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Adapting Individual Components of Pivotal Response Training for the Classroom: Using Basic Research to Inform Practice

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy

in

Psychology

by

Sarah Rebecca Reed

Committee in charge:

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Professor John Wixted

2012

The Dissertation of Sarah Rebecca Reed is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California, San Diego

2012

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ACKNOWLEDGEMENTS

Chapter 1, in full, has been accepted for publication and is a reprint of the material as it will appear in the Journal of Autism and Development Disorders, 2012. Reed, Sarah; Stahmer, Aubyn; Suhrheinrich, Jessica; Schreibman, Laura, Springer, 2012. The dissertation author was the primary investigator and author of this paper.

Chapter 2, in full, has been submitted for publication of the material as it may appear in Journal of Applied Behavior Analysis, 2012. Reed, Sarah; Stahmer, Aubyn; Suhrheinrich, Jessica; Schreibman, Laura, Society for the Experimental Analysis of Behavior, 2012. The dissertation author was the primary investigator and author of this paper.

Chapter 3, in full, has been submitted for publication of the material as it may appear in Research in Autism Spectrum Disorders, 2012. Reed, Sarah; Stahmer, Aubyn; Suhrheinrich, Jessica; Schreibman, Laura; Wilson, Joanna; Ross, Benjamin, Elsevier, 2012. The dissertation author was the primary investigator and author of this paper.

This work would not be possible without the families and children who participated in these studies. I am very grateful for the value they place on participating in research and the time they took from already full schedules to attend sessions. I would also like to thank the multitude of undergraduate research assistants who supported me in these and numerous other projects throughout my graduate career.

On both a professional and personal level, there are numerous people who have supported me to whom I would like to express my gratitude. The laboratory staff and my fellow graduate students in the UCSD Autism Intervention Research Program created a collaborative and supportive environment of which I am grateful to have been a part. Particularly, Jessica Suhrheinrich provided invaluable assistance in all steps of the research process, from study conception to final edits, and I am delighted to continue working closely with her. The Autism Intervention Research Program at UCSD is only possible due to the thoughtful leadership of Laura Schreibman. I am grateful for her supervision as a graduate advisor and for the opportunity to learn from her illustrious academic career. The lessons I have learned under her guidance span topics from the plurality of data to the importance of social validity, and I shall carry them all forward with me throughout my career.

It is nearly impossible to put into writing my gratitude towards my advisor, Aubyn Stahmer. She encouraged me to pursue a doctorate, supported me through each step large and small, and has been a role model to me throughout the process. Her pursuit of applied and collaborative research that both advances understanding and solves real problems in the world is truly admirable. It is difficult to go anywhere in the field of autism, whether it be in services, in research, or in schools, without finding someone extolling Aubyn's hard work and knowledge, and she is fully deserving of these accolades. I am extremely appreciative of her confidence in me and her continual support as we move forward into exciting new territory.

As always, I could not have completed this work without the encouragement and support of my family. Thank you to my parents, Paul and Sally Reed, for instilling in me the value of my own education as well as the importance of supporting the education of others. Though I never wrote my Benjamin Franklin report and I will always resent the Study Machine, those experiences laid the foundation for this dissertation and my future ambitions and I am grateful for them. Thank you especially to my mom for sharing with me her unending love of students and showing me the importance of listening to special educators in order to conduct special education research. Thank you to my father for many, many years of help with my homework, which continued with the crafting of the wooden block stimuli for Chapters 1 and 2. My sisters have played an invaluable role in the completion of my degree. Thank you to Laurel Reed Pavic for blazing the UCSD-Reed-sister-PhD trail, harnessing the power of a watermelon ring pop when all seemed lost, and demonstrating what it means to truly be passionate about a subject. Thank you to Katyrose Reed for sharing her campus meal dollars to keep me fed, providing enough glow sticks and bobby pins to keep me entertained, and instituting the grumpy couch to keep me (and those around me) happy.

Finally, I would like to thank Cory Rieth, whose role in this dissertation and my life defies label. His encouragement to push through the crises of academic faith, his patience in explaining the statistics yet again, and his enthusiasm for strong science are all things I cannot do without. His ability to determine exactly what is needed at any point in time, whether it is assistance with paper revisions or a good laugh, is truly impressive. Surely now that we have faced and conquered the world of graduate school together, anything is possible.

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Funding

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ABSTRACT OF THE DISSERTATION

Adapting Individual Components of Pivotal Response Training for the Classroom: Using Basic Research to Inform Practice

by

Sarah Rebecca Reed

Doctor of Philosophy in Psychology

University of California, San Diego, 2012

Professor Laura Schreibman, Chair

Dissemination of evidence-based interventions for autism spectrum disorders (ASD) is a major challenge facing the field. Collaboration between researchers and practitioners aimed towards developing and adapting interventions with strong scientific support may aid in the widespread adoption of evidence-based intervention in community classrooms. The following three studies were motivated by teacher feedback on the use of one evidence based intervention, Pivotal Response Training (PRT), in the classroom. Two intervention components were selected for examination based on teacher report of difficulty with use and subsequent omission and observed difficulty with implementation:

response to multiple cues and turn taking. Response to multiple cues was evaluated by administering a discrimination learning assessment to typically developing children to determine the age at which it is developmentally appropriate to incorporate conditional discriminations into instruction (Chapter 1). The discrimination learning assessment was also administered to children with ASD to determine the extent to which today's population of children receiving intervention services has difficulty with overselectivity (Chapter 2). Results demonstrated that typically developing children do not consistently respond to simple conditional discriminations until 36 months of age, indicating that response to multiple cues does not need to be incorporated into PRT until children with ASD reach that developmental level. Additionally, a significantly smaller percentage of children with ASD display difficulty with simple conditional discriminations than in previous studies. The turn taking component of PRT was evaluated through a single subject, alternating treatments design that examined the effects of the elements of modeling and contingency on children's communication and play behavior (Chapter 3). Results demonstrated consistent patterns in children's behavior based on the elements of turn taking in use and the functioning level of the child. Avenues for adaptation of the multiple cues and turn taking components and methods of treatment individualization are discussed. Based on these three studies, adaptations to PRT that may support teachers' use of the strategy in the classroom may be made. This research represents a useful model for the iterative and collaborative process of gathering information from front-line practitioners, conducting basic research based on their feedback, and utilizing that basic research to inform clinical practice.

INTRODUCTION

Autism Spectrum Disorders (ASD) represent a class of pervasive developmental disorders characterized by impairments in communication and social functioning along with restricted, repetitive, and stereotyped patterns of behavior (American Psychiatric Association, 2000). Individuals with ASD typically require considerable supports throughout the lifespan (Howlin, Goode, Hutton, & Rutter, 2004). Within the last two decades, estimates of the prevalence of ASD have increased from 4-5 per 10,000 children to nearly 10 times that number, with current estimates at 11.3 per 1000 children (Center for Disease Control and Prevention, 2012). Special education enrollment for ASD has grown particularly quickly, quadrupling nationwide since 2000 (Scull & Winkler, 2011), and more than tripling from 17,508 students statewide in California (2.6% of special education students) in 2001 to 59,690 (8.8%) in 2010 ("Local Prevalence of Disabilities", 2011).

Autism Intervention in Schools

The profound and pervasive nature of the deficits associated with ASD, in conjunction with the rapidly increasing number of students identified with these disorders, presents public school systems with significant challenges in providing intensive, individualized programming. Even teachers who are highly trained in special education practices may not have the qualifications and skills needed to support students with ASD (Loiacono & Allen, 2008; Williams, Fan, & Goodman, 2010). Limited training opportunities for teachers and a dearth of ASD interventions designed specifically for use in schools exacerbate the problem and may contribute to poor student outcomes (McGee & Morrier, 2005; Stahmer, 2007). Recent reviews of intervention practices have identified evidence-based interventions (EBIs) for ASD that have been sufficiently empirically examined and consistently result in favorable child outcomes (National Autism Center, 2009; Odom, Boyd, Hall, & Hume, 2010). However, a majority of these interventions were designed for use in one-on-one interactions or tested in highly controlled conditions; research examining intervention outcomes in applied settings is lacking. Teachers attempting to use these interventions in classrooms report barriers related to staffing, training, the limited flexibility of the intervention to address heterogeneous learning needs, and the fit of the interventions for a classroom setting (Cochran-Smith & Lytle, 1999; Stahmer, Collings, & Palinkas, 2005; Suhrheinrich, Stahmer, Reed, Reisinger, & Mandell, in revision). One way to address the lack of appropriate classroom interventions for students with ASD is for researchers to begin adapting existing EBIs specifically for use in classrooms.

Understanding Active Ingredients of EBI for ASD

Due to the complexity of treating ASD, many EBIs are comprised of several individual components. Outcome studies in research settings typically examine these interventions as a whole while ensuring the intervention is delivered as designed by monitoring fidelity of implementation. Researchers measure fidelity by certifying that all components are utilized and determining whether each component is implemented at the necessary level (e.g., frequency, intensity) specified by the intervention. However, teachers report picking and choosing specific components of an intervention to fit their students and classroom rather than using the intervention in its entirety (Stahmer, 2007). This is problematic. When only some components of EBIs are used or the components are used with low fidelity, it is unknown whether the same favorable outcomes seen in research studies can be expected or how child behavior will be affected. It may be that some components of interventions are the true 'active ingredients' in producing positive outcomes, while others are less important. Alternatively, it may be that there is a range of acceptable implementation in the level of use for some components and variation within this range does not change the effectiveness of the intervention. For example, an intervention protocol may require the therapist to imitate all of the speech sounds a child makes because studies demonstrate that this practice leads to an increased number of speech sounds from the child relative to the therapist not imitating sounds. It is possible, however, that imitating 75% of the child's speech sounds produces a similar increase in child speech sounds as imitating 100%, but this type of detailed distinction is unknown based on previous research.

Because EBIs are being informally modified in applied settings to unknown effects, it is important to examine the relative contribution and necessity of each component of an intervention to achieve optimal student outcomes (Sanetti & Kratochwill, 2009; Schulte, Easton, & Parker, 2009). Basic research studies on the components of an intervention can inform how child behavior and outcomes are likely influenced by teachers' adaptations to EBI. Additionally, these investigations can balance the need to preserve active ingredients of the EBI while ensuring fit with student and classroom characteristics. Intervention protocol can then be altered based on the results of individual component studies to reflect the relative importance of components or acceptable variation in component implementation. If studies show that modifications to a component decrease intervention effectiveness, additional training or support could be provided to ensure that component is implemented with fidelity. These processes could improve teachers' adherence to the intervention and therefore the likelihood that use of the EBI will produce positive student outcomes (e.g., Durlak & DuPre, 2008; O'Donnell, 2008; Sanetti & Kratochwill, 2009; Stahmer & Gist, 2001).

Pivotal Response Training

Pivotal Response Training (PRT) is one EBI developed specifically for ASD that is based on the principles of applied behavior analysis and soundly supported in the scientific literature (National Autism Center, 2009; National Research Council, 2001; Humphries, 2003; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010). PRT was designed based on a series of studies identifying important treatment components. The "pivotal" responses trained in PRT are motivation, child initiations, and responsivity to multiple cues (i.e., increasing breadth of attention). Specific elements include gaining the child's attention, providing clear and appropriate prompts, interspersing maintenance tasks, allowing shared control of teaching tasks and materials by providing child choice and using turn-taking, requiring a response to multiple cues, providing contingent consequences, giving reinforcement directly related to the activity, and reinforcing attempts (Koegel et al., 1989). Definitions for each component are provided in Table I.

Treatment studies have highlighted a wide variety of skills that can successfully be addressed using PRT. For example, in the area of communication, PRT has been shown to be effective for improving speech imitation (Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998; Laski, Charlop, & Schreibman, 1988), labeling (Koegel et al., 1998), question asking (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998), spontaneous speech (Laski et al., 1988), conversational communication (Koegel et al., 1998) and rapid acquisition of functional speech in previously nonverbal children (Sze, Koegel, Brookman, & Koegel, 2003). In contrast to the other interventions that have focused almost exclusively on increasing communication skills, PRT has also been used to teach skills such as joint attention (Pierce & Schreibman, 1995; Rocha, Schreibman, & Stahmer, 2007; Whalen & Schreibman, 2003), sociodramatic play (Thorp, Stahmer, & Schreibman, 1995), symbolic play (Stahmer, 1995), and peer social interaction (Pierce & Schreibman, 1997). Academic skills such as numbers, letters and shapes also have been effectively taught using PRT (Koegel & Koegel, 2006).

PRT in the Classroom

PRT is well suited for use in classroom settings because it is designed to address a variety of communication, play, social, and academic goals within the context of naturalistic adult-child interaction. In a survey of 80 educational providers in the Southern California area, over 70% reported using PRT or similar naturalistic behavioral strategies in their classrooms (Stahmer, 2007), indicating high local dissemination of this particular EBI. In addition, PRT is included in several nationally utilized intervention packages, including Strategies for Teaching based on Autism Research (STAR; Arick, Loos, Falco, & Krug, 2004) and the Early Start Denver Model (Rogers & Dawson, 2009). However, a majority of teachers surveyed report modifying or adapting the practice based on personal preferences or the needs of individual students (Stahmer, 2007). While the individualization of treatment is important given the heterogeneity of ASD, it is unknown to what degree the teacher-adapted versions of the EBI preserve the research-validated components of the original protocol. This uncertainly calls into question whether applying the intervention in this setting will result in the same positive student outcomes that have been demonstrated in tightly controlled research studies.

Table I. PRT Components and definitions.

PRT Component	Definition
Gains Attention	Teacher must have the student's attention before presenting an opportunity.
Clear Opportunity/ Instruction	The question/ opportunity must be clear & appropriate to task.
Maintenance Tasks	Tasks that are easy must be interspersed with more difficult tasks (acquisition).
Child Choice (Shared Control)	Teacher must follow the student's choice of tasks, to a large extent and/or provide choices within tasks.
Turn Taking (Shared Control)	Teacher must model appropriate behavior in the context of a give and take interaction with the student.
Multiple Cues	Some instructions must involve cues that include multiple components (two or more aspects of the environment, stimuli or activity).
Contingent Consequence	Reinforcement must be contingent on the child's behavior.
Direct Reinforcement	Reinforcement must be natural and directly related to the desired behavior.
Reinforcement of Attempts	Goal-directed attempts to respond must be reinforced.

A handful of studies have specifically examined teachers' use of PRT in the classroom and can provide valuable information on how applied usage compares to the intended practice. For example, Suhrheinrich, Stahmer, and Schreibman (2007) investigated teachers' accuracy of PRT implementation in the classroom by observing San Diego County special education teachers who had received some training in PRT. Teachers reported receiving various types of training: a PRT training manual to read, observation, didactic instruction, and feedback from a professional. Results from classroom observations revealed that teachers implemented each component correctly on at least 60% of trials, except for turn taking. The average fidelity of implementation for turn taking was at 10% for teachers with low levels of training (reading the manual and observation), 17% for teachers with medium levels of training (additional didactic instruction) and 8% for teachers with high levels of training (additional feedback from a professional). Teachers' average level of fidelity on each PRT component except turn taking varied systematically with the type and amount of training teachers received (i.e., teachers with higher levels of training were more likely to implement the component correctly). Similarly low levels of fidelity for the turn taking component were found for two groups of teachers who received training in PRT either through a research project or through clinical instruction (Suhrheinrich et al., in revision), even though most other components were conducted with relatively high fidelity. Of the 41 teachers who participated in the study, only 19% correctly implemented the turn taking component of PRT. Turn taking was one of only two components used correctly by fewer than half of the participating teachers. These differential results for the fidelity of turn taking highlight the component as a specific area of implementation difficulty for teachers, and suggest that more than just additional training may be necessary. There appears to be something qualitatively different about the turn taking component that prevents teachers from using it with fidelity in the classroom.

Another component of PRT that may require further study is requiring a response to multiple cues. Although not all research on fidelity of PRT in the classroom has incorporated measurement of multiple cues (Suhrheinrich, 2011; Suhrheinrich et al., 2007), the Suhrheinrich et al. (in revision) study assessed teachers' use of this component and revealed significant difficulty. Only 5% of teachers were implementing the multiple cues component of PRT correctly (the second component used correctly by fewer than half of participating teachers). The lack of data on the use of the multiple cues component in applied settings and evidence of poor implementation of multiple cues highlight the need to further explore this component for adaptation to the classroom.

The above observational findings on difficult components of PRT are supported by qualitative data on teachers' opinions about using PRT in the classroom (Stahmer, Suhrheinrich, Reed, & Schreibman, in review). Thirteen special education teachers participated in focus groups regarding the barriers and benefits to using PRT in the classroom. When presented with a list of PRT components, teachers with and without explicit training in PRT all reported that they felt PRT was 'good teaching' and was intuitive for use with students with ASD. Turn taking and multiple cues, however, were both components that teachers consistently reported as challenging to implement. They found turn taking difficult to use in group settings, as it was difficult to model specific behaviors while managing multiple students. They reported omitting the multiple cues component entirely, often because they did not feel it was developmentally appropriate for the youngest or lowest functioning students with ASD in their classrooms. Additionally, they found it burdensome to collect the necessary materials for using the component and they reported confusion about the process of requiring response to multiple cues as it is described in the existing PRT manual. Though teachers also reported some concerns about other components of PRT, turn taking and multiple cues are the two areas where their perspectives on the challenges of utilizing PRT matched other teachers' observed difficulty with classroom implementation. The match between teacher report and observational data in these areas likely indicates that these difficulties are widespread and consistently lead to poor implementation of PRT for teachers. In order to successfully move high quality PRT into classroom environments, we need to understand the relative contribution of these two components to the intervention as a whole to inform potential modification or additional training.

Bridging the Gap between Research and Practice

The current divide between empirical investigations and applied use of interventions has led researchers to call for innovative models of intervention adaptation that shift from the traditional, unidirectional paradigms of research into practice toward a more reciprocal, interactive effort between researchers and practitioners (Bondy & Brownell, 2004; Mehan, 2008; Meline & Paradiso, 2003; Weisz, Chu, & Polo, 2004). Therefore, our overall approach to addressing the use of PRT in classrooms has been a collaborative one, a joint effort between teachers and researchers. The first step in the collaborative process was gathering information on the current state of EBI use in the classroom, as accomplished by the observational and focus group studies described previously. These studies were designed and implemented by a team of special education teachers and district administrators who share the goal of improving the use of EBI for ASD in school settings. The next step in the collaborative process of adapting PRT was bringing teachers' values and difficulties with PRT back to the laboratory to test suggested adaptations. This ensures that PRT is optimally portable to classroom settings and therefore increase the likelihood of teachers utilizing the practice (Hoagwood, Burns, Kiser, Ringeisen, & Schoenwald, 2001; Huang, Hepburn, & Espiritu, 2003; Rogers, 2003; Schwartz, 1999) while preserving effectiveness of the intervention. This dissertation is comprised of a series of studies that carefully examine the two most troublesome components of PRT for teachers to inform classroom adaptations and improve the quality of educational services for students with ASD.

Research Questions and Hypotheses

Two components of PRT, turn taking and multiple cues, stand out in preliminary studies of classroom use of PRT as areas in need of possible adaptation to improve community implementation. The following three chapters empirically examine these two components of PRT in order to identify how researchers and classroom teachers may alter them for effective use. The specific aims are:

1. Determine the developmental level at which targeting response to simultaneous multiple cues is appropriate for typically developing children.
2. Evaluate the degree to which children with ASD receiving educational services have difficulty responding to multiple cues.
3. Evaluate the relative effectiveness of the elements of the turn taking component of PRT for teaching children with ASD in the areas of expressive language and play skills. Determine whether the current practice of turn taking can be altered and still maintain efficacy.

Conducting targeted research in areas of teachers' reported concern and demonstrated difficulty will facilitate the process of translation of EBI into applied settings and increase the likelihood of teachers' adoption and sustained use of effective practice (Hoagwood et al., 2001; Huang et al., 2003; Schwartz, 1999).

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CHAPTER 1: Stimulus overselectivity in typical development: Implications for teaching children with autism

Stimulus overselectivity refers to control of an individual's behavior by a subset of the elements of a compound stimulus presented during discrimination learning (Lovaas, Koegel, & Schreibman, 1979; Lovaas, Schreibman, Koegel, & Rehm, 1971). Lovaas, Schreibman, Koegel, and Rehm (1971) first identified the phenomenon four decades ago as an abnormality in attention or stimulus control in children with autism spectrum disorders (ASD). Since then, research has consistently demonstrated that many children with ASD, as well as other developmental delays, display difficulty responding to multiple components of a compound stimulus both within and across modalities (see Ploog, 2010 for a comprehensive review). After the initial identification of overselectivity in individuals with ASD (Lovaas et al., 1971), further research revealed the same attentional phenomenon in other populations, including typically developing preschoolers (Bailey, 1981; Bickel, Stella, & Etzel, 1984; Brack, 2001; Dickson, Wang, Lombard, & Dube, 2006; Dube & McIlvane, 1997; Fairbank, Powers, & Monaghan, 1986; Huguenin, 1997; McHugh & Reed, 2007; Schneider & Salzberg, 1982). Studying overselectivity in typically developing children provides useful insight into the process of stimulus control of behavior as well as its role in the formation of complex concepts (McHugh & Reed, 2007), and it continues to be a dynamic area of behavior analytic research (Ploog, 2010).

It is clear from the literature that there exists a strong association between overselectivity and both chronological age and developmental level (Ploog, 2010). First, several studies have demonstrated that the number of cues to which a child can respond in a discrimination task, known as breadth of learning, increases reliably with chronological age in typically developing children (Eimas, 1969; Fisher & Zeaman, 1973; Hale & Morgan, 1973; Schover & Newsom, 1976; Wilhelm & Lovaas, 1976). For example, in Eimas's (1969) study, all children ages five to nine responded appropriately to both components when the task involved only two cues. However, there was a significant correlation between children's ages and the number of cues to which they responded appropriately for tasks involving three and four cues. Similarly, Hale and Morgan (1973) demonstrated that 8-year olds responded appropriately to more color and shape cues than 4-year olds in a two-cue conditional discrimination that involved multiple values for each feature (i.e., five colors and five shapes). Studies examining developmental level have shown a similar relationship with breadth of learning (i.e., positive correlation between mental age and number of cues appropriately responded to) for both typically developing (Eimas, 1969) and clinical populations (Katoh & Kobayashi, 1985; Schover & Newsom, 1976).

Further support for the relationship between development and overselectivity comes from the elimination of between-group differences in overselectivity for clinical populations and their typically developing peers when matched on mental age. For example, Schover and Newsom (1976) demonstrated that children with ASD and typically developing children who were matched on mental age displayed similar response patterns in the type of simple simultaneous discrimination task that is traditionally used to determine overselectivity. They found that the children who displayed overselective responding clustered at the lower end of the 2 years 9 months to 9 years 6 month age range in both groups. Similarly, Kovattana and Kraemer (1974) hypothesized that differences in mental age accounted for the similar performance of verbal children with ASD and their typically developing peers on a three-cue conditional discrimination task.

Despite the clear relationships between overselectivity and both chronological age and developmental level, it remains unknown at what age typically developing children may be expected to respond to multiple elements of a compound stimulus. Previous research has not identified a minimum age or developmental level at which children reliably respond to more than one simultaneous cue. Although several studies have tested typically developing children matched on mental or chronological age as a control group for children with ASD, little information is provided on which of these children, if any, respond overselectively (e.g., Gersten, 1983; Hale & Morgan, 1973; Koegel & Wilhelm, 1973; Rincover & Ducharme, 1987; Schover & Newsom, 1976; Wilhelm & Lovaas, 1976). No study to date has explored overselectivity in young, typically developing children for the purpose of determining the age at which response to multiple cues can be reliably expected. In addition to providing important evidence on stimulus control of behavior in young children, determining a lower age bound for normal simultaneous attention could have crucial implications for individualization and age-appropriate expectations in ASD intervention.

As the age of reliable ASD diagnosis continues to drop (Landa, Holman, & Garret-Mayer, 2007), increasingly younger children are receiving service and interventions that were originally designed for their school-aged peers (Corsello, 2005). One popular evidence-based approach, Pivotal Response Training (PRT), explicitly requires that therapists incorporate conditional discriminations (i.e., discriminations requiring response to simultaneous multiple cues) to enhance the child's ability to respond to multiple cues in the environment. In discussing PRT, practitioners indicated they often omit response to multiple cues in their teaching, as they feel it may not be developmentally appropriate for the youngest children with ASD in their programs (Stahmer, Suhrheinrich, Reed, Vattuone, & Schreibman, 2009). If a developmental boundary could be determined for overselectivity, it may allow practitioners to appropriately omit this component of PRT for the youngest children with ASD. Based on previous studies demonstrating some overselectivity in typically developing preschoolers (e.g., Bickel et al., 1984), it is likely that many children with ASD receiving special education services may be functioning below the developmental level at which typically developing children respond to multiple cues (Corsello, 2005). This type of treatment individualization based on child characteristics will allow practitioners to focus on the aspects of intervention that are likely to have the maximum impact for each child, rather than applying a 'one size fits all' approach.

The current study assessed young typically developing children on a simultaneous multiple cue discrimination task to identify a lower developmental boundary for this task. A two-component discrimination assessment was utilized in this experiment because it is the simplest test for overselectivity and thus appropriate for even the youngest children. The results will provide valuable information on the stimulus control of behavior in young children and inform appropriate adaptations for evidence-based practice for ASD.

Methods

Participants

Thirty-seven participants, ages 19 to 50 months (M=34.1, SD=9.4; 59% male) were recruited through a local childcare program. This age range was selected based on previous studies indicating overselectivity in typically developing children at these ages (Bickel et al., 1984; Hale & Morgan, 1973; Schreibman & Lovaas, 1973). A flier and descriptive letter explaining the study were given to parents through the children's 'mailboxes' in their classrooms at the childcare facility. Interested parents returned the letter and consented to their child's participation and to experimenter access of school records. Of the parents contacted through the initial flier (n=52), a total of a 71% (n=37) returned the letter to express interest. All the families who expressed initial interest agreed to allow their children to participate. Ages and Stages Questionnaires (ASQ; Bricker & Squires, 1999) completed by teachers as part of routine care at the childcare center were available for 76% (n=28) of participating children. The ASQ is a brief questionnaire that allows the adult to assess the child in the natural environment and screen for developmental delays and areas of difficulty. No children participating in the current study displayed delays in the areas assessed by the ASQ: communication, problem solving, personal/social, fine motor or gross motor. Additionally, family medical history forms (available for 92% of participants) indicated that no children participating had any first-degree relatives with ASD.

Procedure

An experimenter conducted the discrimination learning assessment described below with each participant. Experimenters for this study included the first author and a trained research assistant who had experience working with young children. The task took place during the children's regular day at school. Arrangements were made with the child's classroom teacher for one of the experimenters to work independently with the child, either at a small table or area on the floor within the child's regular classroom or in another available room on the school campus.

Each testing session began with a brief warm-up period in which the experimenter interacted with the child with several motivating toys such as squishy balls and colored markers in order to build rapport. During this period, the experimenter naturalistically tested whether the child could receptively and expressively identify colors and shapes (e.g., "Can I have the green marker?", "Ooh, what color is that fish you drew?"). The experimenter probed three colors (from the list red, orange, yellow, green, blue, purple, pink) and two shapes (from the list square, circle, triangle, star) receptively and expressively for each child and recorded all responses. This was done to determine if expressive and receptive knowledge of the type of features being tested (color and shape) contributed to a child's overselective responding. This knowledge was not used as inclusion criteria for the study. After the experimenter judged the child to be comfortable in the testing situation, she began the discrimination learning assessment, as described below. At the conclusion of the discrimination learning assessment, children were given a small prize for participating and returned to their classroom.

Discrimination learning assessment

The discrimination learning assessment used in the present study was modeled after similar simultaneous discrimination learning paradigms designed to assess overselectivity in young children and individuals with ASD and other developmental disabilities (Eimas, 1969; Koegel & Wilhelm, 1973; Ploog & Kim, 2007; Schover & Newsom, 1976; Schreibman, 1975). A two-cue, simultaneous conditional discrimination was used to assess children's response to two features of a compound stimulus, color and shape. Children completed a series of trials in which an experimenter presented two blocks of different shapes and colors and instructed the child to select one block. The children were first trained to choose the block designated by the experimenter as "correct." Once they demonstrated mastery of the discrimination, test trials were presented in which the color and shape features of the original blocks were separated and combined with novel values. A complete and detailed description of the task is provided below.

Assessment materials

Materials included a set of six, 2-inch by 2-inch wooden blocks. Each block represented a unique combination of the features of color and shape. Two blocks were used as training stimuli for all participants: a green cube and an orange pyramid. Four blocks were used as testing stimuli for all participants: a green T, an orange T, a pink cube, and a pink pyramid (see Figure 1.1). These color and shape feature values (including the use of novel color and shape feature values during testing) are identical to the ones used by Schover and Newsom (1976) with the exception that blocks (three dimensional shapes) were used in the present study as opposed to figures on cards (two dimensional shapes). The decision to use three dimensional shapes was motivated by the desire for the materials in the assessment to be similar to objects encountered in children's everyday routines (i.e., a colorful set of building blocks) and to actively capture children's attention. The assessment consisted of repeated presentations of pairs of blocks to the child with instructions to choose one of the blocks. The experimenter conducted a training phase (a minimum of 30 trials and a maximum of 80, depending on the child's performance) and a testing phase (30 trials). Both phases are described in detail below.

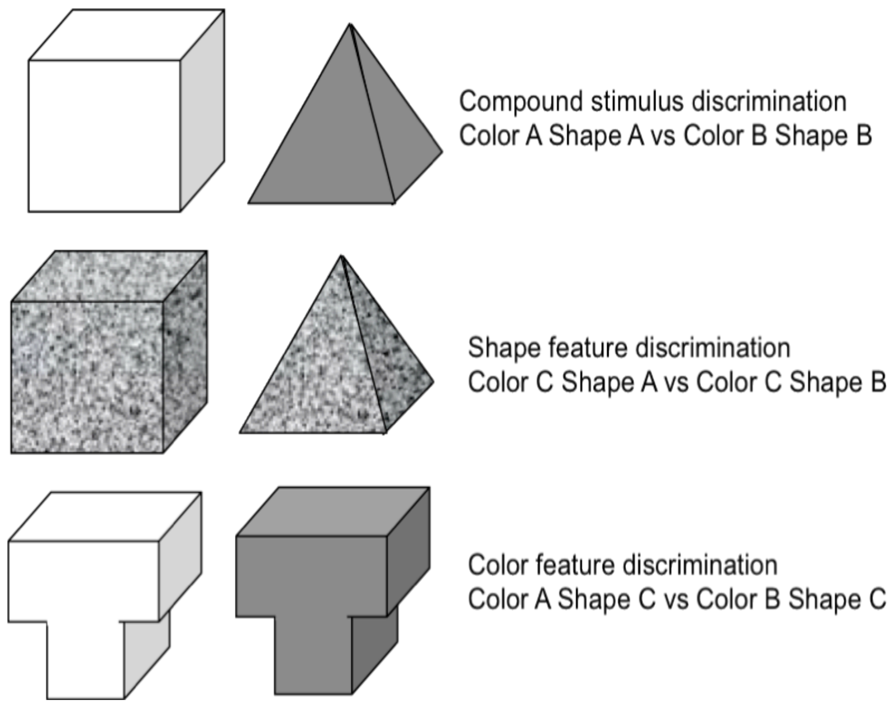

Figure 1.1. Representation of stimuli. Six colored blocks of the types shown were used for all training and testing trials.

Training procedure

Training trial blocks were the green cube and orange pyramid. To begin the assessment, the experimenter held up one of these two blocks for the child and said "[Child's name], this is the correct block" and handed it to the child for a few seconds. She then took both blocks, removed them from the child's view briefly, presented the blocks by setting them on the table in front of the child, and gave the cue "Give me the correct block" followed by a pause for the child to respond. If the child indicated the appropriate block (either by taking and extending the block towards the experimenter, pushing the block across the table, or touching the block and making eye contact), the experimenter provided praise using phrases such as, “That’s the correct block! You got it!” Crucially, the experimenter never named either of the features of interest (color or shape) of the blocks. If the child did something unrelated to the tasks with the blocks (e.g., stacked the blocks on top of one another), the experimenter removed both blocks from the table and re-presented the cue. If the child failed to respond or began to respond incorrectly, the experimenter immediately prompted the correct answer at the necessary level of support (e.g., full physical prompt for failure to respond, gestural prompt for a child beginning to respond incorrectly). On subsequent trials (after at least two initial correct independent responses from the start of the training trials), the experimenter utilized a no-no-prompt strategy (e.g., the experimenter responded with “No” for two consecutive trials to which the child responded incorrectly, then removed the blocks and presented the next trial; if the child moved to respond incorrectly for a third consecutive trial, the experimenter immediately prompted the correct response. Immediate prompting was continued until the child responded correctly and independently across two trials). The experimenter recorded the child’s response after each trial (Correct, Incorrect, Prompted, or No Response). The block designated as correct (green cube or orange pyramid) was randomized across participants, as was the position of the correct block on each trial (designated on the data sheet). Correct responses were initially continuously reinforced with praise and tangibles, such as a spinning top, a sensory ball, or small snacks. After one block of ten trials at 80% or more correct, the experimenter moved to a schedule wherein responses were reinforced on an average of one reinforced correct trial out of three correct trials (variable ratio 3; VR3) to reduce discrimination between the training and subsequent testing trials. This schedule of reinforcement was selected based on previous studies utilizing similar tasks (e.g., Koegel & Wilhelm, 1973; Schover & Newsom, 1976). Given the young age of the children tested, some schedule of reinforcement was necessary to maintain interest in the task. On unreinforced trials, the experimenter responded to any child response by saying "Thank you" or "Okay" in a neutral tone of voice. Training trials continued until the child achieved at least 80% correct responding across two sets of ten trials on the VR3 schedule of reinforcement. After the child reached the criterion for discrimination mastery, the test procedure was begun.

Test procedure

To determine which elements (color and/or shape) were functional in controlling the child's responses, the experimenter randomly interspersed test trials of the color feature blocks (green T and orange T) as well as the shape feature blocks (pink cube and pink pyramid) with the training stimuli (green cube and orange pyramid). The testing phase consisted of ten trials of each of the three types of discrimination trials (compound stimulus, color, and shape) to determine whether the child could accurately identify both features of the 'correct' compound stimulus in a separate discrimination. For example, if the child learned to select the green cube during training trials, then the green T (color feature) and pink cube (shape feature) were the correct responses for each of the feature discriminations. The correct color/shape features are referred to as S+ features of the discrimination. Order of presentation of each type of trial (compound stimulus, shape features, or color features) was randomized across participants, as was the position of the correct block. Trials were conducted in the same manner as training trials except for the nature of the stimuli presented and the schedule of reinforcement. Reinforcement was provided only for correct responses to the trials of the training stimuli, in order to prevent inadvertent learning of the correct feature answers during testing. The experimenter responded neutrally (e.g., "Okay" or "Thank you") to all child responses on test trials, identical to the unreinforced VR3 trials during the training phase. The experimenter also provided reinforcement for behaviors unrelated to the assessment trials throughout the testing period, such as attending to the materials or staying at the table, in order to maintain child motivation to participate in the assessment.

Assessment completion required that the child respond within one minute of stimulus presentation to each of the 30 testing trials. If the child appeared to lose interest in the task or could not be redirected from attempts to leave the testing area within a period of twenty minutes, testing was discontinued. For these participants, a second session of testing was conducted on the following day. If the participant was unable to sustain attention to the task on the second day, testing was discontinued and data for that participant were considered incomplete.

Data Analysis

Upon assessment completion, participants' performance on the discrimination task was classified into four categories based on their performance on both sets of feature discrimination trials: normal simultaneous responding, overselective responding, failure to acquire, or other. Operational definitions based on this assessment for each of these performance categories are identical to previous research and provided in Table 1.1 (Eimas, 1969; Gersten, 1983; Wilhelm & Lovaas, 1976). A cut-off of 80% correct or better was used based on the 95% cut-off for a binomial distribution (i.e., there is a 5% or less chance that a child could respond to 8 or more out of 10 trials correctly if she was responding randomly). For those children who responded to at least one of the sets of feature trials at 80% or better, logistic regression was used to test for a relationship between chronological age and level of response to the second feature.

Table 1.1. Assessment performance classifications.

Category	Definition
Normal Simultaneous Responding	Child correctly responded to both color S+ and shape S+ features at 80% correct or better. Child maintained at least 80% correct responding to the compound S+ during test trials.
Overselective Responding	Child correctly responded to the compound S+ and one feature S+ (shape or color) at least 80% of the time while responding to the other S+ feature at chance (25-75%)
Failure to Acquire	Child did not maintain at least 80% correct responding to the compound S+ during test trials. Therefore, all responses were considered random and results were not considered further.
Other (Preference)	Child correctly responded to the compound S+ and one feature S+ (shape or color) at least 80% of the time while responding to the other S+ feature below chance (under 25% correct), indicating a preference for the S- feature in that discrimination.

Results

Training

The majority of participants (n=26, 70%) met mastery criterion for the training discrimination in the minimum 30 trials (10 trials with continuous reinforcement, 20 trials at a VR3 schedule of reinforcement). There was a significant, negative correlation between participants' age and the number of training trials required to meet mastery criterion (p<.05). The maximum number of training trails to meet mastery required by any participant was 70. Three participants were unable to complete the assessment, as determined by failure to respond to at least 10 trials (either correctly or incorrectly) in a period of 20 minutes on each of two days; these three participants were among the youngest that participated in the assessment (19-24 mos, M=22, SD=2) and were not considered further.

Testing

All 34 participants who successfully completed the training trials were also able to complete the 30 test trials. Figure 2.2 shows participants' performance on the 10 trials of the compound stimulus discrimination during the 30 trials of the testing phase. This performance indicates the participant's ability to maintain the compound stimulus discrimination throughout the testing phase. Of the 34 participants who successfully completed the test trials, six were unable to maintain 80% correct responding or above to the compound stimulus discrimination (failure to acquire). These participants represented the younger end of the age range (24-26 mos; M=26.18; SD=3.23) and their responses to the separate S+ features were not considered further (e.g., Lovaas et al., 1971). The remaining 28 participants successfully responded to the compound stimulus discrimination at 80% or above during the testing phase, indicating maintenance of the compound stimulus discrimination learned during training and valid comparison of separated features to determine overselectivity.

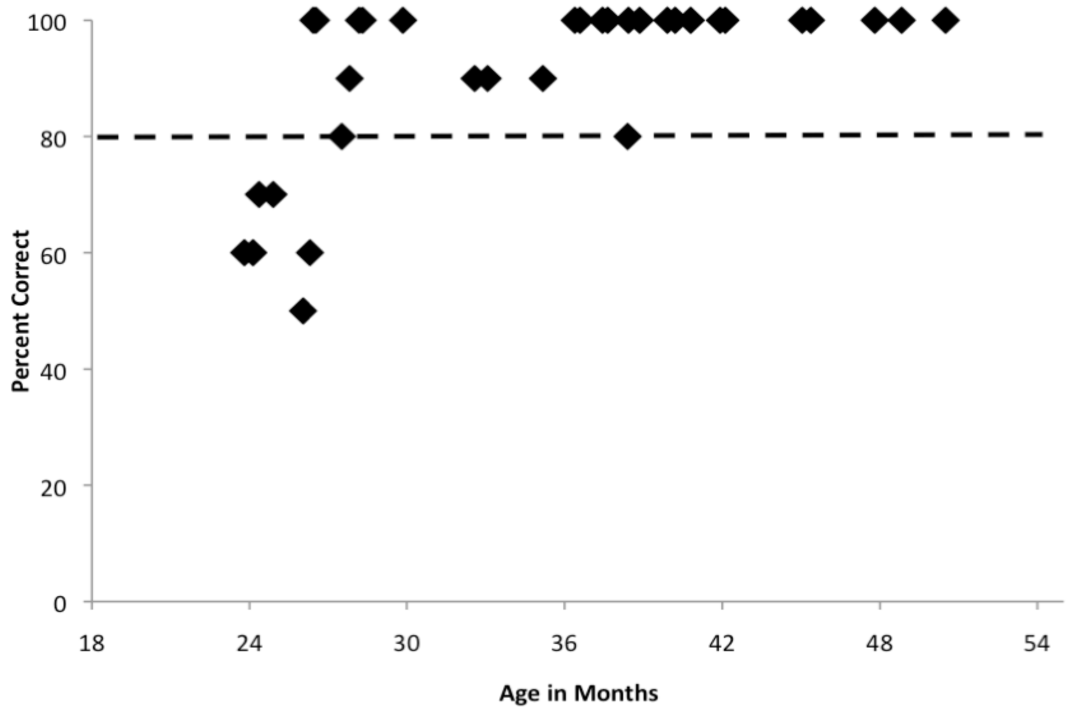

Figure 1.2. Performance on the training discrimination during test trials for participants who completed the assessment. The dotted line indicates required percent correct to consider the training discrimination maintained. Participants performing below this percent correct are considered “failure to acquire” (see Table 1.1).

Figure 1.3 displays individual participants’ performance on the color and shape feature trials conducted during the testing phase. Eight participants displayed overselective responding (Participants A, B, C, F, H, I, J, and O in Figure 1.3), defined as chance responding to one S+ feature (less-preferred feature; M=50% correct, SD=12) and correct responding to the other (preferred feature; M=88.75% correct; SD=8.34). Five of these participants responded exclusively to the shape S+ (Participants B, F, H, I, and O) and the remaining three responded exclusively to the color S+ (Participants A, C, and J). A total of 19 participants displayed normal simultaneous responding; this group of children was significantly older (M=41.68 mos; SD=4.92) than both the failure to acquire group and the overselective group (p<.05). One participant responded at 90% correct to both the compound S+ and the shape feature S+, but below chance to the color feature

S+, indicating a consistent preference for the color feature S- (green, in this instance). This participant was excluded from the logistic regression analysis, as the below chance performance likely indicates the participant was responding to some unknown (and unintended) element of the stimulus. There was no correlation between the numbers of shapes or colors a child could expressively or receptively identify and their percent correct responding to the S+ component discriminations ($p > .05$).

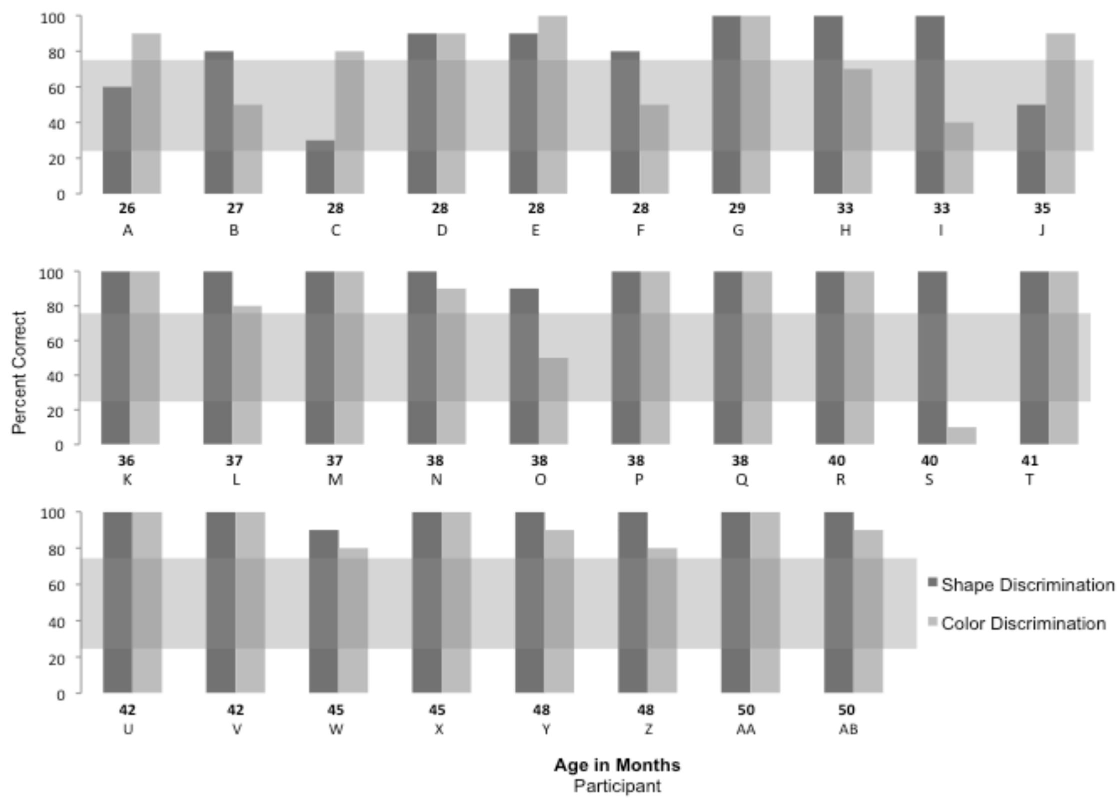

Figure 1.3. Percent correct on shape and color feature discriminations during the testing phase. The shaded bar indicates chance performance. Overselective responding is indicated by one feature performance being within the shaded region and the other feature performance being above the shaded region (see operational definitions in Table 1.1). Participants A, B, C, F, H, I, J and O displayed overselective responding.

Statistical Analysis

Percent correct for the less-preferred cue for each participant is shown in Figure 1.4. A logistic regression considering the factors of age and percent correct on the less-preferred cue feature trials showed a significant relationship between children's chronological age and their performance on the less-preferred cue ($p < .001$). As expected, younger children were more likely to display overselective responding. Analysis of the logistic regression model indicated that, on average, children cross the threshold of 80% correct at 36 months of age (see Figure 1.4). These data indicate that children are likely to display overselectivity prior to their third birthday, but consistently respond to both S+ features at 36 months and later.

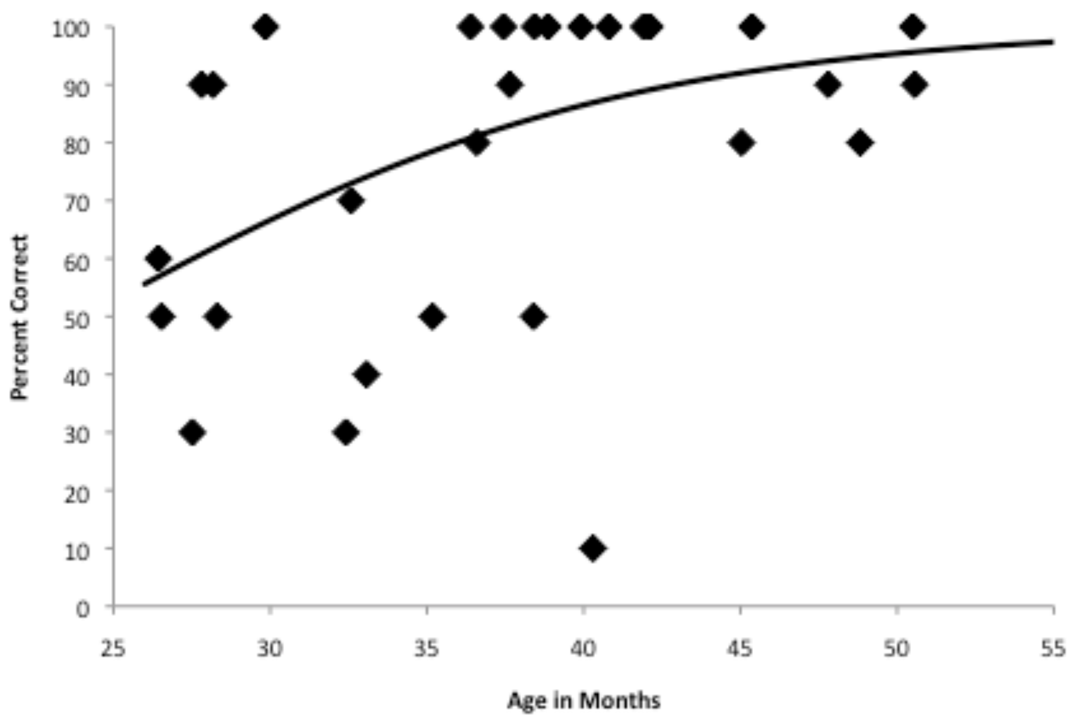

Figure 1.4. Percent correct on the less-preferred cue and regression line. The horizontal dotted line at 80% correct indicates above chance responding. The solid line represents the regression line. The vertical dotted line highlights the intersection of the regression line with above-chance performance, which indicates normal simultaneous responding. This dotted line crosses the ordinate at approximately 36 months.

Discussion

The results of the present study suggest that young children cannot be expected to reliably respond to simultaneous multiple cues until after three years of age. These data are consistent with previous research demonstrating stimulus overselectivity in typically developing preschool children, and extend this knowledge by suggesting the specific age at which young children typically develop this capacity. The current study supports the notion that overselective attention should be understood as a general developmental cognitive delay rather than a specific deficit in ASD or other disorders.

Despite the determination of a lower developmental bound for normal simultaneous responding, age should not be considered the sole determinant of overselectivity. Previous studies report overselectivity in children with ASD and mental retardation with mental ages above this mark (e.g., Rincover & Ducharme, 1987; Schover & Newsom, 1976; Wilhelm & Lovaas, 1976) and therefore other factors may also be contributing to this attentional abnormality. It should also be noted that some studies have reported overselectivity in typically developing children above this developmental level (e.g., Bickel et al., 1984). The fact that children over three years were able to respond to a conditional discrimination in this experiment may be explained by the simplicity of the current discrimination paradigm: two cues within a single modality (visual), presented in materials that were familiar to the participants. Studies that have demonstrated overselectivity in children above 36 months of age have utilized more complex discrimination learning tasks, such as compound auditory cues (Bickel et al., 1984) or visual discriminations with more than two features (Eimas, 1969). The simple version of the task used here allowed insight to the youngest possible age that typically developing children would be successful. Future research should focus on how age and developmental level relate to more complex versions of simultaneous discrimination paradigms.

These results have important implications for practitioners' use of PRT with young children with ASD. Because ASD is often diagnosed around three years of age, and because many children with ASD have concomitant intellectual disability, it is likely that many young children who are receiving intervention services have a mental age below 36 months. Based on the results of the current study, it is inappropriate for practitioners to target response to multiple cues with these children, as the ability is beyond their developmental stage. Practitioners have reported that response to multiple cues did not seem developmentally appropriate for many children on their caseload (Stahmer et al., 2009) and this observation has now been supported by returning to basic research.

There are several limitations to the current study. Children's performance is only assessed on one type of discrimination task. Future research should address whether the same patterns are observed for alternative types of discrimination assessments, such as successive discrimination paradigms (Lovaas et al., 1971; Schreibman, Kohlenberg, & Britten, 1986) and non-visual modalities. Bickel et al. (1984) reported overselectivity in typically developing preschoolers who are 35 months of age and above using auditory stimuli, suggesting that modality may play a role in the course of overselectivity. The current experiment used objects (blocks) and cues (colors and shapes) that are very familiar to young children. Thus, future experiments should focus on extending this exploration to other similar tasks. These results also do not provide any insight as to whether children's responding is a result of limited stimulus control or stimulus control hierarchy (i.e., unspecified stimuli controlling responding; Bickel et al., 1984), nor do they provide information on the question of attention versus retrieval forms of overselectivity (Reed et al., 2009), as these determinations were beyond the scope of the current study. Lastly, the exclusive use of chronological age, on the assumption that the children tested are of average intelligence (and therefore chronological age is equivalent to mental age), is potentially problematic. Although the children were screened for risk for developmental delay, specific mental ages were not obtained. It may be that the participants in this experiment did not represent an average population, and therefore the results may be skewed or the determination of a lower bound for normal simultaneous responding incorrect. Future work should attempt to replicate these findings and include direct measurement of mental age in order to further confirm the age at which typically developing children are likely to display overselectivity.

Overall, the results of this study support practitioners' intuition that conditional discriminations are not developmentally appropriate for all children with ASD. When utilizing PRT or similar naturalistic behavioral methods that call for embedding conditional discriminations within teaching interactions, it is likely that practitioners may appropriately omit this component for children with a developmental age under 36 months. This finding represents an important step towards tailoring intervention based on child characteristics for children with ASD.

Acknowledgements

Chapter 1, in full, has been accepted for publication and is a reprint of the material as it will appear in the Journal of Autism and Development Disorders, 2012.

Reed, Sarah; Stahmer, Aubyn; Suhrheinrich, Jessica; Schreibman, Laura, Springer, 2012. The dissertation author was the primary investigator and author of this paper.

The authors would like to thank Paul Reed for his assistance with stimuli creation and Brooke Kellison for her assistance in conducting the discrimination learning assessment, as well as the families and children who participated in this research.

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CHAPTER 2: Examining conditional discriminations as a necessary component of autism intervention

Several decades of research have demonstrated that stimulus overselectivity is a challenge for individuals with autism spectrum disorders (ASD) as well as other populations (Ploog, 2010). Stimulus overselectivity refers to the control of an individual's behavior by a subset of the total stimuli in the environment (Lovaas & Schreibman, 1971; Lovaas, Schreibman, Koegel, & Rehm, 1971; McHugh & Reed, 2007). This attentional and stimulus control abnormality may contribute to the difficulties experienced by individuals with ASD in learning appropriate social-communication skills (Schreibman & Lovaas, 1973) and generalizing skills across environments (Koegel & Rincover, 1974; Schreibman, 1997). Incorporating conditional discriminations (i.e., discriminations requiring simultaneous response to two or more elements of a compound stimulus) into the teaching of individuals with ASD has been shown to reduce overselectivity and ameliorate associated learning challenges (Burke, 1991; Koegel & Schreibman, 1977; Schreibman, Charlop, & Koegel, 1982). Accordingly, conditional discriminations are one component of behavioral, evidence-based intervention currently utilized with children with ASD such as Pivotal Response Training.

Much of the work on conditional discriminations in ASD was conducted over 20 years ago (e.g., only 16% of the studies cited in a comprehensive review on stimulus overselectivity in ASD were published after 1990; Ploog, 2010). Unlike the current population of children with ASD, participants in the earliest studies on overselectivity in ASD were all severely affected and likely faced permanent hospitalization (Lovaas & Schreibman, 1971; Lovaas et al., 1971). Due to increased awareness and a broadening of the diagnostic criteria for ASD, today's population of children with ASD are likely to have a different topography of symptoms than those participating in research over two decades previous. Changes in diagnostic criteria have resulted in a broader range of social and communication impairments in children with ASD (Tidmarsh & Volkmar, 2003; Volkmar, Lord, Bailey, Schultz, & Klin, 2004). In fact, the time since the majority of overselectivity research was conducted has spanned the introduction of DSM-III, DSM IV, and revisions for both, each of which contained alterations to the criteria of ASD (Tidmarsh & Volkmar, 2003). To take communicative speech as one example of changes in this population, original estimates held that over 70% of individuals with ASD would never acquire functional speech, whereas more recent data indicate that this figure is roughly one third (Tager-Flusberg, Rhea, & Lord, 2005). The broadening of the definition of ASD has played a large role in altering the population of children receiving services for the disorder (Fombonne, 2001; Kabot, Masi, & Segal, 2003; Nassar et al., 2009; Steyaert & Marche, 2008; Wolff, 2004). Though less documented, there may also be an effect of improved knowledge and implementation of effective treatments on specific characteristics of individuals with ASD. As such, it is necessary to re-examine whether characteristics of individuals with ASD that are present in older studies, such as widespread difficulty with conditional discriminations, are still present in today's population. Early studies consistently indicated that approximately 80% of children with ASD displayed difficulty with conditional discriminations, (e.g., Gersten, 1983; Koegel & Wilhelm, 1973; Lovaas & Schreibman, 1971; Lovaas et al., 1971) but it is unknown whether a similar percentage characterizes today's population.

The potential difference in today's population has important clinical implications for ASD intervention delivery. Currently, use of conditional discriminations is one component of evidence-based naturalistic behavioral interventions such as Pivotal Response Training (PRT). PRT protocol requires the therapist to incorporate conditional discriminations within the child's daily routines by giving instructions and tasks to the child that require a response to multiple cues (Koegel et al., 1989). For example, a child who is coloring may be offered a box of crayons and markers in different colors and instructed, "Choose a green crayon." This instruction requires that the child choose something that is both green (not another color) and a crayon (not a marker) in order to make the appropriate response. The complexity of this intervention component and the level of preparation required (i.e., having appropriate and available teaching materials that are fully crossed on at least two features for a variety of activities and learning goals) have led to teachers omitting this component entirely (Schreibman, Suhrheinrich, Stahmer, & Reed, 2012). If children with ASD today do not have the same level of difficulty with conditional discriminations as has previously been reported in the literature, it may be that not all children require specific training to fully utilize the available cues in their environment. It is possible that this component could be adapted to simplify therapeutic procedures, thereby increasing the efficiency of the intervention and potentially enhancing the likelihood of evidence-based intervention adoption and dissemination (Rogers, 2003). The objective of the current study is to determine the extent to which children receiving public intervention services for ASD today have difficulty with simple conditional discriminations and therefore whether it remains a necessary component of behavioral intervention.

Methods

Participants

Forty-two children identified as having ASD, ages 3 to 10 years (M=5.6, SD=1.8), were recruited for participation in the current study. Inclusion criteria were the following: (1) Currently receiving services under an educational classification of autism and (2) receptive language age equivalent at or above 36 months. This age equivalent was selected based on previous work demonstrating that typically developing children do not reliably respond correctly to conditional discriminations until this age (Reed, Stahmer, Suhrheinrich, & Schreibman, in press). The use of an educational classification of autism (rather than a research or clinical diagnosis) was selected in order to obtain a sample of children typically served in community settings. However, Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999) scores were available for 21 participants (50%) from assessment that occurred within three months of the current study and was conducted by a research-reliable assessor. ADOS scores for these participants indicated that 100% exceeded ASD cut-off scores, indicating a high probability of match between educational classification and ASD diagnoses for these participants. Social Communication Questionnaires, Current Form (SCQ; Rutter, Bailey, & Lord, 2003) completed by the teacher within three months of the current study were available for an additional 17 participants (40%). SCQ scores for these participants indicated that 100% exceeded the ASD cut-off scores. These assessments provide a high level of confidence for a match between educational classification and ASD diagnoses in at least 90% of participants.

The majority of participants (n=39, 93%) were recruited through public elementary school and preschool programs. Several local special education teachers with either a history of collaboration or current involvement with the study authors agreed to send home a flier and descriptive letter explaining the study. Interested parents returned the letter and consented to their child's participation. Additional potential participants (n=3) with ASD were contacted through a database of families interested in participating in ASD research. These families were contacted by phone or e-mail and willing families set an initial appointment with an experimenter for consent and assessment. Subsequent assessment sessions were scheduled as needed. Basic participant demographics are presented in Table 2.1.

Table 2.1. Participant demographics.

Variable	**M**	**SD**
Chronological Age	5.6	1.8
Receptive Language Age	4.4	1.2
Gender	*n*	
Male	28	
Female	14	

Procedure

An experimenter conducted a standardized language assessment and the discrimination learning assessment described below with each participant across 1-2 appointments. Experimenters for this study included the first through third authors, all of who have extensive experience with children with ASD. Participants were assessed to determine receptive language age. Receptive language age was selected because conditional discriminations are typically first targeted receptively in early intervention. During initial recruitment, participants (n=18) received a Mullen Scales of Early

Learning (MSEL; Mullen, 1995). The MSEL includes five domain scales for which T scores, percentile ranks, and age equivalents can be computed separately. In a second recruitment wave, several participants (n=21) were enrolled in a larger research project and received standardized testing from the study authors as part of that project. Two standardized language assessments were used in that project: the Preschool Language Scales IV (PLS; Zimmerman, Steiner, & Pond, 2002), which includes both Auditory Comprehension and Expressive Communication subscales, and the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999), which includes several subtests in both receptive and expressive language domains. A total of 18 participants received the PLS and 3 participants received the CASL, as appropriate for the child's age and developmental level. All participants completed testing within 3 months of the current study; therefore scores were used from these assessments in the current study in order to avoid repeated testing for the students. Age equivalents for receptive language subscales from each assessment were available, allowing for comparisons across assessments. A total of three children completed the discrimination learning task but were unavailable for the standardized language assessment due to the end of the school year (n=1) or failure to respond to scheduling phone calls for a second session (n=2). For these children, an estimate of language age equivalence was obtained from the Vineland Adaptive Behavior Scales II (VABS; Sparrow, Cicchetti, & Balla, 2005) scores available in their Individual Education Plans. Details of the number of children receiving each standardized assessment and receptive language age equivalents are presented in Table 2.2.

Table 2.2. Language assessment scores.

Assessment	*N*	Receptive Language Age Equivalent Score	
		M	**SD**
MSEL	18	48.8	8.0
PLS-IV	18	55.3	18.0
CASL	3	75	35.8
Other (VABS)	3	45.6	2.5

Note: MSEL = Mullen Scales of Early Learning; PLS-IV = Preschool Language Scales, IV; CASL = Comprehensive Assessment of Spoken Language; VABS = Vineland Adaptive Behavior Scales, II.

All testing took place in one of two environments, according to the preferences of the child's parent(s). The majority of children (n=38) participated during their regular day at school. Arrangements were made with the child's classroom teacher for an experimenter to work independently with the child, either at a small table or area within the child's regular classroom or in another available room on the school campus. The decision of whether to remain in the child's classroom or use another room in the school depended primarily on the teacher's estimation of the child's ability to attend to the task with the distractions of the classroom, likelihood that the child would be upset by a break from routine in leaving the classroom, and availability of space appropriate for the task elsewhere on campus. A small minority of children (n=4) participated during a visit to a university research laboratory with their parent. For these children, testing took place at a table with the experimenter sitting directly across from the child in a small room with a large one-way mirror on one wall. Parents of these participants watched the assessments from an observation room on the other side of the one-way mirror.

Each testing session began with a brief warm-up period in which the experimenter interacted with the child with several toys to build rapport. After the experimenter judged the child to be comfortable in the testing situation, she began the study assessments. If the child appeared to be bored with testing or attention to the experimenter decreased noticeably even after brief breaks, the session was ended and a second appointment was made with the child's teacher/parent. At the conclusion of testing, children were given a small prize for participating.

Discrimination learning assessment

The discrimination learning assessment used in the present study was modeled after similar simultaneous discrimination paradigms designed to assess response to conditional discriminations in young children and individuals with ASD and other developmental disabilities (Eimas, 1969; Koegel & Wilhelm, 1973; Ploog & Kim, 2007; Schover & Newsom, 1976; Schreibman, 1975).

Materials and procedure

Materials included six wooden blocks approximately 2 inch by 2 inch in size. Two blocks were used as training stimuli: a green cube and an orange pyramid. Four additional blocks were included as testing stimuli: a green T, an orange T, a pink cube, and a pink pyramid (see Figure 2.1). These color and shape feature values are consistent with the ones used by Schover and Newsom (1976) with the exception that blocks (3 dimensional shapes) were used in the present study as opposed to cards (2 dimensional shapes). The decision to use 3 dimensional shapes was motivated by the desire for the materials in the assessment to be similar to objects encountered in children's everyday routines (i.e., a colorful set of building blocks) and to actively capture children's attention. The assessment consisted of repeated presentations of pairs of blocks to the child with instructions to choose one of the blocks. The experimenter conducted a training phase (a minimum of 30 trials and a maximum of 80, dependent upon the child's performance) and a testing phase (30 trials) with each participant. Both phases are described below.

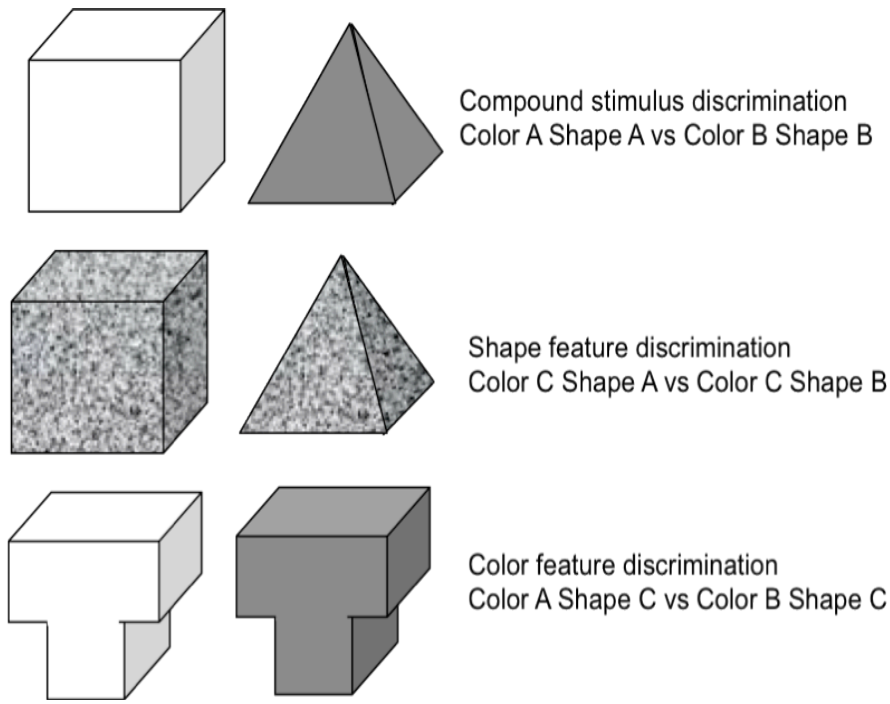

Figure 2.1. Representation of stimuli. Six colored blocks of the types shown were used for the training and testing phases.

Training phase

Training stimuli were the green cube and orange pyramid. To begin the assessment, the experimenter held up one of these two blocks for the child and said, "[Child's name], this is the correct block" and handed it to the child for a few seconds. She then took both blocks, removed them from the child's view briefly, presented the blocks by setting them on the table approximately one foot in front of the child, and gave the cue, "Give me the correct block" followed by a pause for the child to respond. If the child indicated the appropriate block (either by taking and extending the block towards the experimenter, pushing the block across the table, or touching the block and making eye contact), the experimenter provided praise using phrases such as, “That’s the correct block! You got it!” Crucially, the experimenter never named either of the features of interest (color or shape) of the blocks. If the child did something unrelated to the assessment with the blocks (e.g., stacked the blocks on top of one another; pushed one or both blocks off the table), the experimenter removed both blocks from the child’s view, and then re-presented the blocks and the cue. If the child failed to respond or began to respond incorrectly, the experimenter immediately prompted the correct answer at the necessary level of support to ensure a correct response for the first trial. On subsequent trials (after at least two initial correct independent responses from the start of the training trials), the experimenter utilized a no-no-prompt strategy (i.e., the experimenter responded with “No” for two consecutive trials to which the child responded incorrectly, then removed the blocks and presented the next trial; if the child moved to respond incorrectly for a third consecutive trial, the experimenter immediately prompted the correct response. Immediate prompting was continued until the child responded correctly and independently across two trials). The experimenter recorded the child’s response after each trial (Correct, Incorrect, Prompted, or No Response). The block designated as correct (green cube or orange pyramid) was randomized across participants, as was the left/right position of the correct block on each trial. Correct responses were initially continuously reinforced with praise (e.g., “You go it!”, “Way to go!”, “Good job!”) and tangibles (e.g., a spinning top, a ball, small snacks). After one set of ten trials at 80% correct or better, the experimenter shifted to a schedule wherein child responses were reinforced on an average of one reinforced correct trial out of three correct trials (variable ratio 3; VR3) to reduce discrimination between the training and subsequent testing phases. This schedule of reinforcement was selected based on previous studies utilizing similar tasks (e.g., Koegel & Wilhelm, 1973; Schover & Newsom, 1976). On unreinforced trials, the experimenter responded to correct child responses by saying "Thank you" or "Okay" in a neutral tone of voice. Training trials continued until the child achieved at least 80% correct responding across two sets of ten trials on the VR3 schedule of reinforcement (mastery criterion).

After the child reached the criterion for discrimination mastery, the testing phase began. For children beginning the testing phase on a day subsequent to reaching mastery in the training phase, a brief re-introduction of training phase (10 trials total) was conducted at the start of the session to ensure the child was still responding at an 80% correct or above level. If the child was not responding at this level, the experimenter began the training phase a second time. If the child was responding at 80% or above level, the experimenter began the testing phase.

Testing phase

The testing phase involved three pairs of blocks: a green cube and an orange pyramid (training stimuli), a green T and an orange T (color feature stimuli) and a pink cube and a pink pyramid (shape feature stimuli). To determine which features (color and/or shape) were functional in controlling the child's responses, the experimenter randomly interspersed trials of the color feature stimuli (green T and orange T) as well as the shape feature stimuli (pink cube and pink pyramid) with the compound stimuli used in the training phase (green cube and orange pyramid). The testing phase consisted of ten trials of each of the three types of discrimination (compound, color, and shape) to determine whether the child accurately identified both the color and shape features of the training stimulus (i.e., training S+) in a separate discrimination (i.e., S+ features). Order of presentation of each type of trial (training, shape, and color) was randomized within and across participants. The testing phase was conducted in the same manner as the training phase except for the identity of the stimuli presented and the schedule of reinforcement. To prevent inadvertent learning of the correct feature responses during testing, reinforcement was provided only for correct responses to the training stimuli trials. The experimenter responded neutrally to all child responses on feature stimuli trials. The experimenter also provided reinforcement for behaviors unrelated to the assessment trials throughout the testing period, such as attending to the materials or staying at the table, in order to maintain child motivation to participate in the assessment.

Assessment completion required that the child respond within one minute of stimulus presentation to each of the 30 testing trials. If the child appeared to lose interest in the task or could not be redirected from attempts to leave the testing area within a period of 30 minutes, testing was discontinued. For these participants, a second and final session of testing was conducted at a second appointment. If the participant was unable to sustain attention to the task for a period of 30 minutes on the second day, testing was discontinued and data for that participant were considered incomplete.

Stimulus control

Upon assessment completion, participants' performance on the discrimination task was classified into four categories based on the proportion of S+ features to which the participant responded: normal simultaneous responding, overselective responding, failure to acquire, or other. Operational definitions based on this assessment for each of these performance categories are identical to previous research and provided in Table 2.3 (Bailey, 1981; Koegel & Wilhelm, 1973; Schreibman, Koegel, & Craig, 1977).

Table 2.3. Assessment performance classifications.

Category	**Definition**
Normal Simultaneous Responding	Child correctly responded to both color S+ and shape S+ features at 80% correct or better. Child maintained at least 80% correct responding to the compound S+ during test trials.
Overselective Responding	Child correctly responded to the compound S+ and one feature S+ (shape or color) at least 80% of the time while responding to the other S+ feature at chance (25-75%)
Failure to Acquire	Child did not maintain at least 80% correct responding to the compound S+ during test trials. Therefore, all responses were considered random and results were not considered further.
Other (Preference)	Child correctly responded to the compound S+ and one feature S+ (shape or color) at least 80% of the time while responding to the other S+ feature below chance (under 25% correct), indicating a preference for the S- feature in that discrimination.

Re-assessment

Children who displayed overselective responding at the initial assessment were re-tested on the discrimination learning assessment 6-8 months later. This re-test was completed to determine whether difficulty with conditional discrimination was on-going and thus warranted specific intervention addressing this skill. Testing settings and procedures were identical to the first testing session described above. Standardized language assessments were not repeated.

Results

Training

Nearly all participants (98%, n=41) met the mastery criterion for the training phase. The majority (88%, n=37) did so by responding at 80% correct or better across two blocks of ten trials each. Four participants met mastery criterion for the training phase by verbally explaining their selection and further trials were deemed not necessary to ensure learning. The number of trials required to meet the mastery criterion ranged from 30 – 80 (M=39.07, SD=13.99). There was a significant correlation between participants' language age equivalence score and the number of trials they required to meet mastery ($p < .05$). One participant was unable to complete the training phase, as determined by failure to respond to at least 10 trials (either correctly or incorrectly) in a period of 30 minutes on each of two days, and therefore data for this participant were not included in the analysis.

Testing

Maintenance of compound discrimination during the testing phase

Figure 2.2 shows participants' performance on the 10 trials of the training stimulus discrimination during the testing phase. Participants who responded at 80% correct or better to these trials were considered to have maintained the training discrimination required for the assessment. Of the 41 participants who successfully completed the training phase, five failed to maintain the training stimulus discrimination during the testing phase. These participants represented a range of chronological ages and language age equivalents, neither of which was significantly different from the participants who did maintain the discrimination ($p > .05$; see Table 2.3). Responses to the separate S+ features were not considered further for those unable to maintain the training discrimination, and their performance was considered 'Failure to Acquire.' Four participants verbally labeled the correct answer to compound discrimination during the testing phase by naming both the features of interest (color and shape). These detailed verbal responses were considered to indicate maintenance of the compound stimulus discrimination and testing was discontinued as students clearly obtained the discrimination and were not motivated to continue testing in a task that was too simple for their ability level. These children are not represented in Figure 2.2. The remaining 32 participants successfully responded to the training stimulus discrimination at 80% or above during test trials, indicating maintenance of the training stimulus discrimination learned during the training phase and valid comparison of separated S+ features to determine overselectivity. There was no significant relationship between participants' receptive language age equivalence scores and their percent correct on the training discrimination during the testing phase ($p > .05$).

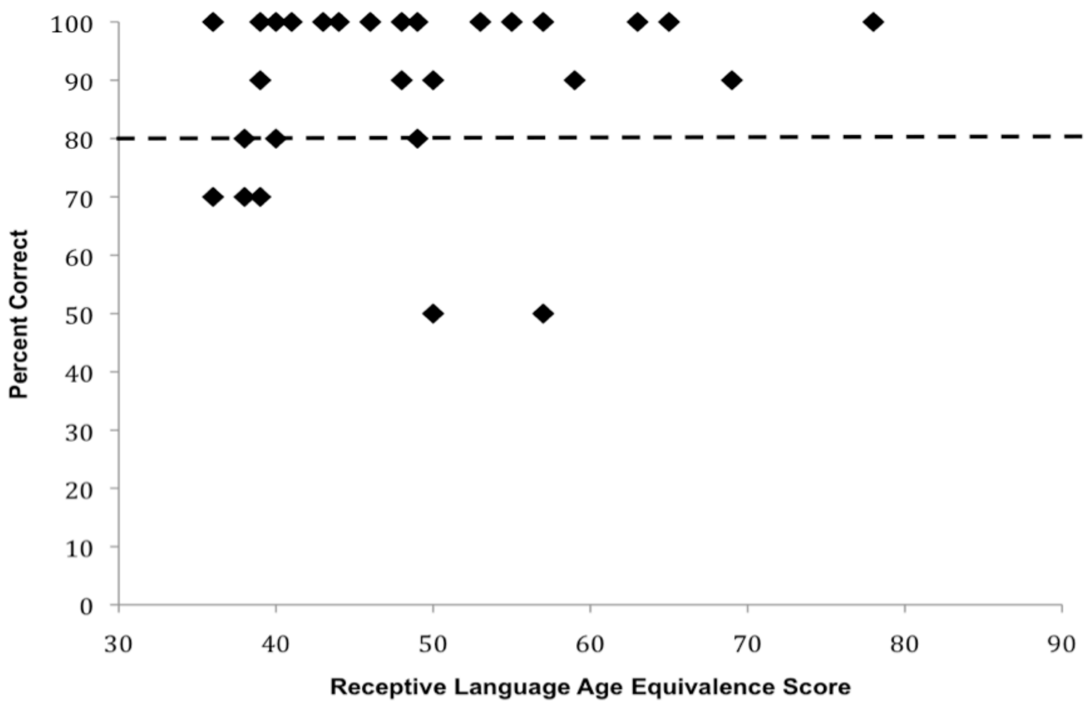

Figure 2.2. Performance on the training discrimination during test trials for participants who completed the assessment. The dotted line indicates required percent correct to consider the training discrimination maintained. Participants performing below this percent correct are considered "Failure to Acquire" (see Table 2.3).

Response to test trials

Participants' individual performances on feature discrimination trials of the testing phase are shown in Figure 2.3c. Eight participants (19%) displayed overselective responding, with chance responding to one feature S+ and above 80% correct responding to the other (participants C, H, I, M, Z, AA, AB, and AF). No one feature was preferred: four children overselected by color and four by shape. Two participants (5%) displayed chance responding to both feature S+, despite maintenance of the original discrimination (participants E and T). A total of 26 (72%) participants displayed normal simultaneous responding. Twenty-two did so by correctly responding to both the original discrimination and both feature S+ discriminations at 80% correct or better during testing trials. Four additional participants displayed normal simultaneous responding by verbally explaining their selection of the block in each of the feature discriminations across the first three to five test trials, indicating explicit awareness of both features of the compound stimulus. These four children were considered to display normal simultaneous responding and the assessment was discontinued at that point. Their data are not represented in Figure 2.3.

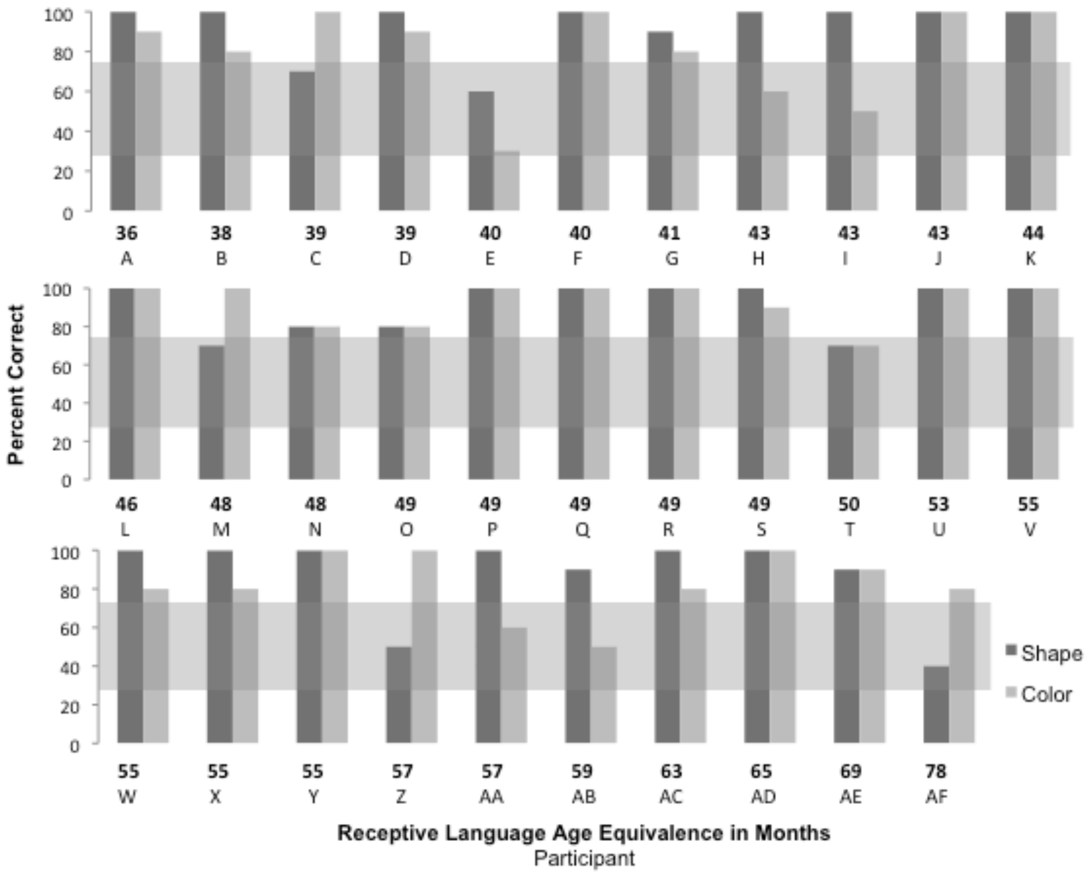

Figure 2.3. Percent correct on shape and color feature discriminations during the testing phase. The shaded bar indicates chance performance. Overselective responding is indicated by one feature performance being within the shaded region and the other feature performance being above the shaded region (see operational definitions in Table 2.3). Participants C, H, I, M, Z, AA, AB, and AF displayed overselective responding.

Table 2.4 summarizes the number, mean age, and mean receptive language age equivalence score of participants in each category of performance. A between subject analysis of variance examining both the chronological age and receptive language age equivalence scores across performance types reveals that children who verbally explained their stimuli selection are significantly older and have higher receptive language age equivalence than all other groups ($p < .05$). There were no other significant differences on chronological or receptive language age equivalence scores across performance types.

Table 2.4. Number, mean age and mean receptive language age equivalent scores of participants by assessment performance.

Performance Type	Source	Number of Participants (% of sample)	Mean Age in Years (SD)	Receptive Language Age Equivalence (SD)*
Normal Simultaneous Responding	Testing	22 (54%)	5.45 (1.8)	4.13 (.73)
	Verbal Explanation	4 (10%)	8.70 (1.68)	7.54 (1.36)
Overselective Responding	Testing	8 (20%)	6.6 (1.74)	4.42 (1.1)
Failure to Acquire	Testing	5 (12%)	4.88 (1.63)	3.66 (.76)
Other (Unclear)	Testing	2 (5%)	5.61 (1.88)	3.75 (.60)

* Receptive language ages were drawn from the MSEL, PLS, CASL, or VABS based on which assessment the child received.

Re-assessment

A total of five children (63%; C, I, M, AA, and AF in Figure 2.3) who displayed overselective responding were available for re-assessment 6-8 months after their initial assessment. These children did not differ in chronological or receptive language age equivalence from the children who displayed overselective responding but were not available for re-assessment ($p > .05$). All five children displayed normal simultaneous patterns of responding (over 80% correct for both color and shape features) at re-assessment.

Discussion

Results of this study demonstrate that the majority of children with ASD assessed did not display difficulty with simple conditional discriminations. These results stand in contrast to older studies of overselectivity in ASD using similar paradigms, which found high percentages of individuals with ASD displayed overselectivity. Based on these data, modifications to clinical intervention programs may be advisable. Treatments that require the use of conditional discriminations as a component of the protocol, such as PRT, may potentially be reduced in complexity by omitting use of conditional discriminations for children who display normal simultaneous responding.

There are several possible explanations for the shift in percentage of children with ASD displaying overselectivity on simple conditional discriminations. One possibility is the broadened range of impairments seen in children with ASD based on changes to the DSM criteria across the last three decades (Tidmarsh & Volkmar, 2003). As the heterogeneity and subtleties of ASD have become more fully understood, the diagnosis has grown to include individuals not only with classic signs of autism but also children with similar but less severe clinical symptoms (Fombonne, 2001). Perhaps the 20% of participants who displayed overselective responding in the current study represent a subset of the population that is most similar to individuals in previous studies. However, we do have evidence that children who displayed difficulty with conditional discriminations in this study were not simply the most severely impacted among those tested. Available ADOS scores did not reveal any significant patterns for those who displayed overselective versus normal simultaneous responding. Still, these data were not collected systematically as part of the current study thus future research should continue to explore the potential relationship between ASD severity and stimulus overselectivity.

Another explanation for the contrasting results found here may be the type and timing of intervention available to children with ASD today. Because many children with ASD have difficulty with generalization, evidence-based intervention strategies have shifted to incorporate treatment elements to specifically address these skills (National Research Council, 2001). These strategies, such as teaching concepts with multiple exemplars and task variation, may be sufficient to increase responsivity to cues in the environment for children with ASD, therefore alleviating the challenges of overselectivity (Ploog, 2010). Additionally, children are receiving diagnoses of ASD, and therefore treatment, at increasingly younger ages (Corsello, 2005; Lord et al., 2006; Stone et al., 1999). It is possible that by intervening at the early stages of children's concept formation we are ameliorating some of the difficulties of simple overselectivity. Though it is not the case that all challenges related to stimulus overselectivity in ASD can be captured through a two-feature discrimination learning assessment with familiar objects, these data provide preliminary evidence that the basic deficit may be different in the current ASD population.

Though these results suggest that conditional discriminations may not be a necessary component of intervention for all individuals with ASD, further examination is necessary. For example, in PRT, it is possible that the process of responding to conditional discriminations interacts with the other components of the intervention in some unidentified way, and that removing this component hinders effectiveness of the intervention as a whole. However, the current study provides a foundation on which to base further exploration of the necessity of conditional discriminations in intervention for ASD and the possibility for individualization.

One limitation to the current study is that the conditional discrimination task used was the simplest possible type (simultaneous discrimination, two features). It may be, and is even likely, that a higher percentage of children with ASD would show difficulty with conditional discriminations with a more difficult task, either in the number of cues presented or the modality tested. Indeed, earlier research has demonstrated increased overselective responding with increased number of stimulus components in a compound (Lovaas et al., 1971; Lovaas & Schreibman, 1971). There is also recent research demonstrating that children with ASD have more difficulty responding to multiple cues than their developmental level matched peers when the stimuli are tactile (Ploog & Kim, 2007). Tactile conditional discriminations are likely a more unfamiliar and difficult task than the visual task used here, possibly explaining these differences. A simple conditional discrimination task was selected for the current study as a replication of the type of tasks used in early studies (Schover & Newsom, 1976; Koegel & Wilhelm, 1973) and in order to provide preliminary information on overselectivity demonstrated by children with ASD today. However, different results may be found with a more complex task. Future research should seek to further examine more complex types of conditional discriminations and clarify their role in teaching strategies for this population.

The current study indicates that a smaller percentage of children in today's population of individuals with ASD may have difficulty with conditional discriminations than previously thought. These results suggest that conditional discriminations may only need to be incorporated into intervention for children with this specific difficulty, thus simplifying the PRT protocol for use with the majority of children. Overall, this study represents the importance of returning to basic research in order to inform optimal clinical practice.

Acknowledgements

Chapter 2, in full, has been submitted for publication of the material as it may appear in Journal of Applied Behavior Analysis, 2012. Reed, Sarah; Stahmer, Aubyn; Suhrheinrich, Jessica; Schreibman, Laura, Society for the Experimental Analysis of Behavior, 2012. The dissertation author was the primary investigator and author of this paper.

The authors would like to thank Paul Reed for his assistance with stimuli creation and the families and children who participated in this research.

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CHAPTER 3: Identifying critical elements of treatment: Examining the use of turn taking in autism intervention

Recent reviews have identified evidence-based educational and psychosocial interventions for individuals with autism spectrum disorders (ASD) through extensive literature review and careful classification of outcome data (National Autism Center, 2009; Odom, Boyd, Hall, & Hume, 2010; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010; Rogers & Vismara, 2008). Though no single intervention has emerged as effective for all children (Rogers & Vismara, 2008; Schreibman, 2000; Stahmer, Schreibman, & Cunningham, 2011) there is fairly good agreement across reviews on which interventions are consistently supported by well-designed research studies (National Professional Development Center on Autism Spectrum Disoders, 2011b). Recently, the National Professional Development Center on ASD has organized and developed relevant resources for interventions identified as evidence-based (National Professional Development Center on Autism Spectrum Disorders, 2011a), which represents an important step forward in supporting wide-spread dissemination and consistent implementation of these interventions in applied settings (Rogers, 2003).

As described by the National Professional Development Center, many evidence-based interventions (EBIs) are comprised of multiple components. For example, a therapist may have to implement several components such as giving appropriate prompts and providing contingent reinforcement to correctly implement a single EBI. Although some components are specific to individual packages, there is a high degree of overlap across interventions. This overlap has led to interventions with different brand names (e.g., Incidental Teaching, Early Start Denver Model, Pivotal Response Training) and from diverse theoretical backgrounds (i.e., behavioral versus developmental-social pragmatic) having many similarities in actual implementation. For example, many EBIs for children with ASD involve teaching episodes that are initiated by the child based on the child's interests and preferences. Similarly, many involve direct reinforcement, where the reward offered for the child's communication is natural to the interaction (e.g., the child says "push" and is pushed on a swing). In many cases, components are selected for inclusion in an intervention after research elucidates the component's specific effects on child behavior and outcomes. The high degree of overlap between interventions possibly represents good reliability on what is known to be effective for supporting interaction and promoting development in children with ASD.

One component that is included in interventions across theoretical perspectives is turn taking, or facilitation of back and forth exchanges between the therapist (e.g., teacher, parent, speech pathologist) using the intervention and the child with ASD. To use turn taking, the therapist initiates with and responds to the child in specific ways according to the principles of the intervention procedure using strategies designed to enhance the child's social-communication skills and development. In the earliest interventions for children with ASD, the therapist's role involved strict presentation of cues and consequences (Wolf, Risley, & Mees, 1964). The introduction of therapist turns into ASD intervention shifted the therapist's role to supporting a back and forth structure that more closely resembles the social exchange between parents and their typically developing children. Turn taking is now present in both naturalistic behavioral interventions, such as Milieu Teaching and Pivotal Response Training (Alpert & Kaiser, 1992; Koegel et al., 1989) and developmental social pragmatic interventions, such as Floortime and Responsive Teaching (Greenspan & Wieder, 2006; Mahoney & MacDonald, 2007; Sussman, 1999), as well as combined interventions that integrate strategies from both the behavioral and developmental literature, such as Project IMPACT (Ingersoll & Dvortscak, 2010) and the Early Start Denver Model (Rogers & Dawson, 2010). Because therapist turn taking focuses on supporting the back-and-forth interactional structure that is a primary mechanism of early learning (Harrist & Waugh, 2002), its inclusion in ASD interventions is intuitively appealing. However, despite the widespread incorporation, there has been limited empirical investigation of the practice in isolation.

The lack of knowledge on the mechanisms of change and absence of direct empirical validation for turn taking stands in contrast to other individual components of ASD interventions. Components such as creating environmental opportunities for the child to initiate communication (Hart & Risley, 1968; Kaiser, Ostrosky, & Alpert, 1993), contingent, direct reinforcement of target behaviors (Koegel & Williams, 1980; Williams, Koegel, & Egel, 1981), and imitation of child behavior (Ingersoll & Schreibman, 2006) have all been studied in isolation and their influence on child behavior within the larger framework of each intervention is well documented. Though many components of individual interventions have benefitted from clear empirical studies validating their function and purpose, turn taking has not undergone this type of rigorous examination and the rationale for its inclusion in various treatments remains unclear.

Further motivation for examining turn taking is identifying the optimal and necessary implementation of the component. Without scientific investigation, it is unknown which aspects of turn taking do (or do not) influence child behavior. For example, a turn may consist of the therapist modeling a communication or play behavior for the child, such as labeling or describing objects in the child's immediate environment in which he is interested. Modeling may also involve the therapist completing a play action with the toys the child is using that is at or just above the child's developmental level. A second element of turn taking in some treatments is contingency, where the therapist takes a turn by gaining control of the materials and then requires a response from the child to regain access, typically by presenting an explicit cue for the child to respond (e.g., asking "What do you want?" while holding up two toys). These two elements of *modeling* and *contingency* are combined in various ways to comprise turns across ASD treatments. For example, naturalistic behavioral treatments tend to focus the therapist's use of contingency (Alpert & Kaiser, 1992) while developmental, social-pragmatic treatments are more likely to emphasize modeling (Greenspan & Wieder, 2006; Mahoney & MacDonald, 2007; Sussman, 1999). Other interventions, such as Pivotal Response Training, require the therapist to use both modeling and contingency in a turn (Koegel et al., 1989). Because turn taking has not been studied explicitly, there is considerable debate across interventions as to which pieces are truly necessary to optimally influence child behavior. Because less complex interventions are more likely to be adopted and used with fidelity in the community (Rogers, 2003), it is important to experimentally identify the effects of each turn taking element in order to inform best practice. This type of examination of micro-level differences in intervention components from interventions known to be effective as a whole (in contrast to broader theoretical differences) can advance the field of ASD intervention towards identification of true active ingredients in interventions, as well as individualization of treatment for specific children.

In an effort to address the lack of research on turn taking, the current investigation focused on the relative effectiveness of the therapist's use of the individual elements of modeling and contingency on child expressive language and play behavior.

Methods

Participants

A total of six children ages 2 to 4 years participated (M=36.00 mo, SD=3.21). Children were recruited from a local university research program. Inclusion criteria for participation were the following: (1) A diagnosis of autism or pervasive developmental disorder – not otherwise specified, as determined through administration of the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore; & Risi, 1999) and best clinical judgment of a licensed psychologist with expertise in ASD employed by the university research program and (2) Chronological age between 2 and 4 years. Demographics and assessment scores at intake for each participant are displayed in Table 3.1.

Setting and Materials

All sessions were conducted in a treatment room at the university autism research program laboratory or in a small play room or area in the participants' home. A variety of developmentally appropriate, motivating toys were used during all treatment sessions. The types of toys for each participant were determined based on developmental level and parent-reported child preferences. Four bins of toys were created from matched sets of materials (e.g., each bin contained a barn or zoo and a set of animals, each from different toy manufacturers and of slightly different types). Bins of toys were randomly rotated across conditions in order to minimize the influence of the toys on the child's behavior. Toys in these bins were used exclusively during treatment sessions and no other materials were available to participants.

Table 3.1. Participant demographics and intake assessment scores.

Name	Gender	Age (in mos)	ADOS	Diagnosis	MSEL Expressive Language (T-score)	MSEL Early Learning Composite	VABS ABC
Anne	F	39	ASD	PDD-NOS	38	70	67
Ethan	M	36	Autism	Autistic Disorder	21	49	81
John	M	34	Autism	Autistic Disorder	63	118	89
Ken	M	38	Autism	Autistic Disorder	31	61	74
Lauren	F	30	ASD	PDD-NOS	63	128	87
Tom	M	39	Autism	Autistic Disorder	46	78	71

Note: ADOS = Autism Diagnostic Observation Schedule; MSEL = Mullen Scales of Early Learning, VABS ABC = Vineland Adaptive Behavior Scales –II, Adaptive Behavior Composite

Procedure

The experiment utilized a within-subjects, alternating treatments design (Barlow & Hayes, 1979), where the treatments were based on the two elements of turn taking: modeling and contingency. This design was selected to allow for a rapid comparison of two or more conditions (Barlow & Hayes, 1979; Hayes, Barlow, & Nelson-Gray, 1999). Each participant received randomly rotated sessions in each of four conditions, two that included the turn elements of modeling and contingency in isolation and two that combined the elements with varied timing, such that the conditions were as follows:

Modeling only, Contingency only, independent use of modeling and contingency (henceforth referred to as Independent), and simultaneous modeling and contingency (henceforth referred to as Combined). Across all conditions, the therapist used a specific EBT, Pivotal Response Training (PRT), to interact with the child. PRT was selected to allow for natural, systematic therapeutic interaction with the child, while allowing also for manipulation of the turn taking component. All conditions required that the therapist use the components of PRT with fidelity, with the variation in the turn taking component as the only manipulation. Components of PRT that were held constant include, (1) gaining the child's attention; (2) using clear, developmentally appropriate instructions; (3) providing a mixture of easy (maintenance) and difficult (acquisition) tasks; (4) following the child's lead and using preferred materials for teaching; (5) providing direct reinforcement; (6) providing contingent reinforcement; and (7) rewarding goal-directed attempts at correct responding (Koegel et al., 1989). Abbreviated operational definitions for each turn taking condition are provided in Table 3.2 and additional information is available from the authors.

Three of the authors (BR, SR, JW) served as therapists in the current study. The first author has expertise in PRT and regularly conducts PRT training. The other two therapists were trained in typical implementation of PRT through didactic lecture (3 hrs) and hands-on practice with feedback (5-10 hrs; M = 6.4, SD = 2.1) from the first author. Therapists learning PRT practiced until achieving 80% fidelity of implementation (see below) across two sessions with a child prior to working with study participants. To ensure treatment adherence, fidelity was continually monitored throughout the study by the first author and observers blind to the study hypotheses.

Table 3.2. Turn taking component conditions.

Condition	Description of Therapist's Turn
Modeling Only	Therapist models appropriate play and/or language, but does not require a specific response from the child for child to regain access to materials. The therapist may or may not take control of a toy, but if so returns it immediately after modeling.
Contingency Only	Therapist requests a turn and takes control of the motivating toy or part of the toy the child is using, but does not model play or language. The therapist requires a response from the child before returning the toy, and prompts behavior as necessary.
Independent	The therapist uses either modeling or contingency (as described above) but does not use both in the same exchange and instead switches between them throughout the session.
Combined	Therapist requests a turn and takes control of the motivating toy or part of the toy, models appropriate play or language, then requires a response from the child before returning the toy.

Each child participated in seven sessions, one introductory session followed by six treatment sessions. Sessions were scheduled twice per week for a period of three weeks. Due to cancellations, the average time for completion of the six treatment sessions was just over one month (M=4.8 weeks, SD = 1.2 weeks). Introductory sessions consisted of a brief meeting between the parents, therapist, and child to gather informed consent, determine the session schedule, and build rapport with the child. Because all children had received a comprehensive developmental evaluation by a licensed clinical psychologist with expertise in ASD within the three months preceding study enrollment, separate study specific child assessments were not conducted. Assessment scores for all six participants are presented in Table 3.1. After the introductory session, the series of six therapy sessions began. Each session consisted of two, 20-minute treatment blocks and a short break between blocks to reduce possible child frustration and increase distinction between the conditions. Across all sessions, participants were presented with each of the four conditions a total of three times. The four turn taking conditions occurred randomly across periods of two sessions (four blocks), such that each condition occurred once before any condition repeated. Randomization of the four conditions across the two session periods occurred separately for every two sessions to reduce possible order effects for the conditions. All other elements of PRT remained constant across all four turn taking conditions.

Dependent Measures

Video scoring procedures

All treatment sessions were digitally recorded to allow for behavioral scoring and data analysis. Scoring definitions for each variable (see below) were based on coding schemes used in previous studies, a review of the literature, and discussion among the authors. Scoring was completed using The Observer ® by Noldus Information Technology, an event logging software for observational data that allows for precise recording of behavioral events. Undergraduate research assistants were trained in behavioral scoring methods through review of the definitions and practice scoring. Research assistants were required to meet 80% reliability (identical codes within a 3-second window; [agreements/agreements + disagreements] x 100) across two consecutive video clips to be considered reliable. A primary rater was assigned for each scoring type (communication, play, and fidelity of implementation) and these data were used in all analyses. A secondary rater scored every third observation to ensure interrater reliability. All raters were blind to the order of the conditions and the study hypotheses.

Communication

Child communication was scored by identifying the function (comment or request), complexity (vocalization, one-word, word combination), and type (spontaneous, cued, imitated) of communicative child utterances (i.e., excluding self-stimulatory verbal behavior and any self-talk). Frequency counts were obtained for codes in each category.

Play

Child play behavior was scored for the frequency of discrete play behaviors and the total duration of functional play. Each discrete play behavior was further classified as either novel or repeated.

Abbreviated definitions for all communication and play behaviors scored are provided in Table 3.3.

Fidelity of implementation

Undergraduate research assistants were trained to score the type of turn used in each condition as well as fidelity of implementation of PRT using developer-derived methods. Fidelity of implementation was scored by watching the first ten minutes of each session. Therapists were unaware when fidelity would be scored and did not know that it would consistently occur in the first ten minutes of the session. For both fidelity of implementation of PRT and the turn conditions, a second rater scored every third session for reliability.

Coders rated the therapist's implementation of each PRT component (excepting turn taking) on a 1-5 Likert scale, where 1 indicated that therapist did not implement the component throughout the session and 5 indicated that the therapist implemented the component competently and consistently throughout the session. A score of 4 or 5 was required to be considered meeting fidelity for PRT. PRT was implemented with 80% accuracy or above during all sessions (range 92 – 100%).

Fidelity of implementation for the turn taking conditions was scored by identifying the frequency of the types of turns taken by the therapist during each session. For all conditions, the therapist was required to take a minimum of 20 turns to meet fidelity. For the Modeling, Contingency, and Combined conditions, a total of 80% of turns matching the assigned condition were required to meet fidelity (e.g., at least 80% of the therapist's turns during the Modeling condition must be modeling turns). For the Independent condition, the therapist was required to implement an equal number of contingent turns and modeling turns, within a 10% window on either side (i.e., if 16 contingent turns occurred in the session, the required number of modeling turns was 14 – 18 to pass fidelity). Therapists were required to use only one type of turn for each exchange in the Independent condition (i.e., if a therapist provided a model and contingency in the same exchange, this was considered incorrect).

The turn taking conditions were implemented with 80% accuracy or above during all sessions (range 79.8 – 100%). Additionally, the number of turns taken by the therapist did not differ significantly across conditions ($p > .05$).

Reliability

A total of one third of all treatment sessions for each child were double-coded for reliability purposes. Identical codes within a 3-second window were considered agreements (language, play, and types of turns). For PRT fidelity, codes within 1 point on the Likert scale were considered agreements. Percent agreement between coders was calculated using the following formula: [Agreements / (Agreements + Disagreements)] x

100. Mean percentage agreement was above 80% in all areas, indicating high levels of agreement (see Table 3.4).

Table 3.3. Behavioral definitions of communication and play behaviors.

Communication		
Category	**Kind**	**Description**
Function	Comment	Communicative child verbalizations not for the purpose of regulating the behavior of others.
	Request	Child verbalizations for the purpose of regulating the behavior of others.
Complexity	Vocalization	Purposeful, appropriate verbalizations that cannot be identified as words or approximations of words.
	One word	Verbalizations that are understandable enough to be identified as a word or word approximation.
	Word combination	Verbalizations that include more than one word or word approximation.
Type	Spontaneous	Verbalizations that do not follow a related verbalization or nonverbal action by the therapist.
	Cued	Verbalizations that follow a verbal model, question, or gesture by the therapist.
	Imitated	Appropriate verbalizations or approximations that immediately follow and imitate all or part of a therapist's verbalization.
Play		
Category	**Kind**	**Description**
Action	Novel	The first time any individual play action (separated by at least 5 seconds from other play actions) is performed by the child.
	Repeated	Subsequent occurrences of individual play actions (separated by at least 5 seconds from other play actions) during the same session.
Duration	Functional Play	The duration of time the child is using a toy in conventional manner or is appropriately participating in a social game or motor activity with the therapist.

Table 3.4. Interobserver agreement for all categories scored.

	Percent Agreement	
Category	**Mean**	**Range**
Language		
Function	83	76 - 91
Type	81	72 - 95
Complexity	94	85 - 96
Play		
Action	84	69 - 91
Duration	93	79 - 96
PRT Fidelity	97	92 - 100
Turn Condition Fidelity	87	85 - 92

Data Analysis

Observationally scored communication and play data were analyzed by visual inspection (Gilner, Morgan, & Harmon, 2000). Level, trend, variability, overlap, and consistency of data patterns across participants were all used to determine whether results demonstrated a causal relationship, as is recommended by national standards for single subject research (Kratochwill et al., 2010). Percentage of non-overlapping data points was calculated for observed patterns to confirm visual inspection (Parker, Hagan-Burke, & Vannest, 2007).

Results

Results varied by skill targeted as well as developmental level of participants. Consistent patterns seen across multiple participants and conditions are discussed below.

Language

Figure 3.1 displays the number of requesting utterances that each participant used across conditions. Results were variable by child, but two distinct patterns emerged. Anne, Ken, Tom and Ethan show a decreased level of requesting in the Modeling condition, and similar, higher levels of requesting across the three other conditions (percentage of all non-overlapping data points: 100, 100, 100, and 66, respectively). John and Lauren show an increased number of requests in the Combined condition, and similar, lower levels of requesting across the other three conditions (percentage of all non-overlapping data points: 100 and 66, respectively).

Figure 3.2 displays the number of commenting utterances across conditions. For participants who consistently commented (Anne, John, and Lauren), more commenting occurred in the Modeling condition than other three conditions (percentage of all non-overlapping data points: 100 for all three participants). For participants using comments sporadically (Ken and Tom), there did not appear to be any differentiation between conditions (all data points overlapping). Ethan was not using any comments at the time of the study and therefore also did not show any differentiation between conditions.

Table 3.5, Panel A displays the average number of each type of utterance in each condition for all participants. Though there was significant variation in the amount of spontaneous language used by each child, no differences emerged in the amount of spontaneous language used based on the condition (all data points overlapping). Cued language showed a decrease in the Modeling condition for all six participants, with similar levels of cued language across the other three conditions (percentage of non-overlapping data points: 100 for Anne, 100 for John, 100 for Ken, 66 for Tom, 100 for Lauren, 66 for Ethan; not shown). Imitated language showed high variability both within and across children and no consistent differences across conditions (all data points overlapping; not shown).

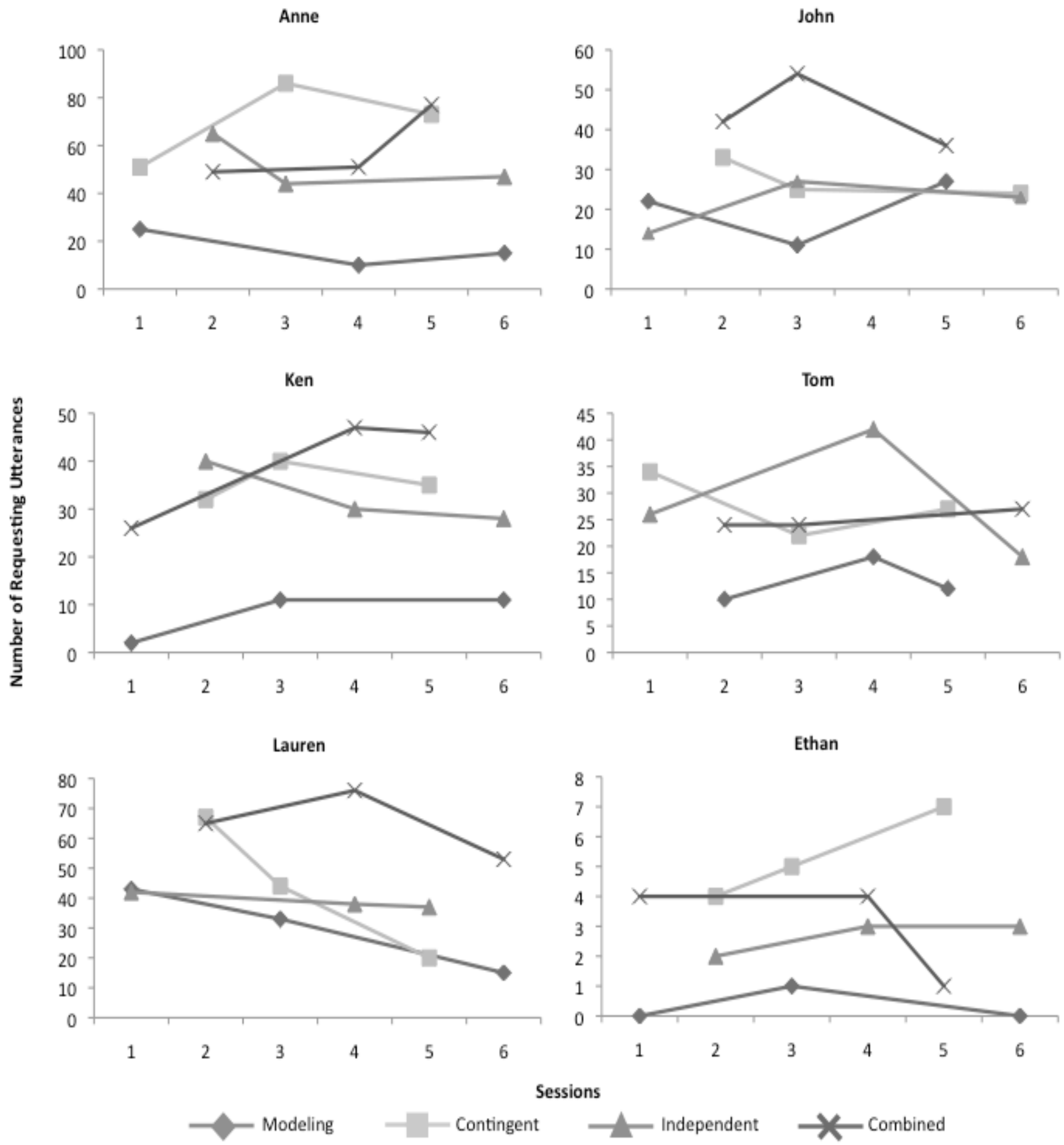

Figure 3.1. Number of requesting utterances across conditions.

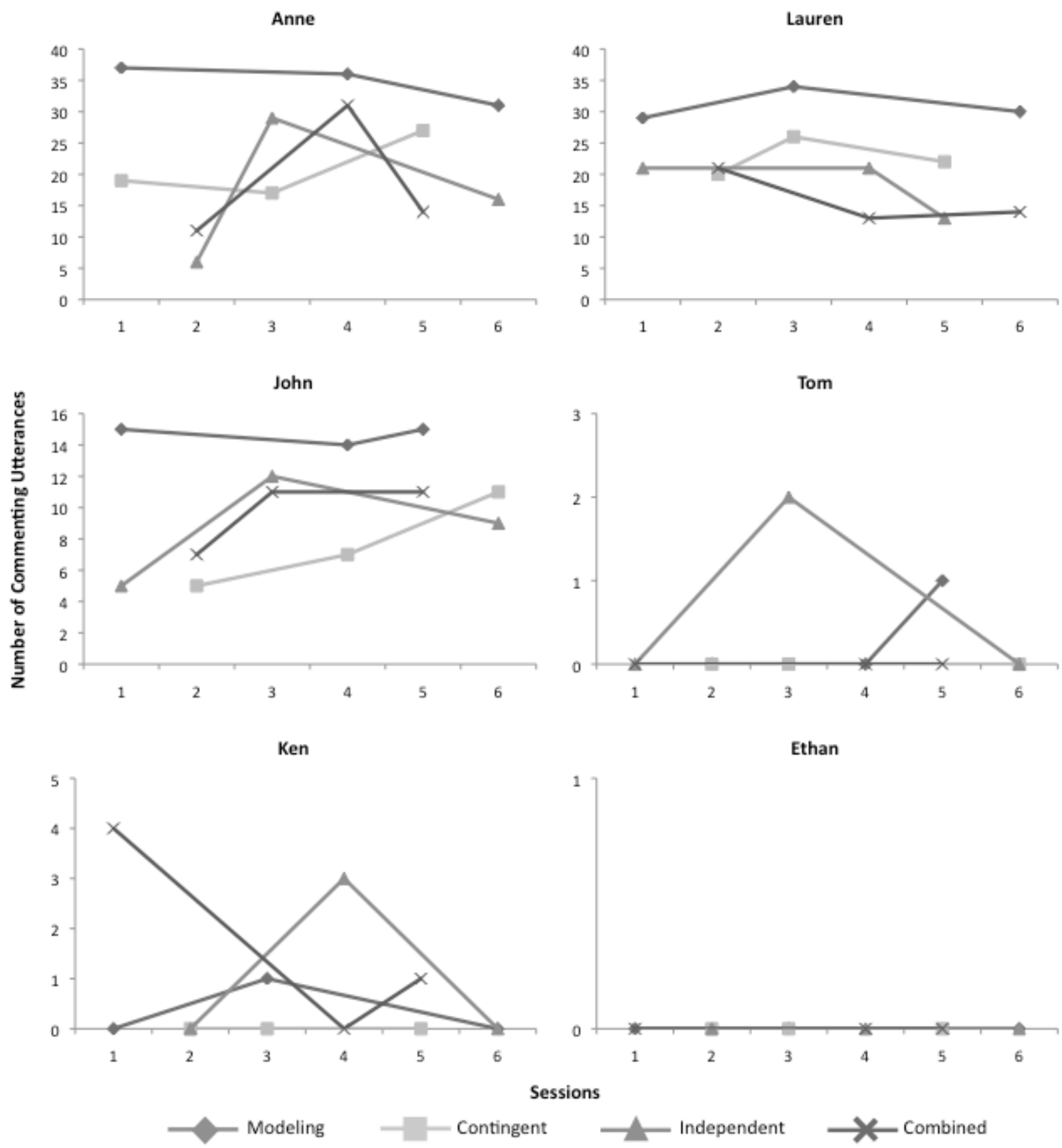

Figure 3.2. Number of commenting utterances across conditions.

Table 3.5, Panel B displays the complexity of utterances for each participant averaged across conditions of the same type. These data illustrate that the language complexity for each child stayed relatively stable across conditions; it does not appear that the length of utterances children used was affected by the differences in the therapist's behavior.

Play

Figure 3.3 displays the number of discrete play actions performed by each participant across conditions. A larger number of discrete play actions were seen in the Independent and Combined conditions than in the Modeling or Contingent conditions for all participants. Number of play actions appeared equivalent during Independent and Combined conditions, as indicated by the overlapping data paths. The same is true for the Contingent and Modeling conditions. There are no overlapping data points between the Contingent/Modeling conditions and the Independent/Combined conditions and this pattern is consistent across all six participants. Data for duration of functional play showed a very similar pattern, with the Modeling and Contingent conditions producing less functional play than either the Independent or Combined conditions (no overlapping data points; not shown). Though there was variation in the proportion of novel versus repeated play actions across children, each child demonstrated little variation across conditions (i.e., the proportion of novel versus familiar play actions for each child was stable across conditions; not shown).

Table 3.5. Average type and complexity of utterances across conditions.

A: **Type**

		Spontaneous				Cued				Imitated			
		Mod	**Cont**	**Ind**	**Comb**	**Mod**	**Cont**	**Ind**	**Comb**	**Mod**	**Cont**	**Ind**	**Comb**
Anne	**M**	**59.3**	**61.7**	**62.0**	**57.0**	**11.3**	**32.0**	**29.0**	**27.7**	**10.3**	**15.0**	**13.7**	**16.7**
	SD	7.8	6.1	7.3	12.1	3.0	5.6	3.7	4.9	2.3	4.6	3.7	2.3
John	**M**	**43.3**	**35.0**	**38.3**	**45.0**	**5.7**	**20.0**	**20.7**	**22.7**	**6.0**	**4.0**	**4.7**	**5.3**
	SD	11.6	13.5	12.7	9.6	2.5	2.0	2.5	2.5	3.0	3.5	1.2	0.6
Ken	**M**	**10.7**	**14.7**	**12.3**	**15.7**	**2.0**	**21.0**	**20.0**	**20.7**	**11.7**	**8.7**	**6.7**	**12.0**
	SD	4.7	3.1	4.5	6.4	1.0	6.0	3.0	3.5	1.2	1.2	2.5	7.2
Tom	**M**	**7.7**	**10.7**	**8.7**	**8.3**	**23.3**	**29.3**	**35.0**	**22.0**	**24.7**	**28.7**	**23.0**	**20.0**
	SD	2.3	15.6	4.6	3.0	5.0	10.6	10.5	3.6	5.6	23.1	11.0	8.9
Lauren	**M**	**40.7**	**45.0**	**37.7**	**56.0**	**11.0**	**29.7**	**24.7**	**25.0**	**9.0**	**13.0**	**4.0**	**7.3**
	SD	0.6	2.0	0.6	2.6	6.2	7.9	6.1	7.3	14.6	23.1	11.6	10.8
Ethan	**M**	**.03**	**0.3**	**0.3**	**0.3**	**0.3**	**0.7**	**0.7**	**0.0**	**0.0**	**4.3**	**2.7**	**2.0**
	SD	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	2.1	0.6	1.7

B: **Complexity**

		Vocalization				Single Word				Word Combination			
		Mod	**Cont**	**Ind**	**Comb**	**Mod**	**Cont**	**Ind**	**Comb**	**Mod**	**Cont**	**Ind**	**Comb**
Anne	**M**	**2.0**	**3.0**	**1.7**	**0.7**	**28.7**	**31.3**	**21.3**	**26.0**	**75.3**	**74.3**	**72.7**	**72.7**
	SD	1.7	1.7	2.0	0.6	8.0	6.1	4.1	4.6	16.2	12.5	7.7	23.4
John	**M**	**1.3**	**2.0**	**0.7**	**3.0**	**21.0**	**15.0**	**16.3**	**19.0**	**37.7**	**42.0**	**36.7**	**59.3**
	SD	0.6	2.0	0.6	2.6	19.2	9.8	11.1	11.3	14.6	23.1	11.6	10.8
Ken	**M**	**0.7**	**0.0**	**3.0**	**4.0**	**6.0**	**9.3**	**10.3**	**15.3**	**7.7**	**35.0**	**25.7**	**29.0**
	SD	1.2	0.0	2.6	6.9	6.6	8.5	6.8	10.1	4.9	6.1	1.5	14.1
Tom	**M**	**7.7**	**2.7**	**5.0**	**6.3**	**17.7**	**14.0**	**25.7**	**17.3**	**29.3**	**32.0**	**32.0**	**32.7**
	SD	2.3	2.6	4.6	5.7	2.5	7.2	7.8	8.5	14.7	12.9	10.5	10.0
Lauren	**M**	**6.7**	**2.3**	**3.0**	**4.3**	**8.3**	**17.7**	**23.0**	**18.0**	**45.7**	**67.7**	**40.3**	**66.3**
	SD	0.6	2.0	0.6	2.6	4.3	9.8	4.1	7.3	14.6	13.1	11.6	10.8
Ethan	**M**	**0.3**	**5.3**	**2.7**	**3.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	SD	0.6	1.5	0.6	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: Mod = Modeling; Cont = Contingent; Ind = Independent; Comb = Combined.

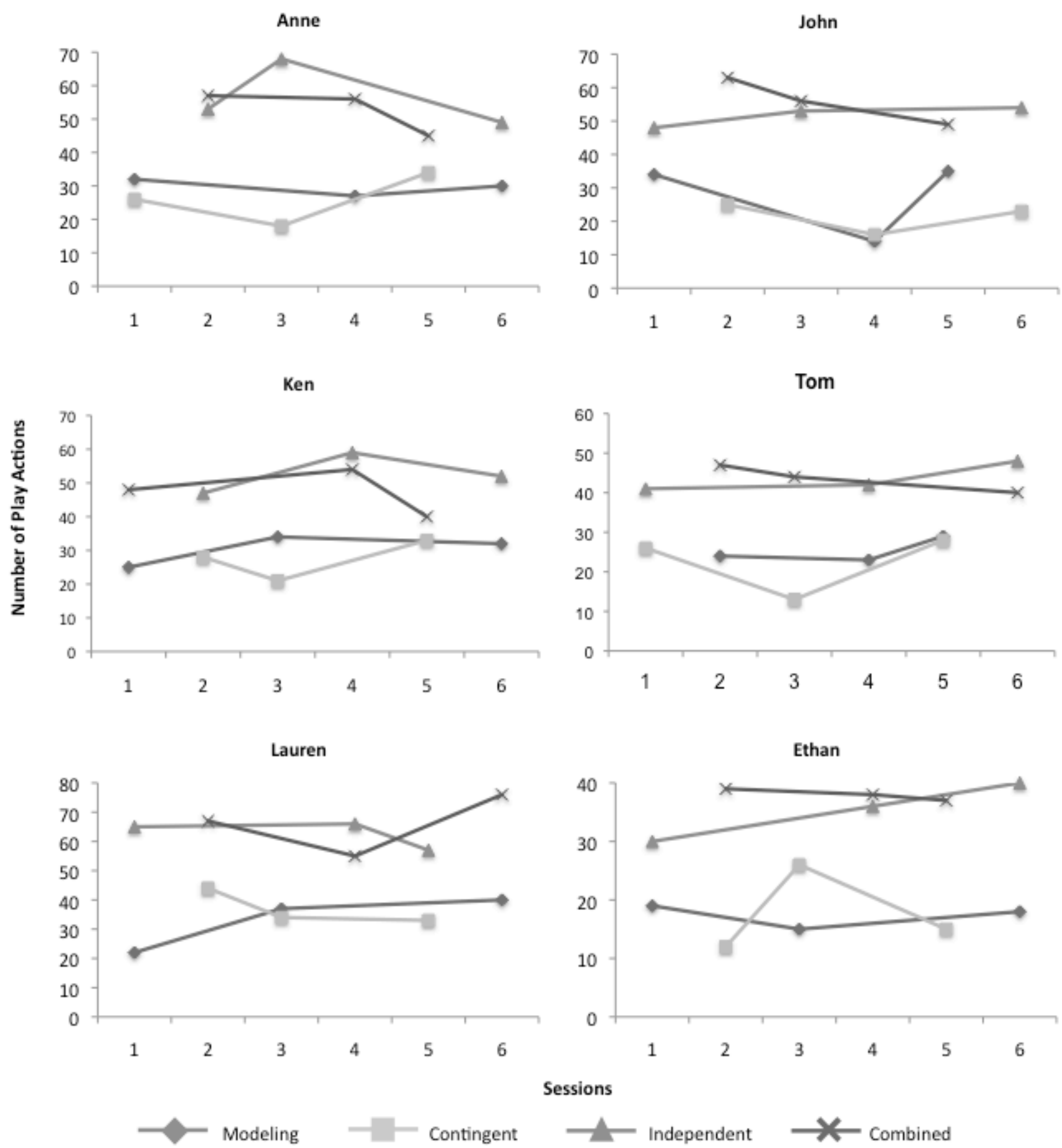

Figure 3.3. Number of play actions across conditions.

Discussion

The results of this study suggest that the use of different elements of the turn taking component can affect responsiveness of children with ASD. The types of turns the therapist used had predictable effects on participants' communication and play behavior that varied by the functioning level of the child. Based on these data, preliminary recommendations for the types of turns therapists should use to target various child skills can be made.

Gaining control of materials and requiring a contingent response from the child is an element of therapist turns present in all conditions except Modeling. Conditions involving contingency promoted the use of requesting utterances for a subgroup of children. These children all had expressive language age equivalents under 60 months of age and MSEL Early Leaning Composite scores under 80. For this group, modeling alone did not promote the same level of requesting as the conditions involving contingency. Requesting is often the first expressive language skill targeted in naturalistic, behavioral interventions for children with ASD. These results are consistent with previous research indicating that children with lower language levels respond more favorably to interventions that use direct prompting than those that use purely facilitative strategies (Yoder et al., 1995). Additionally, the lack of differentiation between the Contingency, Independent and Combined conditions suggests that therapists need not necessarily use both modeling and contingency within the same exchange when targeting requesting with these children, thus potentially simplifying implementation of turns with some children. These data support contingency as a critical element in increasing the use of requests for children acquiring early language skills. Though this is not surprising, it is useful to demonstrate that modeling alone was insufficient to promote this type of communication for certain children, as this is a current debate in the ASD intervention literature.

In contrast, the two participants with expressive language age equivalents above 60 months, who also had above average MSEL Early Learning Composite scores, used increased requests in the Combined condition, indicating a need for both modeling and contingency to occur within the same exchange for optimal responding. These data are also consistent with earlier research on the positive influence of facilitative strategies such as responsive commenting on children at higher language levels (Yoder et al., 1995). One possible explanation for this result is that a turn in the Combined condition is the most similar to the give and take of a typical interaction, where both participants alternate offering new content and providing a lead for the other partner to follow. The more advanced developmental level of the participants who were optimally supported by the Combined condition suggests the need for a shift in the type of turn used over time, such that therapists incorporate modeling alongside contingency as children make progress and gain new skills. This is important information for how to best individualize intervention to a child's changing needs over time.

The type of therapist turns that supported commenting were also variable across children but demonstrated a consistent pattern. The Modeling condition best supported use of comments for participants who were already using this type of communication. Children who were consistently commenting during intervention either had higher cognitive scores (John and Lauren) or less severe autism symptoms (Ann and Lauren). This finding may indicate that therapist modeling may play an important role as children become increasingly skillful in using language for a variety of functions beyond requesting. These data provide specific information on when therapists might want to use Modeling alone during treatment sessions. The identification of which communication skills are best taught using specific components of interventions is crucial for the continued refinement and improved efficiency of ASD intervention (Schreibman, Suhrheinrich, Stahmer, & Reed, 2012).

Consistent patterns were also seen in the type of language (spontaneous, cued, imitated) children used across conditions. Children used cued speech less often in the Modeling condition. It is possible that the decrease in the use of cued language is primarily due to the therapist's lack of explicit withholding of materials, which is consistent with previous research (Ingersoll, 2011). The lack of differentiation between conditions for spontaneous language is noteworthy, as a common goal across behavioral interventions for ASD is independent communication that does not rely on therapist support or environmental manipulation. The similar levels of spontaneous language across conditions replicates results seen in previous comparison of Milieu Teaching (a naturalistic behavioral approach that includes contingency; Alpert & Kaiser, 1992), Responsive Interaction (a developmental approach more likely to include modeling alone; Mahoney & MacDonald, 2007), and a combined approach for children with ASD (Ingersoll, 2011), as well as comparison of behavioral versus responsive teaching methods for children with Down Syndrome and agenesis of the corpus collosum (Salmon, Rowan, & Mitchell, 1998). The consistency of this result is encouraging, as it indicates that children's spontaneous use of language is supported equally across variations in therapist behavior.

The data for the frequency of functional play behaviors were consistent across all six children, indicating good reliability on the effect of the therapist's type of turn on the object play behavior of children with ASD. It appears that both modeling and contingency are necessary to promote functional play (both in duration and number of discrete acts). The consistency of the response pattern across children may indicate a feature of how play is learned versus how language is learned. Children have the opportunity to hear others speak and communicate with each other continually, regardless of whether they are the ones being spoken to or are participating in the interaction. It is more rare, however, for a child to observe or witness a play interaction that they are not themselves a part of. One explanation for the requirement for modeling to support a child's use of play behaviors is the decreased input of play behaviors that children otherwise likely receive. However, these data do not speak directly to this issue. It is clear that using modeling and contingency at the same time is equivalent to using both strategies separately, which reduces the complexity of using turns to promote children's play behavior and therefore increases the likelihood of adoption of this effective strategy (Rogers, 2003). For example, a therapist could model a play action for several children, while providing contingent reinforcement for completing play actions at different times for each child in the group.

There are several limitations to the current study. The work presented here is preliminary and relies on a small number of children, and therefore requires replication in future research. Additionally, each condition was implemented a limited number of times, which restricts the strength of the conclusions that can be made regarding differences in condition. The short duration, low intensity, and lack of baseline data all indicate that these data cannot assess whether the conditions used improve overall language ability, nor the long-term effects of each condition on child behavior. Future research should investigate these conditions at greater intensities and over longer periods of time to address these limitations. Furthermore, only a small number of potential target skills (expressive language and play) were assessed in the current study, and it may be that other skills are supported in different ways by the type of therapist turn, thus limiting the extent to which these results can be generalized to other learning domains. Lastly, the turn manipulations used here resulted in somewhat artificial implementation of PRT, with strict controls on how many opportunities to respond the therapist provided to allow for consistency across therapists and turn taking conditions. Results from children participating in this slightly contrived therapy context may not match what would happen if the intervention were used in a more natural way.

These results identify the influence of therapist turn taking on child communication and play behavior during behavioral treatment sessions. The elements of a turn that optimally support child responding are dependent on the nature of the skill being targeted (requesting, commenting, play behaviors) and the developmental level of the child. This study provides an important model for elucidating critical elements in intervention strategies for children with ASD and informing the individualization of treatment.

Acknowledgements

Chapter 3, in full, has been submitted for publication of the material as it may appear in Research in Autism Spectrum Disoders, 2012. Reed, Sarah; Stahmer, Aubyn; Suhrheinrich, Jessica; Schreibman, Laura; Wilson, Joanna; Ross, Benjamin, Elsevier, 2012. The dissertation author was the primary investigator and author of this paper.

The authors would like to thank the families and children who participated in this research.

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DISCUSSION

In his book *Pasteur's Quadrant*, Donald Stokes (1997) championed the idea that research could both advance the quest for fundamental understanding (basic research) while simultaneously being beneficial to society (applied research). Stokes asserted that all research could be classified along the separate dimensions of improving our understanding of nature and solving an immediate problem. Because Pasteur's work was groundbreaking in both the science of microbiology and the treatment and prevention of diseases, Stokes identified 'Pasteur's quadrant' as the area representing high marks on both dimensions. The goal of this dissertation has been to report research in the field of autism spectrum disorders (ASD) that reaches toward Pasteur's Quadrant: it both moves forward our understanding of ASD and has important implications for the delivery of ASD intervention in community settings.

Each of the studies reported here was motivated by collaborative work with teachers that identified areas of adaptation needed to move PRT into classrooms effectively. Turn taking and response to multiple cues were identified through both quantitative (observational) and qualitative (focus groups) study to be areas of difficulty for teachers attempting to use PRT with their students. Though this work requires replication and continued examination, these results support both modifications to the turn taking component and removal of the requirement to use conditional discriminations with all students. These alterations may help reduce the complexity of PRT for use in the classroom, and are largely in line with what teachers are currently doing (Suhrheinrich, Stahmer, Reed, Reisinger, & Mandell, in revision). Because complexity and compatibility with existing practice are major factors influencing the successful dissemination of practices into applied settings (Rogers, 2003), these potential changes should improve the likelihood of teachers adopting PRT.

In the case of response to multiple cues, the research here largely confirmed teachers' existing practices. Their intuition that presenting conditional discriminations was not developmentally appropriate for all children (Schreibman, Suhrheinrich, Stahmer, & Reed, 2012) was correct, as typically developing children under 36 months could not consistently complete these discriminations (Chapter 1). Furthermore, the large majority of children with ASD being served in classrooms did not have difficulty with simple conditional discriminations, indicating that targeting this specific skill as part of PRT may be unnecessary (Chapter 2). Future work should specifically examine the role of the use of multiple exemplars in addressing stimulus overselectivity as well as the effectiveness of PRT with conditional discriminations omitted. Teachers can now exclude conditional discriminations for some students based on research, rather than out of difficulty or time constraints. This example of research validating teachers' perspectives may help improve teachers' opinions of EBI and make them more likely to use scientific evidence as a criteria for intervention selection in the future (Boardman, Arguelles, Vaughn, Hughes, & Klingner, 2005).

The close examination of turn taking in PRT (Chapter 3) did not confirm teachers' existing practice but did result in several potential modifications to current protocol, and provided a more clear indication of the role turn taking plays in child behavior. The therapist's use of modeling and contingency had consistent and specific effects on child language and play behavior depending on the developmental level of the child and the type of skill being targeted. The clarification on why turn taking is important in PRT may potentially enhance the extent to which teachers' value the component. Teachers are more likely to implement a component correctly when they clearly perceive the value of that component, regardless of the difficulty (Stahmer, Suhrheinrich, Reed, & Schreibman, in review). Future research should examine these findings with larger numbers of students, and develop methods of training teachers to use turn taking more effectively in classroom environments.

The traditional model of research, development, dissemination, and evaluation as a linear process has resulted in separate research, practice, and policy communities that are each falling short of their potential to affect educational improvement (Brown et al., 1999). Scientific evidence is not currently a criteria that teachers report using when selecting what interventions to use (Boardman et al., 2005; Landrum, Cook, Tankersley, & Fitzgerald, 2002), and teachers express skepticism regarding EBI because they feel the models do not adequately capture the complexity of student needs (Cochran-Smith & Lytle, 1999; Stahmer, Collings, & Palinkas, 2005). Using a collaborative method of gathering feedback from teachers and utilizing that information to inform research in order to improve practice is a step towards the "collaborative problem-solving research and development" identified as crucial in education over a decade ago (Brown et al., 1999). Working collaboratively in this way may also result in more equally shared responsibility for change between researchers and practitioners: researchers are responsible for creating or adapting interventions to fit the context of applied settings, but equally the practitioners are responsible for utilizing those practices and sharing information on their suitability for the classroom with researchers. Sharing responsibility in this way is more likely to result in both improved practice and advanced theory than when either group tackles the problem alone (Mehan, 2008).

A similar issue is pervasive in the mental health field, where a large body of clinical trials exist (including on ASD specifically) but only a very small fraction of those studies influence how clinicians operate in usual care (Chorpita & Regan, 2009). Treatment manuals for specific EBI procedures are unpopular with front-line clinicians (Addis & Krasnow, 2000). Like education, mental health has a long tradition of "divided laboratories" (Chorpita, 2002, pg 432) where the work of treatment development is done separately from the work of effectiveness testing. The calls for shared responsibility in education parallel attempts to push all stages of research on mental health treatments (i.e., pilot work, tightly controlled randomized efficacy trials, community effectiveness trials) into the final context in which the practice will be used (Chorpita, 2002).

In addition to facilitating the translation of EBI to applied settings, this research also contributes to the goal of individualization of intervention for ASD. The heterogeneity of the disorder and variability in treatment response has created an acute awareness of the need to identify which intervention and settings will be maximally effective for which children. Research on how to prospectively identify what intervention to deliver and how is still in the early stages, but some methods for tailoring treatment based on curriculum area, setting, child characteristics, or activities exist (Stahmer, Schreibman, & Cunningham, 2011). Chapters 1 and 2 add to this growing body of literature by suggesting child characteristics on which to base the use of conditional discriminations in treatment. If a child has a developmental level under 36 months of age or is not displaying difficulty with conditional discriminations when explicitly tested, then it is likely appropriate to omit this component of treatment. Chapter 3 also addresses the question of individualization by identifying which modifications to the turn taking component of PRT optimally benefit particular children. Early language learners are more likely to produce speech when the therapist utilizes contingency, whereas children who are already commenting may benefit from the more facilitative and less directive strategy of modeling. Therapists targeting play skills with children should use both modeling and contingency throughout the interaction to promote play actions, but they need not necessarily occur together. Thus Chapter 3 informs individualization of treatment both by curriculum area as well as by child characteristics.

The dissemination of EBI into community settings is a major challenge (Chorpita, Becker, & Daleiden, 2007) and practices are unlikely to simply trickle into applied settings of their own accord (Chorpita & Regan, 2009). The previous chapters represent the close examination of the components of PRT known to be difficult for teachers in classroom settings. These studies were motivated by collaborative work with teachers aimed at improving educational outcomes for students with autism. The process of gathering feedback and scientifically testing potential adaptations to interventions is an important model for knowledge transfer and exchange. Results of these studies suggest several modifications to PRT protocol that are likely to enhance teacher adoption of this intervention, and therefore potentially improve student learning. Overall, these studies highlight the importance of returning to basic research to improve the delivery of quality intervention to individuals with ASD in applied settings.

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