00	4:01-4:30	4:31-5:00	5:01-5:30	5:31-6:00	6:01-6:30	6:31-7:00	7:01-7:30	7:31-8:00	8:01-8:30	8:31-9:00	9:01-9:30	9:31-10:00
G																				
V																				
W																				
Phr																				
Total:																				

Total Spontaneous Communication =

Inappropriate communication: (Time, behavior)

Notes:

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