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Integrating Treatment Strategies for Children with Autism

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by

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2012

EPIGRAPH

Listen to the mustn'ts, child. Listen to the don'ts. Listen to the shouldn'ts, the impossibles, the won'ts. Listen to the never haves, then listen close to me... Anything can happen, child. Anything can be.

Shel Silverstein

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ABSTRACT OF THE DISSERTATION

Integrating Treatment Strategies for Children with Autism

by

Allison Brooke Jobin

Doctor of Philosophy in Psychology

University of California, San Diego, 2012

Professor Laura Schreibman, Chair

Treatment studies indicate that substantial gains may be achieved by some children with autism spectrum disorders (ASD) when behavioral treatment is provided at an early age (National Autism Center, 2009; Vismara & Rogers, 2010). However, heterogeneity of treatment response is common to all evidence-based approaches (Delmolino & Harris, 2012; Sherer & Schreibman, 2005). Currently, no treatment

completely ameliorates the symptoms of ASD and no specific treatment has emerged as the established standard of care.

Investigators have hypothesized that customizing treatments based on individual child and family needs should increase the overall number of children that benefit from intervention (Stahmer, Schreibman, & Cunningham, 2011). Improved understanding of how to match specific treatments to children exhibiting different behavioral characteristics may enhance our ability to tailor interventions to individual children, thereby improving treatment effectiveness.

The current investigation evaluated the relative efficacy of DTT and PRT for teaching children with autism under the age of 3 receptive and expressive language, play, and imitation skills. A single-subject adapted alternating treatments design was used, whereby children received both DTT and PRT for 12 weeks. Potential predictor variables were collected at pre-treatment. Data were collected during treatment and at 3-month follow-up.

All participants learned target skills in both treatments and demonstrated some generalization, maintenance, and spontaneous use of skills acquired during DTT and PRT. However, each child benefited to differing degrees from intervention. PRT was more effective for some children, domains, and dimensions of behavior, whereas DTT was more effective for others. The results also suggested that a combination of PRT and DTT may be optimal in some cases. Pre-treatment adult avoidance and language skills may aid in prospective treatment planning efforts. Additionally, early rates of learning may be predictive of longer-term treatment response.

The results confirm the importance of treatment individualization and begin to suggest specific methods for tailoring treatment programs to individual child needs. The strengths and weakness of DTT and PRT may vary depending on child variables, as well as curriculum area focus.

INTRODUCTION

It is widely acknowledged that early intervention for children with autism spectrum disorders (ASDs) is important for promoting positive child outcomes. Although the causes of the disorder are known to be biological, a large and growing body of literature suggests that substantial gains may be achieved by some children when evidence-based treatment is provided at a very early age (Dawson & Burner, 2011; National Autism Center, 2009; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010; Vismara & Rogers, 2010). Gains made by children with ASD in early intervention programs have included improvements in receptive and expressive language, play, imitation, and other social interaction skills, as well as reductions in frequently associated challenging behaviors.

Currently, no treatment method completely ameliorates the symptoms of ASD and no specific treatment has emerged as the established standard of care for all children with ASD. However, several methods have been demonstrated to be efficacious with some children in research settings. The most well researched programs are based on the principles of applied behavior analysis (National Autism Center, 2009; Odom, Boyd, Hall, & Hume, 2010; Schreibman, 2000; Vismara & Rogers, 2010). These range from highly structured programs that are conducted in a one-on-one treatment setting to behaviorally based inclusion programs that include typically developing children as models. Some of these programs are distinguishable by “brand names,” such as discrete trial training (DTT) and pivotal response training (PRT), while other programs use the principles of applied behavior analysis more generally. Some programs that are not exclusively based on behavioral principles are also beginning to demonstrate efficacy. These include approaches using structured environments and visual support systems (Callahan, Shukla-Mehta, Magee, & Wie, 2010; Mesibov & Shea, 2010; Ozonoff & Cathcart, 1998) and developmentally-based, social-pragmatic models (Dawson et al., 2010; Kasari, Paparella, Freeman, & Jahromi, 2008; Vismara, Colombi, & Rogers, 2009). Principles of behavior are often an integrated component of these interventions, as well. Both focused and comprehensive early intervention approaches have shown success using the techniques described above or a combination of techniques (Odom et al., 2010; Vismara & Rogers, 2010).

Given the known heterogeneity and developmental nature of the disorder, it is unlikely that one specific treatment will be best for all children with ASD, or will work for any one child throughout his or her treatment course. Indeed, research points to the inadequacy of one approach for all areas of learning and there is now a consensus that there is no "one-size-fits-all" treatment for this population (Delmolino & Harris, 2012; National Autism Center, 2009; Sherer & Schreibman, 2005; Wallace & Rogers, 2010). Differential response to treatment is common for evidence-based approaches, in that up to 50% of children fail to show substantial positive response (Cunningham, Schreibman, Stahmer, Koegel, & Koegel, 2008; Dawson et al., 2010; Lovaas, 1987; Sallows & Graupner, 2005; Sandall et al., 2011; Sherer & Schreibman, 2005). Moreover, evidence suggests that treatment providers working in community settings do not select just one intervention but rather report using a combination of evidence-based and non-evidence-based interventions to teach these children (Love, Carr, Almason, & Petursdottir, 2009; Stahmer, Collings, & Palinkas, 2005). Although treatment providers are combining interventions, very little is known about *how* to individualize treatment protocols or how to best determine *a priori* which intervention is most likely to benefit individual children (Humphrey & Parkinson, 2006; Stahmer, Schreibman, et al., 2011; Yoder & Compton, 2004).

Research validating different methods for individualizing treatment is critical. For instance, investigations of treatment/behavior interactions may indicate that children may make more gains in a particular intervention or that different behaviors may be best addressed via different treatment strategies. The ultimate goal of this line of research is to enable practitioners to prospectively tailor treatments to specific children and increase the overall rate of positive outcomes for children with ASD.

Discrete Trial Training and Pivotal Response Training

Two commonly used interventions for teaching language, play, and social skills to children with autism are discrete trial training (DTT) and pivotal response training (PRT). Both treatment models, developed via applied behavior analysis, are accepted as best practice for these children and are used in community clinic and educational settings (National Autism Center, 2009; Odom, Collet-Klingenberg, et al., 2010; Vismara & Rogers, 2010). Both treatments follow a trial-based format, where each learning opportunity consists of an antecedent cue, the child response, and a contingent consequence. These approaches share many similar features and some differences, which are described below. The primary difference between the two interventions is that DTT is a structured behavioral intervention and PRT is a naturalistic behavioral intervention. The core components by which DTT and PRT differ include the format of the teaching situation, selection of instructional materials and tasks, type of reinforcement contingencies, and approach to generalization.

DTT is the earliest empirically validated form of behavioral intervention for children with autism. It is a highly structured treatment model, based primarily on operant discrimination learning. A large body of literature attests to the substantial gains that this technique may facilitate in children with autism (Lovaas, 1987; National Autism Center, 2009; Odom, Collet-Klingenberg, et al., 2010; Sallows & Graupner, 2005; Smith, Eikeseth, Klevstrand, & Lovaas, 1997; Smith, Groen, & Wynn, 2000; Taubman et al., 2001). A discrete trial is a small unit of instruction composed of a discriminative stimulus provided by the therapist, child response, and immediate consequence contingent upon the child's response. Each discrete trial is followed by a short inter-trial interval before presenting the discriminative stimulus for the next trial. DTT consists of these basic components: (1) the learning environment is highly structured; (2) target behaviors are broken down into a series of discrete sub-skills and taught successively; (3) teaching episodes are initiated by the therapist; (4) instructional materials and task are selected by the therapist and are held consistent within a task during acquisition and varied in maintenance; (5) the child's production of the target response may be explicitly prompted; (6) reinforcers, albeit functional, may be indirect in that they are not directly related to the target response; (7) the child receives reinforcement only for correct responses or successive approximations of the target behavior; and (8) generalization of target behaviors is typically the focus after a particular skill is initially acquired (Lovaas, 2002; Maurice, Green, & Luce, 1996; Smith, 2001).

PRT is a naturalistic behavioral intervention that is also soundly supported in the scientific literature (Baker-Ericzén, Stahmer, & Burns, 2007; Humphries, 2003;

Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998; Koegel, O'Dell, & Koegel, 1987; Koegel, Koegel, Harrower, & Carter, 1999; Laski, Charlop, & Schreibman, 1988; National Autism Center, 2009; Odom, Collet-Klingenberg, et al., 2010; Smith et al., 2010). Similar to DTT, implementation of PRT consists of sets of trials composed of a discriminative stimulus provided by the therapist, child response, and immediate consequence contingent upon the child's response. PRT was designed to address some of the well-researched potential limitations of DTT (e.g., Koegel et al., 1998; Koegel, Koegel, & Surratt, 1992; Koegel et al., 1987; Smith, 2001). In particular, PRT was developed to reduce prompt dependency, and increase spontaneity and motivation to respond, as well as improve stimulus and response generalization. PRT includes the following components: (1) the learning environment is loosely structured; (2) teaching occurs within ongoing naturalistic interactions between the child and the adult; (3) the child initiates the teaching episode by indicating interest in an item or activity; (4) teaching materials are selected by the child and varied often; (5) the child's production of the target behavior may be explicitly prompted; (6) a direct relationship exists between the child's response and the reinforcer; (7) the child is reinforced for attempts to respond, not only correct responses or successive approximations; and (8) generalization of target behaviors is typically the focus throughout all of the intervention process (e.g., Koegel et al., 1989; Stahmer, Suhrheinrich, Reed, Schreibman, & Bolduc, 2011).

These two treatment strategies, or their individual component parts, have been compared in an effort to determine the overall superiority of one treatment over the other for teaching children with autism (see Delprato, 2001 for review). Early studies found that children demonstrated more rapid acquisition when natural, direct reinforcers were used compared to indirect reinforcers (Koegel & Williams, 1980; Williams & Koegel, 1981), as well as when goal-direct attempts were reinforced in comparison to explicit shaping procedures (Koegel, O'Dell, & Dunlap, 1988). Several studies have also been conducted comparing PRT and DTT as complete treatment packages. These studies have found patterns of acquisition to be similar between the interventions (Koegel et al., 1998) or superior in PRT (Koegel et al., 1992, 1987). PRT has also been found to facilitate greater generalization, maintenance, and spontaneity of skill use, in addition to lower rates of disruptive/challenging behaviors (Koegel et al., 1998, 1992, 1987, 1988; Sigafoos et al., 2006). Studies of training parents in behavioral techniques found increased parent affect and decreased stress in parents who learned PRT compared to DTT (Koegel, Bimbela, & Schreibman, 1996; Schreibman, Kaneko, & Koegel, 1991). Studies comparing DTT to naturalistic behavioral interventions similar to PRT have found similar results (LeBlanc, Esch, Sidener, & Firth, 2006; McGee, Krantz, & McLannahan, 1985; Miranda-Linné & Melin, 1992; Neef & Walters, 1984). Although the majority of these studies utilized single-subject designs and small sample sizes, the cumulative results suggest an added benefit of PRT in several important outcome areas.

Predictors of Outcome

A few investigators have examined the possibility that one treatment may not be better overall, but that instead, different treatments (e.g., PRT or DTT) might be most appropriate for different children and at different points in the treatment process. This area of research is important given the heterogeneity of response to treatment, widespread combining and tailoring of treatments in community settings, and common emphasis by experts of the importance of treatment individualization (Delmolino & Harris, 2012; Hurth, Shaw, & Izeman, 1999; Sandall et al., 2011; Schreibman & Anderson, 2001; Schreibman, Dufek, & Cunningham, 2011; Simpson, Mundschenk, & Heflin, 2011; Smith, 2001; Stahmer, Schreibman, et al., 2011; Steege, Mace, Perry, & Longenecker, 2007). A small handful of studies have examined child variables associated with differential responsivity to PRT and DTT. One of these studies found that 3- to 5-year-old children demonstrating high levels of non-verbal stereotypy and avoidance, as well as low levels of verbal stereotypy, toy play, and approach behaviors, were less likely to respond to PRT than those exhibiting the opposite behavioral profile prior to treatment (Sherer & Schreibman, 2005). A follow-up study suggested that this predictive profile was specific to PRT and that it was not predictive of response to DTT (Schreibman, Stahmer, Cestone Bartlett, & Dufek, 2009). A related study found that level of peer social avoidance influenced the extent to which children with autism benefited from an inclusive school setting using naturalistic approaches such as PRT (Ingersoll, Schreibman, & Stahmer, 2001). In particular, children who were more avoidant of their peers tended to benefit less from the inclusive classroom setting. Finally, a community-based study of PRT used in a parent education model found that children who were younger and less impaired at the start of treatment were more likely to benefit from the 12-week intervention (Baker-Ericzén et al., 2007).

A recent randomized comparison study evaluated potential predictors of the differential effects of a language-based approach (PRT) and visually-based approach (the Picture Exchange Communication System, PECS; Frost & Bondy, 2002) on communication in very young (i.e., 2-4 years-old) primarily nonverbal children with autism (Cunningham et al., 2008). The study found that early word use predicted spoken language gains in both interventions. In particular, children who entered treatment with no words, compared to those who entered treatment with 1-9 words, were significantly less likely to make spoken language gains during the 6-month intervention. Importantly, the variables composing the PRT predictive profile (Sherer & Schreibman, 2005) were not predictive of responsivity in this younger aged sample. These data suggest that the profile may require adaptations in order to be appropriate for addressing treatment responsivity in younger-aged children with autism.

One other systematic comparison of the differential effects of two interventions has been conducted, with the focus of identifying whether each intervention would be most appropriate for different types of children. Yoder and Stone (2006a, 2006b) conducted a randomized comparison experiment comparing a vocally-based naturalistic intervention, Responsive Education and Prelinguistic Milieu Teaching (RPMT), to PECS. The investigators found that while both PECS and RPMT resulted in an increase in initiating joint attention across treatment, RPMT resulted in more initiating joint attention for those children who had at least some joint attention skills prior to intervention. PECS resulted in more requests in comparison to RPMT and greater gains in initiating joint attention bids for those children with little joint attention skill at intake (2006a). In a different report, Yoder and Stone (2006b) found that pre-treatment levels of object exploration moderated growth rates in the number of nonimitative words in PECS versus RPMT. Children who began treatment with low object exploration benefited more from RPMT, while children who began treatment with higher levels of object exploration benefited more from PECS. These researchers proposed that while both PECS and RPMT involve objects as rewards for communicative attempts, only RPMT specifically taught children how to play with objects. Thus, children with low object exploration at pre-treatment were more likely to benefit from intervention after learning to play with objects.

In a related body of literature, several investigators have evaluated outcome predictors for children receiving comprehensive early and intensive behavioral interventions. The studies typically referenced the use of comprehensive treatment manuals with DTT at the core (Leaf & McEachin, 1999; Lovaas, 2002; Maurice et al., 1996). These models have historically emphasized the structured behavioral end of the continuum of applied behavior analytic treatments. Some of them incorporate some common components of naturalistic behavioral strategies, usually after skills have been acquired in the structured format. The most commonly cited predictors of treatment outcome have been IQ, language ability, symptom severity, and age at start of treatment (Ben-Itzchak & Zachor, 2006, 2011; Darrou et al., 2010; Granpeesheh, Dixon, Tarbox, Kaplan, & Wilke, 2009; Harris & Handleman, 2000; Itzchak, 2009; Perry et al., 2011; Sallows & Graupner, 2005; Smith et al., 2000; Zachor & Ben-Itzchak, 2010). Other variables that have been related to more positive treatment outcomes include initial learning rates (Sallows & Graupner, 2005; Weiss, 1999; Worcester et al., 2012) and intensity of intervention via number of treatment hours and supervision (Eikeseth, Hayward, Gale, Gitlesen, & Eldevik, 2009; Granpeesheh et al., 2009). A recent study found that children who were motivated by socially mediated consequences tended to do better than children with a high number of automatic/sensory reinforcers (Klintwall & Eikeseth, 2012). Finally, an exploratory study on treatment outcomes found that more responsive children made continual progress during 1:1 and group arrangements, demonstrated challenging behaviors that served clear functions, and were easily motivated, sociable, and able to generalize new skills (Boulware, Schwartz, Sandall, & McBride, 2006).

Collectively, these studies suggest variables that may be useful in tailoring treatments to individual children and provide evidence that specific behavioral profiles may be useful in identifying which children are likely to respond to particular treatments and in making treatment decisions. However, several gaps in the literature remain.

Gaps in the Literature

Importantly, most of the studies evaluating DTT and PRT, individually and in comparison, were conducted with children over the age of 3, whereas children are now beginning to start treatment at an even earlier age (Dawson, 2008; Schertz, Baker, Hurwitz, & Benner, 2010). Some have theorized that naturalistic interventions may be best suited for younger children (Stahmer, Brookman-Frazee, Lee, Searcy, & Reed, 2011; Wallace & Rogers, 2010). Similarly, naturalistic interventions are more consistent with well established foundational tenets of early intervention, including providing learning opportunities in the least restrictive environment and family involvement (Iovannone, Dunlap, Huber, & Kincaid, 2003; National Research Council, 2001). As noted above, our research suggests that the behavioral predictors of response to treatment may differ in younger children (Cunningham et al., 2008).

Although a large body of literature has identified overall predictors of treatment outcome, it is not well understood how these variables may differentially impact responsivity to different evidence-based approaches, such as DTT and PRT.

An additional gap in the literature is that comparison studies have focused on teaching expressive language, although these interventions are also commonly used to teach receptive language, play, imitation, and other social skills (Ingersoll & Schreibman, 2006; Koegel, Werner, Vismara, & Koegel, 2005; Pierce & Schreibman, 1995, 1997; Stahmer, 1999; Stahmer, Ingersoll, & Carter, 2003; Thorp, Stahmer, & Schreibman, 1995). Some early studies comparing individual components of these interventions did evaluate effects on some other learning domains and indicated a superiority of PRT (Koegel & Williams, 1980; Williams & Koegel, 1981). However, comparative studies of the complete PRT and DTT packages have evaluated the differential effects on expressive language only. It is unknown whether the same strengths and limitations of each approach extend to these other learning domains and to younger children with autism, or if the best practice method would depend on child characteristics and skill area.

Combining Approaches

Some researchers have specifically suggested that a combination of structured and naturalistic procedures may be the most effective method for some children with autism (Smith, 2001; Steege et al., 2007; Sundberg & Partington, 2010) or have developed comprehensive models that combine the use of these interventions in different ways (Arick et al., 2003; Dawson et al., 2010; Stahmer & Ingersoll, 2004; Stahmer, Akshoomoff, & Cunningham, 2011). Among others, these include the Early

Start Denver Model (ESDM; Dawson et al., 2010), Strategies for Teaching Based on Autism Research (STAR; Arick, Loos, Falco, & Krug, 2005), and Alexa’s PLAYC (formerly Children's Toddler School; Stahmer & Ingersoll, 2004; Stahmer, Akshoomoff, et al., 2011). Moreover, community treatment providers report using a combination of highly structured (e.g., DTT) and naturalistic (e.g., PRT) interventions to teach children with autism (Stahmer et al., 2005). As previously mentioned, it has been hypothesized that incorporating multiple treatment methods in a comprehensive program and customizing it to the individual needs of specific children should increase overall effectiveness (Hurth et al., 1999; Iovannone et al., 2003; Schreibman, 2000; Schreibman et al., 2011; Stahmer, Schreibman, et al., 2011; Steege et al., 2007).

No studies have explicitly examined specific approaches to treatment combination or provided evidence supporting how to combine treatment methods. As a general rule, most combination efforts have not been based on empirical research. A handful of studies have reported positive child outcomes in programs that systematically utilize a variety of methods to comprise the comprehensive program (Arick et al., 2003; Dawson et al., 2010; Ingersoll, Dvortcsak, Whalen, & Sikora, 2005; Stahmer, Akshoomoff, et al., 2011). However, decisions about which strategy to implement when and for whom, as well as program procedures describing how to move through the various strategies, were often theoretically driven or based on clinical judgment. Other treatment outcome studies have evaluated eclectic treatment models (Eikeseth, Smith, Jahr, & Eldevik, 2002; Harris & Handleman, 2000; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005) and found them to be inferior to the research-based treatment packages to which they were compared. However, these studies did not identify the specific components making up the eclectic treatment model and may simply reflect the inadequacy of combining techniques in the absence of a specific methodology for doing so.

A specific, systematic method of combining strategies may be needed to ensure that interventions remain effective when combined as a way to individualize for a particular child and family. More research is needed in this area, which might evaluate combining intervention strategies in the following ways: (a) using more than one intervention for teaching multiple skill areas, but varying the proportions of time spent using each; (b) combining interventions into a modified single approach, including components of multiple modalities; (c) varying which intervention is used depending on skill area, child/family characteristics, or response to treatment.

As one example of these approaches, the STAR Program (Arick et al., 2003, 2005) is a manualized comprehensive treatment model that combines structured and naturalistic behavioral methods in a pre-determined way for all children. In this model, DTT is used to teach receptive language and pre-academic concepts while PRT is used to teach play and spontaneous language concepts. This is based on the premise, albeit non-research based, that some strategies are better suited to teaching particular skills. For example, PRT relies on a child choosing a particular activity, or having a reward directly related to the task, which may seem difficult when teaching academic skills or receptive language. Therefore, an intervention such as DTT, which is adult-directed and utilizes indirect reinforcement may be more appropriate. An intervention such as PRT, which is play-based and child driven, may seem more appropriate for teaching play and imitation skills. The developers of the STAR program have published 16-month treatment outcome data for children aged 2 to 6 participating in the program. In this quasi-experimental study, the majority of children demonstrated significant gains in language and social interaction skills, as well as decreases in impairments associated with autism (Arick et al., 2003).

In a different approach to treatment combination, both Alexa's PLAYC (Stahmer & Ingersoll, 2004; Stahmer, Akshoomoff, et al., 2011), a model toddler inclusion program, and the Early Start Denver Model (ESDM; Dawson et al., 2010), use decision tree, or pre-specified sequence of rules, to guide which intervention is used with a particular child. At Alexa's PLAYC, behavioral strategies are implemented following a least to most structure approach for all children and domain areas. For example, PRT is implemented initially and a more structured behavioral approach, such as DTT, is introduced if the child is nonresponsive over time. These additional supports are faded as quickly as possible (Stahmer & Ingersoll, 2004; Stahmer, Akshoomoff, et al., 2011; Stahmer, Schreibman, et al., 2011). In the ESDM, the treatment team follows a decision tree to adapt the teaching approach for children who do not to make gains with the typical intervention model. The clinician is guided to move down the decision modules after a pre-specific amount of time based on how the child responds. Developmentally-based techniques blended with PRT are utilized initially. If the child does not make measurable gains within 3-5 sessions (if the child is receiving 20+ hours of treatment per week), augmentative and then discrete trial training procedures are introduced. Similar to the STAR Program, researchers have not explicitly compared these approaches to other potential decision rules. However, the concepts are founded on the philosophy that children benefit from learning in the least restrictive, most developmentally appropriate environment, as well as research confirming that not all children benefit from one single treatment approach. Also, some research suggests that children who do not respond to PRT in the first several weeks of treatment (i.e., 6 weeks) are unlikely to make significant gains but may respond to a more structured approach (Schreibman et al., 2009; Sherer & Schreibman, 2005).

Finally, Thomson (2011) recently published a manual on blending discrete trial and naturalistic interventions. Children are characterized using a resource called the *Autism Intervention Responsiveness Scale (AIRS)*, where the clinician rates the child on a variety of autism characteristics and common predictors of treatment responsivity. These include communication, joint attention, and imitation skills, as well as level of social interest, narrow interests, and insistence on sameness. Based on the child's profile, it is recommended that they either receive a discrete trial, naturalistic, or blended approach to intervention (Thomson, 2011). Case study data are presented to confirm that children assigned based on their profile demonstrated gains in the assigned intervention. Importantly, however, these results were not based on experimental data or random assignment and do not identify whether the children would benefit more or less from another type of approach.

Overall, it makes intuitive sense that some strategies may be better suited to specific target areas than others, or that decision rules would be important in clarifying individualization procedures, but there are very little data to support specific guidelines. There is no comparative evidence to suggest that DTT would be most appropriate for teaching receptive language or that PRT would be more appropriate for addressing social skills deficits. In addition, the comprehensive treatment packages allocating different interventions to different learning domains or profiles of children have not explicitly been compared to any other approach. For instance, although Arick and colleagues' research (2003) importantly suggests that a majority of children will learn via a combined treatment approach, it is yet to be established whether the STAR Program's combination approach has divided the interventions in a best practice manner or in a way that will facilitate optimal outcome for all children. This is particularly true in younger children with autism and in the domains of receptive language, play, and social interaction abilities, where naturalistic and structured behavioral approaches have not yet been thoroughly compared. Additionally, further research would be necessary to determine when a treatment-specific nonresponder can be categorized as such. In other words, it would be important to identify when in the treatment process patterns of responding or nonresponding become apparent.

Current Investigation

The current investigation systematically addressed the question of how to most effectively combine naturalistic and structured treatment methods for children with ASD beginning treatment under the age of 3. Using a single subject research methodology, this project compared the relative efficacy of DTT and PRT for teaching different skill areas across children with varying pre-treatment characteristics. The overall goal of this line of research is to identify methods of optimally allocating treatment time and tailoring comprehensive treatment programs to the individual needs of different children with autism. The specific aims were:

1. To evaluate the relative efficacy of discrete trial training (DTT) versus pivotal response training (PRT) for teaching children with autism, or identified as at risk for autism, under age 3 in the areas of (a) receptive and expressive language, (b) play skills, and (c) imitation skills.
2. To identify specific child variables that influence whether specific children were more likely to benefit from DTT or PRT in each of the tested domain areas.
3. To identify how early on in the treatment process patterns of responsivity emerged in DTT and PRT, respectively.

METHODS

Participants

Four children participated in this investigation. Participants were recruited from the UCSD Autism Center of Excellence (ACE) pool of research subjects (n=49). These children received treatment through a comprehensive in-home treatment program managed and delivered by the UCSD Autism Intervention Research Program. Recruitment through this pool of subjects offered control over the influences of outside treatment, such that observed treatment effects could be better attributed to the experimental manipulations. Children met the following inclusion criteria: (a) chronological age of less than 36 months, (b) diagnosis of risk for autism or provisional autism diagnosis (see *Diagnosis*), (c) developmental level on the Mullen Scales of Early Learning (MSEL; Mullen, 1995) within two standard deviations of the mean of the larger ACE pool of research subjects (between the range of 53-99, see *Developmental Level*), and (d) participation in no longer than one month of treatment for autism. See Table 1 for a summary of child pre-treatment characteristics. The means and standard deviations for the ACE pool of research subjects are included for comparison.

Jonah was 27 months of age at pre-treatment with developmental functioning in the very low range on the Early Learning Composite of the MSEL (Mullen, 1995). He exhibited severe delays in receptive and expressive language, mild to moderate delays in fine motor abilities, and average visual reception abilities according to the MSEL subscales. His parents reported that he said 11 words (8 of which were non-animal sounds) and understood 121 words based on the MacArthur-Bates Communicative Developmental Inventory (MCDI; Fenson et al., 1993). Jonah’s adaptive functioning was in the moderate low range across the communication, daily living skills, and socialization domains according to parent report on the Vineland Adaptive Behavior Scales, 2nd Edition (VABS-II; Sparrow, Cicchetti, & Balla, 2005). His motor skills were in the adequate range. Jonah was classified as having difficulty with temperament and self-regulation based on the Temperament and Atypical Behavior Scales (TABS; Neisworth, Bagnato, Salvia, & Hunt, 1999) with elevated scores on the temperament and regulatory index (TRI) and detached, hypersensitive/active, and underactive subscales. The clinician providing the Autism Diagnostic Inventory-Toddler Module (ADOS-T; Lord, Luyster, Gotham, & Guthrie, 2012) rated him as being at moderate-to-high concern for an autism spectrum disorder.

Mario was 22 months of age at pre-treatment with developmental functioning in the average range on the Early Learning Composite of the MSEL. He exhibited severe delays in expressive language and average receptive language, fine motor, and visual reception abilities according to the MSEL subscales. His parents reported that he said 5 words (1 of which was a non-animal sounds) and understood 117 words based on the MCDI. Mario's adaptive functioning was in the adequate range overall according to parent report on the VABS-II. He demonstrated elevated scores on the TRI and detached and hypersensitive/active subscales on the TABS. He was rated as being at moderate-to-high concern for an autism spectrum disorder.

Sally was 29 months of age at pre-treatment with developmental functioning in the very low range on the Early Learning Composite of the MSEL. She exhibited severe delays in expressive and receptive language and average fine motor and visual reception abilities according to the MSEL subscales. Her parents reported that she said 0 words and understood 30 words based on the MCDI. Sally's adaptive functioning was in the low range for communication and moderately low range for daily living skills and socialization skills according to the VABS-II. Her motor skills were in the adequate range. She demonstrated moderately elevated scores on the TRI and detached and underactive subscales on the TABS. She was rated as being at moderate-to-high concern for an autism spectrum disorder.

Leo was 26 months of age at pre-treatment with developmental functioning in the very low range on the Early Learning Composite of the MSEL. He exhibited severe delays in expressive and receptive language and average fine motor and visual reception abilities on to the MSEL subscales. His parents reported that he said 2 words (0 of which were non-animal sounds) and understood 77 words based on the MCDI. Leo's adaptive functioning was in the moderately low range for communication and socialization and adequate for daily living and motor skills. He demonstrated moderately elevated scores on the TRI and hypersensitive/active subscales on the TABS. The clinician providing the ADOS-T rated him as being at moderate-to-high concern for an autism spectrum disorder.

All participants were diagnosed with autism spectrum disorder once they turned 3.

ACE Treatment Program

In addition to the experimental treatment procedures for this study, all participants received treatment through a comprehensive in-home treatment program managed and delivered by the UCSD Autism Intervention Research Program. The Strategies for Teaching Based on Autism Research Program (STAR; Arick et al.,

2005) and Social Communication Curriculum (Ingersoll & Dvortcsak, 2010) were used as the basis for in-home programming. Children in this study received an average of 8 hours per week of 1:1 therapy (range: 6.9-8.4) and 1.4 hours of supervision by a masters-level clinician (range: 1.1-1.8). The children's parents received an average of 17 hours of parent education during the course of the study (range: 11.5-25.5). All children also received speech therapy and occupational therapy from an outside provider an average of 1.8 hours per week (range: 0-3 hours per week). UCSD treatment supervisors, family members and all outside providers agreed to work on skills that did not overlap with the experimental treatment targets and to specifically refrain from teaching behaviors targeted in this study.

The STAR Program (Arick et al., 2005) is a comprehensive behavioral program with a developmentally appropriate curriculum specifically developed for young children with autism. STAR is based on current research regarding appropriate treatment for children with autism and incorporates strategies based on applied behavior analysis, including discrete trial training (e.g, Lovaas, 1987; Maurice et al., 1996; Smith, 2001), pivotal response training (e.g., Koegel et al., 1987, 1989), and teaching in functional routines (Brown, Evans, Weed, & Owen, 1987; Ganz, 2007; Iovannone et al., 2003). An individualized curriculum was developed for each child and focused on teaching in six major areas: expressive language, receptive language, spontaneous language, functional routines, pre-academic concepts, and play and social interaction skills. Research studies of over 100 children with autism participating in the STAR program showed that the majority of children made significant progress in the areas of social interaction, expressive speech, and use of language concepts (Arick et al., 2003, 2005). The STAR Program was supplemented with the Social Communication Curriculum (Ingersoll & Dvortcsak, 2010), a developmental social-pragmatic (DSP) approach to early social communication learning that also has evidence to support its use with this population (Ingersoll, 2010; Ingersoll et al., 2005). Goals addressed using this curriculum were focused on social-affective communication development for very young children, which were not fully addressed in the STAR Program.

Procedure

An adapted alternating treatments design (AATD; Sindelar, Rosenberg, & Wilson, 1985) was used, which involves the comparison of two or more treatments that are alternated in rapid succession. In AATDs, a unique set of equivalent but functionally independent instructional items are randomly assigned to the different treatment conditions. This is in contrast to the standard alternating treatments design (ATD; Barlow & Hayes, 1979) which compares the effects of two or more treatments on the same behavior(s). This type of research design is appropriate for early studies addressing treatment individualization, because it allows for treatment comparisons within the same subject during the same developmental stage. In AATDs, experimental control is demonstrated when the treatment conditions are consistently associated with divergent levels of responding. Each successive data point serves as a predictor of future behavior under the same treatment, and also verifies and replicates the differential effects produced by the treatment conditions.

The relative efficacy of PRT and DTT was compared for teaching early learning skills to young children identified as at risk for autism in four domains:

expressive language, receptive language, play, and imitation. In the language domains, both actions and objects were taught separately, resulting in 6 total skill categories. As is customary of these designs, the order of treatments was randomly determined and counterbalanced across participants, in order to minimize carryover effects.

Prior to the start of treatment, a series of assessments and observational behavioral measures were administered to assess eligibility for participation, and to identify treatment targets and potential moderators of treatment effects. Then, the treatment phase lasted 12 weeks and consisted of three 45-minute sessions of in-home treatment per week in each treatment. Data were collected during treatment sessions, as well as during weekly skill acquisition and generalization probes. Additional assessments were administered at post-treatment and maintenance of gains was assessed after a 3-month follow-up period. In the follow-up phase, family members and other treatment providers were asked to continue refraining from teaching any of the experimental targets and children received no intervention addressing treatment targets. See *Assessments* for a full description of the measures and Table 2 for a list of the assessments administered at each phase of the study.

Setting

Pre-treatment acquisition probes were conducted in a 6 x 8-ft carpeted room with a one-way mirror in the UCSD Autism Intervention Research Laboratory. Treatment sessions were conducted in the child's home and in the same room regularly used for the child's other in-home treatment program. Acquisition probes during the treatment and follow-up phases were conducted in the same room where the child received treatment. During the treatment phase, generalization probes were conducted in a room of the house not used for treatment (e.g., living room, another bedroom, office). Due to scheduling difficulties and parental request, either the lab or home generalization setting was used for the post-treatment and follow-up generalization probes.

Materials

A small table and set of two chairs were available for all treatment sessions and acquisition probes. Teaching and assessment materials consisted of a variety of developmentally-appropriate toys and snacks. Stimuli for generalization probes were kept separate from potential teaching stimuli for the duration of the project, such that the generalization materials were unfamiliar to the child and different from those used during treatment. Materials for treatment and assessments were frequently added and rotated as new targets were introduced and to maximize motivation and increase the potency of potential reinforcers. A binder containing treatment protocols and data collection documents, as well as a handheld digital video camera to film sessions and assessments were kept at each child's home.

Assessments

Standardized Measures

Several measures were administered prior to the start of treatment to characterize the participants and to evaluate the utility of standard measures as predictors of differential response to treatment.

Diagnosis. Each child's diagnosis of risk for autism was determined by the administration of the Toddler Module of the Autism Diagnostic Observation Schedule

(ADOS-T; Lord et al., 2012) and overall clinical judgment by research-reliable doctoral-level research staff and based on the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition, Text Revision (American Psychiatric Association, 2000). Specific item scores on the ADOS-T were also evaluated in terms of their utility as potential treatment predictor variables.

The ADOS is a standardized diagnostic tool that provides a diagnostic algorithm consistent with the diagnostic criteria for Autism Spectrum Disorders (ASDs). The ADOS has been shown to have excellent reliability in diagnosing autism (Lord et al., 2006) and has recently been standardized for use with children under 30 months of age (Lord et al., 2012; Luyster et al., 2009). This observational measure consists of a series of semi-structured "presses" to elicit specific communication and social interaction behaviors. The administrator then rates the individual on a variety of items, scored on a scale of 0-3, and calculates an overall diagnostic algorithm score. The ADOS-T module was used for this sample. The ADOS-T is appropriate for use with children between the ages of 12 to 30 months who have no or some words.

Developmental Level. The Mullen Scales of Early Learning (MSEL; Mullen, 1995) was administered prior to treatment. The MSEL is a standardized assessment designed to assess cognitive functioning for infants and preschool children. The MSEL assesses developmental functioning in five domains, including gross motor (not administered in this study), visual reception, fine motor, receptive language, and expressive language. It yields standardized scores for each area, as well as a cognitive composite standard score, the Early Learning Composite, providing an estimate of the child's general level of developmental functioning. Standard scores (*M*=100, *SD*=15) are reported for the Early Learning Composite and T scores (*M*=50, *SD*=10) are reported for each domain. These scores were evaluated as potential predictor variables.

Adaptive Behavior. The Vineland Adaptive Behavior Scales, 2nd Edition (VABS-II; Sparrow et al., 2005) was administered to assess child adaptive functioning. The VABS-II is a standardized, semi-structured parent interview used to assess functioning levels in communication, daily living skills, socialization, and motor skills. It yields standard scores in each subdomain and an overall adaptive behavior composite. The VABS-II is widely used in community and research settings and has strong psychometric properties. Standard scores on this assessment have a mean of 100 and standard deviation of 15. Standard scores on the VABS-II were evaluated as potential predictor variables.

Temperament and Atypical Behavior. The Temperament and Atypical Behavior Scale Assessment Tool (Neisworth et al., 1999) was administered to assess child atypical temperament and self-regulatory behaviors. The TABS is a norm-referenced, parent report measure of early emerging patterns of atypical temperament and self-regulatory behaviors. The assessment has been found to have high sensitivity, as well as strong interrater and rater-rerating reliability, internal consistency, and social validity. The parent is asked to answer 55 yes/no questions that address a variety of behaviors, including temperament, attention, attachment, social behavior, play, vocal/oral behavior, senses and movement, self-stimulation, self-injury, and neurobehavioral state. The TABS yields an overall Temperament and Regulatory Index (TRI; *M*=100, *SD*=15) and four statistically-derived subtests, which include detached, hyper-sensitive/active, underactive, and dysregulated behavioral patterns (*M*=50, *SD*=10). Standard scores on the TABS were evaluated as potential predictor variables.

Target Selection

The MacArthur-Bates Communicative Development Inventory (MCDI; Fenson et al., 1993) and Student Learning Profile-adapted (aSLP; Arick et al., 2005) were used to identify non-acquired treatment targets for the study. Pre-treatment expressive language according to the MCDI was also evaluated as a potential treatment predictor. The MCDI is a standardized parent report instrument of early language competence that has been used widely in research with both typically and atypically developing infants and children up to 30 months. The instrument consists of two protocols, the Words and Gestures and Words and Sentences form, which both contain a vocabulary checklist of words frequently found in young children's first vocabularies. The parent is asked to indicate which words he or she thinks the child comprehends and/or which words he or she thinks the child comprehends and says. Parents filled out the Words and Gestures form. Parents also filled out the Words and Sentences form if needed to increase the pool of potential targets.

The aSLP is a curriculum-based assessment for determining student learning goals in six domains: receptive language, expressive language, spontaneous language, functional routines, preacademic concepts, and play and social interaction concepts (Arick et al., 2005). The aSLP provides information on baseline skill levels and indicates skills the child is not yet performing (e.g., imitates two-step actions, follows one-step play instructions). The aSLP was administered by child's ACE Treatment

Program masters-level supervisor via specific probes in the child's treatment setting and direct observation. The aSLP identifies broad learning concepts, such as "follows one-step play instructions." The results of the aSLP were used to identify an appropriate goal in the play and imitation domains. Specific target skills were then selected, as described below.

A pool of potential expressive language, receptive language, imitation, and play goals were selected based on non-mastery on these two assessments. Skills were selected that were at or just slightly above the child's developmental level. Specific words, as well as play or imitation skills currently being taught by children's parents or other treatment providers were excluded as potential targets. In addition, targets were excluded if parents or treatment providers felt it would negatively impact the child to have them isolated to this study. An initial acquisition probe was also conducted to confirm that the child did not know the potential targets in the pool. These probes followed the same format as the *Acquisition Probe* described below. Items were removed from the target pool if the child demonstrated correct, discriminated responding during the assessment. Potential target items were re-probed for mastery immediately prior to introduction as an experimental target. Finally, pairs of targets were matched by domain area, difficulty and similarity of materials (e.g., animal names, play actions with pretend food, imitation with blocks), and developmental appropriateness. These matches were then randomly assigned to treatment conditions.

The MCDI was also administered at post-treatment and follow-up as a secondary measure of skill mastery. See Tables 3-6 for a list of the target pairs that were taught in each treatment condition and for each participant. Families and other treatment providers were asked to refrain from teaching the experimental targets for the duration of the study, including the 3-month follow-up period. It is important to note parents and treatment providers were told to respond as usual if the child used the experimental targets (e.g., the child said “fish” when at the aquarium). This included naturally occurring situations where the child was exposed to receptive language targets (e.g., “It’s time to go to the park.”). The experimenter was also in contact with other outside treatment providers (e.g., speech therapists) to ask that they also did not teach treatment targets. All involved received a list of “Skills Not to Teach” that was updated as the study progressed.

Clinical Judgment Assessment

The supervisor of each child’s other in-home behavioral treatment program (i.e. the ACE treatment component) was asked to fill out the Clinical Judgment Assessment (CJA) at the start of treatment (Appendix A). The CJA was designed by the investigator to gather information about how treatment decisions would be made for child participants in his/her regular treatment program. This measure provided information about the content of clinician judgment (e.g., how and why clinicians make decisions on which treatment to use when and for whom). Clinician responses were compared to actual child responsivity during the study.

Clinicians were asked which of the available ACE treatments they predicted would work best for the individual child in each domain (PRT, DTT, combined). Although other intervention choices were included in this form (e.g., Interactive techniques from Ingersoll & Dvortcsak (2010), Other), these advocating of these options were not included in analyses. Clinician predictions were compared to actual child responsivity in each domain during the study (See *Child Response* section below).

Behavioral Measures

Structured Laboratory Observation. The Structured Laboratory Observation (SLO) is a non-standardized, parent-child observational assessment used to assess child characteristics at pre-treatment (Schreibman et al., 2009; Sherer & Schreibman, 2005). The SLO is conducted in a generalization setting in the laboratory (i.e. in a room that is unfamiliar to the child and caregiver, as well as with toys that are unavailable during treatment). The 15-minute observation is broken into three 5-minute segments in which the primary caregiver attempts to elicit different behaviors from the child within a naturalistic interaction. In the first segment, the adult is instructed to sit on the couch and allow the child to explore the environment. The adult is instructed to refrain from initiating interaction with the child, but to respond as usual if the child initiates. In the second segment, the adult is instructed to attempt to elicit language, including both expressive and receptive language. In the third segment, the adult is instructed to attempt to elicit play and imitation from the child. Caregivers are provided with instructions prior to beginning the assessment and are instructed to elicit behaviors in any way they choose.

Five child behaviors, toy contact/object manipulation, approach, avoidance, non-verbal stereotypy, and verbal stereotypy, were recorded by the experimenter or trained research assistants (RAs) via videotape using partial interval scoring across 30-second intervals. Data are reported as percentage of intervals in which each behavior occurred. The five behaviors were selected as predictor variables as an extension of an earlier study indicating their predictive value for PRT responsivity (Sherer & Schreibman, 2005). Operational definitions for the behaviors were adapted from Sherer and Schreibman (2005). See Table 7 for a summary of the operational definitions for the behaviors scored from the SLO.

Session data. Within-session patterns of responding for experimental targets were scored on a trial-by-trial basis by the therapist in vivo during DTT sessions, as is customary of this intervention procedure. Trial-by-trial data for PRT was scored from by a second trained research assistant in vivo, due to difficulty of data collection while conducting a naturalistic, behavioral intervention. See Appendix B for a copy of the operational definitions. These data provided a measure of within session learning and were used for determining mastery of target skills (i.e. 80% correct for discriminated responding). The total number of trials per session was also collected for 33% of all sessions to compare number of trials per session in each intervention and to assess procedural fidelity of target opportunities (i.e. at least 5 opportunities for targets in acquisition, described in *Treatment*).

Spontaneous Skill Use. Child spontaneous use of target skills was scored from video by the experimenter or trained RAs. Observers captured instances of spontaneous use of the target words or actions using partial interval scoring across 30-second intervals. Spontaneous skill use was measured for words and actions, or expressive language and play, where children could potentially demonstrate target skills in a spontaneous fashion (i.e. receptive language and imitation require a cue from an adult). Consensus coding was utilized due to the rare nature of these behaviors. Two reliable coders watched each video independently and then met to compare items. For instances of disagreement, the coders convened, discussed, and came to a consensus. When the coders disagreed after discussion, a third reliable coder observed the video clip and a consensus was met. These data are reported as percent of intervals with demonstrated spontaneous words or actions (i.e. when the child said one of the target skills or engaged in one of the targeted behaviors), as well as number of different target skills used during the probes. Spontaneous behavior was scored during generalization probes. See Table 8 for the operational definitions.

Acquisition probes. Weekly acquisition probes were administered prior to treatment, during treatment, and at post-treatment and follow-up, as a controlled and unbiased sample of participants' weekly learning. These probes were conducted weekly, or after 3 treatment session sets had occurred. They were conducted at a child-size table in the regular treatment area in the child's home and were administered by one of the participant's regular therapists.

The assessment consisted of up to 5 randomly ordered presentations of representative stimuli for each of the introduced targets from the two treatment conditions. These data are reported as number of skills performed correctly. Targets were scored as correct if the child responded correctly at a rate of 80% or better. Therefore, once the child responded correctly to four trials or incorrectly to two trials, the administrator discontinued probing this skill. For skills that the child demonstrated 80% or better on the two previous consecutive probes, one trial probes were conducted if the first trial was correct. These modifications were made to prevent child frustration with the increasing duration of the probe assessments across weeks of treatment. Data were collected in vivo by the administrator of the assessment (Appendix C).

Stimuli were selected from the materials used during treatment sessions. Receptive and play trials were conducted within a field of at least 3 stimuli, such that discriminated responding was required. All trials were preceded by a consistent *SD* selected for each domain area (e.g., "Give me (object)" for receptive objects). No prompts, reinforcers, praise, nor feedback were delivered contingently for correct or incorrect responding to the target presentations. The therapist simply provided a neutral response (e.g., "OK") or removed the materials and presented another trial. Trials of known stimuli were interspersed on a variable ratio 5 schedule. Children were provided with praise and access to materials for correct responding to these non-target stimuli and for general attending behaviors.

Generalization probes. Generalization probes were conducted weekly, or after 3 treatment session sets occurred, as well as at the end of treatment and during the follow-up phase. They were conducted in a room of the house not used for treatment (e.g., living room, another bedroom, office), with the exception of the post-treatment and follow-up assessments. As previously specified, either the lab or home generalization setting was used for these probes due to scheduling difficulties and parental request. The administrator did not have previous treatment experience with the child, but did have experience working with children with autism and was trained in the relevant assessment procedures.

Probes began with 5 minutes of a *spontaneous* generalization probe, followed by the *elicited* generalization probe, and 5 additional minutes of the *spontaneous* *(primed)* generalization probe. Targets were included in the generalization probe once the participant had demonstrated acquisition based on within session data or the acquisition probe for that week. Materials that were not used during any treatment procedures were used and selected based on child motivation and relationship to experimental targets to be probed. In other words, materials were selected that maximized the likelihood that the child would use the skills being probed in both a spontaneous and elicited fashion. For example, if one of the participant's targets was the word, *frog*, a variety of toys and materials representing frogs would be available.

In the *spontaneous* probe portion, the administrator was instructed to sit in the room and allow the child to explore the environment. A sample of potentially motivating materials was distributed throughout the room. Although some materials were made accessible to the child, a variety of materials were also made inaccessible to encourage spontaneity (e.g., out of the child's reach, in a closed container, turned off). The administrator was instructed to refrain from initiating interaction with the child, but to respond as usual if the child initiated with him or her.

The *elicited* portion of the probe was not timed, but rather lasted until the administrator presented all necessary trials. Similar to the acquisition probes, this consisted of up to 5 presentations of each of the target items. These data are reported as number of skills performed correctly. Targets were scored as correct if the child responded correctly at a rate of 80% or better. Therefore, once the child responded correctly to four trials or incorrectly to two trials, the administrator discontinued probing this skill. For skills that the child demonstrated 80% or better on the two previous consecutive probes, one trial probes were conducted if the first trial was correct. These modifications were made to prevent child frustration with the increasing duration of the probe assessments across weeks of treatment.

The administrator was instructed to create opportunities where the child was motivated for a particular object or activity. He/she then presented a cue related to a target item (e.g., restrict access to elicit an expressive response, ask the child to "give me (object)" for a receptive response, instruct the child to "do this" for an imitative response) while withholding access to the reinforcer. No prompts other than withheld access, nor reinforcers, praise, or feedback were delivered contingently for correct or incorrect responding to the target presentations. The administrator simply provided a neutral response (e.g., "OK") or removed the materials and presented another trial. Trials of known stimuli were interspersed on a variable ratio 5 schedule. Children were provided with praise and access to materials for correct responding to these non-target stimuli and for general attending behaviors.

Data on correct/incorrect responding during the elicited generalization probe were collected in vivo by the administrator of the assessment (Appendix D). Spontaneous use of the skills in the generalization setting was coded via videotape (see *Spontaneous Behavior* for description of scoring procedures).

Procedural Fidelity. Procedural fidelity for implementation of acquisition and generalization probes was collected on 33% of all probes (Appendices E-F). The average number of items passed for the acquisition probes was 99.5% (range: 89-100%). For the generalization probes, 100% of the items were implemented with fidelity.

Child Response. Summary child response categories were derived from the child outcome measures of acquisition, generalization, maintenance, spontaneity, and parent report of skill use. It should be emphasized that visual analyses of the graphical data are more comprehensive and this information was used to summarize findings. The categories of child response included PRT, DTT, or Equal. Child response was categorized as PRT or DTT if the child responded better in one treatment. A superiority of PRT or DTT was considered when there was skill mastery and/or mean difference of greater than 2 targets between treatments for acquisition, generalization, and maintenance measures. This was considered a clinically significant difference based on visual analysis of differences in response patterns between PRT and DTT across measures. For spontaneity of skill use and parent report of skill use, a treatment was considered superior when there was a difference of greater than 1 target skill acquired. For spontaneity, this difference was greater than the overall mean difference across data comparisons. A difference of at least 2 words on the MCDI (parent report) at post-treatment or follow-up was considered clinically significant. If the child responded equally in both treatments, child was categorized as Equal.

Treatment

Children received three 90 minute sessions of treatment per week, including 45 minutes each of DTT and PRT, for 12 weeks. Order of treatment procedures was varied randomly between days. This order was randomly determined on the first day of the study and counterbalanced across subjects. Randomization included a rule that no more than 3 consecutive session sets began with the same intervention. Both interventions were implemented according to the procedures described in their oftcited treatment manuals (Koegel et al., 1989; Lovaas, 2002) by either the experimenter or trained undergraduate research assistants (referred to as therapists hereafter). The specific procedures for each treatment are described in more detail below.

The therapist simultaneously taught one target item from each of 6 categories in each intervention. In other words, a child had one active acquisition target in each of the following areas at all points in treatment: receptive objects, receptive actions, expressive objects, expressive actions, play, and imitation. Families and other treatment providers were asked to refrain from teaching the experimental targets for the duration of the study (see *Target Selection*). Therapists were instructed to present at least 5 opportunities per session of each target in acquisition. Additional trials were presented based on clinician judgment during the session depending upon child motivation and behavior. Once an item was acquired (i.e. 80% correct response criteria across two sessions), it was practiced in maintenance and generalization per the respective treatment manuals. At this point, a new non-acquired item in the relevant category was introduced. All treatment sessions and assessments were videotaped.

Discrete Trial Training

Discrete trial training (DTT) was implemented according to manualized procedures (Lovaas, 2002). See Figure 1 for a flowchart summarizing the steps in each trial of DTT. At the start of the session, the therapist selected a domain to target (e.g., expressive objects, play) and consistent materials for the current acquisition and/or maintenance targets. Materials during acquisition were pre-determined to ensure consistency across therapists, as per the treatment manual. The therapist conducted reinforcement sampling to identify potential reinforcers for the child. After gaining child's attention, the therapist presented a clear, consistent discriminative stimulus (*SD*) or cue for the relevant domain (e.g., "Do this" + model action, "What is it?" + 3-D object, "Show me [action]"). For new skills, a prompt was presented with the *SD* and systematically faded as the child progressed. For mastered skills, a prompt was presented after two consecutive incorrect responses. The therapist then waited 3-5 seconds for a child response. He/she provided tangible reinforcement accompanied by social praise for correct responses. A neutral response was provided for either incorrect responses or non responses. A short pause followed where, if appropriate, the child was allowed to enjoy the reinforcer for a few seconds before the therapist began the next discrete trial.

Discrimination training procedures for all new targets followed the treatment manual. Once a target was acquired, the therapist varied the S^Ds presented and stimuli used to actively target generalization. These mastered items were maintained throughout the treatment phase during random rotation with other targets. Play breaks were interspersed throughout the session based on child motivation and attention. The therapist followed the above procedures for each learning domain during the session.

Pivotal Response Training

Pivotal response training (PRT) was also implemented according to manualized procedures (Koegel et al., 1989). See Figure 2 for a flowchart summarizing the steps in each trial of PRT. It is important to note that individual treatment targets were introduced one at a time due to the experimental design of this study, which is a modification to how PRT was originally designed. More typically, several objectives in a particular domain might be taught at the same time, with the focus on targeting ‘pivotal areas’ such as motivation. At the start of the session, the therapist followed the child’s lead to materials of interest to the child, which were used for instructional materials and child reinforcement. Rather than moving through one learning domain at a time, trials for different experimental domains were interspersed throughout the session. Additionally, materials used were varied frequently throughout treatment. After gaining child’s attention, the therapist presented a clear and developmentally appropriate *SD* that was related to the activity and intended target. As per PRT procedures, the *SD* was varied across trials. Prompts were provided based on the child’s pattern of responding (e.g., if he/she was responding correctly, the therapist faded the prompts; if he/she was tending to respond incorrectly, the therapist increased the supportiveness of the prompt). The therapist then waited 3-5 seconds for a child response. He/she provided tangible reinforcement accompanied by social praise for correct responses and some goal-directed attempts. Direct reinforcement was provided, in that it was directly related to the child’s behavior and the activity. For incorrect responses or non-responses, the therapist withheld from providing reinforcement. A short pause followed where, if appropriate, the child was allowed to enjoy the reinforcer for a few seconds before the therapist prepared for the next learning opportunity.

The therapist interspersed maintenance and acquisition tasks throughout each treatment session. In addition and outside of explicit learning trials, he/she took turns while playing with the child. Frequent reinforcement sampling occurred to maximize child motivation and ensure that the instructional materials would serve as reinforcers.

Therapist Training

Therapists received a copy of the published materials summarizing the procedures for PRT and DTT. These were the manual, *How to teach pivotal behaviors to children with autism: A training manual* (Koegel et al., 1989), and relevant excerpts of the manual, *Teaching individuals with developmental delays: Basic intervention techniques* (Lovaas, 2002), for PRT and DTT respectively. They also listened to a didactic lecture presented by the experimenter on each intervention, which detailed the components of the therapies and appropriate implementation, and also included specific video examples of the techniques. Therapists observed other trained therapists and practiced implementing PRT and DTT and were provided with feedback. They were gradually introduced into the therapy sessions with study participants and were given feedback from the experimenter or another trained therapist. Fidelity of implementation probes (described below) were frequently administered as a training tool. Therapists continued with supervised practice and feedback until trained to fidelity, at which point they independently administered treatment procedures. The experimenter also provided ongoing supervision to trained therapists at least weekly.

Fidelity of Implementation

Fidelity of implementation (FI) probes were used for training therapists prior to independent administration of treatment, as well as for validating the integrity of the independent variables during the study. Treatment FI probes were 10-minute video segments randomly selected from therapy or training sessions. Video segments were selected post hoc to reduce reactivity from the therapist and excluded segments where the experimenter was providing feedback. Implementation of the components of PRT or DTT was rated on a scale of 1 to 5 by the experimenter or RAs reliable with the scoring procedures (See Appendices G-J). The criterion for passing FI was scoring 4 or 5 on all items.

Therapists were considered “trained to fidelity” when they received a passing score on two consecutive FI probes. They were required to pass and maintain this level of fidelity in order to administer treatment procedures independently. FI was also collected throughout treatment on 33% of the sessions. Ninety-seven percent of PRT session probes and 100% of DTT session probes received a passing score. In the one instance where the therapist did not pass FI, they did not pass on one item. Feedback and specific supervision were provided in this component and the therapist regained FI criteria rapidly.

Interobserver Agreement

Interobserver agreement was calculated on PRT and DTT fidelity of implementation, procedural fidelity for acquisition and generalization probes, and behavioral coding procedures. Two independent observers independently scored 33% of all sessions on identical data sheets, unless otherwise specified. Data sheets were compared and agreement was scored. Prior to coding, observers were trained to 80% reliability on practice sessions and/or video clips.

Point-by-point agreement was calculated for DTT and PRT trial-by-trial session data (i.e. each learning trial was compared). Coders were considered to be in agreement if they both scored a trial as “correct” or both scored it as “not correct.” A disagreement was scored any time the observers marked different items or did not both score an occurrence. For the purposes of data analysis, responses that were prompted, attempts, and incorrect were all considered "not correct." Percent agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100. Interobserver agreement was 91% (range: 80-100%) for PRT and 94% (range: 81-100%) for DTT.

Percent agreement was calculated for the following behaviors: toy contact, approach, avoidance, verbal stereotypy, and non-verbal stereotypy. Two observers scored 25% of the videos using identical data sheets. Percent agreement was 87% for toy contact, 77% for approach, 93% for avoidance, 90% for verbal stereotypy, and 77% for non-verbal stereotypy.

Interobserver agreement was also calculated for the total number of trials administered per experimental target during each session and total number of trials to criterion for experimental targets. Agreement for number of trials per target was 99% (range: 95-100%) for PRT and 96% (range: 83-100%) for DTT. Agreement for total number of trials to criterion was 99% (range: 95-100%) across both treatments.

Agreement for acquisition and generalization probes was also calculated using point-to-point correspondence. Interobserver agreement was 90% (range: 82-98%) for scoring of the acquisition probe trials and 100% overall for procedural fidelity of acquisition probe implementation. Agreement was 90% (range: 81-100%) for scoring of the elicited generalization probe trials and 100% overall for procedural fidelity of generalization probe implementation.

Interobserver agreement for DTT and PRT fidelity of implementation scoring was calculated by evaluating the consistency between each coder on each treatment component. Agreement was defined as scoring within 1 point of each other on a 5-point scale, as well as agreement on overall “pass” or “fail” criteria for the probe session. Interobserver agreement was 92% (range: 80-100%) for DTT fidelity of implementation scoring and 94% (range: 94-100%) for PRT fidelity of implementation scoring.

Data Analysis

Analysis of the data gathered during all phases of the study was conducted using visual analysis, as is customary in studies employing alternating treatments designs (Kratochwill et al., 2010). Estimates of level, trend, and variability in the different data series were assessed and compared between conditions and across time. Additionally, summary child response categories were derived from the above child outcome measures to summarize findings. Potential predictor variables, as well as clinician treatment predictions, were collected at pre-treatment and explored in relation to patterns of child response between treatment conditions.

RESULTS

Relative Efficacy of DTT and PRT

The first aim of this study was to evaluate the relative efficacy of DTT compared to PRT for teaching children with autism in the areas of receptive and expressive language, play, and imitation. The results are presented by participant and domain area for patterns of acquisition, generalization, and maintenance. Maintenance of gains was assessed via an acquisition and generalization probe administered 3-months after treatment was withdrawn. Spontaneous use of skills learned and parent report of language skills, based on the MCDI, are also reported. As patterns of acquisition were similar during the treatment sessions and acquisition probes, these results are presented together. See Table 9 for a summary of the number of skills acquired and generalized in each domain for each participant by the end of the treatment phase. Table 10 presents the means and standard deviations for number of skills acquired and generalized across probes in each domain for each participant.

A summary of child response outcomes is presented in Table 11.

Jonah

Acquisition. Overall, Jonah demonstrated more rapid overall acquisition of skills in PRT. He acquired 41 targets in PRT and 31 targets in DTT by the end of the treatment phase (Figure 3). The mean number of targets demonstrated correctly during the acquisition probes was 20.6 and 15.9 in PRT and DTT respectively. The superior upward trend emerged during the third week of treatment and was consistent throughout the treatment phase. However, the relative benefit of PRT was primarily driven by expressive language acquisition, where Jonah acquired 20 (*M*=7.8) and 11 (*M*=4.1) targets in PRT and DTT respectively (See Figure 4 for all domains). During the seventh and eleventh acquisition probes, Jonah demonstrated a drop in number of skills due to illness and noncompliance respectively. The same patterns were maintained at a lower level and performance returned on subsequent sessions. In the receptive language domain, Jonah learned more rapidly in PRT from week 3 to 11, but this difference leveled out by the termination of the treatment phase. Jonah acquired 14 receptive language targets in both treatments. The mean number of skills demonstrated during acquisition probes was 8.8 for PRT and 7.2 for DTT. There was a slight superiority of DTT for play skills, where Jonah acquired 4 skills in PRT (*M*=2.7) and 6 skills in DTT (*M*=1.9). The mean difference was minor between treatment conditions. Jonah's pattern of acquisition was undifferentiated for imitation skills (*M*=2.1 in PRT, *M*=2.0 in DTT), where he demonstrated generalized imitation after 3 target pairs. Thus, no additional targets were introduced.

Generalization. Patterns of generalization generally mirrored that of acquisition for Jonah. He demonstrated more effective overall generalization of skills in PRT with 35 (*M*=14.1) and 25 (11.9) overall in PRT and DTT respectively (Figure 5). The greatest differentiation between the two treatment conditions was in expressive language, where Jonah generalized 17 targets in PRT (*M*=5) and 10 targets in DTT (1.7) by the end of the treatment phase (See Figure 6 for all domains). This pattern of superiority was replicated across all generalization probes. In the receptive language domain, Jonah demonstrated some slight superiority of PRT, but this was coupled with overlapping data points between the conditions. He generalized 12 PRT and 10 DTT receptive language targets. The mean number of skills generalized across the probes was similar between PRT (*M*=6.1) and DTT (*M*=5.4). In play and imitation, Jonah demonstrated similar patterns of generalization in both treatments. He generalized 2 and 3 play targets in DTT and PRT respectively, *M*=1.3 for both conditions. He generalized all 3 imitation targets in PRT (*M*=1.8) and DTT (*M*=1.6).

Maintenance. Jonah demonstrated strong skill maintenance across domains. He retained most of the experimental targets during the maintenance acquisition and generalization probes (Figures 3-6). The overall relative benefit of PRT was maintained across for the overall analysis, as well as for expressive language specifically. Receptive language gains were maintained better in PRT during the acquisition probes and in DTT for the generalization probes. Although Jonah maintained play skills better in PRT and imitation skills better in DTT, the difference between conditions was minor and relatively insignificant.

Spontaneity. Spontaneous skill use was more frequent in PRT compared to DTT based on mean percent of intervals across generalization probes (*M*=8%, *SD*=9 in PRT; *M*=19%, *SD*=16 in DTT). However, the high degree of variability and overlap across probes indicates that no treatment was consistently superior along this measure (Figure 19). PRT was superior during 5 weeks in the treatment phase compared to 2 weeks where DTT was superior. Although Jonah spontaneously engaged in DTT skills more frequently at follow-up, the variability noted in previous assessments suggests that one data point is unlikely to provide an accurate assessment. Jonah demonstrated a greater variability of spontaneous skill use in PRT compared to DTT. He used 7 different PRT actions and 4 different DTT actions (Figure 20). He did not use words spontaneously in either treatment condition.

Parent Report of Language Skills. Based on the MCDI, parents reported that Jonah understood a relatively equal number of receptive language targets taught in PRT and DTT (Figure 21). In particular, they reported that he knew 10 words receptively taught in both PRT and DTT at post-treatment. At follow-up, they reported that he understood 10 words taught in PRT and 9 words taught in DTT. In contrast, they reported that Jonah said a greater number of expressive language targets taught in PRT. At post treatment, his parents reported that Jonah said 17 and 10 words in PRT and DTT respectively. At follow-up, they reported he said 16 words in PRT and 10 words in DTT.

Mario

Acquisition. Data are presented for 8 weeks of treatment, as Mario discontinued participation due to scheduling difficulties. He demonstrated a modest superiority of PRT in overall number of skills acquired by the end of the 8 weeks (Figure 7). He acquired 12 targets in PRT (M=7.3) compared to 9 (M=6) in DTT. However, the paths overlapped throughout the first 5 weeks of the treatment phase. Mario acquired 2 expressive language targets (M=.6) in DTT compared to 0 (M=0) in PRT (See Figure 8 for all domains). Although this overall pattern reflects a possible superiority of DTT for this domain, these results should be interpreted with caution due to the small number of expressive language skills learned in either treatment. Mario acquired receptive language skills more rapidly in PRT. He acquired 8 targets (M=4.3) compared to 3 targets (M=2.1) in DTT. This pattern began to emerge during the fourth week of treatment. There was also a more consistent upward trend in PRT compared to DTT, where Mario demonstrated difficulty with maintenance across the treatment phase. There was an overall lack of differentiation in play and imitation acquisition. Mario acquired 2 skills each in PRT and DTT for both domains. The mean number of play skills acquired was 1.8 and 2 in PRT and DTT respectively. The mean number of imitation skills acquired was 1.3 in both PRT and DTT.

Generalization. Mario demonstrated superior generalization in PRT compared to DTT early in treatment, but this difference attenuated as treatment progressed (Figure 9). He generalized 9 (*M*=4.6) and 10 (*M*=3.4) targets in PRT and DTT respectively. Mario's pattern of generalization also generally mirrored how he learned during treatment. He generalized one of the expressive language targets he acquired in DTT, with a mean of 0 across probes in PRT and .4 in DTT (See Figure 10 for all domains). In receptive language, he demonstrated a consistently superior rate of generalization in PRT, where he generalized 7 targets (*M*=3.6) compared to 5 (*M*=1.8) in DTT. Although the overall and mean difference between conditions was lower compared to other comparisons, this difference was highly consistent across data points. Similar to patterns of acquisition in play and imitation, there was little differentiation in generalization between the two treatments. There were negligible mean differences between treatment conditions in these domains.

Maintenance. Maintenance was not measured for Mario as he discontinued participation prior to this phase of the study.

Spontaneity. Spontaneous skill use was more frequent in DTT compared to PRT based on mean percent of intervals across generalization probes (*M*=12%, *SD*=9 in PRT; *M*=22%, *SD*=28 in DTT). However, this superiority was driven by an extreme outlier during the Week 2 generalization probe. When removed, there was no mean difference between conditions and significant overlap across probes. No treatment was consistently superior in terms of percent of intervals with spontaneous skill use (Figure 19). Mario demonstrated a greater variability of spontaneous skill use in PRT, where he used 6 different actions, compared to DTT, where he used 5 different actions. He also spontaneously said 2 different words in PRT compared to no words learned in DTT (Figure 20).

Parent Report of Language Skills. Parents reported that Mario understood and said an equal number of words that were taught in PRT and DTT (Figure 21). In particular, they reported that he knew 2 receptive language targets taught in both PRT and DTT at post-treatment. They reported that he knew 1 expressive language target taught in PRT and DTT at follow-up.

Sally

Acquisition. Sally demonstrated more rapid overall acquisition of targets in DTT (Figure 11). She acquired 11 (*M*=3.3) and 18 (6.8) targets in PRT and DTT respectively. This pattern emerged during the fourth week of treatment and continued throughout the treatment phase. By domain, she acquired 7 (*M*=2) expressive language targets in PRT and 5 (*M*=1.5) in DTT (See Figure 12 for all domains). Given the frequent overlap throughout the treatment phase and small mean difference, clear superiority was not demonstrated. Sally acquired 1 (*M*=.5) and 2 (*M*=1.3) receptive language targets in PRT and DTT respectively. However, it appeared she may have had a later emerging and slight superiority of DTT for the acquisition of receptive language targets. She acquired 0 (*M*=0) and 3 (*M*=.5) play targets in PRT and DTT respectively. This difference emerged in the last several sessions of the treatment phase and should be interpreted cautiously. The bulk of the superiority of DTT appears to have been driven by the acquisition of imitation targets. Sally acquired 3 targets in PRT (*M*=.8) and 8 in DTT (*M*=3.4). The superiority of DTT emerged during week 4 and was consistent across the treatment phase.

Generalization. Sally generalized 5 targets in PRT (*M*=1.6) and 12 targets in DTT (*M*=4.3) by the end of the treatment phase. She demonstrated consistently superior generalization in DTT across probes (Figure 13). In expressive language, Sally tended to generalize expressive targets better in PRT, especially during later generalization probes (See Figure 14 for all domains). She generalized 5 targets in PRT (*M*=1.3) and 2 in DTT (*M*=.8). In receptive language, Sally generalized 2 targets in DTT (*M*=.4) and 0 targets in PRT (*M*=0). There was a clear advantage of DTT in imitation where Sally generalized 5 (*M*=2.8) compared to 0 (*M*=.3) targets in DTT and PRT respectively. Finally, she generalized 3 play targets in DTT (*M*=.3) compared to 0 in PRT (*M*=0) by the end of the treatment phase. This pattern was delayed, as a difference only emerged during the last 2 probes of the treatment phase.

Maintenance. Sally demonstrated a high degree of skill loss overall during the follow-up period (Figures 11-14). She maintained approximately half of the previously acquired target skills overall, however the relative superiority of DTT remained. Although PRT was superior at the end of the treatment phase for expressive language, this did not sustain over time. Sally maintained most of the receptive language targets, where there was a continued superiority of DTT. She did not demonstrate any play skills at follow-up. Finally, she maintained the majority of the imitation skills in both conditions. Similar to during the treatment phase, DTT was superior in this domain.

Spontaneity. Spontaneous skill use was more frequent in DTT compared to PRT based on mean percent of intervals across generalization probes for Sally (Figure 19; *M*=8%, *SD*=9 in PRT; *M*=19%, *SD*=16 in DTT). Similar to other participants, these data were highly variable across weeks. There were no differences between conditions during the first 7 weeks of the treatment phase, followed by a superiority of DTT during weeks 8-11. During the last week of treatment, this pattern reversed followed by a superiority of DTT at follow-up. Interestingly, DTT appeared to be superior for Sally in terms of spontaneous use of actions, whereas PRT was superior for spontaneous word use. She used 4 different PRT actions and 7 different DTT actions (Figure 20). She used 3 different words spontaneously in PRT compared to 1 different word in DTT.

Parent Report of Language Skills. Parents reported that Sally understood a greater number of receptive language targets that were taught in DTT compared to PRT (Figure 22). They reported that she understood 0 and 3 receptive language targets taught in PRT and DTT respectively at post-treatment. At follow-up, they reported that she knew 1 and 6 targets in PRT and DTT respectively. In regards to the expressive language domain, parents reported that Sally said 1 PRT and DTT target each at post-treatment. They reported that she said 6 PRT targets and 5 DTT targets at follow-up.

Leo

Acquisition. Leo demonstrated more rapid overall acquisition of skills in DTT, where he acquired 17 target skills (*M*=7.1) as compared to 11 in PRT (*M*=4.1). This trend emerged during the sixth week or treatment and was consistent throughout the remainder of the treatment phase (Figure 15). During the middle phase of treatment, Leo had acquired slightly more expressive language targets in DTT (See Figure 16 for all domains). However, he had difficulty maintaining these skills, while he demonstrated the opposite effect in PRT. There was a swap of this modest superiority during the tenth week of treatment. Again, since Leo did not acquire many expressive language targets, 2 in PRT (*M*=.7) and 0 in DTT (*M*=.9), and given the lack of difference in overall probe means, these results should be interpreted with caution. Acquisition of receptive language and play targets was superior in DTT. Leo acquired 4 receptive language targets in PRT (*M*=1.3) and 7 in DTT (*M*=2.3). He acquired 1 (*M*=.7) and 5 (*M*=2.2) play targets in PRT and DTT respectively. Leo acquired approximately the same number of imitation skills in both treatments. He acquired 5 targets in PRT (*M*=1.5) and 4 in DTT (*M*=1.8) with significant overlap throughout the treatment phase.

Generalization. Leo's pattern of generalization was similar to his acquisition of target skills. Overall, he generalized 12 targets in DTT (*M*=5.1) and 8 targets in PRT (*M*=2.7; Figure 17). His generalization of expressive language skills was similar across treatments, where he generalized 1 skill in PRT (*M*=.3) and DTT (*M*=1; See Figure 18 for all domains). In this domain, he initially demonstrated better generalization in DTT, which attenuated at the same time this change occurred in acquisition. Also similar to acquisition, Leo demonstrated superior generalization of receptive language and play targets in DTT. However, the superiority of DTT for receptive language was less clear and may not represent a clinically significant difference. During the final generalization probe, he generalized 2 (*M*=.6) PRT and 3 (*M*=1.2) DTT receptive language targets. There was overlap of treatments in receptive language during the first 8 weeks of treatment. In play, he generalized 1 (*M*=.6) PRT target and 4 (*M*=1.8) DTT targets. His pattern of generalization in the imitation domain was similar across treatments. He generalized 4 imitation targets in each condition by the final probe, with a mean of 1.2 and 1.1 for PRT and DTT respectively.

Maintenance. The overall superiority of DTT that was demonstrated during the treatment phase did not maintain in the follow-up period (Figures 15-18). Overall, Leo demonstrated significant overall skill loss in DTT compared to minor skill loss in PRT. These patterns were consistent across acquisition and generalization probes. In expressive language, where Leo demonstrated similar patterns between conditions during treatment, he demonstrated a minor superiority of DTT based on the maintenance probe. However, this difference is not considered clinically significant. Similarly, he demonstrated a minor but clinically insignificant superiority of PRT for receptive language. Importantly, Leo lost all of the receptive language skills he had learned in DTT compared to maintaining those he learned in PRT. This same pattern occurred for play skills. Finally, patterns demonstrated during the treatment phase were similar at follow-up for imitation skills, where Leo performed similarly in PRT and DTT.

Spontaneity. Spontaneous skill use was similar between conditions based on mean percent of intervals across generalization probes for Leo (Figure 19; *M*=22%, *SD*=22 in PRT; *M*=27%, *SD*=17 in DTT). Again, these data were highly variable across weeks. There were some weeks where DTT was superior, primarily during the first half of the treatment phase. There were other weeks, primarily during the later half of the treatment phase, where PRT was superior. At follow-up, Leo performed spontaneous skills learned in DTT more frequently. As mentioned previously, these results should be interpreted with caution given the extreme variability during the treatment phase. In regards to variability of skills used spontaneously, there was a minor superiority of PRT. Leo used 10 actions learned in PRT compared to 9 learned in DTT. Overall, neither treatment emerged as clearly superior for spontaneous skill use.

Parent Report of Language Skills. Parents reported that Leo understood a greater number of receptive language targets that were taught in DTT compared to PRT (Figure 22). They reported that he understood 1 PRT and 5 DTT receptive language targets at post-treatment. At follow-up, they reported that he knew 2 PRT and 7 DTT targets. In the expressive language domain, parents reported that Leo said a greater number of expressive language targets from PRT compared to DTT by the follow-up period. They reported that he said no PRT targets and 1 DTT target at post-treatment, reflecting a minor superiority of DTT. They reported that Leo said 3 PRT and 1 DTT target at follow-up, indicating superiority of PRT.

Number of Opportunities

The total number of trials per session was collected for 33% of all sessions to assess procedural fidelity of target opportunities (i.e. at least 5 opportunities for targets in acquisition) and compare the total number of learning opportunities for the experimental target between conditions. Overall, the total number of trials per session was comparable in PRT and DTT across participants. An overall average of 45 trials (range: 22-74) occurred during PRT sessions. An overall average of 41 trials (range: 15-64) occurred during DTT sessions. For Jonah, the average number of trials was 44 (range: 28-60) for PRT and 38 (range: 27-47) for DTT. For Mario, the average number of trials in PRT was 43(range: 22-65) and 35 (range: 17-56) in DTT. The average number of trials was 43 (range: 25-58) in PRT and 46 (range: 15-64) in DTT for Sally. For Leo, the average number of trials was 49 (range: 31-74) and 44 (range: 30-59) for PRT and DTT respectively.

Procedural fidelity of target opportunities was high in both PRT and DTT. On average, RAs provided at least 5 opportunities per session for 93% of PRT targets (range: 50%-100%). And 90% of DTT targets (range: 33%-100%). RAs reported a handful of reasons for not providing sufficient opportunities. These included difficulty creating motivation for the target skill (specific to PRT), running out of session time, and disruptive behaviors during session.

Predictors of Differential Treatment Response

The second aim of this study was to identify whether there were specific child variables related to how specific children responded to DTT and/or PRT. In particular, a variety of standardized and non-standardized behavioral measures were examined in terms of their relationship to whether participants were more likely to benefit from DTT or PRT in each of the tested domain areas. Due to the small sample size, these results are presented descriptively. These results are preliminary given the sample size and should be interpreted with caution.

Standardized Measures

There was no clear relationship between pre-treatment scores on the Mullen Scales of Early Learning or Vineland Adaptive Behavior Scales and differential response to treatment across participants. Similarly, specific item scores on the ADOS-T were also evaluated in terms of their utility as potential treatment predictor variables and no clear patterns were identified.

Sally and Leo, who tended to perform better in DTT in some domains, had fewer words said/understood on the MCDI at pre-treatment. Similarly, parents reported that they said fewer words. In particular, they said zero non-animal sounds/words. Jonah and Mario, who tended to perform better in PRT in some domains, obtained lower standard scores on the Temperament and Regulatory Index of the TABS, which reflects a greater number of early emerging atypical temperament and self-regulatory behaviors. See Table 1 for a summary of pre-treatment scores on these assessment measures.

Behavioral Measures

SLO Behaviors. There were no clear patterns between the majority of the behaviors derived from the PRT Predictive Profile and differential response to PRT and DTT (Figure 23). Jonah, Mario, Sally, and Leo engaged in toy contact/object manipulation 67%, 63%, 37%, and 87% of intervals respectively. They engaged in approach 3%, 30%, 10%, and 10% of intervals respectively. Verbal stereotypy was observed in 13%, 27%, 20%, and 30% of intervals for Jonah, Mario, Sally, and Leo. Nonverbal stereotypy was observed in 27%, 10%, 30%, and 27% respectively. Finally, patterns of avoidance during this assessment did follow a pattern potentially related to response to treatment. Jonah and Mario, who tended to learn better in PRT in some domains, demonstrated avoidant behavior in fewer percent of intervals compared to Sally and Leo, who tended to do better in DTT in some domains. In particular, Jonah and Mario demonstrated avoidance behaviors in 20% and 27% of intervals. Sally and Leo demonstrated avoidance behaviors in 40% and 53% of intervals. These differences were even greater when avoidance was only compared during intervals where the parent actively attempted to engage the child (i.e. during the last 10 minutes of the assessment). At this level of analysis, Jonah and Mario both demonstrated avoidance behaviors in 20% of intervals. Sally and Leo demonstrated avoidance behaviors in 37% and 40% of intervals (Figure 24).

Clinician Judgment. Clinician responses on the Clinical Judgment Assessment (CJA) were compared to actual child responsivity across child in each domain (Table 12). Clinician judgment was considered congruent to child response if either the clinician advocated the intervention to which the child responded best in the given domain or the clinician advocated PRT or DTT and the child responded equally to both interventions. Clinicians selected interventions congruent with actual treatment response in 38% of the child/domain items. This percent agreement was approximately at chance as there were 3 options (i.e. PRT, DTT, and Combined). In all cases of agreement, the clinician predicted that the child would respond best to

PRT. The majority of the disagreements occurred when the clinician predicted that a combined approach would be optimal and the child responded best to either PRT or DTT alone. Reasons clinicians provided as rationale for PRT included that the child was already talking, imitating others, or interested in toys. In addition, clinicians suggested that PRT was helpful for counteracting stereotyped play, for teaching within the natural environment and with child motivation, and for generalization. Reasons clinicians provided as rationale for DTT included that the child was considerably behind in the domain area or rigid during play. In addition, the structured format of DTT and speed of acquisition were listed as reasons for using DTT. When clinicians suggested a combined approach, they reported that children needed the structure of DTT and PRT for the focus on generalization and learning in the natural environment.

Time to Responsivity

The final aim of the study was to identify how early on in the treatment process patterns of responsivity emerged in DTT and PRT, respectively. As these data are based on a small sample size and exploratory in nature, they should be interpreted with caution. For many of the domain areas where there was a clear differentiation in treatment responsivity between PRT and DTT, patterns emerged by the first or second discrimination. In other words, patterns emerged at approximately the same time the child learned to differentiate 2-3 skills in a particular domain area. The week during treatment that this occurred varied between participants and domains. For Jonah, the superiority of PRT emerged during weeks 2 and 3, whereas it emerged during weeks 3 and 4 for Mario. Sally demonstrated clear patterns in the imitation domain during week 4 but patterns for expressive language and play did not emerge until weeks 9 and

11 respectively. Finally, the superiority of DTT for Leo emerged during week 5 for play and week 9 for receptive language.

DISCUSSION

PRT and DTT for Children At-risk for Autism

The current investigation involved providing both Discrete Trial Training (DTT) and Pivotal Response Training (PRT) to children at risk for ASD under the age of 3 for teaching expressive and receptive language, play, and imitation skills. All participants learned target skills in both treatments. The children also demonstrated some generalization, maintenance, and spontaneous use of skills acquired during both DTT and PRT. This strengthens the literature on the evidence base for both treatments. Importantly, this also provides support for the use of these treatments for teaching children under the age of 3, for which evidence is growing (Dawson et al., 2010; Stahmer, Akshoomoff, et al., 2011). This is significant given the increasingly early age at start of intervention for children with autism (Dawson, 2008; Schertz et al., 2010). Additionally, this study provides support for the use of PRT for teaching a broader range of skills. Although PRT has been shown to be effective for teaching expressive language and play skills (e.g., Koegel et al., 1998, 1992; Stahmer, 1999; Stahmer, Thorp & Schreibman, 1995), this study extends the evidence supporting PRT for teaching other important skills, such as receptive language and imitation skills. Finally and as expected, treatment response varied significantly across participants and domain areas. In line with what has been found in a multitude of other studies (e.g., Sallows & Graupner, 2005; Sandall et al., 2011; Sherer & Schreibman, 2005), each child benefited to differing degrees from intervention.

Relative Efficacy of DTT and PRT

The primary aim of this study was to evaluate whether the efficacy of DTT and PRT varied between children and domain of focus. The results do not support the concept of one best treatment for all children with autism. Instead, the findings suggest that individual children respond in unique ways to PRT and DTT, and even more, that the same child may respond differently to these interventions depending on the skill or dimension being measured. The results emphasize the apparently idiosyncratic and variable nature of autism spectrum disorders and treatment responsivity that has been referenced by many (Delmolino & Harris, 2012; Stahmer, Schreibman, et al., 2011; Wallace & Rogers, 2010). Indeed, in this sample, PRT was more effective for some children, domains, and dimensions of behavior, whereas DTT was more effective for others. Even more, the results suggest that in some cases, a combination of PRT and DTT may be optimal. Although several groups have emphasized the potential value in blending structured and naturalistic behavioral interventions (Smith, 2001; Steege et al., 2007; Sundberg & Partington, 2010), the results do not support the pre-determined prescription of specific approaches for specific domain areas across all children, which has been suggested by some researchers (e.g., Arick et al, 2003). Instead, the results suggest that the most effective method of combination may vary by child, both in regards to domain and dimension of the target skill (e.g., acquisition, maintenance, generalization). The specific patterns are discussed in more detail below, which provide some insight into methods of treatment individualization.

There were two participants whose response patterns tended to favor PRT. Jonah demonstrated a superiority of PRT overall, however this was most salient for expressive language gains. There was some preference for PRT for receptive language; however this difference dissipated over time. One explanation may be that receptive language became a strength for Jonah, such that he learned well in both interventions. Alternatively, he may not have required specialized instruction for receptive language at this point in the treatment process.

Overall, Mario also tended to benefit more from PRT. However, the areas where the differences between treatments emerged were distinct. Mario showed a relative benefit of PRT in receptive language, primarily. It is worth pointing out that Mario did demonstrate a slight superiority of DTT in expressive language. However, as this difference was based on a very small number of targets and given the design of the study, this difference may be an artifact of the difficulty level of the targets. Targets matched on difficulty level were randomly assigned to conditions, but specific targets may have been particularly challenging for a given child. With a larger number of targets, it is expected that any idiosyncratic differences would be counterbalanced between conditions. Importantly, both Jonah and Mario learned similarly in DTT and PRT for play and imitation skills. No firm conclusions can be drawn for expressive language or maintenance of skills for Mario.

The patterns across domains for these two participants were similar for the acquisition, generalization, and maintenance of gains. These findings corroborate previous reports of the benefits of PRT for the generalization and maintenance of learned skills (Koegel et al., 1998, 1992, 1987, 1988; Sigafoos et al., 2006; Williams & Koegel, 1981). Gains made in DTT were also generalized and maintained across time, but the relative benefit of PRT for these participants was greater across dimensions. Both Jonah and Mario also demonstrated greater spontaneity of the skills learned in PRT, which replicates previous research comparing naturalistic and structured behavioral treatments (See Delprato, 2001 for review). Finally, parents reported that their children knew an equal or greater number of words receptively and expressively in PRT outside the treatment setting.

Taken as a whole, these participants' response profiles suggest that a child like Jonah or Mario would benefit most from a naturalistic behavioral approach alone. These differences were most apparent for expressive and receptive language. There did not appear to be any relative strengths of DTT for these children, nor does it appear that providing both treatments would have led to any added benefit. There were some domains where the participants responded equally to both interventions. However, it is argued that a naturalistic intervention is more appropriate for this population when all else is found to be equal. Indeed, researchers have suggested that naturalistic interventions are best suited for younger children (Stahmer, Brookman-Frazee, Lee, Searcy, & Reed, 2011; Wallace & Rogers, 2010). Additionally, approaches like PRT are more consistent with the central concept of providing learning opportunities to children in the least restrictive environment (National Research Council, 2001; Iovannone, Dunlap, Huber, & Kincaid, 2003).

In contrast, the other two participants benefited more from DTT overall. For Sally, this was most apparent for imitation skills. A later emerging DTT superiority was also evident in receptive language and play. Interestingly, PRT was more effective for expressive language, although to a lesser degree. The relative benefits of DTT and PRT held consistent for assessments of generalization and spontaneity. She demonstrated greater spontaneity of actions learned in DTT and words learned in PRT, mirroring the relative benefit demonstrated with DTT for imitation, play, and receptive language, and PRT for expressive language. A different pattern emerged for maintenance of gains, where Sally demonstrated significant skill loss of targets learned in both interventions at follow-up. The relative benefit of DTT was maintained for imitation and receptive language, whereas gains made in play and expressive language did not maintain through follow-up.

Leo also learned more rapidly in DTT overall. This pattern was demonstrated to the greatest degree for play and receptive language. Similar to Sally, there was a trend of superiority of PRT for expressive language. These patterns were consistent across generalization assessments and parent report of skill use. There were no clear differences between conditions in spontaneity of skill use. Importantly, the superiority of DTT did not maintain across follow-up. Leo maintained most of the target skills he learned in PRT, but he lost a relatively larger proportion of the target skills learned in DTT. This resulted in undifferentiated maintenance of targets skills between conditions.

Whereas Jonah and Mario tended to acquire more skills in PRT, Sally and Leo tended to acquire more skills in DTT. However, an interesting difference between these response patterns was apparent. For both Sally and Leo, there were dimensions and learning domains where performance was limited in DTT and superior in PRT, suggesting that a hybrid approach may be best for these children. This suggests that there may be reasons to implement both DTT and PRT with these children. This differs from the patterns observed with Jonah and Mario, who had optimal or equal performance across areas and dimensions in PRT. As mentioned previously, several researchers have specifically suggested that a combination of structured and naturalistic procedures may be the most effective method for some children with autism (Smith, 2001; Steege et al., 2007; Sundberg & Partington, 2010) and have developed models that combine the use of these interventions in different ways (Arick et al., 2003; Dawson et al., 2010; Stahmer & Ingersoll, 2004; Stahmer, Akshoomoff, & Cunningham, 2011). Importantly, these arguments have been primarily theoretical and not based on systematic, comparative research.

Importantly, this research enabled more concrete conclusions to be drawn regarding methods of individualization. In particular, children who tended to respond well to DTT benefited from DTT in the acquisition and generalization of skills, including receptive language, play, and imitation. DTT had some limitations in regards to expressive language learning, maintenance of gains, and spontaneous use of skills learned. This is consistent with early comparative research that identified some limitations of DTT with older children (Delprato, 2001; Miranda-Linné & Melin, 1992).

For both Sally and Leo, there was a trend of PRT superiority for expressive language. This finding, along with patterns identified for Jonah and Mario, emphasizes the importance of incorporating naturalistic and motivated-based procedures into interventions targeting functional communication skills. Importantly, these results extended beyond basic expressive language (i.e. preferred objects) about which the bulk of PRT research has been conducted. In this sample, some children also made measureable gains in learning expressive actions, as well as receptive objects and actions. Additionally, Sally and Leo also showed some failure to maintain and spontaneously use skills acquired and generalized in DTT. It may be that combining both DTT and PRT for children fitting profiles similar to Sally and Leo would result in improved outcomes over time and across settings. This approach may incorporate the strengths of each intervention.

Contrary to earlier research (See Delprato, 2001 for review), patterns of generalization often mirrored patterns of acquisition in DTT. This may be related to the fact that highly structured interventions like DTT have been modified since many of the comparison studies were conducted. Some of these modifications were designed to address some of the known limitations of DTT, such as lack of generalization. This study followed manualized approaches that more closely match the way these interventions are implemented today (Lovaas, 2002; Smith, 2001). Alternatively, this finding may also be related to the relatively contrived nature of the generalization assessments. Although generalization across people, materials, and settings was assessed, the generalization probes still involved relatively explicit cues from an adult. These assessments may not reflect potential differences in the generalized use of target skills in more naturally occurring opportunities. Finally, it may be that younger children identified at risk for autism may possess different behavioral profiles than those children examined in earlier research. For instance, they may demonstrate fewer or less severe symptoms early on, such that learning may follow a more typical trajectory. They may not demonstrate the same deficits with generalization. Follow-up research on this question is important.

Ultimately, these results support the importance of treatment individualization for young children with autism and provide some preliminary evidence for different clusters of children in regards to treatment response. For this information to be useful to clinicians making a priori treatment decisions, it would be important to identify child characteristics related to these response patterns.

Predictors of Differential Treatment Response

An ultimate goal of this line of research is to identify pre-treatment variables that can be used even before treatment begins to identify the most likely beneficial intervention. Accordingly, the second aim of this study was to identify whether there were child variables that related to how specific children responded to PRT and DTT. As was previously mentioned, these results are exploratory given the small sample size. Further study with a larger sample size would be important to confirm these preliminary results.

Standardized Measures

Many variables typically used to characterize children with autism failed to discriminate those participants who benefited to a greater degree from PRT or DTT. In particular, there were no clear relationships between pre-treatment developmental functioning, adaptive behavior, or symptom severity and differential response to treatment. Similarly, child age did not appear related to which intervention benefited particular participants, nor did overall rate of learning. This is notable as these variables have often been cited in relation to overall treatment outcome (Ben-Itzchak & Zachor, 2009, 2011; Ben-Itzchak & Zachor, 2006; Darrou et al., 2010; Granpeesheh et al., 2009; Harris & Handleman, 2000; Perry et al., 2011; T. Smith et al., 2000). However, this study is unique as it explored variables related not to overall treatment outcome, but instead to differential responsivity to two distinct treatment approaches.

Although this result may reflect a true disconnect between these variables and differential responsivity to specific treatments, it might also be explained by the small sample size, lack of variability on these measures in this sample, or lack of sensitivity of these measures for this purpose. Indeed, all participants scored relatively low on measures of developmental functioning and adaptive behavior. They were also all rated as being at moderate-to-high risk for an autism spectrum disorder on the ADOS-T. Finally, the ADOS was designed to detect categorical risk rather than to measure minute differences in symptom severity. Thus, it may lack the sensitivity to detect individual differences in symptom presentation (Cunningham, 2012). Although these results are interesting, they should be interpreted with caution and warrant follow-up study. Jonah and Mario, who tended to perform better in PRT, obtained more impacted scores on the Temperamental and Regulatory Index of the TABS. This finding is difficult to interpret and may be an artifact of the exploratory nature of these analyses.

It is notable that Sally and Leo, who tended to perform better in DTT in some domains, were reported to have limited vocabularies on the MCDI compared to Jonah and Mario at pre-treatment. This was particularly evident for non-animal sounds/words, where both children were reported to use no non-animal sound/words expressively on the MCDI. Similar results were found in another study evaluating naturalistic behavioral interventions, where children with some language at pre-treatment were significantly more likely to benefit from PRT or the Picture Exchange Communication System than those with no expressive language at pre-treatment (Cunningham et al., 2008). Additionally, early language use has been noted as one of the strongest predictors of overall treatment outcomes for children with autism (Ben-Itzchak & Zachor, 2009, 2011; Ben-Itzchak & Zachor, 2006; Darrou et al., 2010; Sallows & Graupner, 2005). This study contributes to the literature by suggesting that children who enter treatment with very little language may benefit from the incorporation of both highly structured behavioral intervention strategies and naturalistic behavioral approaches. Importantly, although the results do emphasize that a hybrid approach may be optimal for these children, additional research would be necessary to better understand the necessary components of this combination.

Behavioral Measures

There was not a clear relationship between the majority of the behaviors included in the original PRT Predictive Profile (Sherer & Schreibman, 2005) and differential response to PRT and DTT. This finding is not surprising, as previous research on younger aged children receiving PRT found similar results (Cunningham et al., 2008; Schreibman et al., 2011). Indeed, early child characteristics of autism have been found to be less stable, more variable, and qualitatively different in comparison to children assessed at older ages (Sutera et al., 2007; Macdonald, Green, Mansfield, Geckeler, Gardenier, Anderson, et al., 2007) . Importantly, levels of avoidance did follow a pattern potentially related to response to treatment. Jonah and Mario, who tended to respond more positively to PRT, demonstrated lower levels of avoidance compared to the Sally and Leo. This finding is notable and is consistent with other studies that have found avoidance to be predictive of response to naturalistic behavioral interventions (Ingersoll et al., 2001; Sherer & Schreibman, 2005) but not necessarily structured behavioral interventions such as DTT

(Schreibman et al., 2009). Additionally, it makes theoretical sense that children who are avoidant of adults might be challenged in responding to a child-driven intervention. The adult-directed and highly structured format of DTT might help the child understand the expectations of therapy. Follow-up research would be important to identify the active ingredients of DTT or PRT that may make it relatively more or less effective for children demonstrating high levels of adult avoidance. Additionally, a larger-scale study would be necessary to evaluate the generalizability of these results.

Finally, clinician judgment or choice of interventions a priori was not congruent with actual treatment response. This finding further validates the utility of this type of research. Although providers report picking and choosing treatments based on the individual needs of children with autism (Stahmer, Collings, & Palinkas, 2005), this research suggests they may not be making optimal choices. This is not surprising given the paucity of evidence to support these decisions. This line of study may provide practitioners with evidence-based resources to better tailor treatments. Some of the rationale clinicians provided was congruent with the results of this study. For example, they advocated for PRT because the child was already using language and DTT because of the need for structure, which may have a relationship to avoidance. It might be valuable, in follow-up research, to collect clinician hypotheses and evaluate them systematically. Indeed, the literature on translating research to practice supports the use of collaborative, bi-directional research (Bondy & Brownell, 2004; Weisz, Chu, & Polo, 2004).

Time to Responsivity

The final aim of this study was to identify when in the treatment process patterns of responsivity emerged. There was some variability in regards to when, during treatment, patterns of differentiation emerged (should they occur). For some children and domains, differentiation became apparent as early as the third week of treatment. However, for other children, these patterns did not emerge until much later. Although preliminary, the data do suggest that for domains where the differentiation occurred earlier, the participants tended to demonstrate stronger maintenance of gains.

Despite the variability in time to responsivity, what was more notable was the small number of discriminations that occurred prior to the establishment of a pattern. Across all participants, patterns of differentiation—should they occur—emerged around the time that the first few skills were acquired in the superior treatment. Thus, these results suggest that it might be effective to provide both PRT and DTT early on and select the intervention where the child begins learning first. This method may be one way to adapt “decision tree” approaches, which have often based treatment decisions on the lack of responsivity after a certain amount of time (Dawson et al, 2010).

In sum, these results suggest a handful of variables that might be predictive of responsivity patterns in young children with autism just starting treatment. These include early learning patterns, adult avoidance, and language at intake. These child variables may be valuable in guiding early treatment decisions. These results of this study have important implications for the individualization of treatment for young children with autism learning language, play, and imitation skills.

Limitations and Future Directions

Although this study has some important implications, there are also several important limitations. First of all, because of the design of this project, PRT was implemented in a relatively contrived manner. It would not be typical for only one target to be introduced at a time in each domain or for very specific targets to be chosen for teaching. Instead, therapists would likely select a pool of targets related to the interests of the child. This is especially true for play and imitation, where choosing specific targets made it difficult to teach in as naturalistic of a manner. The results of this study might differ if the design of the project better matched how PRT might typically proceed. Follow-up studies where PRT is implemented more naturally would be beneficial to tease apart the influence of this modification.

Additionally, the format of the generalization probes may not have detected some potential differences in the generalization of skills. Although the assessments did measure generalization across people, settings, and materials, the administrators still provided explicit opportunities for the child to display the target skills. Potential differences in generalization to more natural environments were not measured. Based on previous comparative research on highly structured and naturalistic behavioral interventions, it is hypothesized that targets in PRT would demonstrate a greater breadth of generalization in natural environments.

A third limitation is that PRT and DTT share many similar features and a handful of distinctive features. It is difficult to tease apart whether the package of DTT and PRT or particular components make one treatment more effective than the other.

Along these lines, research aimed at identifying the active ingredients of interventions, such as a component analysis, would be a valuable area of further research.

Finally, the small number of subjects inherent in a single-subject design limits the generalizability of these findings across other children with autism. This is particularly important given the well known variability in behavioral presentation of autism spectrum disorders. Similarly, some children learned very few skills in some domains, which makes it difficult to draw overall conclusions. Although this type of design was necessary as a first phase of research, additional large-scale group design studies with a broader range of children would is essential.

Future directions for this line of research include examining response patterns and potential predictor variables through a prospective, large-scale group design. It would also be valuable to conduct community-based research whereby the findings were distilled into a useable format for community providers and evaluated for their utility. Finally, a component analysis of these interventions would be informative in regards to the active ingredients driving differential responsivity.

In sum, this study confirms that children respond in unique ways to PRT and DTT and suggests that the most effective approach may depend on the child, as well as the domain a nd dimension of interest. Additionally, some variables that may moderate these effects include early language use and adult avoidance. Finally, early response patterns may be predictive of longer-term responsivity. Overall, the results of this study confirm the importance of tailoring treatments to individual child needs and begin to suggest specific methods for such efforts. Ultimately, this study has important implications for treatment individualization for young children with autism and provides the foundation for further directions in this line of research.

TABLES

Table 1. Child Pre-treatment Characteristics

	Jonah	**Mario**	**Sally**	**Leo**	**ACE Subjects *M*(*SD*)**
Age (months)	27	22	29	26	23 (4.2)
Mullen Scales of Early Learning					
Early Learning Composite[a]	62	85	69	67	73 (19.5)
Expressive Language[b]	20	30	28	<20	30 (13.3)
Receptive Language[b]	20	44	20	<20	28 (14.8)
Fine Motor[b]	35	52	42	50	42 (11.4)
Visual Reception[b]	42	43	44	40	41.7 (10)
Vineland Adaptive Behavior Scales[a]					
Adaptive Behavior Composite	81	94	80	83	83 (9.4)
Communication	79	90	69	74	77.6 (14.3)
Daily Living Skills	82	99	82	93	88.5 (11.4)
Socialization	82	92	82	80	85.9 (14.2)
Motor	93	102	100	96	95 (11.2)
MacArthur Communicative Development Inventory					
Words Said	11	5	0	2	-
Non-animal Sounds Said	8	1	0	0	-
Words Said and Understood	121	117	30	72	-
Temperament and Atypical Behavior Scale[c]					
Temperament & Regulatory Index[a]	<51	<51	74	82	-
Detached[c]	<24	<24	29	42	-
Hyper-Sensitive/Active[c]	36	34	49	34	-
Underactive[c]	30	40	<28	53	-
Dysregulated[c]	53	53	53	40	-

[a]Standard Score, *M*=100, *SD*=15; [b]T-score, *M*=50, *SD*=10; [c]Standard Score, *M*=50, *SD*=15

Table 2. Assessments Administered at Each Treatment Phase

Condition	**Frequency**	**Assessments**
Pre-Treatment ⇓	1-3 days	Autism Diagnostic Observation Schedule-Toddler Module Mullen Scales of Early Learning Vineland Adaptive Behavior Scales, 2nd Edition Temperament and Atypical Behavior Scale MacArthur-Bates Communicative Development Inventory Adapted Student Learning Profile Structured Laboratory Observation Clinical Judgment Assessment Initial Acquisition Probe
Treatment ⇓	12 weeks	Trial-by-trial Session Data Spontaneous Use of Skills Fidelity of Implementation Acquisition Probes Generalization Probes
Post-Treatment ⇓	1-3 days	MacArthur-Bates Communicative Development Inventory Spontaneous Use of Skills Acquisition Probes Generalization Probes
3-month Follow-up	1-3 days	MacArthur-Bates Communicative Development Inventory Spontaneous Use of Skills Acquisition Probe Generalization Probe

Table 3. Experimental Target Treatment Pairs for Jonah

Expressive Objects		Expressive Actions		Receptive Objects		Receptive Actions		Play		Imitation	
PRT	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**
Keys	Bird	Sleeping	Reading	Button	Airplane	Wiping	Pulling	Stir Food	Pour Drink	Roll ball	Bounce ball
Bear	Fish	Breaking	Drawing	Penny	Necklace	Splashing	Driving	Answer the Phone	Put on Glasses	Put Object on Arm then Head	Put Object on Leg then Belly
Paper	Melon	Kicking	Ripping	Noodles	Pillow	Stamping	Pinching	Pump Gas	Wash Car	Roll & Cut Playdough	Flatten & Stamp Playdough
Beads	Ankle	Cutting	Twisting	Rock	Watch	Covering	Holding	Go on Swing	Spin on Round		
Cake	Bug	Building	*	Pen	Cheek			Stir Food (symbolic)	Pour Drink (symbolic)		
Tongue	Soap	Dumping	*	Shovel	Donut			*	Put on Glasses (symbolic)		
Pants	Shirt	Swimming	*	Doctor	Fireman			*	Wash Car (symbolic)		
Money	Crayon	Sweeping	*	Cowboy	Police						
Diaper	*	Smelling	*	Mailman	Clown						
Comb	*	Singing	*	Farm	Zoo						
				Playground	Park						

Note: *= No target introduced

Table 4. Experimental Target Treatment Pairs for Mario

Expressive Objects		**Expressive Actions**		**Receptive Objects**		**Receptive Actions**		**Play**		**Imitation**	
PRT	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**
Pen	Cup	Swinging	Dancing	Penny	Button	Breaking	Hitting	Pour Drink	Stir Food	Squish	Roll
*	Fish			Pants	Shirt	Wiping	Driving	Wash Car	Pump Gas	Stack & Knock Over	Put on Side & Roll
				Shovel	Paper	Sweeping	Dumping	Answer Phone	Put on Hat	Put Object on Arm then Head	Put Object on Leg then Belly
				Melon	*	Building	Drop it	Pour Drink & Take a Sip	Stir Food & Take a Bite		
				Pasta	*						

Note: * = No target introduced

Table 5. Experimental Target Treatment Pairs for Sally

Expressive Objects		Expressive Actions		Receptive Objects		Receptive Actions		Play		Imitation	
PRT	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**
Bird	Fish	Falling	Reading	Beads	Comb	Driving	Breaking	Put on Glasses	Answer the Phone	Make Animal Jump	Make Animal Sleep
Cup	Plate	Tickling	Blowing	*	Pen	Swinging	Wiping	*	Fly Airplane	Roll Ball	Bounce Ball
Bear	Horse			*	Pants			*	Push Car	Put Object on Arm	Push Blocks Together
Apple	Banana			*	Shirt					*	Roll Playdough with Pin
Fork	*									*	Put Object on Top
										*	Put Object on Belly
										*	Stack & Knock Over
										*	Animal Sleep then Blanket

Note: * = No target introduced

Table 6. Experimental Target Treatment Pairs for Leo

Expressive Objects		Expressive Actions		Receptive Objects		Receptive Actions		Play		Imitation	
PRT	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**
Pig	Bear	Reading	Hitting	Apple	Banana	Pulling	Drawing	Stir Food	Pour Drink	Stamp in Playdough	Cut Playdough
Spoon	*	Driving	Kicking	Cow	Horse	Sweeping	Wiping	Bounce Ball	Roll Ball	Animal Jump	Animal Sleep
				*	Pants	Shake	Knocking	Pump Gas	Wash Car	Clap 2 Blocks Together	Push 2 Blocks Together
				*	Shovel	*	Falling	*	Put on Hat	Put Object on Belly	Put Object on Arm
								*	Go Down Slide	Animal Jump then Go In	Animal Sleep then Blanket
								*	Spin on Round		

Note: * = No target introduced

Table 7. Summary of Operational Definitions of Structured Laboratory Observation (SLO) Behaviors

Toy Contact / Object Manipulation	The child interacts with a toy in the room in a functional and appropriate way for 5 consecutive seconds or more. The behavior should be scored if it is consistent with the object's intended function(s), even if it occurs repetitively. If a child has appropriate object interest with fewer than 3 objects during the entire assessment, score their overall toy contact as 0%.
Approach	The child moves to at least within arm's reach of the adult or looks at the adult's face outside of arms reach (must be clear). Do not score more than one interval for each occurrence of approach (do not include the whole time walking).
Avoidance	The child moves away from the adult, out of arm's reach, or actively physically avoids contact. Do not score during intervals in which the child remains away from the adult or moves further away. Only score those intervals in which the child physically moves away.
Verbal Stereotypy	Vocal utterances that appear to serve no apparent function and are not parent-directed. May or may not be odd in intonation.
Non-Verbal Stereotypy	Object or motor behaviors that appear to serve no apparent function and are not parent-directed.

Note. Operational definitions adapted from Sherer and Schreibman (2005).

Table 8. Summary of Operational Definitions for Spontaneous Behavior

Instructions: All scoring for the following behaviors are occurrence / non-occurrence across 30 second intervals. Indicate if the child spontaneously engaged in a target action or used a target word spontaneously at least once during the interval. If the child spontaneously engages in more than one target word or action during the interval, it is still only scored once. Use the skill bank sections to list the skills introduced by the date of the clip you are scoring. These are the skills you will be scoring. **Do not** score actions or words that were not targets.

Words	The child spontaneously says a word that was taught as a target skill. Positive Examples: The child says, "blanket" when the blanket is on the floor.; The child says, "ball" after the RA hands the child the ball while saying, "Good job!" Negative Examples: The child says, "ball," while the RA is expectantly holding balls in front of the child; The child says, "blanket" within 5 seconds of the RA saying, "What is it? ."
Actions	The child spontaneously engages in an action that was taught as a target skill. This skill may have been taught in play, imitation, or actions. Only score if the child is engaging in an action on the list. Positive Examples: The child stirs food after the RA gives her the bowl of food; The child takes a book from the floor and turns the pages. Negative Examples: The child stirs food after the RA just stirred another bowl of food; The child turns the pages of the book after the RA says, "What should we read?"

Table 9. Number of Skills Acquired and Generalized by Domain and Child

	Jonah		Mario		Sally		Leo	
	PRT	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**	**PRT**	**DTT**
Acquisition								
All	41	34	12	9	11	18	11	17
Expressive Language	20	11	0	2	7	5	2	0
Receptive Language	14	14	8	3	1	2	4	7
Play	4	6	2	2	0	3	1	5
Imitation	3	3	2	2	3	8	4	5
Generalization								
All	35	25	9	10	5	12	8	12
Expressive Language	17	10	0	1	5	2	1	1
Receptive Language	12	10	7	5	0	2	2	3
Play	3	2	1	2	0	3	1	4
Imitation	3	3	1	2	0	5	4	4

Table 10. Means and Standard Deviations for Number of Skills Acquired and Generalized in Each Domain for Each Participant

	Jonah				**Mario**				**Sally**				**Leo**			
	PRT		**DTT**		**PRT**		**DTT**		**PRT**		**DTT**		**PRT**		**DTT**	
Acquisition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
All	20.6	11.4	15.9	9.7	7.3	4.7	6	4.6	3.3	3.8	6.8	5.7	4.1	3.9	7.1	5.5
Expressive Language	7.8	5.5	4.1	3.2	0	0	.6	.5	2.0	2.3	1.5	1.8	.7	.8	.9	.9
Receptive Language	8.8	4.3	7.2	4.2	4.3	3.1	2.1	2.1	.5	.5	1.3	1.2	1.3	1.5	2.3	2.4
Play	1.9	1.3	2.7	2.1	1.8	.8	2.0	1.4	0	0	.5	.9	.7	.5	2.2	1.9
Imitation	2.1	1	2	1	1.3	.9	1.3	.8	.8	1.1	3.4	2.4	1.5	1.5	1.8	1.5
Generalization																
All	14.1	11	11.9	7.7	4.6	3.7	3.4	3.9	1.6	2.2	4.3	4.1	2.7	2.9	5.1	4.8
Expressive Language	5	5.7	1.7	3.4	0	0	.4	.5	1.3	1.8	.8	.9	.3	.5	1	.9
Receptive Language	6.1	4.2	5.4	3.4	3.6	2.8	1.8	1.8	0	0	.4	.7	.6	.8	1.2	1.5
Play	1.3	1.3	1.3	.7	.4	.5	.5	.8	0	0	.3	.9	.6	.5	1.8	1.6
Imitation	1.8	1.1	1.6	1.1	.6	.5	.8	.9	.3	.8	2.8	2.3	1.2	1.4	1.1	1.5

Table 11. Summary of Outcomes for Acquisition, Generalization, Maintenance, Spontaneity, and Parent Report of Skill Use

<table>
<tr><th></th><th colspan="2">All Skills</th><th colspan="2">Expressive Language</th><th colspan="2">Receptive Language</th><th colspan="2">Play</th><th colspan="2">Imitation</th></tr>
<tr><th>Jonah</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th></tr>
<tr><td>Acquisition</td><td>✓</td><td></td><td>✓</td><td></td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td></tr>
<tr><td>Generalization</td><td>✓</td><td></td><td>✓</td><td></td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td></tr>
<tr><td>Maintenance</td><td>✓</td><td></td><td>✓</td><td></td><td>✓
(a)</td><td>✓
(g)</td><td colspan="2">E</td><td colspan="2">E</td></tr>
<tr><td>Spontaneity</td><td>✓</td><td></td><td colspan="2">E</td><td></td><td></td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Parent Report</td><td></td><td></td><td>✓</td><td></td><td colspan="2">E</td><td></td><td></td><td></td><td></td></tr>
<tr><th></th><th colspan="2">All Skills</th><th colspan="2">Expressive Language</th><th colspan="2">Receptive Language</th><th colspan="2">Play</th><th colspan="2">Imitation</th></tr>
<tr><th>Mario</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th></tr>
<tr><td>Acquisition</td><td>✓</td><td></td><td colspan="2">E</td><td>✓</td><td></td><td colspan="2">E</td><td colspan="2">E</td></tr>
<tr><td>Generalization</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td></tr>
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<tr><td>Parent Report</td><td></td><td></td><td colspan="2">E</td><td colspan="2">E</td><td></td><td></td><td></td><td></td></tr>
<tr><th></th><th colspan="2">All Skills</th><th colspan="2">Expressive Language</th><th colspan="2">Receptive Language</th><th colspan="2">Play</th><th colspan="2">Imitation</th></tr>
<tr><th>Sally</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th></tr>
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<tr><td>Generalization</td><td></td><td>✓</td><td>✓</td><td></td><td colspan="2">E</td><td></td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>Maintenance</td><td></td><td>✓</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td><td></td><td>✓</td></tr>
<tr><td>Spontaneity</td><td colspan="2">E</td><td>✓</td><td></td><td></td><td></td><td></td><td>✓</td><td></td><td></td></tr>
<tr><td>Parent Report</td><td></td><td></td><td colspan="2">E</td><td></td><td>✓</td><td></td><td></td><td></td><td></td></tr>
<tr><th></th><th colspan="2">All Skills</th><th colspan="2">Expressive Language</th><th colspan="2">Receptive Language</th><th colspan="2">Play</th><th colspan="2">Imitation</th></tr>
<tr><th>Leo</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th><th>PRT</th><th>DTT</th></tr>
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<tr><td>Generalization</td><td></td><td>✓</td><td colspan="2">E</td><td colspan="2">E</td><td></td><td>✓</td><td colspan="2">E</td></tr>
<tr><td>Maintenance</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td><td colspan="2">E</td></tr>
<tr><td>Spontaneity</td><td>✓</td><td></td><td colspan="2">E</td><td></td><td></td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Parent Report</td><td></td><td></td><td>✓</td><td></td><td></td><td>✓</td><td></td><td></td><td></td><td></td></tr>
</table>

✓ - Superiority of treatment (skill mastery and/or mean difference >2); E - Equal performance across treatments (skill mastery difference and/or mean difference ≤2); a - Superiority for acquisition only; g - Superiority for generalization only; ✓ (Spontaneity/Parent Report) - Treatment with >1 difference; Gray – not applicable

Table 12. Comparison of Clinician Judgment and Child Response by Treatment and Domain

	Clinician Judgment		
Child Response	**PRT**	**DTT**	**Combined**
PRT	6	1	5
DTT	0	0	3
Combined	1	0	0

FIGURES

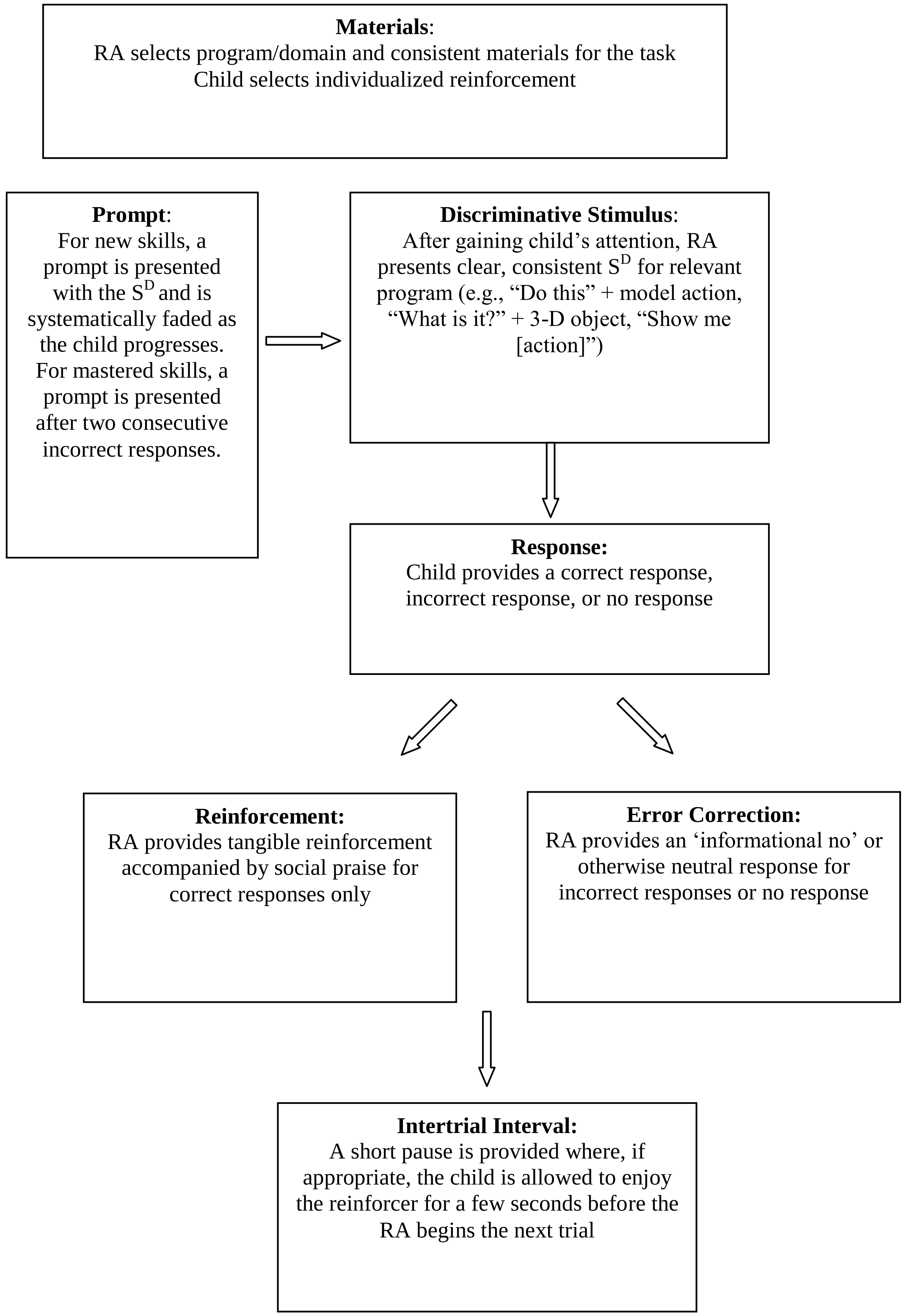

Figure 1. Discrete Trial Training Sequence

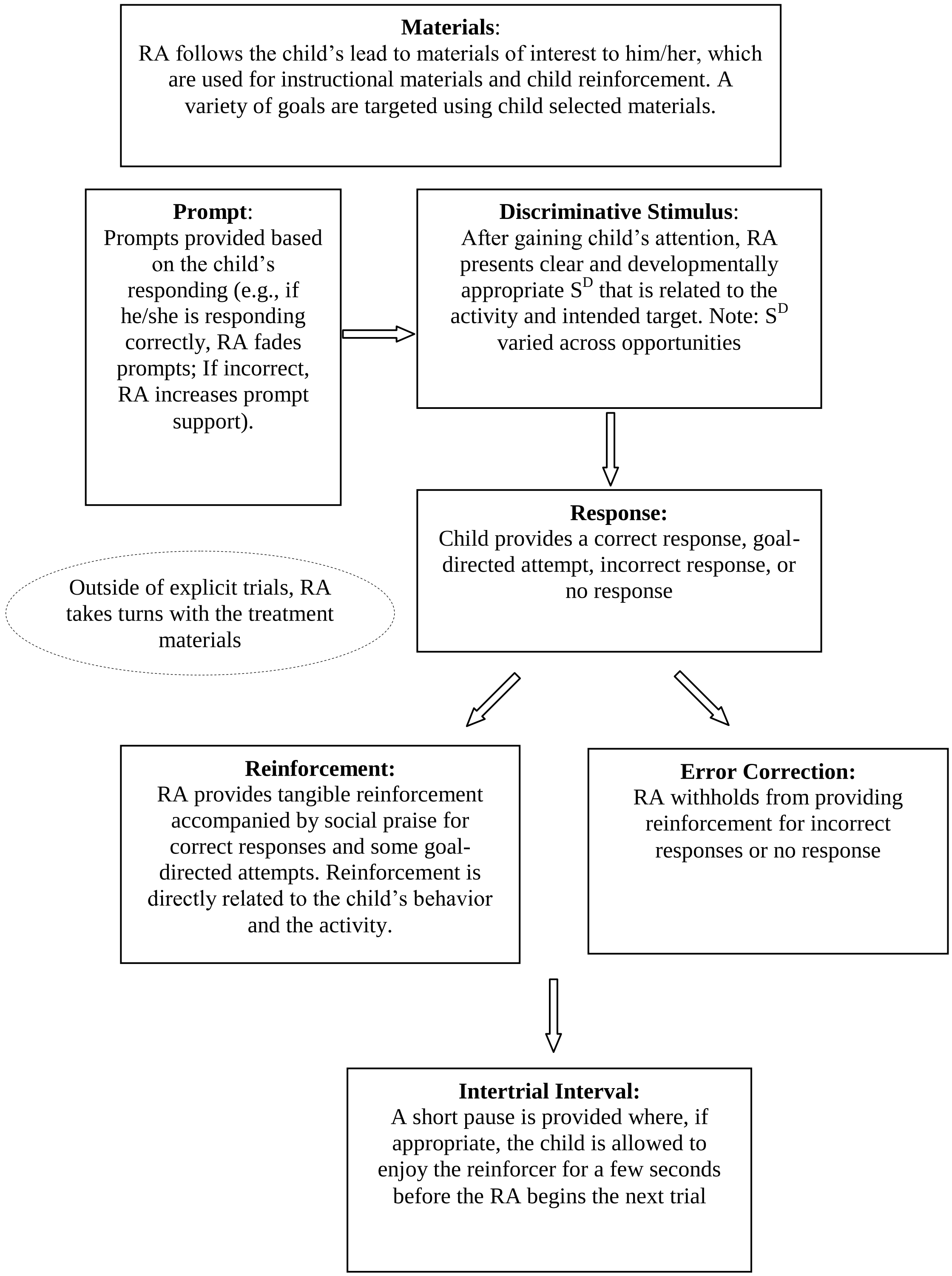

Figure 2. Pivotal Response Training Sequence

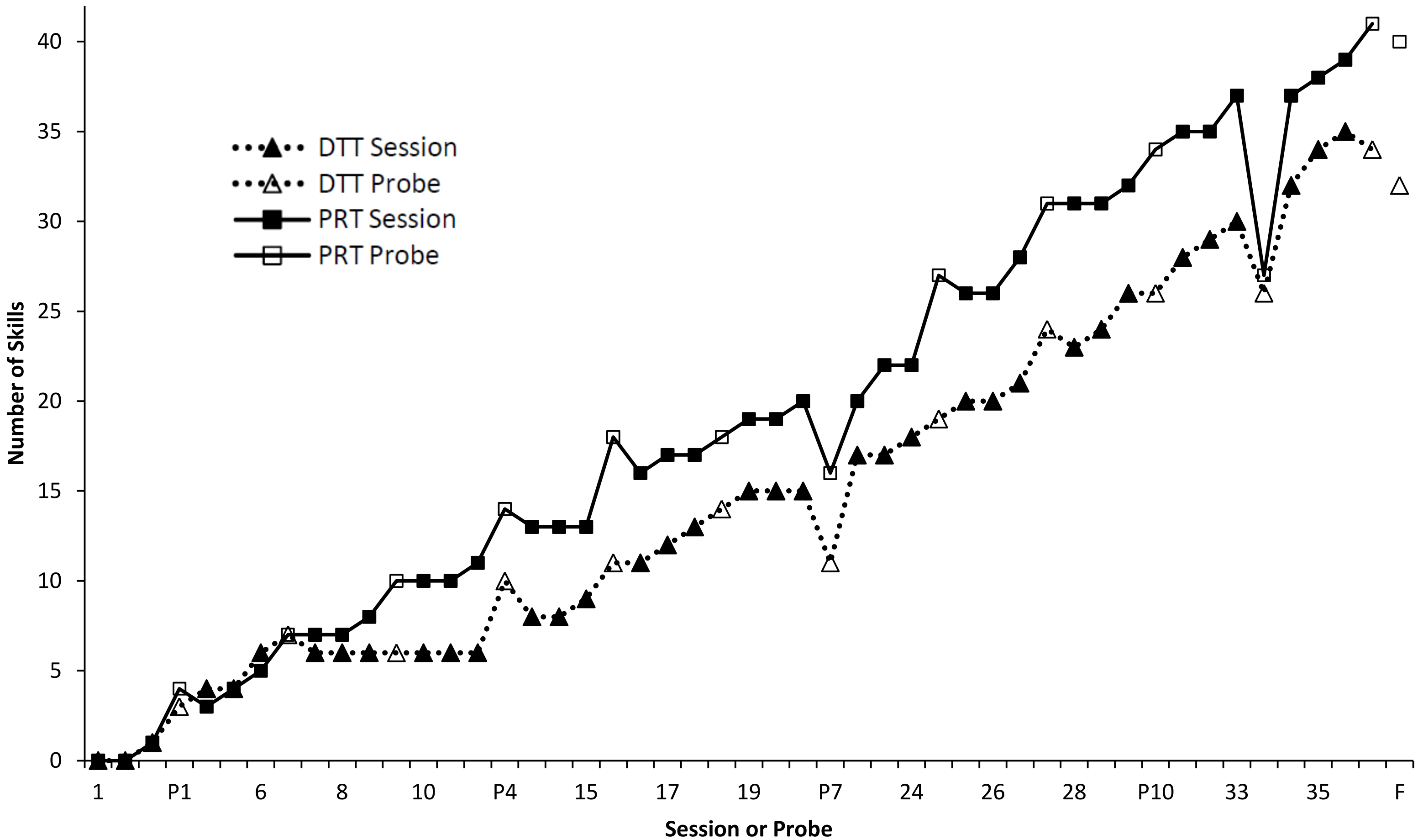

Figure 3. Jonah: Number of Skills Acquired for All Domains

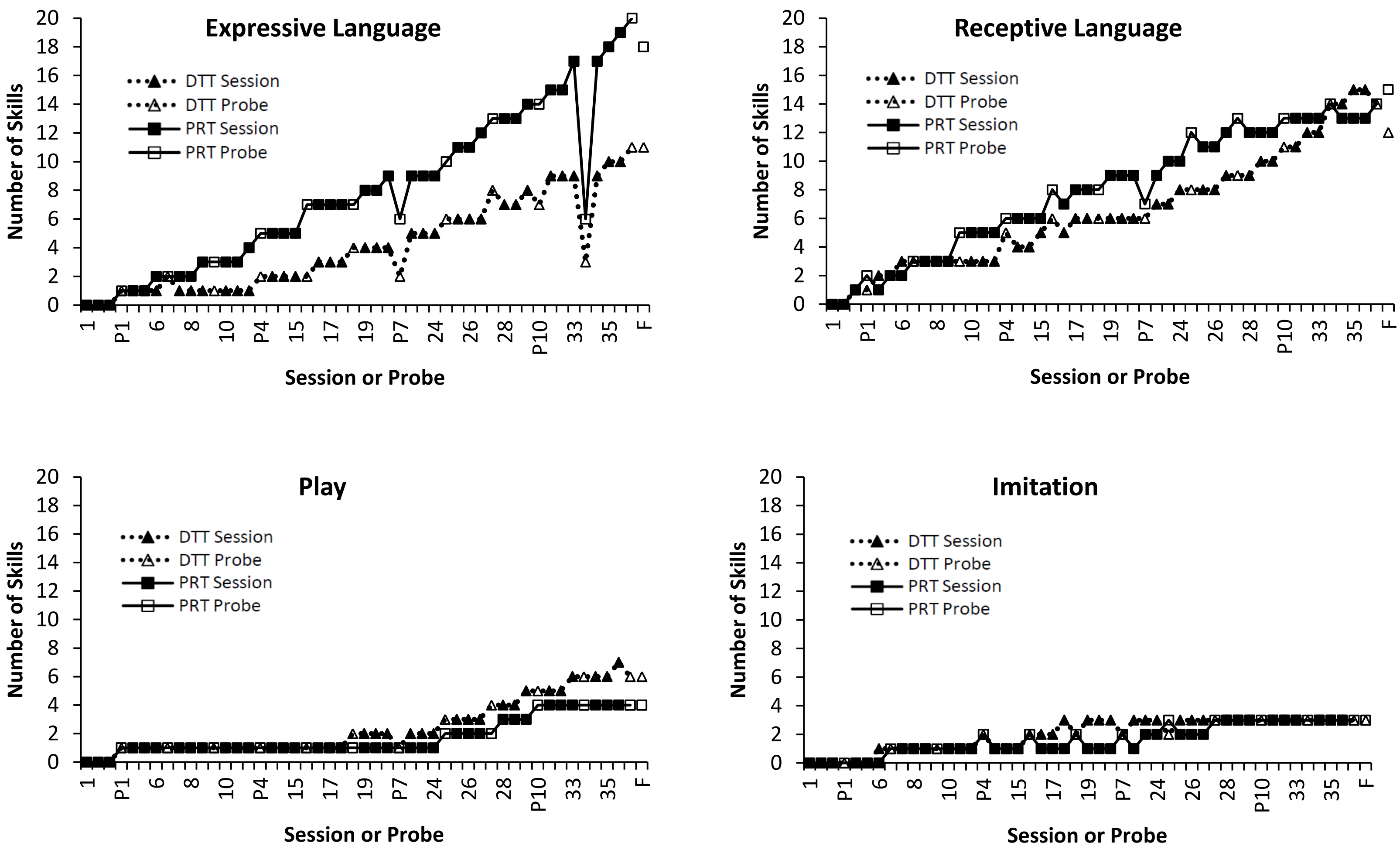

Figure 4. Jonah: Number of Skills Acquired in Expressive Language, Receptive Language, Play, and Imitation Domains

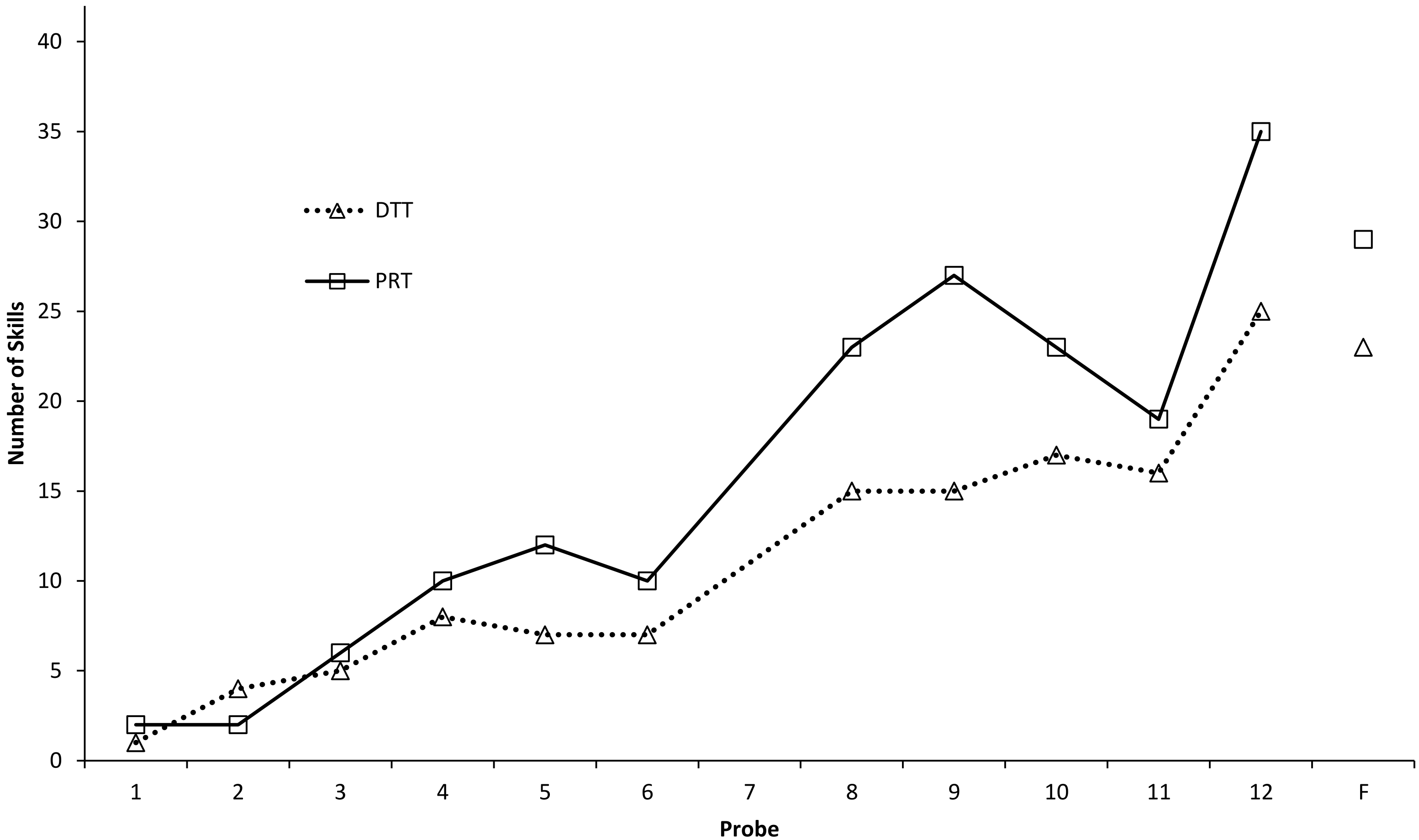

Figure 5. Jonah: Number of Skills Generalized in All Domains

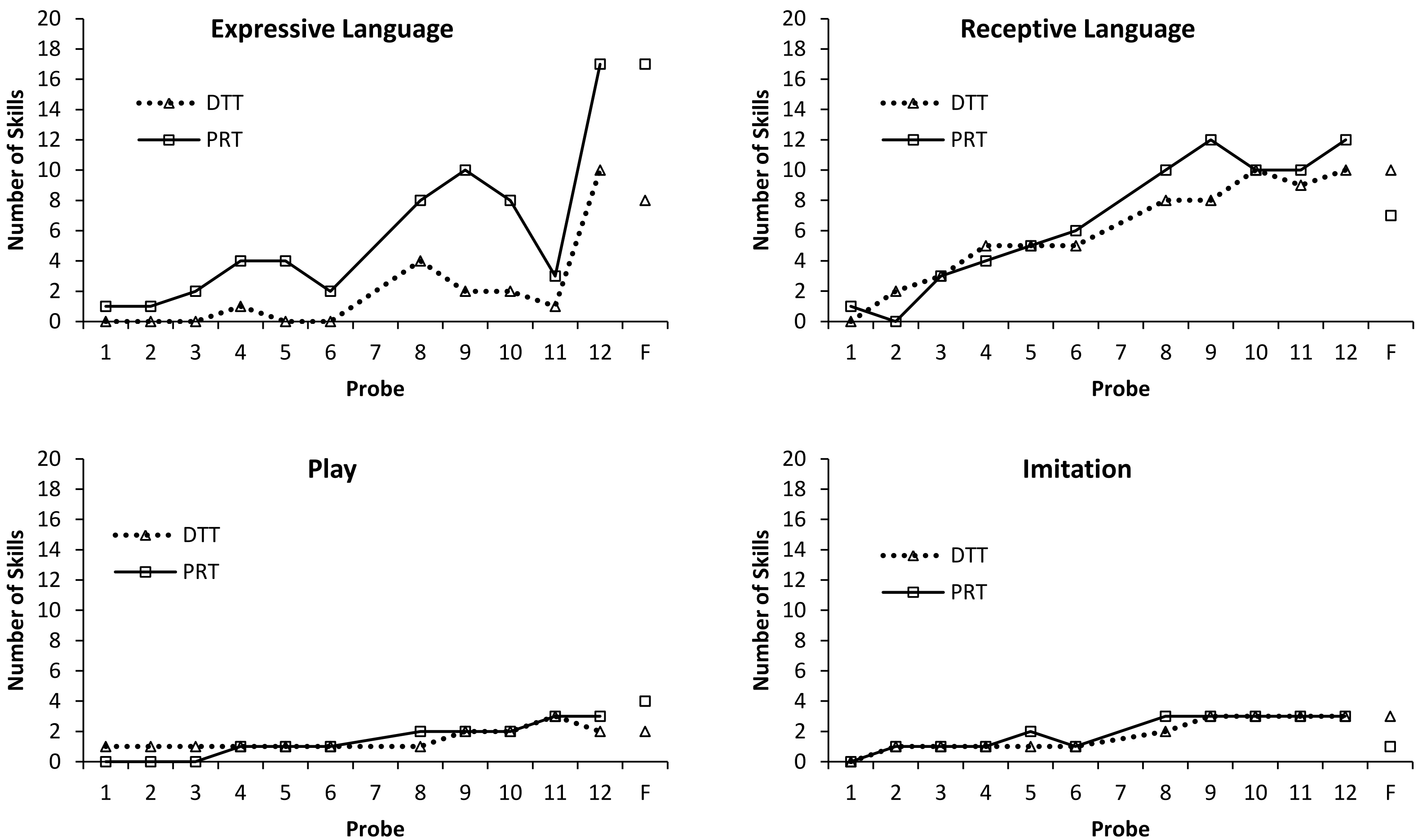

Figure 6. Jonah: Number of Skills Generalized in Expressive Language, Receptive Language, Play, and Imitation Domains

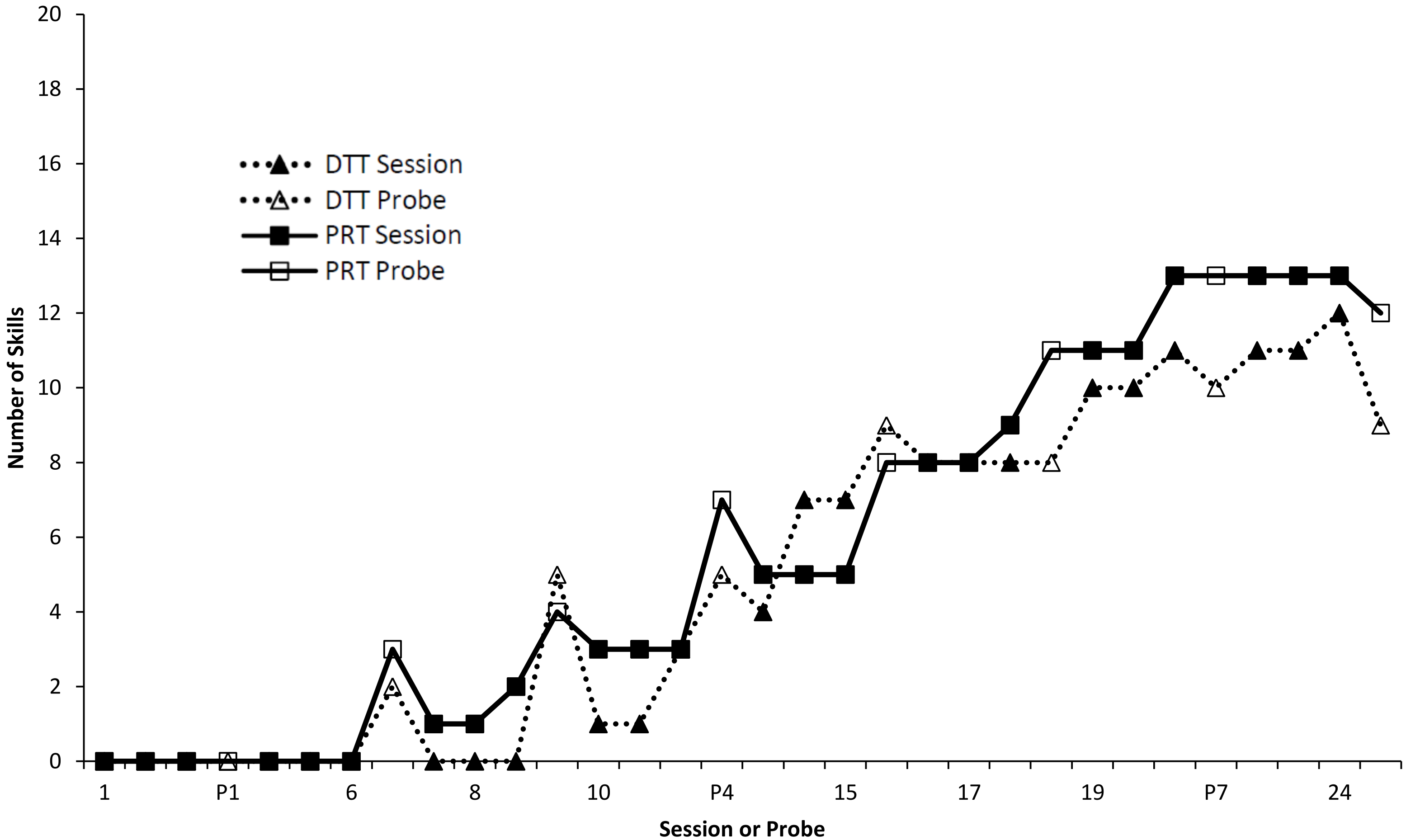

Figure 7. Mario: Number of Skills Acquired in All Domains

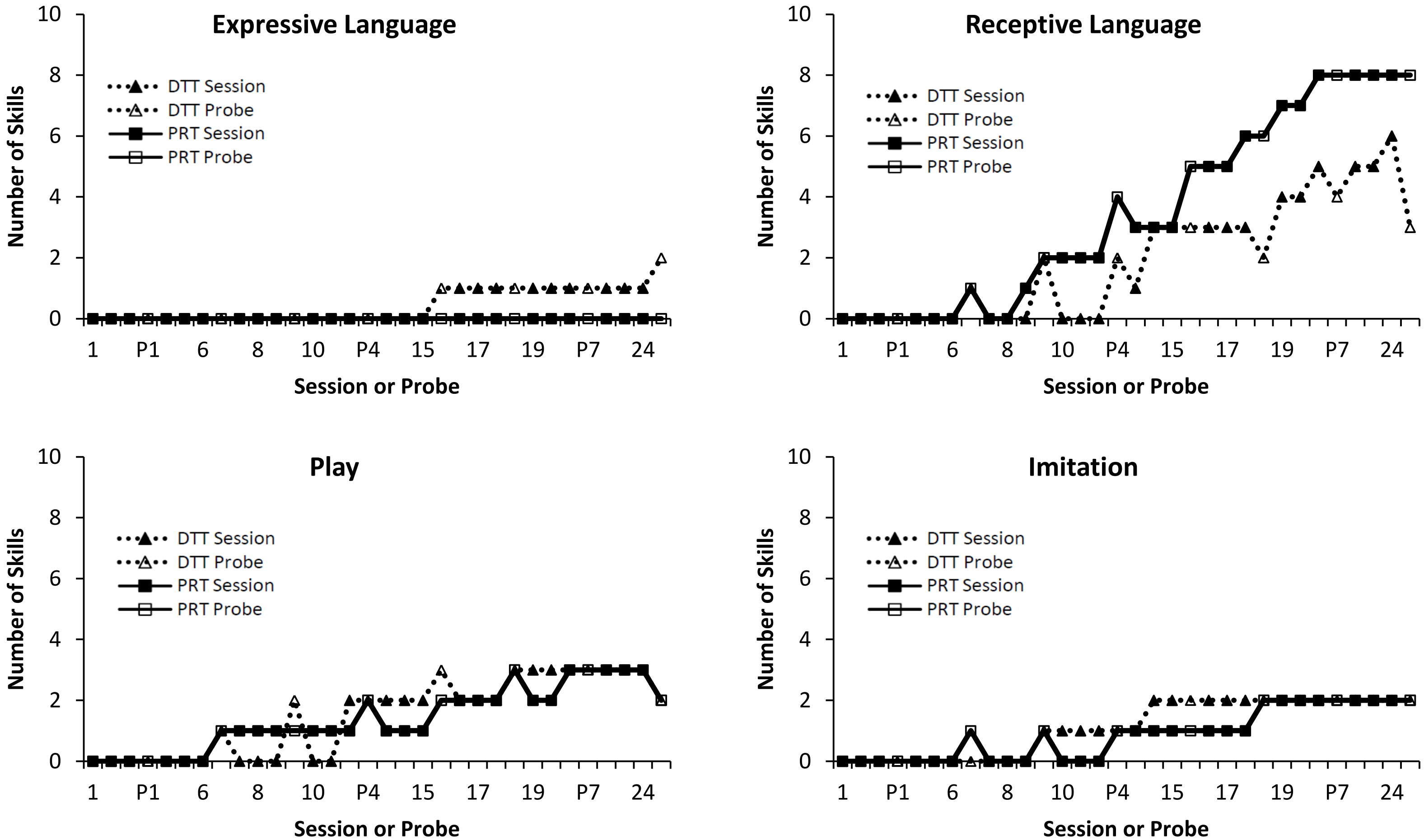

Figure 8. Mario: Number of Skills Acquired in Expressive Language, Receptive Language, Play, and Imitation Domains

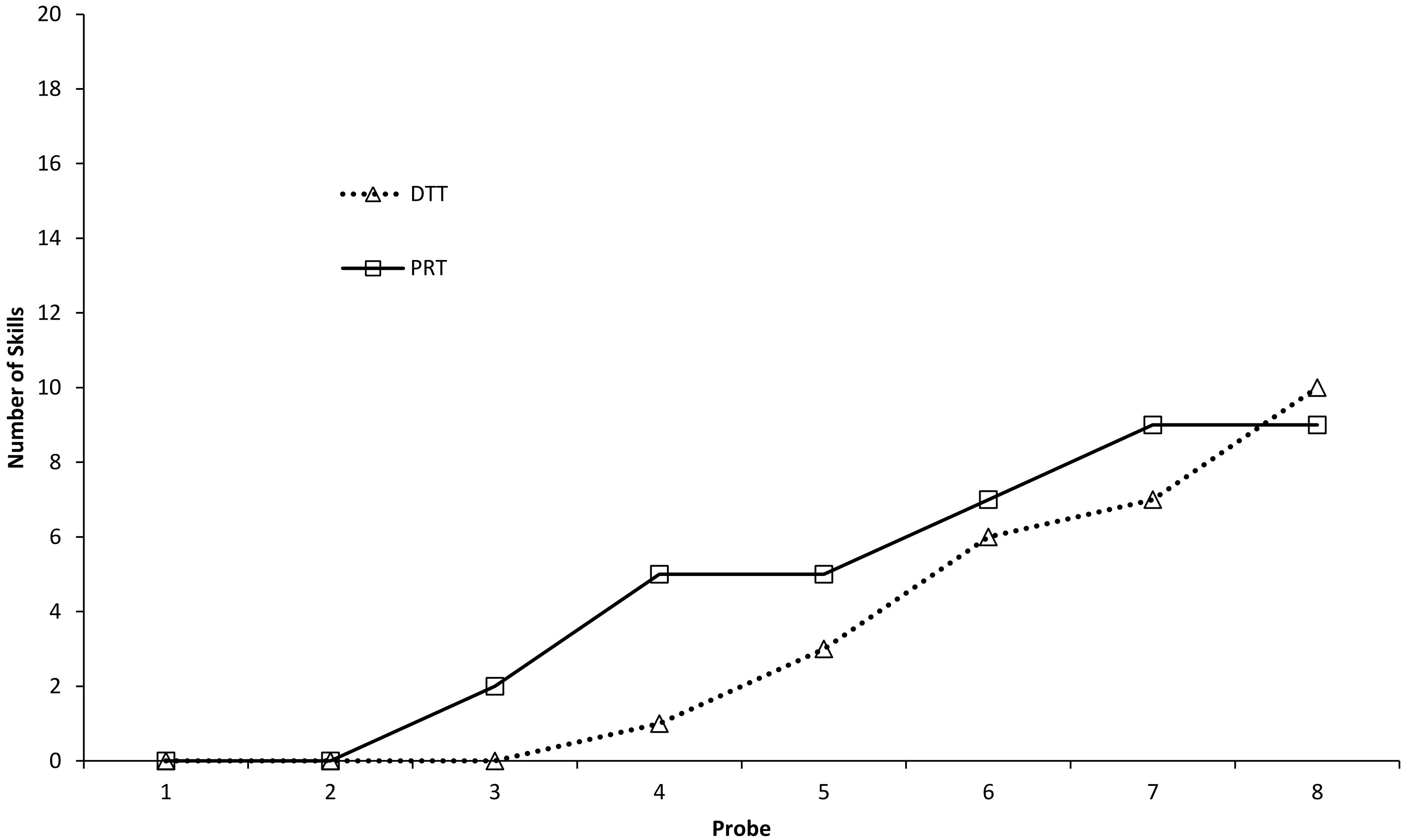

Figure 9. Mario: Number of Skills Generalized in All Domains

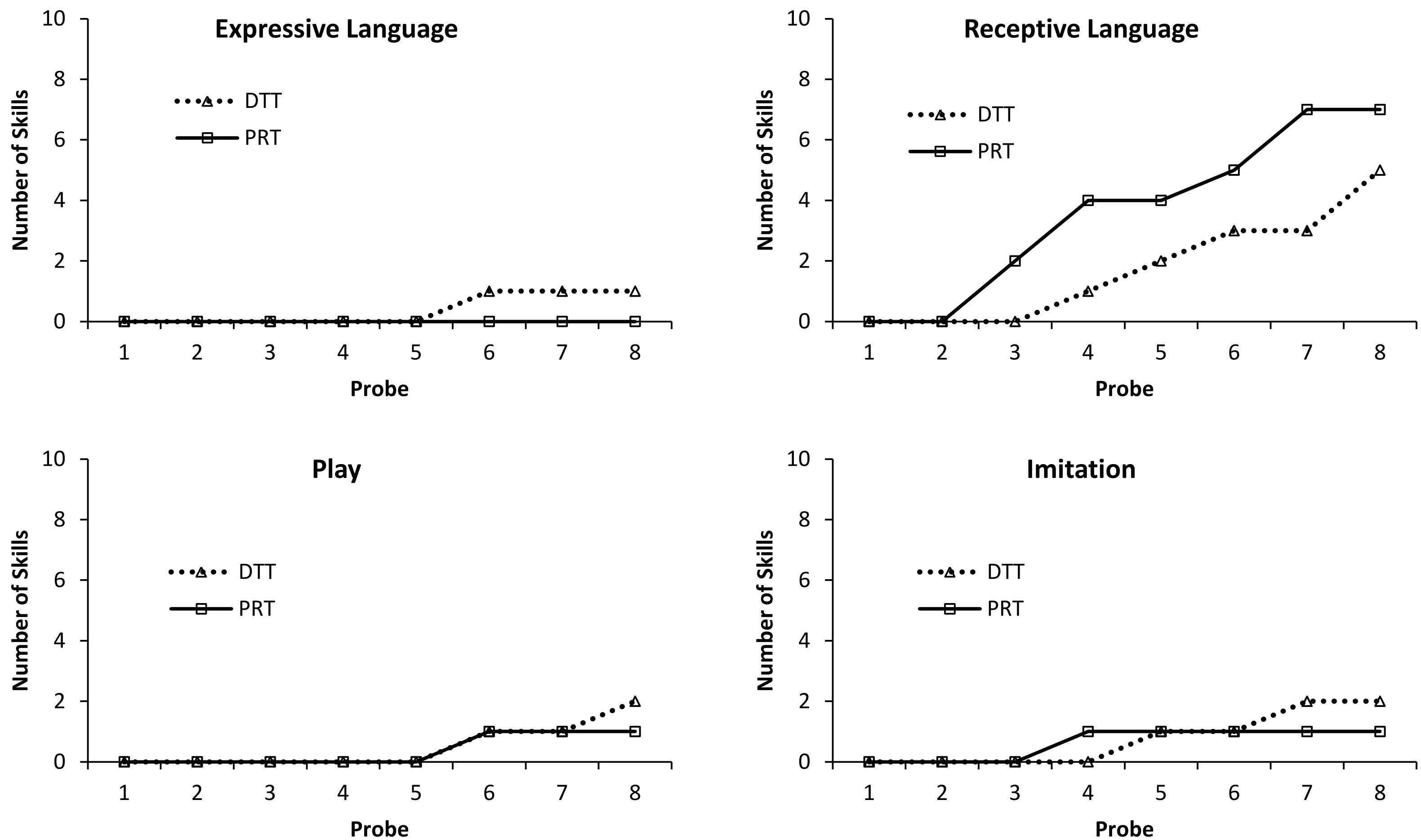

Figure 10. Mario: Number of Skills Generalized in Expressive Language, Receptive Language, Play, and Imitation Domains

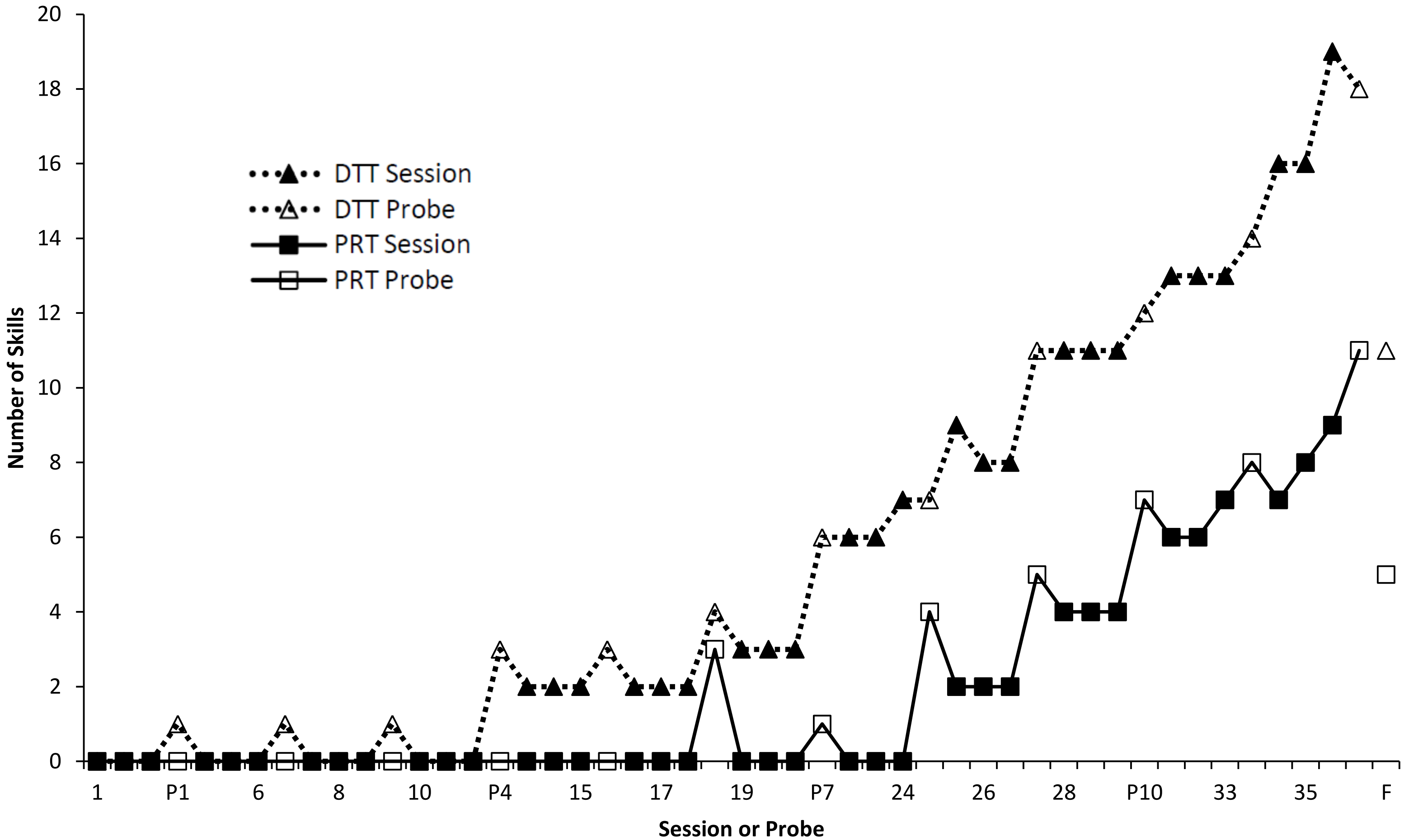

Figure 11. Sally: Number of Skills Acquired in All Domains

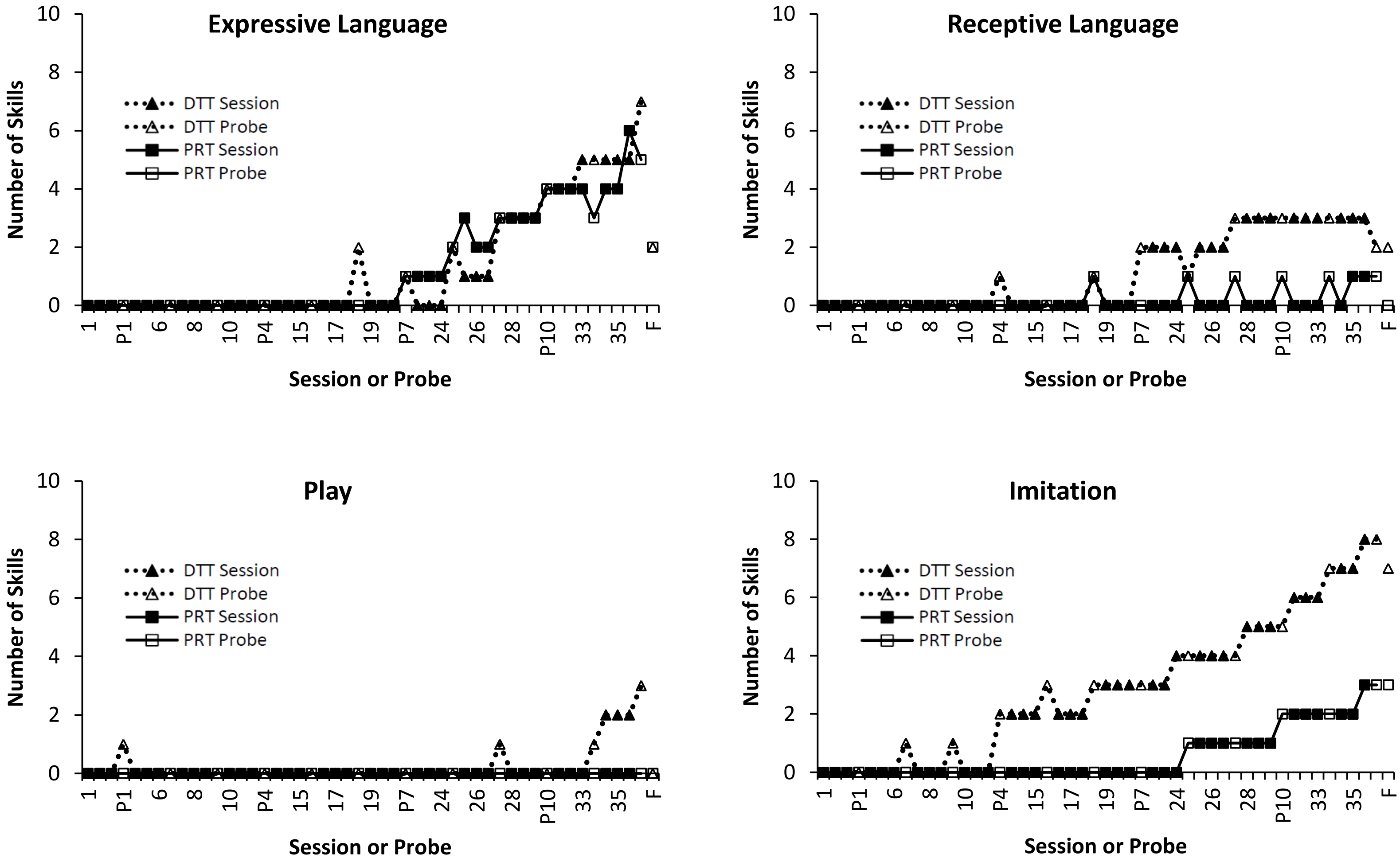

Figure 12. Sally: Number of Skills Acquired in Expressive Language, Receptive Language, Play, and Imitation Domains

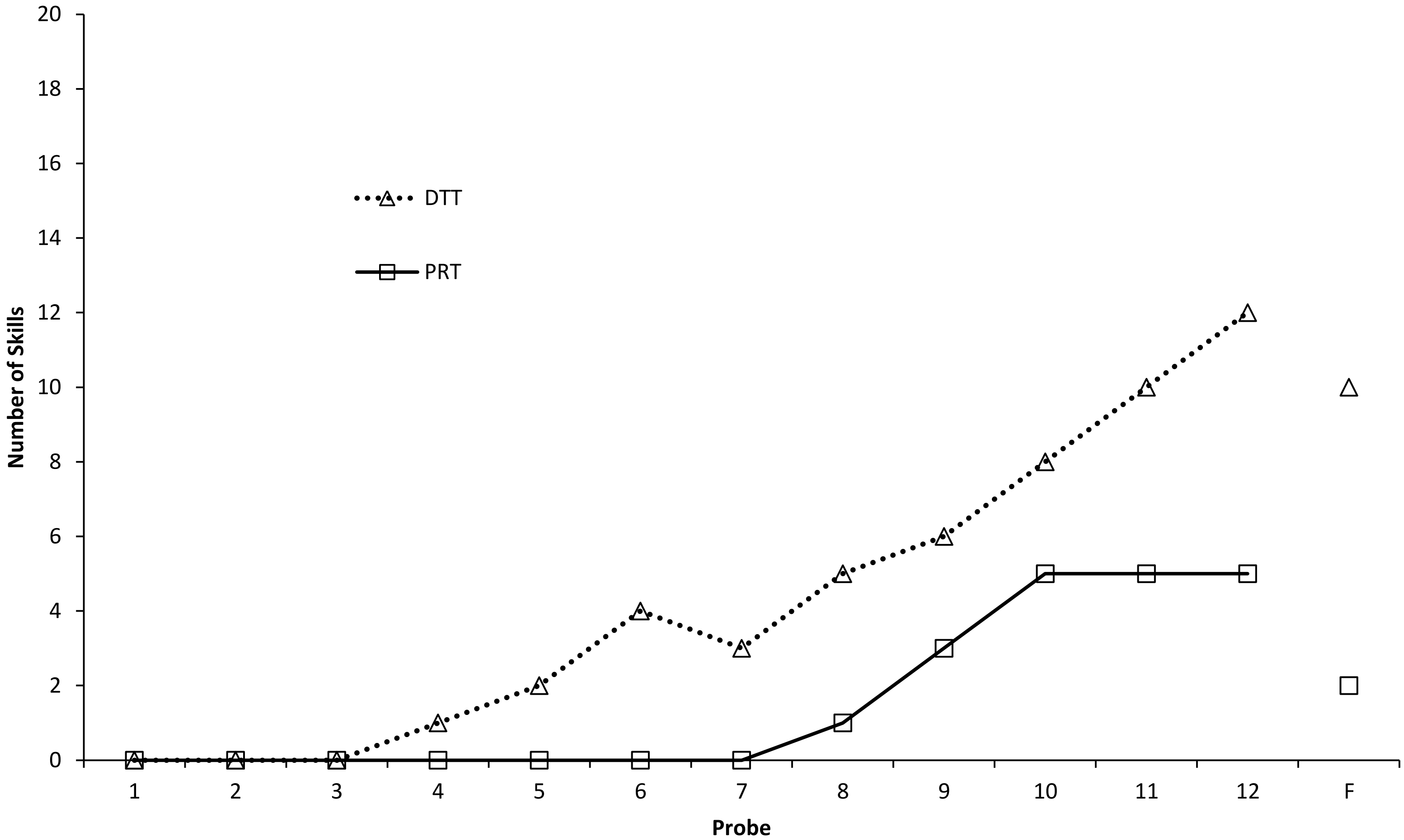

Figure 13. Sally: Number of Skills Generalized in All Domains

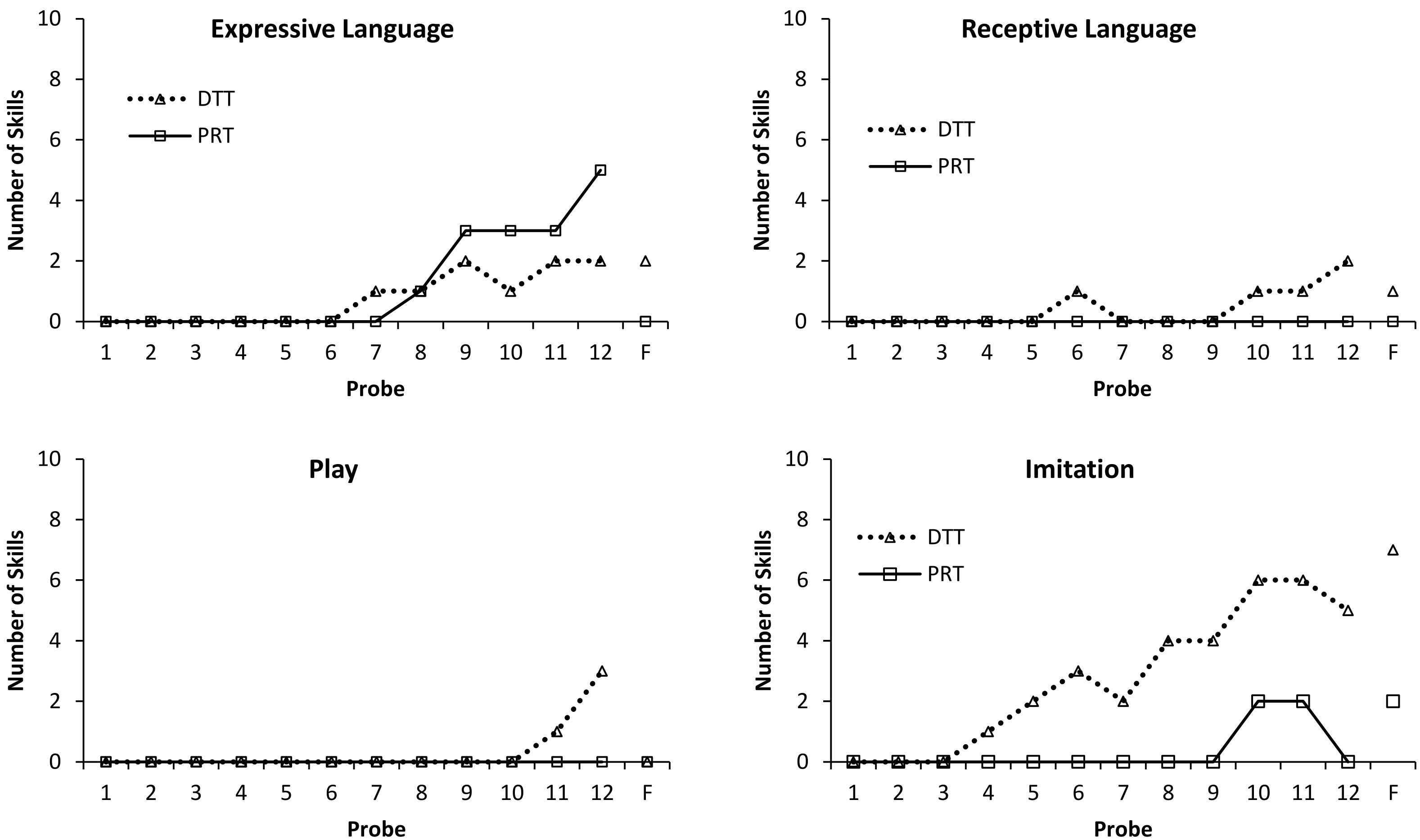

Figure 14. Sally: Number of Skills Generalized in Expressive Language, Receptive Language, Play, and Imitation Domains

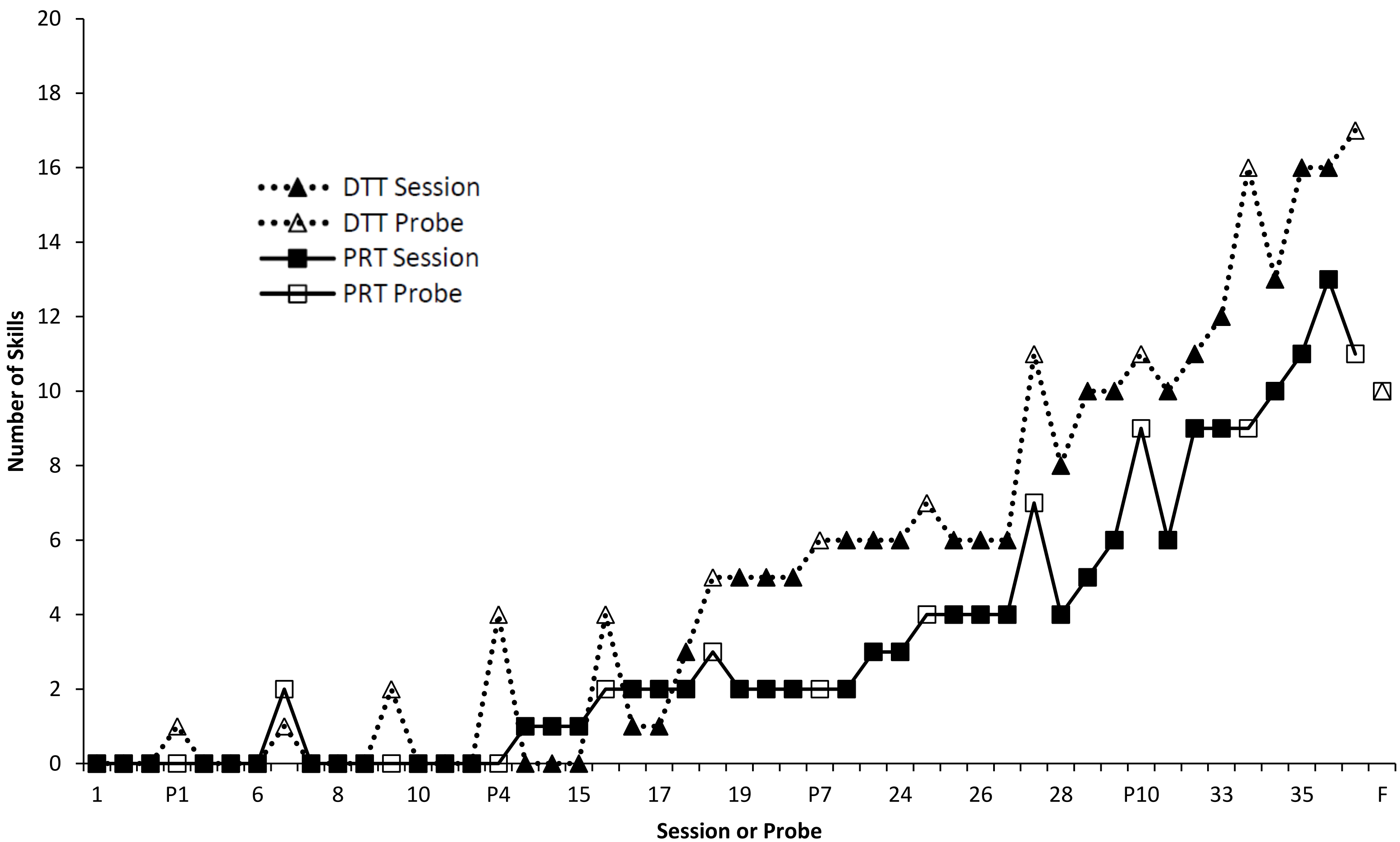

Figure 15. Leo: Number of Skills Acquired in All Domains

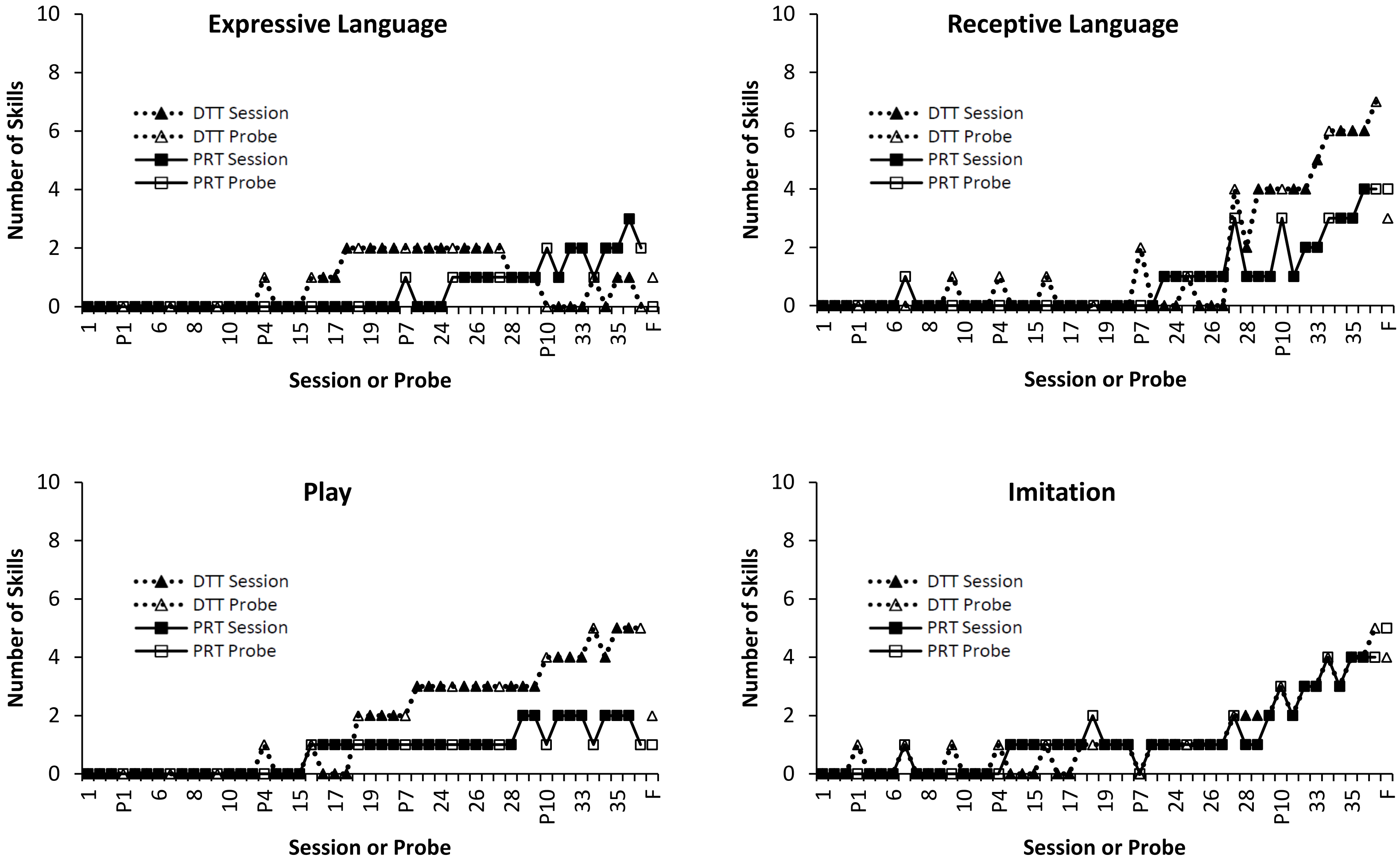

Figure 16. Leo: Number of Skills Acquired in Expressive Language, Receptive Language, Play, and Imitation Domains

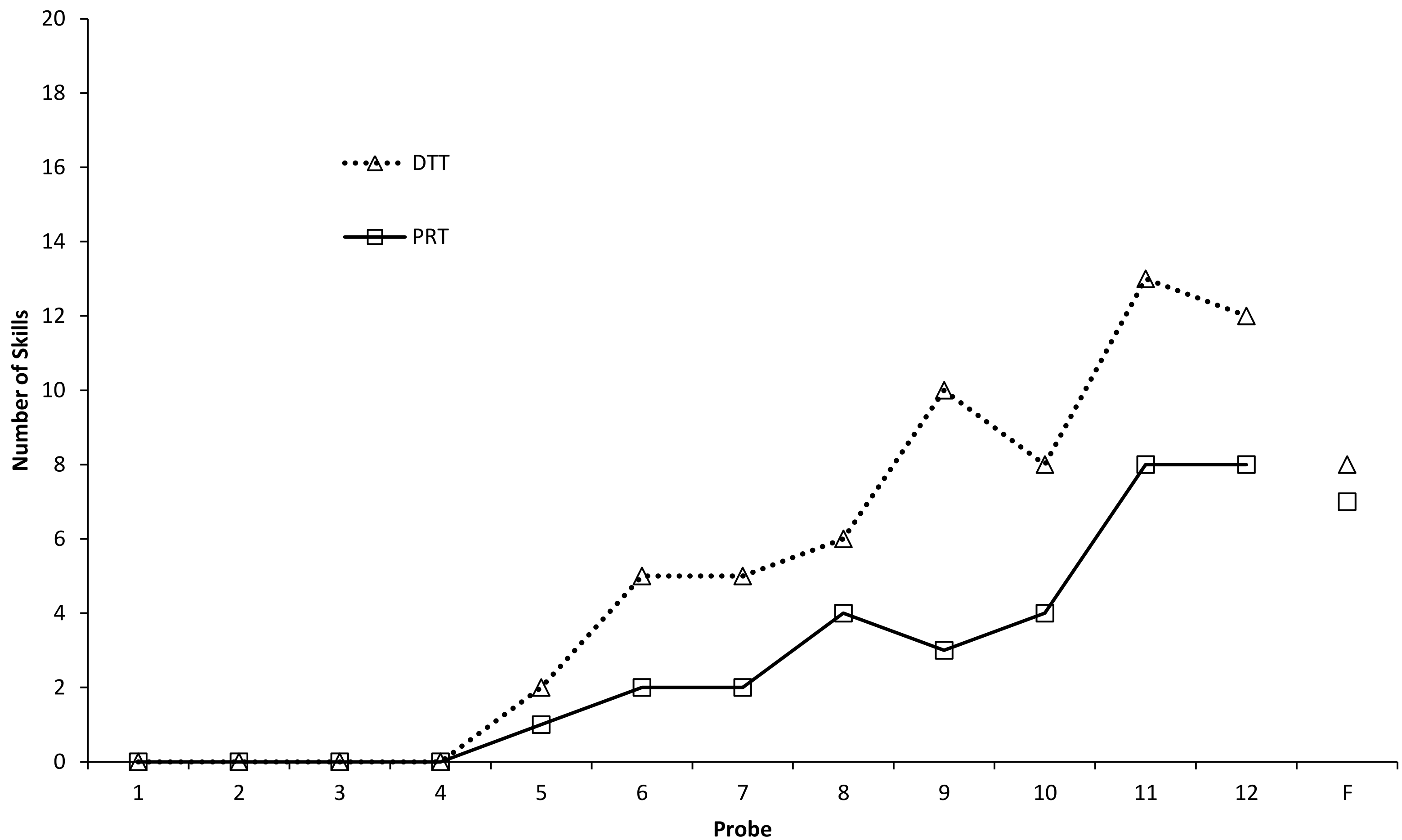

Figure17. Leo: Number of Skills Generalized in All Domains

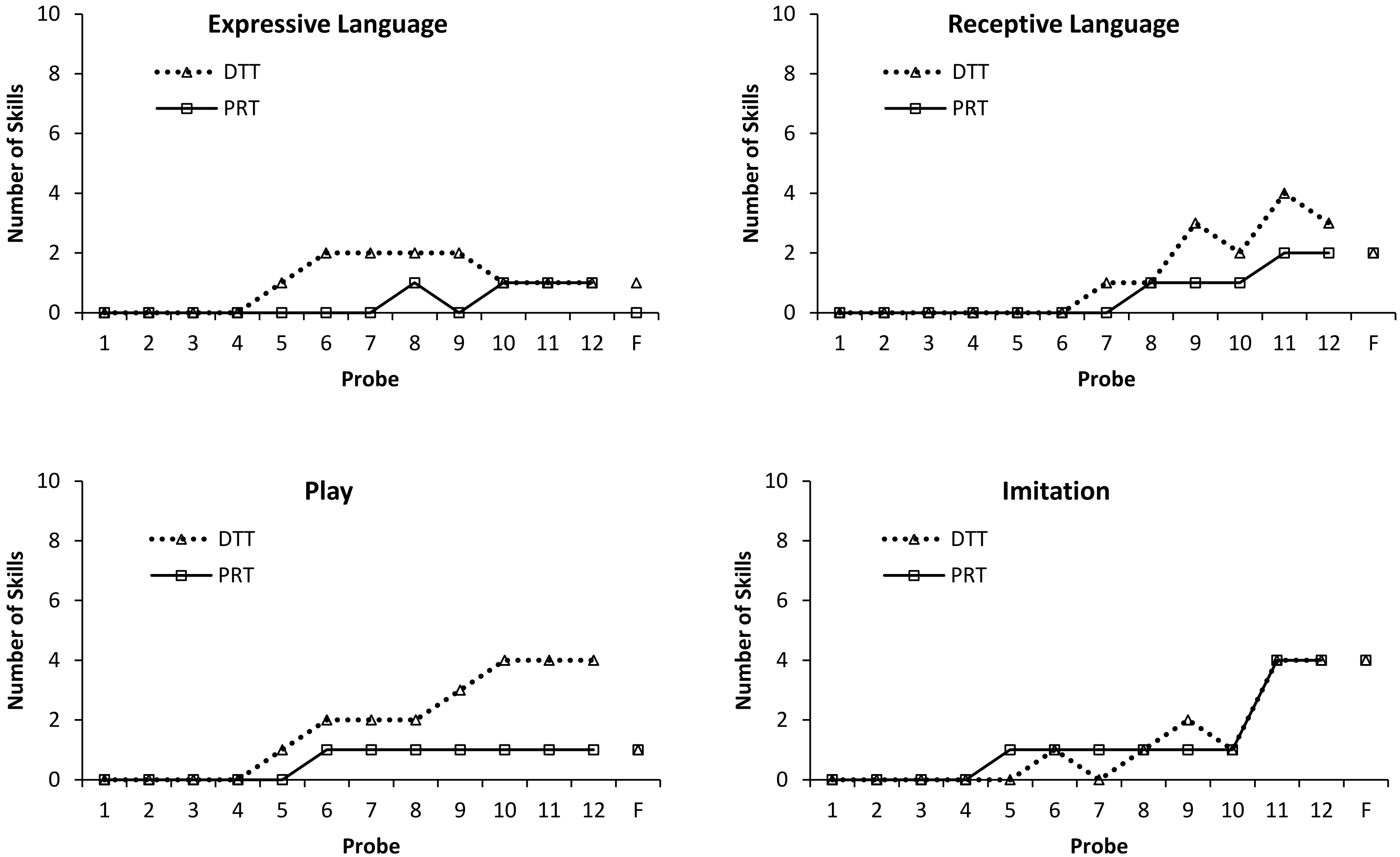

Figure 18. Leo: Number of Skills Generalized in Expressive Language, Receptive Language, Play, and Imitation Domains

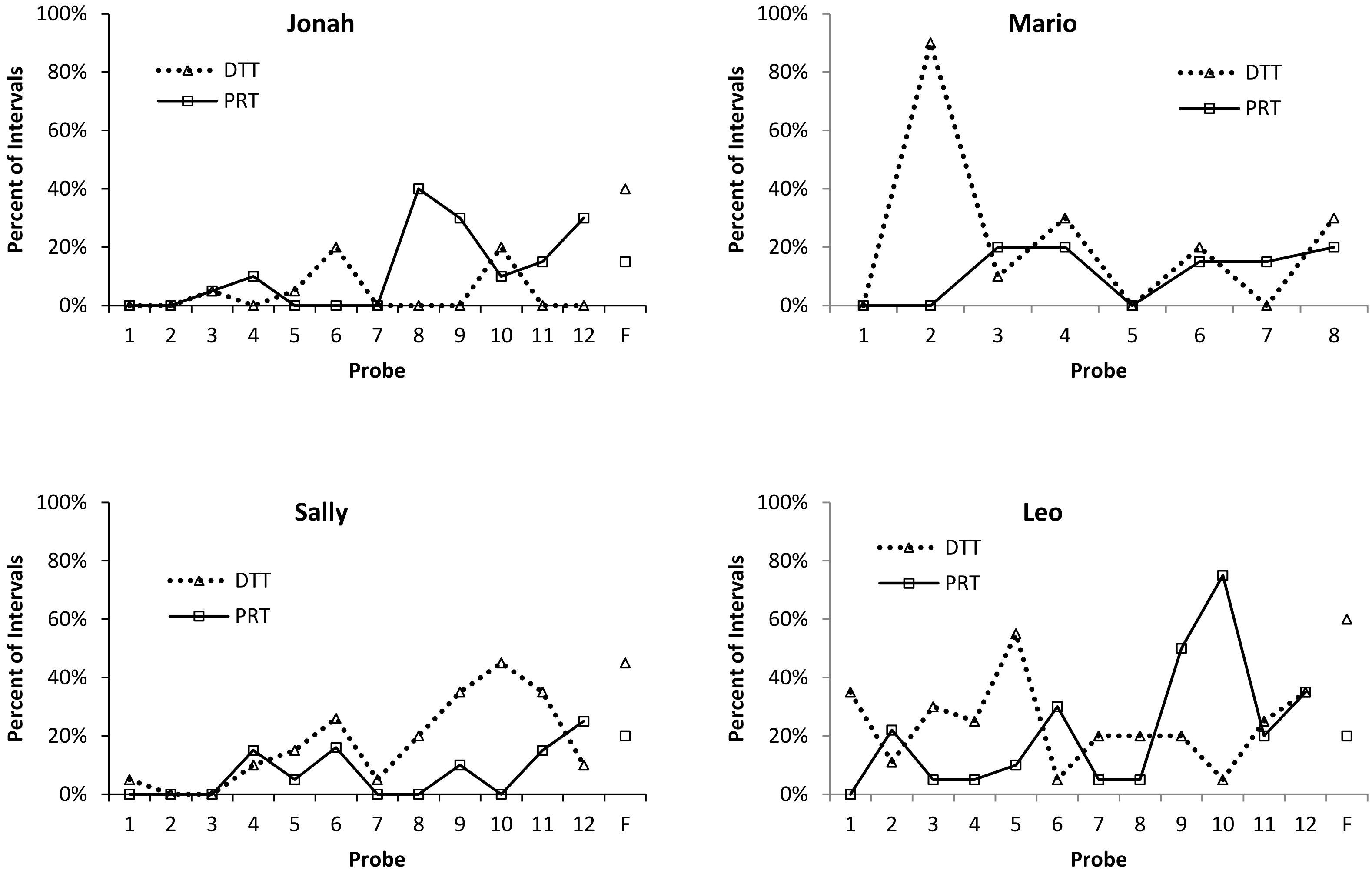

Figure 19. Percent of Intervals with Spontaneous Use of Target Skills in Generalization Probes

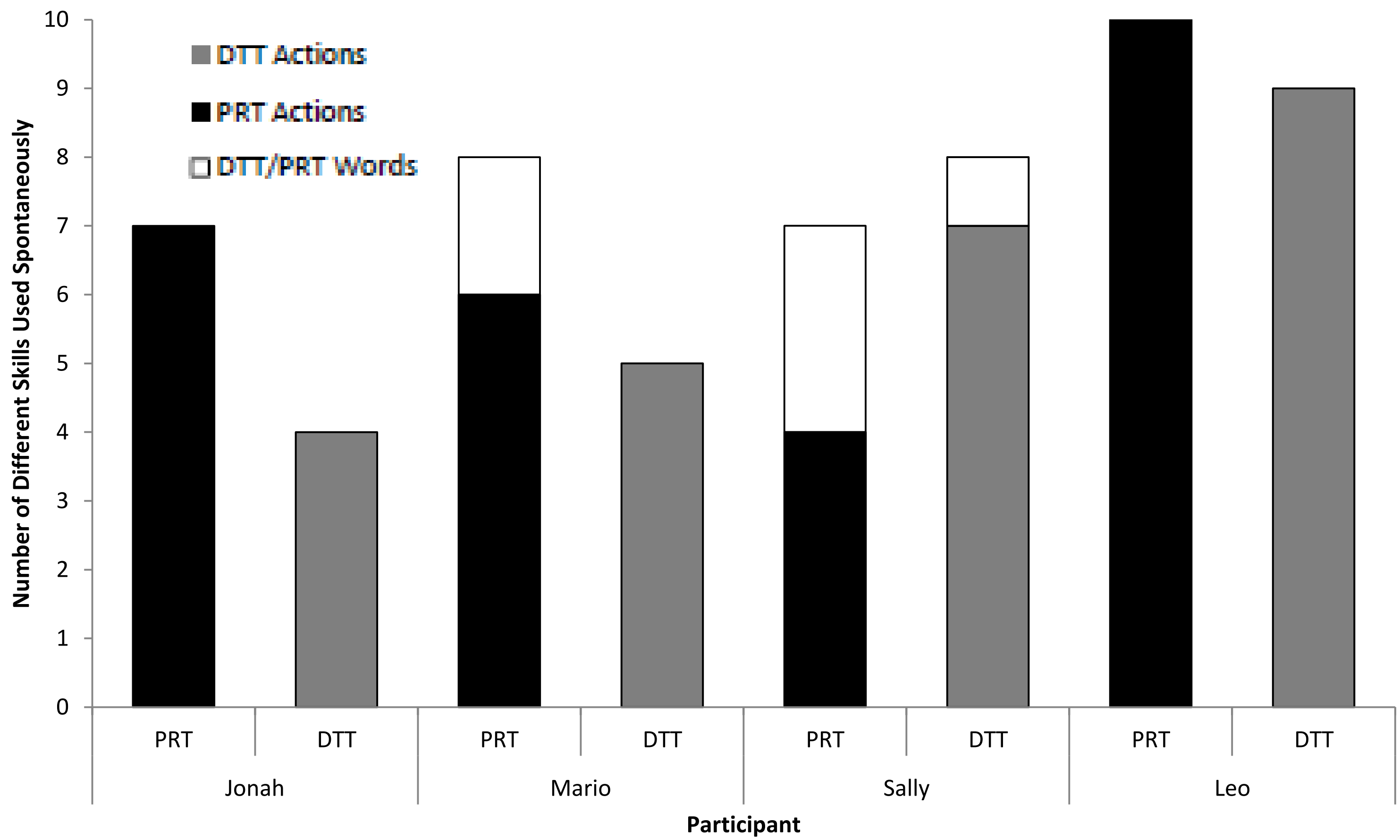

Figure 20. Number of Different Target Skills Used Spontaneously During Generalization Probes

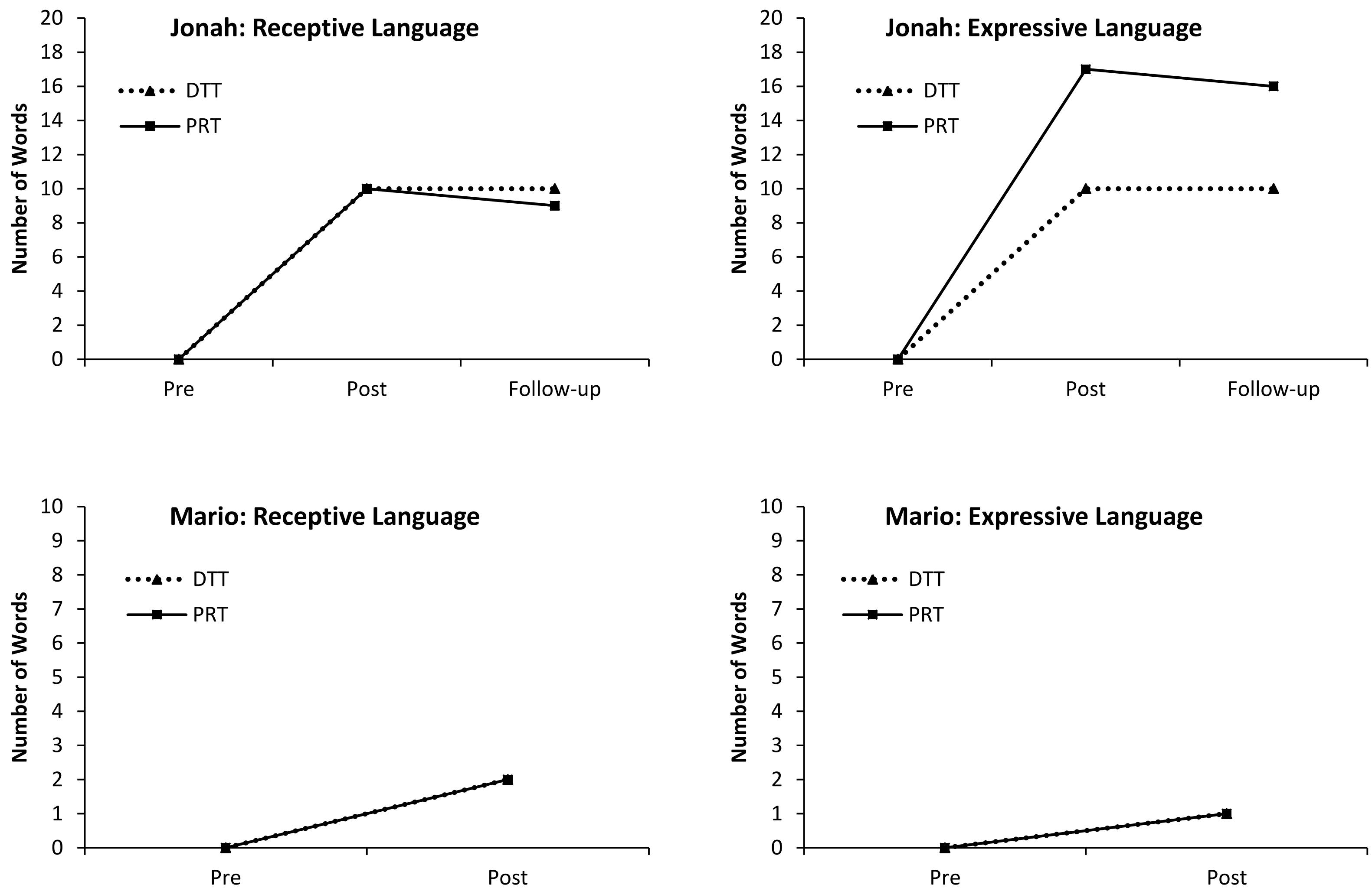

Figure 21. Jonah and Mario: Parent Report of Language Skill Use

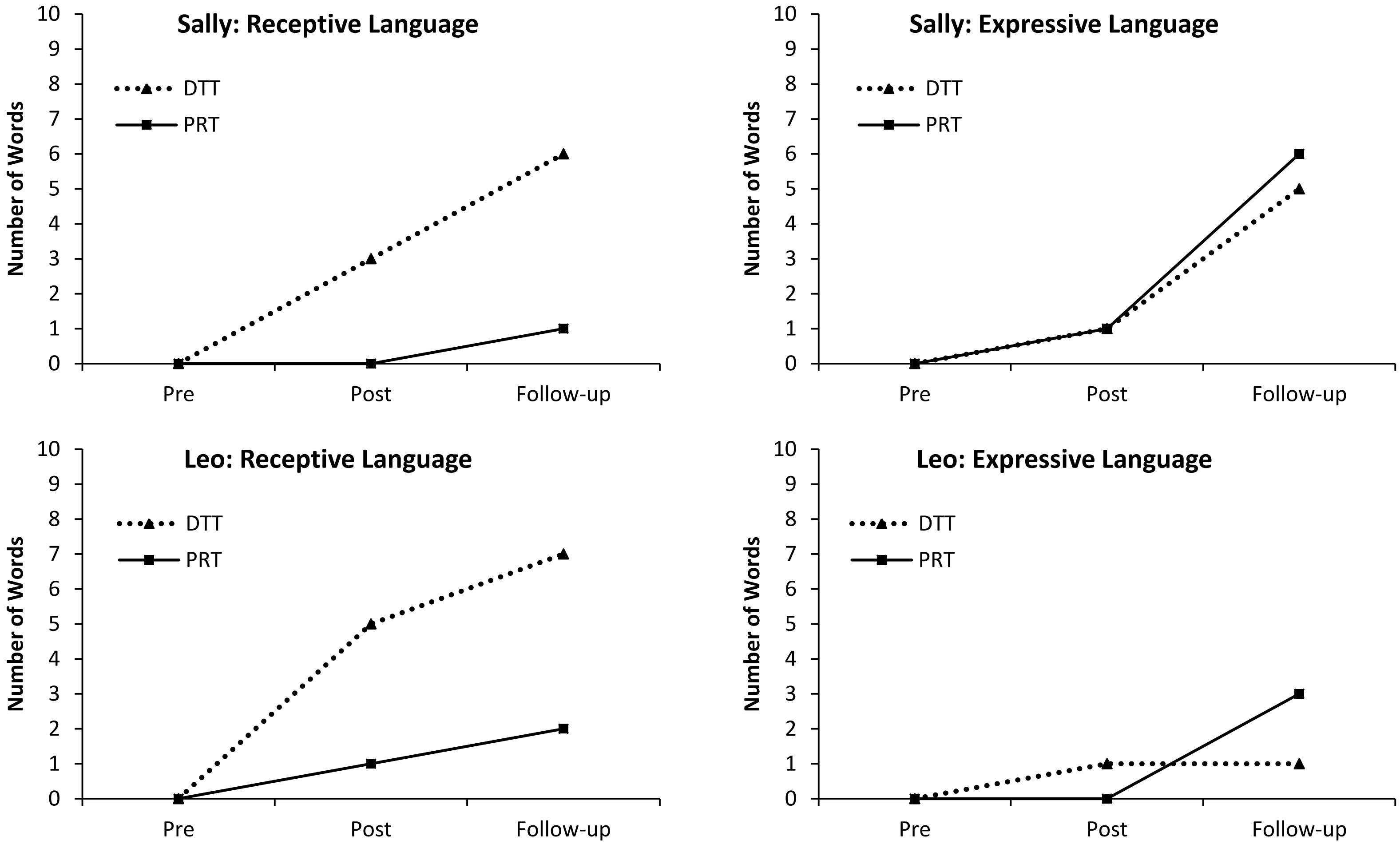

Figure 22. Sally and Leo: Parent Report of Language Skill Use

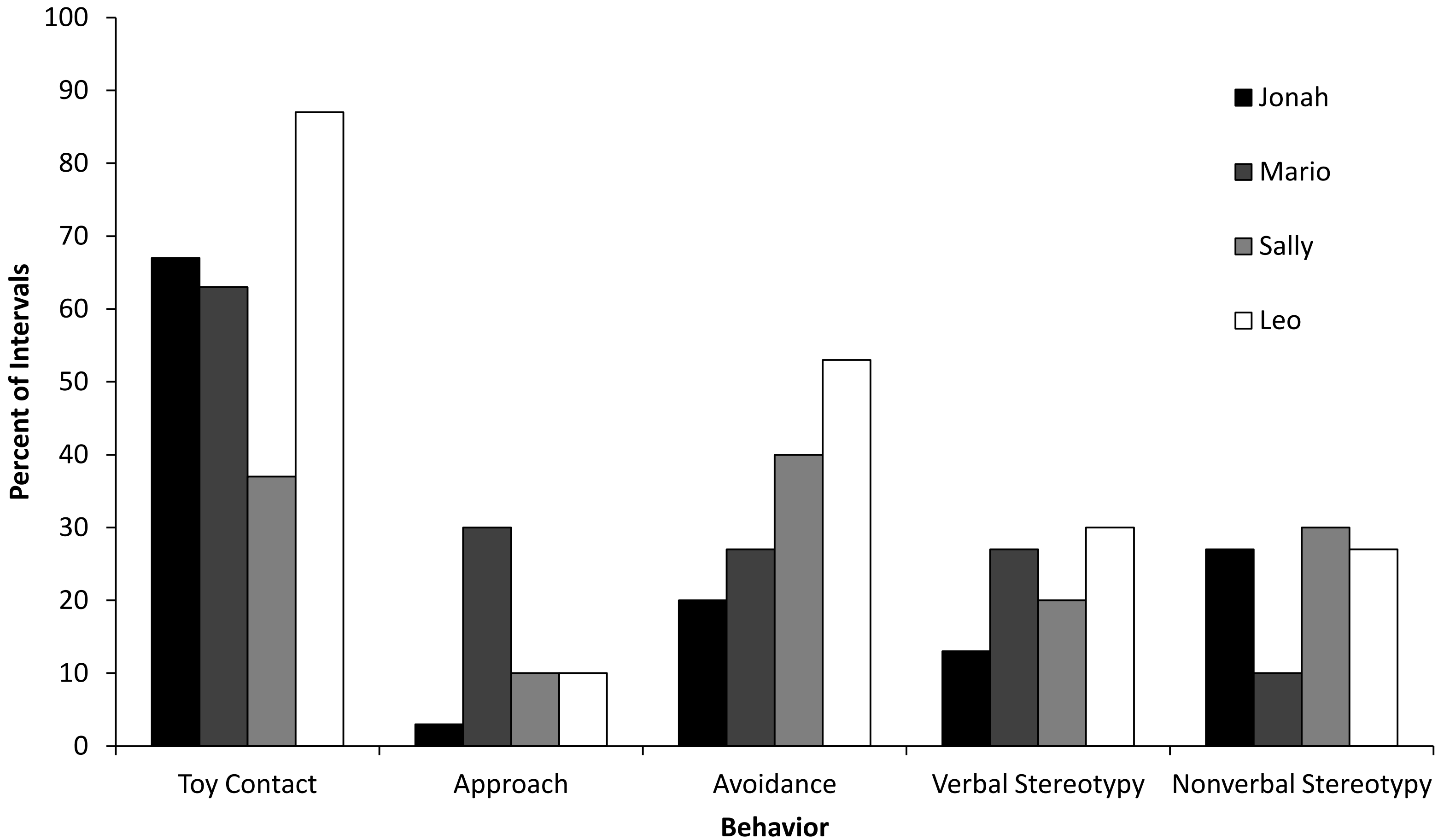

Figure 23. Percent Occurrence of SLO Behaviors at Pre-treatment

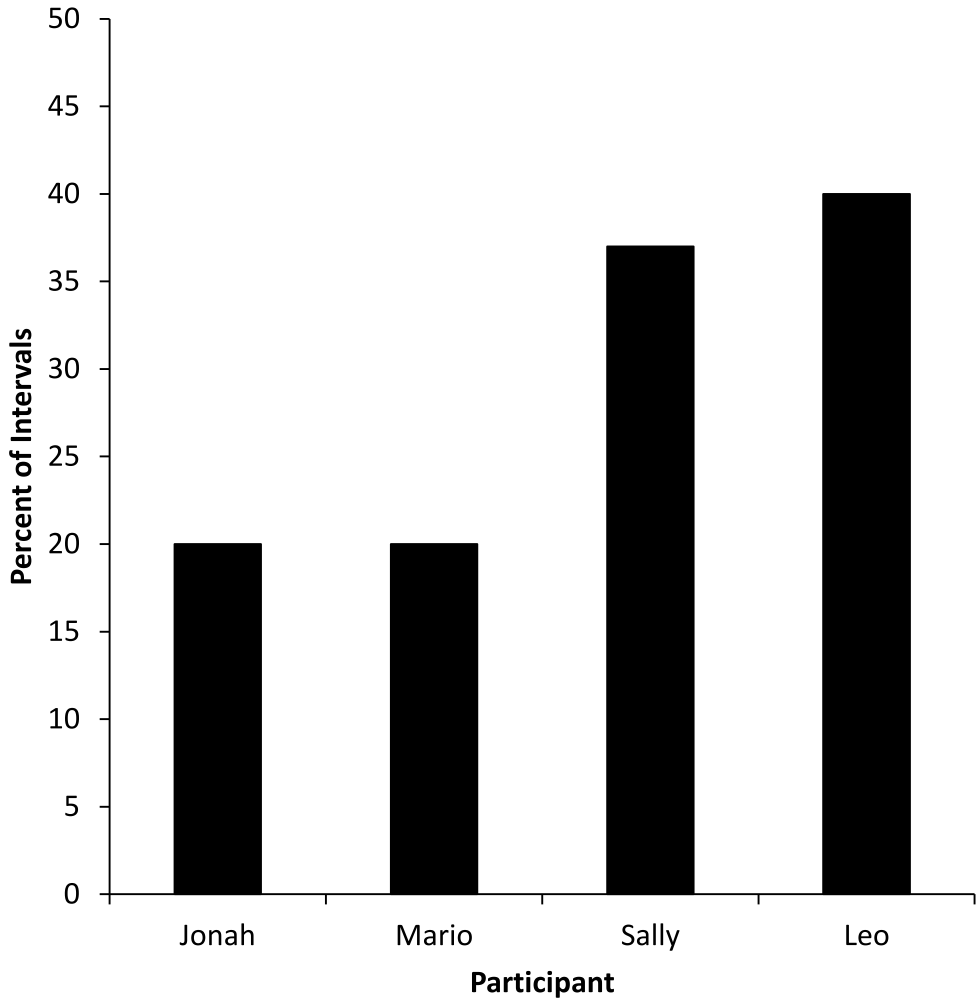

Figure 24. Percent Occurrence of Avoidance at Pre-treatment

APPENDICES

Appendix A. Clinical Judgment Assessment

Clinical Judgment Assessment

Child: **Supervisor:** **Date:**

1. Which intervention(s) do you feel would be most appropriate for teaching this child **expressive language** skills? (e.g., PRT, DTT, Interactive, Combined approach, Other)

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2. If the child is learning words, please indicate what you feel would be most appropriate for teaching **expressive objects** and **expressive actions** (if your answer would differ from above).

---

3. Why do you feel the interventions you specified would be most appropriate for teaching this child these skills?

---

4. Is this what you currently use with this child to teach these skills? If no, why not?

---

5. If you specified a combined approach, what would this combination look like? What interventions would you include? How would you combine them? For example, you might implement each approach in separate blocks of time, do a few trials using one intervention and then a few trials of the other, integrate them into one fluid approach using components of each, or do something else? Please explain.

---

6. Which intervention(s) do you feel would be most appropriate for teaching this child **receptive language** skills? (e.g., PRT, DTT, Interactive, Combined approach, Other)

---

7. If the child is learning words, please indicate what you feel would be most appropriate for teaching **receptive objects** and **receptive actions** (if your answer would differ from above).

---

8. Why do you feel the interventions you specified would be most appropriate for teaching this child these skills?

---

9. Is this what you currently use with this child to teach these skills? If no, why not?

---

10. If you specified a combined approach, what would this combination look like? What interventions would you include? How would you combine them? For example, you might implement each approach in separate blocks of time, do a few trials using one intervention and then a few trials of the other, integrate them into one fluid approach using components of each, or do something else? Please explain.

---

11. Which intervention(s) do you feel would be most appropriate for teaching this child **play** skills? (e.g., PRT, DTT, Interactive, Combined approach, Other)

---

12. Why do you feel the interventions you specified would be most appropriate for teaching this child these skills?

---

13. Is this what you currently use with this child to teach these skills? If no, why not?

---

14. If you specified a combined approach, what would this combination look like? What interventions would you include? How would you combine them? For example, you might implement each approach in separate blocks of time, do a few trials using one intervention and then a few trials of the other, integrate them into one fluid approach using components of each, or do something else? Please explain.

---

15. Which intervention(s) do you feel would be most appropriate for teaching this child **imitation** skills? (e.g., PRT, DTT, Interactive, Combined approach, Other)

---

16. Why do you feel the interventions you specified would be most appropriate for teaching this child these skills?

---

17. Is this what you currently use with this child to teach these skills? If no, why not?

---

18. If you specified a combined approach, what would this combination look like? What interventions would you include? How would you combine them? For example, you might implement each approach in separate blocks of time, do a few trials using one intervention and then a few trials of the other, integrate them into one fluid approach using components of each, or do something else? Please explain.

Appendix B. DTT and PRT Trial-by-Trial Data Collection Instructions

Discrete Trial Training (DTT) Trial-by-Trial Data Collection Instructions

Trials occur when the RA provides an SD (with or without a prompt) for one of the child's specific target skills. This includes withholding access to an item representing a target word without providing any other verbal or nonverbal cue. Score each trial after the child provides a response or initiation, or after the appropriate response period has passed with no response (e.g., 3-5 seconds). If the RA administers DTT incorrectly, try your best to score based on individual trials. If the RA repeats an SD multiple times with no opportunity for the child to respond between trials, score as one trial (fewer than 3 second time window). If the child has an opportunity to respond (3 seconds or more) or does something between cues from the RA, score as distinct trials. Examples:

1) The RA says, "What is it?" while holding a bowl, which is one of the child's target words.
2) The RA is holding a bucket of beads and the child says, "Beads." The RA may or may not give the child the beads.
3) The RA says, "Show me splashing," and the child throws the ball across the room.
4) The RA makes an animal jump up and down and then says, "You try."

SD: This is where you write the discriminative stimulus. Every trial targeting an acquisition or maintenance skill that is an experimental target should be written on one line. You can use short-hand as long as it would be discriminable from other targets and clear which target was provided. You can also skip lines and draw an arrow down if a target was repeated over several trials.

Child Response: The child can respond correctly (C), incorrectly (I), or correctly with a prompt (P). Each trial will have one of these items circled.

Correct: The child responds correctly without a prompt from the RA. Correct response criteria will vary based on the target and the child. This should be solidified and written down ahead of time with the team. If you are unsure of correct response criteria, score as best as possible and clarify during or after the session. If needed, you should re-score from videotape to ensure accuracy.

Incorrect: The child responds incorrectly. The child may have been provided an SD with or without a prompt. Indicate in the comments section whether a prompt was provided and what type.

Prompt: The child responds correctly with a prompt from the RA. The criteria here is identical to "correct" except that a prompt was provided. Indicate the type of prompt provided in the comments section what type of prompt was provided.

Pivotal Response Training Trial-by-Trial Data Collection Instructions

Trials occur when the RA provides an SD (with or without a prompt) for one of the child's specific target skills. This includes withholding access to an item representing a target word without providing any other verbal or nonverbal cue. Score each trial after the child provides a response or initiation, or after the appropriate response period has passed with no response (e.g., 3-5 seconds). If the RA administers PRT incorrectly, try your best to score based on individual trials. If the RA repeats an SD multiple times with no opportunity for the child to respond between trials, score as one trial (fewer than 3 second time window). If the child has an opportunity to respond (3 seconds or more) or does something between cues from the RA, score as distinct trials. Examples:

1) The RA says, "What is it?" while holding a bowl, which is one of the child's target words.
2) The RA is holding a bucket of beads and the child says, "Beads." The RA may or may not give the child the beads.
3) The RA says, "Show me splashing," and the child throws the ball across the room.
4) The RA makes an animal jump up and down and then says, "You try."

<u>SD:</u> This is where you write the discriminative stimulus. Every trial targeting an acquisition or maintenance skill that is an experimental target should be written on one line. You can use short-hand as long as it would be discriminable from other targets and clear which target was provided. You can also skip lines and draw an arrow down if a target was repeated over several trials.

<u>Child Response</u>: The child can respond correctly (C), with a correct, good attempt (Att), incorrectly (I), or correctly with a prompt (P). Each trial will have one of these items circled.

> <u>Correct:</u> The child responds correctly without a prompt from the RA. Correct response criteria will vary based on the target and the child. This should be solidified and written down ahead of time with the team. If you are unsure of correct response criteria, score as best as possible and clarify during or after the session. If needed, you should re-score from videotape to ensure accuracy.
>
> <u>Attempt:</u> The child responds with a correct, good attempt but the response would not be considered fully correct. The RA may or may not reinforce an attempt (they have a choice). Also, a prompt may have been provided, but it should be scored as attempt only if the response was not fully correct.
>
> <u>Incorrect:</u> The child responds incorrectly. The child may have been provided an SD with or without a prompt. Indicate in the comments section whether a prompt was provided and what type.
>
> <u>Prompt:</u> The child responds correctly with a prompt from the RA. The criteria here is identical to "correct" except that a prompt was provided. Indicate the type of prompt provided in the comments section what type of prompt was provided.

Appendix C. Sample Acquisition Probe Data Sheet

Acquisition Probe Data Sheet

Date __________ Child__________ Acquisition Probe # _____ Administrator__________

Instructions: Indicate if child responds correctly or incorrectly each time the item is presented. Once the child responds correctly to four trials or incorrectly to two trials, discontinue probing. Exclude trials where the administrator did not gain the child's attention prior to cue presentation (i.e. re-present the trial). For skills the child demonstrated 80% or more on the two previous consecutive probes, probe one trial only if the first trial is correct (otherwise proceed as usual). Those skills will be indicated by a checkmark next to the skill.

									Comments
Expressive Language			**Objects**						
	1		Bear	C I	C I	C I	C I	C I	
	2		Pig	C I	C I	C I	C I	C I	
	3			C I	C I	C I	C I	C I	
	4			C I	C I	C I	C I	C I	
	5			C I	C I	C I	C I	C I	
			Actions						
	1		Read/Reading	C I	C I	C I	C I	C I	
	2		Pull/Pulling	C I	C I	C I	C I	C I	
	3			C I	C I	C I	C I	C I	
	4			C I	C I	C I	C I	C I	
	5			C I	C I	C I	C I	C I	
Receptive Language			**Objects**						
	1		Apple	C I	C I	C I	C I	C I	
	2		Banana	C I	C I	C I	C I	C I	
	3			C I	C I	C I	C I	C I	
	4			C I	C I	C I	C I	C I	
	5			C I	C I	C I	C I	C I	
	6			C I	C I	C I	C I	C I	
	7			C I	C I	C I	C I	C I	
	8			C I	C I	C I	C I	C I	
	9			C I	C I	C I	C I	C I	
			Actions						
	1		Hit/Hitting	C I	C I	C I	C I	C I	
	2		Draw/Drawing	C I	C I	C I	C I	C I	
	3			C I	C I	C I	C I	C I	
	4			C I	C I	C I	C I	C I	
	5			C I	C I	C I	C I	C I	
Play and Imitation			**Imitation**						
	1		Animal jump	C I	C I	C I	C I	C I	
	2		Animal sleep	C I	C I	C I	C I	C I	
	3			C I	C I	C I	C I	C I	
	4			C I	C I	C I	C I	C I	
	5			C I	C I	C I	C I	C I	
			Play						
	1		Stir food	C I	C I	C I	C I	C I	
	2		Pour drink	C I	C I	C I	C I	C I	
	3			C I	C I	C I	C I	C I	
	4			C I	C I	C I	C I	C I	
	5			C I	C I	C I	C I	C I	

Appendix D. Sample Elicited Generalization Probe Data Sheet

Elicited Generalization Probe Data Sheet

Date __________ Child__________ Gen Probe # _____ Administrator__________

Instructions: Indicate if child responds correctly or incorrectly each time the item is presented. Once the child respond correctly to four trials or incorrectly to two trials, discontinue probing. Exclude trials where the administrator did not gain the child's attention prior to cue presentation (i.e. re-present the trial). For skills the child demonstrated 80% or more on the two previous consecutive probes (listed below), probe one trial only if the first trial is correct (otherwise proceed as usual). Those skills will be indicated by a checkmark next to the skill.

Receptive Objects

1	☐	Apple	☐	☐	☐	☐	☐
2	☐	Banana	☐	☐	☐	☐	☐
3	☐		☐	☐	☐	☐	☐
4	☐		☐	☐	☐	☐	☐
5	☐		☐	☐	☐	☐	☐
6	☐		☐	☐	☐	☐	☐

Expressive Objects

1	☐	Bear	☐	☐	☐	☐	☐
2	☐	Pig	☐	☐	☐	☐	☐
3	☐		☐	☐	☐	☐	☐
4	☐		☐	☐	☐	☐	☐
5	☐		☐	☐	☐	☐	☐
6	☐		☐	☐	☐	☐	☐

Receptive Actions

1	☐	Hit/Hitting	☐	☐	☐	☐	☐
2	☐	Draw/Drawing	☐	☐	☐	☐	☐
3	☐		☐	☐	☐	☐	☐
4	☐		☐	☐	☐	☐	☐
5	☐		☐	☐	☐	☐	☐
6	☐		☐	☐	☐	☐	☐

Expressive Actions

1	☐	Read/Reading	☐	☐	☐	☐	☐
2	☐	Pull/Pulling	☐	☐	☐	☐	☐
3	☐		☐	☐	☐	☐	☐
4	☐		☐	☐	☐	☐	☐
5	☐		☐	☐	☐	☐	☐
6	☐		☐	☐	☐	☐	☐

Imitation

1	☐	Animal jump	☐	☐	☐	☐	☐
2	☐	Animal sleep	☐	☐	☐	☐	☐
3	☐		☐	☐	☐	☐	☐
4	☐		☐	☐	☐	☐	☐
5	☐		☐	☐	☐	☐	☐
6	☐		☐	☐	☐	☐	☐

Play

1	☐	Stir food	☐	☐	☐	☐	☐
2	☐	Pour drink	☐	☐	☐	☐	☐
3	☐		☐	☐	☐	☐	☐
4	☐		☐	☐	☐	☐	☐
5	☐		☐	☐	☐	☐	☐
6	☐		☐	☐	☐	☐	☐

Appendix E. Acquisition Probe Procedural Fidelity Form

Acquisition Probe Procedural Fidelity Form

Child:_______ Administrator:_______ Date of Clip:_______ Observer:_______ Date Scored:_______

Reli: Yes No

Score each element based on your observation of the Administrator and child. To achieve fidelity, the Administrator must receive a score a "yes" or "3" on each of the procedural points that are being measured.

1/No (No Pass)	2 (No Pass)	3/Yes (Pass)
Administrator implements occasionally or not at all.	Administrator implements some of the time.	Administrator implements throughout the majority or all of the session.

Procedural Points	Fidelity	Notes
Administrator Qualifications		
Administrator is one of the child's regular therapists	Yes No	
General Set-up		
Child is seated in a location with limited or no distractions (e.g., child size table)	Yes No	
Toys are selected from materials used during treatment	Yes No	
Acquisition Probe Administration		
Administrator presents 5 randomly ordered trials testing acquisition of the introduced targets (Acceptable to provide 4 trials if all correct and 2 trials if incorrect). Exception: for skills demonstrated on 2 previous consecutive probes, may present just one trial if correct.	Yes No	
Trials are preceded by a consistent S^D (i.e. "What is it?, What is he/she doing?", and "Do this?")		
Administrator presents receptive language, play, and imitation target opportunities such that the child is required to discriminate between materials in order to respond correctly	1 2 3	
No prompts, reinforcers, or praise are delivered for correct or incorrect responding to the target presentations	1 2 3	
Administrator intersperses trials of, as well as praise and reinforcement, for non-target responses and attending behavior approximately every 5 opportunities	1 2 3	
Administrator proactively provides the child with play breaks to prevent frustration	1 2 3	

Met Fidelity: Yes No

Notes:

Reliability:

Appendix F. Generalization Probe Procedural Fidelity Form

Generalization Probe Procedural Fidelity Form

Child:_______ **Administrator:**_______ **Date of Clip:**_______ **Observer:**_______ **Date Scored:**_______

Reli: Yes No

Score each element based on your observation of the Administrator and child. To achieve fidelity, the Administrator must receive a score of "yes" or "3" on each of the procedural points that are being measured.

1/No (No Pass)	2 (No Pass)	3/Yes (Pass)
Administrator implements occasionally or not at all.	Administrator implements some of the time.	Administrator implements throughout the majority or all of the session.

Procedural Points	Fidelity	Notes
Administrator Qualifications		
Administrator has treatment experience working with children with autism	Yes No	
Administrator has not provided treatment to the child	Yes No	
General Room Set-up		
Toys are arranged in a room not used for treatment (generalization room in the lab and non-treatment room in the child's home*) *N/A if room not available	N/A Yes No	
Toys are selected from materials representing target skills, but were never used during treatment sessions	Yes No	
The toys are placed in such a way that the child can access some independently, but requires administrator assistance to access others (e.g., out of reach, in containers, turned off)	Yes No	
Spontaneous Generalization Probe (first five minutes and last five minutes)		
Toys representing all relevant targets are interspersed throughout the room	Yes No	
Administrator attends to child passively and allows the child to explore the environment	1 2 3	
Administrator refrains from initiating interaction with the child, but responds as usual if the child initiates	1 2 3	
Elicited Generalization Probe		
Administrator playfully entices the child with the target materials and reinforcers	1 2 3	
Administrator presents 5 randomly ordered trials testing generalization of the previously acquired targets (Acceptable to provide 4 trials if all correct and 2 trials if incorrect). Exception: for skills demonstrated on 2 previous consecutive probes, may present just one trial if correct.	Yes No	
Administrator provides no prompts other than withholding access	1 2 3	
Administrator provides no reinforcers or praise contingently for correct or incorrect responding to the target presentations	1 2 3	
Administrator presents receptive language, play, and imitation target opportunities such that the child is required to discriminate between materials in order to respond correctly	1 2 3	
Administrator intersperses trials of, praise and reinforcement for, non-target responses and attending behavior approximately every 5 opportunities	1 2 3	
Administrator proactively provides the child with play breaks to prevent frustration	1 2 3	

Met Fidelity: Yes No

Notes:

Reliability:

Appendix G. DTT Fidelity of Implementation Scoring Form

DTT Fidelity Form

Child: **Therapist:** **Observer:** **Date Scored:**

Date of Clip: **Time on Clip:** **Reli: Yes No**

Score each element based on your observation of the therapist and child. After scoring each element, provide a summary score for the intervention technique that best captures how the therapist performed on the elements.

Teaching Targets (based on clip):

Did at least 10 trials occur in the clip? **Yes** **No**

Low Fidelity 1	**2**	**3**	**4**	**High Fidelity 5**
Therapist does not implement throughout session.	Therapist implements occasionally, but misses majority of opportunities	Therapist implements up to half of the time, but misses many opportunities	Therapist implements more than half of the time, but misses some opportunities	Therapist implements throughout the session.

DTT Components	**Fidelity**	**Notes**
Instructional cue (S^D)		
Has child's attention before giving the cue	1 2 3 4 5	
Gives a clear verbal cue, question, or instruction (S^D)	1 2 3 4 5	
Uses appropriate S^D	1 2 3 4 5	
Summary	***1 2 3 4 5***	
Appropriate prompt level		
Prompt occurs at the same time or immediately after the S^D (if needed)	N/A 1 2 3 4 5	
Prompt elicits the target behavior	N/A 1 2 3 4 5	
Uses appropriate prompting rules	N/A 1 2 3 4 5	
Prompts are progressively and systematically faded	N/A 1 2 3 4 5	
Uses differential reinforcement for prompted trials	N/A 1 2 3 4 5	
Summary	***N/A 1 2 3 4 5***	
Contingent consequences		
Consequences are immediate	1 2 3 4 5	
Instructions are followed by the proper consequence	1 2 3 4 5	
Responds to child's first response	1 2 3 4 5	
Reinforcers appear individualized to the child	1 2 3 4 5	
Uses tangible reinforcement accompanied by social praise	1 2 3 4 5	
Rewards appropriate behavior	1 2 3 4 5	
Includes inter-trial interval pauses	1 2 3 4 5	
Summary	***1 2 3 4 5***	
Other Important Components		
Conducts discrimination training when introducing new targets	N/A 1 2 3 4 5	
Targets generalization of previously acquired targets	N/A 1 2 3 4 5	
Intersperses play breaks throughout sets of trials (if needed)	1 2 3 4 5	
Maintains previously acquired targets	N/A 1 2 3 4 5	
Uses shaping appropriately	N/A 1 2 3 4 5	
Summary	***1 2 3 4 5***	

Met Fidelity: Yes No

Notes:

Reliability:

Appendix H. DTT Fidelity of Implementation Definitions

DTT Fidelity of Implementation Definitions

Basic Procedures:

- Before scoring, please review the child's current targets. Write them down so the list is available as a reference. If these are not available, do not score this section unless you know the child.
- Keep these definitions available as a reference as you are scoring.
- The RA should provide at least 10 learning opportunities in a 10-minute session. Count the number of learning opportunities (until you reach 10) to ensure the RA meets this requirement. Check the appropriate box on the scoring form. If the RA does not provide at least 10 learning opportunities, fidelity cannot be coded.
- Choose a number 1-5 (or N/A) that best represents the quality of PRT implementation you observe. If the technique is not being implemented correctly, score a 1, regardless of frequency throughout the session. In order to pass, the RA needs a score of 4, 5, or N/A in each category.

Score	Definition
N/A	There were no opportunities to demonstrate item in the clip provided.
1	RA does not implement throughout session.
2	RA implements occasionally, but misses a majority of opportunities.
3	RA implements up to half the time, but misses many opportunities.
4	RA implements a majority of the time, but misses some opportunities.
5	RA implements throughout the session. Misses no opportunities.

Calculating the summary score; After each section choose a summary score for that section. In general, the summary score will be an average of the individual scores for that area. However, an instruction cannot earn a summary score of 5 unless all of the individual scores for that area are 5.

Instructional Cue (SD)

Has the child's attention before giving the cue – The RA makes sure the child is oriented toward, or looking at, the toy/stimuli or the RA before the instructional cue is given. The RA makes sure the child is not playing, crying, wandering, looking away or engaging in self-stimulatory behaviors before giving the cue. The child should not have access to toys and other materials that are distracting.

Gives a clear verbal cue, question or instruction (SD) – The RA uses an SD that is clear, concise, and consistent. It is obvious what response is expected from the child. The SD should be uninterrupted and have a distinct beginning and ending. The RA does not repeat the SD without consequating the child's response (i.e. all trials discrete).

Uses appropriate SD – The RA identifies and follows the appropriate SD based on the lesson plan and supervisor notes (this can be located on the data sheets from the child's program binder). If scorer does not know the appropriate cue, do not score this item.

Appropriate Prompt Level

Prompt occurs at the same time or immediately after the SD (if needed) – When a prompt is used, it occurs at the same time or immediately after the SD. It should be clear that the RA decided to use a prompt before presenting the SD, rather than deciding to prompt after the child fails to respond to the SD and time has passed. The RA does not provide a prompt after the child has started to respond incorrectly or present a prompt without also presenting the SD.

Prompt elicits the target behavior – The RA uses a prompt that helps the child make a correct response. The prompt should offer just enough assistance so that the child makes a correct response, but not so much assistance that it the response required by the child is below his/her level.

Uses appropriate prompting rules – If the target is in acquisition, the RA prompts on the trial immediately following an incorrect response and fades the prompt over time. This may include providing another prompted trial immediately following or fading after the first prompted response. If the target is mastered, the RA follows the no-no-prompt sequence. The RA prompts on the third trial after two consecutive incorrect responses. A prompted trial should be followed by an unprompted trial and returned to later on in the session.

Prompts are progressively and systematically faded – For acquisition skills, the RA systematically fades the prompts by moving from the most-to-least intrusive prompt in accordance with the child's success rate and across trials. For example, s/he moves from a full to partial model prompt, and then to a time delay prompt. The RA may periodically probe for independence during the fading process by providing no prompt on a trial and assessing the child's response (and prompting in accordance with the child's response on subsequent trials). For mastered/maintenance skills that require prompting, the RA moves from least to most intrusive prompts as necessary.

Uses differential reinforcement for prompted trials – The RA provides more potent reinforcers (e.g., more highly preferred, larger amounts, longer periods of time) for acquisition skills and unprompted responses in comparison to maintenance skills and prompted responses. In the case that a prompted skill is in acquisition, this response may receive the most potent reinforcer.

Contingent Consequence

Consequences are immediate – The RA provides the consequence within approximately 3 seconds of the child's response. Reinforcement for a correct response is provided before any other non-target behaviors occur. If another behavior occurs prior to providing reinforcement, reinforcement is withheld.

Instructions (SD) are followed by the proper consequence – Every SD is followed by a consequence. If the child's response is correct, then the RA provides tangible reinforcement and social praise. The RA should use consistent response criteria to determine which response is correct. If the child does not respond, or responds incorrectly, then the RA provides an "informational no," or otherwise neutral response (e.g., "okay" or extinction). The RA should use appropriate consequences for disruptive behaviors, such as extinction and follow through. Extinction should be used for behaviors that serve as attention and tangible seeking function. Response blocking may also be used in response to aggressive behaviors. Follow through should be used for behaviors that serve as escape or avoidance function. In all situations, the RA should follow through with any demand placed on the child and the child should not receive reinforcement for disruptive behaviors.

Responds to child's first response – The child's first response should be followed by a consequence from the RA. In the case that the child is engaging in "processing" or "thinking" behaviors, the final child response should be clearly specified (e.g., the child may scan a receptive field with his hands prior to handing the object to the RA). The RA does not allow the child to make one response and then seek out a reaction from the RA and then switch responses.

Reinforcers appear individualized to the child – RA verifies that potential reinforcers are truly reinforcing to the child prior to using it as a positive reinforcer. This may be done by allowing the child to choose from an array of items, observing how the child plays with the toys, or using a child's verbal request as an indication. This preference assessment should be conducted throughout the sessions, to ensure that the items are still reinforcing. If the child appears to have lost interest in a reinforcer, the RA should identify a different potential reinforcer prior to the subsequent trial.

Uses tangible reinforcement accompanied by social praise – When providing positive reinforcement for new skills, the RA provides a motivating item to the child (the child must appear to want the item) and social praise. The RA may use general praise (e.g., "good job"), specific praise (e.g., "I like the way you matched the spoon."), or may repeat the label of the item. Note that the RA may provide verbal praise only or intermittent tangible reinforcement and social praise for maintaining previously learned skills.

Rewards appropriate behavior – The RA provides positive reinforcement for appropriate behavior. This may include the child coming to the table, sitting in a chair, and keeping his/her hands in lap. The frequency of responding to appropriate behavior will vary depending on the child's compliance level (i.e. if the child is very compliant, it is appropriate to not reward this behavior very frequently).

Includes inter-trial interval pauses – There is an inter-trial interval pause where the child is allowed to enjoy the reinforcer for a few seconds before the RA begins the next trial.

Other Important Components

Conducts discrimination training when introducing new targets – The RA correctly conducts discrimination training when introducing new targets. For teaching additional targets beyond the first two in discrimination, the RA begins with massed trials and progresses through expanded trials and random rotation based on the child's responding. For teaching the first two targets in a program, the RA begins with massed trials and progresses through blocked trials and random rotation based on the child's responding. For blocked trials, the RA prompts on the "switch trial." See the "DTT Manual" for more information about these procedures, if necessary for scoring purposes.

Targets generalization of previously acquired targets – The RA varies the S^Ds presented and stimuli used for previously acquired targets to actively target generalization.

Intersperses play breaks throughout sets of trials – The RA intersperses play breaks throughout the session. The RA adjusts the number of trials provided prior to a play break based on the child's motivation and attention. He/she appears to anticipate breaks rather than providing them reactively. The RA does not provide play breaks after incorrect responses. Note that play breaks may not occur within the 10-minute video probe, as it may not be appropriate during that amount of time.

Maintains previously mastered targets –The RA intersperses trials of mastered items during random rotation.

Uses shaping appropriately – The RA reinforces successive approximations of the target behavior by beginning with accepting a lower-level approximation and increasing the expectation based on the child's ability to consistently express the previous response. The RA continues raising the criterion to a closer approximation of the target behavior and no longer reinforces lower-level approximations.

Appendix I. PRT Fidelity of Implementation Scoring Form

PRT Fidelity Form

Child: **Therapist:** **Observer:** **Date Scored:**

Date of Clip: **Time on Clip:** **Reli: Yes No**

Maintenance Tasks:
Acquisition Tasks:

Score each element based on your observation of the therapist and child. After scoring each element, provide a summary score for the intervention technique that best captures how the therapist performed on the elements. To achieve fidelity, the therapist must receive a score of 4 or 5 on each of the technique scores that are being measured.

Did at least 10 trials occur in the clip? **Yes** **No**

Low Fidelity 1	**2**	**3**	**4**	**High Fidelity 5**
Therapist does not implement throughout session.	Therapist implements occasionally, but misses majority of opportunities	Therapist implements up to half of the time, but misses many opportunities	Therapist implements more than half of the time, but misses some opportunities	Therapist implements throughout the session.

Intervention Technique	**Fidelity**	**Notes**
Therapist maximizes child motivation		
Follows child's choice of activity	1 2 3 4 5	
Takes turns by modeling appropriate behavior	1 2 3 4 5	
Intersperses tasks the child has already mastered (maintenance tasks)	1 2 3 4 5	
Reinforces child's goal-directed attempts (good trying)	N/A 1 2 3 4 5	
Summary	***1 2 3 4 5***	
Therapist facilitates child responding		
Gains child's attention before providing a cue	1 2 3 4 5	
Provides clear and developmentally appropriate cues	1 2 3 4 5	
Provides cues related to the activity	1 2 3 4 5	
Provides cues that require responding to multiple elements (Multiple Cues)	N/A 1 2 3 4 5	
Summary	***1 2 3 4 5***	
Therapist provides appropriate consequences		
Provides appropriate consequences based on child's behavior (Contingent)	1 2 3 4 5	
Provides reinforcement directly related to the child's behavior	1 2 3 4 5	
Summary	***1 2 3 4 5***	
Therapist prepares for session and manages environment		
Determines clear instructional goals	1 2 3 4 5	
Identifies effective reinforcing materials	1 2 3 4 5	
Eliminates distractions from the teaching environment	1 2 3 4 5	
Maintains control of instructional materials	1 2 3 4 5	
Fades prompts effectively	N/A 1 2 3 4 5	
Adjusts affect appropriately to match child's needs	1 2 3 4 5	
Summary	***1 2 3 4 5***	

Met Fidelity: Yes No

Notes:

Reliability:

Appendix J. Pivotal Response Training Fidelity of Implementation Scoring Definitions

PRT Fidelity of Implementation Scoring Definitions

Basic Procedures:

- Before scoring, please review the child's current maintenance and acquisition skills. Write them down so the list is available as a reference. If these are not available, do not score this section unless you know the child.
- Keep these definitions available as a reference as you are scoring.
- The RA should provide at least 10 learning opportunities in a 10-minute session. Count the number of learning opportunities (until you reach 10) to ensure the RA meets this requirement. Check the appropriate box on the scoring form. If the RA does not provide at least 10 learning opportunities, fidelity cannot be coded.
- Choose a number 1-5 (or N/A) that best represents the quality of PRT implementation you observe. If the technique is not being implemented correctly, score a 1, regardless of frequency throughout the session. In order to pass, the RA needs a score of 4, 5, or N/A in each category.

Score	Definition
N/A	There were no opportunities to demonstrate item in the clip provided.
1	RA does not implement throughout session.
2	RA implements occasionally, but misses a majority of opportunities.
3	RA implements up to half the time, but misses many opportunities.
4	RA implements a majority of the time, but misses some opportunities.
5	RA implements throughout the session. Misses no opportunities.

Calculating the summary score; After each section choose a summary score for that section. In general, the summary score will be an average of the individual scores for that area. However, an instructor cannot earn a summary score of 5 unless all of the individual scores for that area are 5.

RA maximizes child motivation

<u>Follows child's choice of activity</u> – The RA follows the child's interest in toys/activities. The RA may provide specific choices, either within or between activities, as a way to determine the child's interest or engage the child.

<u>Takes turns by modeling appropriate behavior</u> – The RA takes turns while playing with the child. A skillful turn occurs when the RA has control of the materials and models play or language while maintaining the child's attention. Turns may vary in frequency and length depending on the attention span of the child.

<u>Intersperses tasks the child has already mastered (maintenance) with new learning (acquisition)</u> – The RA should intersperse maintenance and acquisition tasks. Score based on the initial cue presented by the RA regardless of the child's response (e.g., If

the RA provides an acquisition cue "ball" and the child responds with a maintenance skill "buh," it should still be considered a cue for an acquisition skill).

RA facilitates child responding

Gains child's attention before providing a cue – The child is attending to the RA before the RA presents a cue and typically would be oriented toward the RA when the cue is provided. If the RA is repeating the instruction often, this is a sign that s/he does not have the child's attention.

Provides clear and developmentally appropriate cues – A clear cue indicates to the child how he should respond and uses language or play models that are at or slightly above the child's response level. If the child is not expected to respond (e.g., the RA is presenting a rhetorical question) or does not understand how he should respond (e.g., the skill level or language used is too advanced), the cue is not clear.

Provides cues related to the activity – The RA should only present cues that are related to the activity at hand. Instructions such as "Push the car" or an expectation that the child would ask for a car would be related if the child and RA are playing with toy cars. Receptive instructions that are presented in an effort to regain the child's attention (e.g., "Look at me") are acceptable.

Provides cues that require responding to multiple elements (multiple cues) – If the child is using phrase speech and descriptive language, the RA should include some cues that require the child to make discriminations based on multiple simultaneous environmental stimuli. The RA would present at least two cues (e.g, color and type of utensil - providing a box of variously colored markers and crayons for the child to discriminate) and would require a verbal or receptive response.

RA provides appropriate consequences

Provides appropriate consequences based on child's behavior (contingent) – The RA should provide a consequence that is dependent on the child's behavior immediately after the child responds. If the child does not respond appropriately, the RA should withhold reinforcement.

Provides reinforcement directly related to the activity – The RA should provide reinforcement that is directly related to the child's behavior and the activity. For example, if the child is talking about a puzzle, or appropriately follows an instruction regarding a puzzle, then free access to the puzzle would be the direct reinforcer. Praise alone is not a direct reinforcer.

Reinforces the child's goal-directed attempts (good trying) - The RA should provide reinforcement after most of the child's reasonable attempts. The RA does not need to reinforce every attempt. However, if the child appears frustrated because he is not receiving enough reinforcement for good trying, the RA should be rewarding more attempts. The child is making a reasonable, goal-directed attempt if he is attending to the RA and approximating the targeted response at his skill level (e.g., if the RA provides the cue "bubbles" to a child who can make a "buh" sound but does not yet say words, and the child says "buh" while reaching for the bubbles, he is making a reasonable attempt).

RA prepares for session and manages environment

Determines clear instructional goals – The RA's cues follow a pattern that indicates she has clear goals for the child. You can tell from watching what the RA is expecting from the child.

Identifies effective reinforcing materials – The child is highly motivated by the materials available as evidenced by his attempts to look at, reach for or request them.

Eliminates distractions from the teaching environment – The RA is aware of possible distractions in the environment and attempts to eliminate them if possible.

Maintains control of the instructional materials – The RA practices shared control of the instructional materials. When the RA wants to gain the child's attention or present a cue, she effectively limits the child's access to the materials.

Uses prompts effectively – The RA's prompts follow a pattern based on the child's responding (e.g., if the child is responding correctly, the RA fades prompts and if the child is incorrect, the RA increases the supportiveness of the prompt). Prompts should increase the child's understanding of how he is supposed to respond.

Adjusts affect appropriately to match child's needs – The RA uses an appropriate level of animation and silliness in order to keep the child's attention. However, the RA is not so loud or animated that the child appears to be afraid of or bothered by the action or noise. The RA should appear to enjoy the interaction and use things such as exaggerated facial expressions and gestures to keep the child's attention.

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