TEACHING JOINT ATTENTION TO CHILDREN WITH AUTISM THROUGH A SIBLING-MEDIATED BEHAVIORAL INTERVENTION

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A thesis submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

for the degree of

Master of Science

Graduate Program in Psychology

written under the direction of

Sandra L. Harris

and approved by

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New Brunswick, New Jersey

October, 2008

ABSTRACT OF THE THESIS

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Severe deficits in socialization are intrinsic to the diagnosis of Autism Spectrum Disorders. A specific deficit in joint attention has been identified in this population; it appears to be universal and pivotal to the development of more complex social skills and language. Behavioral interventions targeting joint attention are evidenced to be effective in teaching these skills to young children with autism, but these treatments have traditionally been implemented by adults. In the present study three typically developing children were trained to implement a joint attention intervention to their siblings with autism. Gains in responding to joint attention were observed for all three targets; gains in initiations were observed in two targets. These differential results provide information about the merits of conceptualizing joint attention as a set of specific skills rather than an individual construct. Siblings found the treatment to be acceptable, and parent ratings indicated high satisfaction with the procedures. The implications of these findings for treatments targeting joint attention and for siblings as interventionists are discussed.

Acknowledgements

The author would like to thank Sandra Harris for her constant guidance, encouragement, and advice throughout the course of this study. She is also grateful to her committee members, Alan Leslie and Maurice Elias, Lara Delmolino for her methodological contributions and Akanksha Kumar for her assistance with reliability. To the parents of the participants, the author expresses immeasurable thanks for inviting her into your homes to work with your wonderful children. This thesis was funded in part by a generous grant from the LeBec Fund.

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Introduction

Since 2003, an estimated 1 in 335 children have been diagnosed with autistic disorder (Yeargin et al., 2003); this number increases to 1 in 150 (CDC, 2007) when estimating prevalence rates of autism spectrum disorder (i.e., Autistic Disorder, Asperger's Disorder, Pervasive Developmental Disorder Not Otherwise Specified [PDD-NOS]). Autism is a pervasive developmental disorder characterized by core deficits in language and communication, impairments in social interactions, and restricted quality of behaviors (i.e., stereotyped or repetitive behaviors and a circumscribed range of interests) (American Psychiatric Association, 1994, PL-ADOS: DiLavore, Lord, & Rutter, 1995). Arguably the most palpable feature of autism is impairment in both quality and quantity of social interaction. Diagnostic measures divide social deficits into three areas: a lack of varied non-verbal behaviors, a lack of spontaneous initiation of shared enjoyment or interests, and failure to respond to initiations made by others (PL-ADOS, 1995; ADI-R: Lord, Rutter, & LeCouteur, 1994). The purpose of the present review is to examine joint attention, a pivotal feature of autism that encompasses these three social deficits.

In addition to the core features of the disorder, children with autism often exhibit ancillary social deficits such as a lack of imitation (Charman et al., 1997), perspective-taking deficits (Rogers, Hepburn, Stackhouse, & Wehner, 2003), and the absence of pretend play skills (Wing, 1978). Research suggests that social deficits including joint attention are more prevalent in individuals with autism than in other developmentally

disordered, mentally retarded, and Down syndrome populations (Baron-Cohen, 1989; Charman et al., 1997; Leekam et al., 1997; Mundy et al., 1994), which suggests a joint attention deficit specificity in children with autism.

Joint Attention

Joint attention is a social-communicative behavior that is generally defined as a child's ability to use "gestures and eye contact to coordinate attention with another person in order to share the experience of an interesting object or event" (Mundy, Sigman, & Kasari, 1994). However, diagnostic tools such as the Early Social Communication Scale (Seibert, Hogan, & Mundy, 1982) further break down the specific elements of joint attention: initiating requests through gestures (e.g., pointing) or eye contact, spontaneous initiation of shared enjoyment through establishing or alternating eye contact, responding to another person's eye gaze or point, responding to social bids by another person (e.g., "give it to me"), spontaneous offering of an object for the purpose of sharing or getting help.

In typical children, joint attention skills develop in the period between nine and twelve months. A characteristic joint attention interaction emerges when a typical child sees something of interest, such as an airplane. To share his enjoyment in this interesting object the child will make eye contact with his mother, switch his gaze to the plane, and then look at his mother again to confirm that she is also looking at the plane. This example illustrates the phenomenon of triadic joint attention (between two people and another object). Dyadic joint attention maps onto the responding element of the event; it involves two people, one responding to a bid for attention made by the other. Given that triadic orienting builds upon the dyadic skill, it is not surprising that children with autism

show marked deficits in both dyadic and triadic joint attention (Leekam & Ramsden, 2006). Further evidence suggests that, in relation to typically developing peers, children with autism display greater deficits in triadic joint attention than in dyadic joint attention (MacDonald et al., 2006). Existing literature on social skills deficits in autism implicates joint attention as a pivotal skill. Sigman and Capps (1997) define pivotal deficits by specificity to a disorder, universality to the population, and primacy of emergence. Research suggests that joint attention meets these criteria and can be accepted as one of the core deficits of autism.

It is hypothesized that the development of certain "pivotal" behaviors acts as a prerequisite for and a facilitator of later collateral changes in maladaptive autistic behavior (Koegel, Koegel, & Schreibman, 1991). Severity of autism as measured by diagnostic tools can be correlated with joint attention deficits (Turner, 2006). The literature also indicates that acquiring joint attention skills in children with autism produces ancillary gains in other social abilities including social initiations, positive affect, imitation, and expressive language (Jones, Carr, & Feeley, 2006; Whalen, Schreibman, & Ingersoll, 2006). It is important to note, however, that targeting reciprocal imitation skills in children with autism also leads to collateral gains in these domains and in joint attention (Ingersoll & Schreibman, 2006). This may confound evidence of the pivotal nature of joint attention. Theoretically, if joint attention were a pivotal skill, more significant changes would likely be observed as a result of targeting joint attention than targeting another skill. However, it may be possible that imitation is also a pivotal skill in children with autism or that using *reciprocal* imitation training inadvertently targets joint attention (i.e., the social component of the task may elicit more social responses).

More research is needed to replicate these findings and to distinguish the function of these ancillary gains (Jones, Carr, & Feeley, 2006).

Language delays and a lack of spontaneous communication have long been a hallmark of autism. Research over the past 15 years has implicated joint attention as a predictor of language delays. Differences in joint attention skills among children with autism are correlated with later language development, and specific components of joint attention are associated with these developments (Mundy, Sigman, & Kasari, 1990). A study of 15 children with autism versus a sample of children with mental retardation matched for IQ, illustrated that children with autism show a more significant lack of gestural joint attention skills. Moreover, gestural joint attention deficits were a specific predictor of language development in the children with autism but not the children with mental retardation. Additional research is needed to further examine the discrete components of joint attention as they relate not only to language development, but also to the aforementioned collateral gains in other social domains.

Individuals with autism demonstrate enough of an observable difference in joint attention skills to be distinguishable from other delayed populations from a very young age. Lewy and Dawson (1992) examined the social context of joint attention responsiveness in 20 preschool-aged children with autism and receptive-language matched groups of 20 children with Down syndrome and 20 typically developing children. Each child engaged with his parent in a free play activity for an unspecified period. The experimenter then manipulated the social context of the subsequent conditions by providing either adult or child-centered play. During the adult-centered condition, the experimenter initiated typical play schemes with toys and non-contingently

alternated eye gaze between the child and the toys. During the child-centered condition, the experimenter imitated the child's toy play, verbalizations, and body movements. Results indicated that children with autism were more likely to engage in joint attention in the latter condition, although they were generally less responsive to the experimental conditions than their matched peers.

In their 1998 study (Dawson, Meltzoff, Osterling, Rinaldi, & Brown) findings were replicated with 59 children with autism or PDD-NOS, Down syndrome, and typical development who were matched on chronological age, receptive language mental age, and the communication subscale of the Vineland Adaptive Behavior Scales. Each child participated in a play session in which s/he was presented with social (e.g., name calling) and non-social (e.g., rattle) orienting tasks. The examiner also engaged the child in a responding to pointing task to measure shared attention. Research assistants who were blind to diagnosis coded whether or not the child shifted his gaze during the two conditions. Results indicated that children with autism showed a significantly greater failure to orient than their matched Down syndrome and typical peers ($p < .001$). In addition, children with autism had significantly fewer orients to social stimuli than to non-social stimuli ($p = .029$). These results illustrate that a general impairment in joint attention orienting is compounded by a more significant deficit in social interaction. These two studies are of importance because they implicate a social component in joint attention deficits. Children with autism were taught to initiate and respond to joint attention, but demonstrated no motivation to do so without experimental manipulation.

Neurobiological Evidence for Joint Attention Deficits in Autism

Although the literature mainly approaches joint attention from a behavioral perspective, there are numerous findings that social deficits in children with autism may be biologically based. Neuroimaging studies to examine social development have implicated distinct regions of the brain in social growth. Social-emotional and theory of mind tasks activate the medial prefrontal and frontal cortex (Damasio, 1994; Zeinab & Tonmoy, 2004), while emotion processing and memory for emotional events are linked to the limbic system, specifically the amygdala (Zeinab & Tonmoy, 2004). Individuals with amygdala damage show a diminished capacity to process complex social stimuli (Adolphs, Baron-Cohen, & Tranel, 2002). Functional MRI studies of individuals with autism have shown metabolic deficits in the frontal cortex and cerebellum (Rumsey & Ernst, 2000) as well as reduced or no amygdala activity during tasks that require emotional processing (e.g., face expression judgment; Baron-Cohen et al., 2000). It is therefore probable that individuals with autism have a biologically based deficit in expressing and recognizing emotions, to engage in social relatedness (Bormann-Kischkel, Amorosa, & von Benda, 1993; Goodman, 1989), and to develop joint attention skills (Mundy, 2003).

Mundy and Crowson (1997) propose a "cybernetic model of autism" to explain the relationship between neurological processes and behavioral treatments. Their model details the linear development of skills in typical children. In the early stages of childhood development, the child with autism diverges from this line and follows a separate path. This course of development increasingly departs from the original line as the child ages, to represent the increase in observed differences between children with

autism and their typical peers. Mundy and Crowson propose that providing a child with autism with early intervention alters the "autism development" path to make it more parallel with the development of a typical child. The authors further posit that early intervention provides a neurological foundation that enhances a child's ability to develop the necessary skills to integrate with his peers. The methodologies of these intervention strategies will be discussed below.

Joint Attention Training

There have been relatively few longitudinal studies of children with autism that focus specifically on joint attention skills. A 2003 study by Olson described a seven-year evaluation of two siblings with autism and their developmental progress in the social skills domain. Results indicated that certain joint attention skills emerged with temporal development and other joint attention behaviors remained impaired (Olson, 2003). These findings are not conclusive regarding the sustained impairment of joint attention behaviors over time because the author did not implement an intervention to target these skills. However, additional longitudinal research does suggest that social skills development is an ongoing challenge for children with autism and that continual social skills training is necessary across a child's development (Strain & Hoyson, 2000).

A longitudinal study used PET to monitor brain development processes (Zilbovicius et al., 1995) in young children with autism. The authors found developmentally immature levels of cerebral blood flow in the brain's frontal hemispheres at 3-4 years. By age 6-7 the children's cerebral blood flow had normalized to age-appropriate levels. This supports the hypothesis that children with autism have a delayed capacity to make gains in skills mediated by the frontal lobes, such as social

skills. These findings have significant implications for treatment, and further evidence the need for systematically targeting social skills well beyond the preschool years.

Olson's research also targeted social deficits as a contributing factor to problem behaviors in autism beyond the preschool years, findings that explicate the need for effective social skills interventions. It is therefore not surprising that children with autism who are not taught appropriate interaction skills fail to attend to their autistic and typically developing peers (DiSalvo & Oswald, 2002). Consequently, they miss out on opportunities to learn from modeling of social behavior that is critical for appropriate social development.

Numerous studies have demonstrated the effectiveness of social skills training, as well as interventions that target joint attention, in a naturalistic setting (Hwang & Hughes, 2000; Kohler, Leslie, Steighner, & Hoyson, 2001). Because skills taught in a naturalistic setting are more likely to generalize and endure, interventions are typically run either in a preschool setting or with peers. However, behaviors such as eye contact and motor imitation are more likely to generalize than other joint attention behaviors such as eye gaze (Hwang & Hughes, 2000), a concern that will be addressed below. Treatment methodologies vary, but evidence suggests that a systematic breakdown of social interaction components into smaller skill units best facilitates increases in targeted joint attention behaviors (Hwang & Hughes, 2000).

Training by Peers

The positive effects of using peers as models or trainers for social skills in children with autism are well documented. Peer training can lead to increases in both social initiation frequency and quality of social interactions (Kamps et al., 2002;

McGrath, Bosch, Sullivan, & Fugua, 2003). In fact, peer-trained social skills are evidenced to be more robust and more generalizable than adult-centered training (Kamps et al., 2002). Generalization may be the critical component in social skills training, considering the ongoing nature of social development. Kamps and colleagues also found that social behaviors were more generalizable when taught by familiar peers than when taught by unfamiliar peers. It is therefore evidenced-based practice to use familiar peers in training to enhance the naturalistic quality of the intervention.

Training by Siblings

Siblings are the most familiar peers to a child with autism, so it follows that they should also have the potential to elicit increases in social behavior from children with autism. According to DiSalvo and Oswald, "peer-mediated strategies typically involve the use of socially competent peers to model and reinforce appropriate social behavior" (2002). Because autism may have a partially genetic etiology, concerns have arisen that typical children may display similar delays to their autistic siblings. However, the literature suggests that most typical siblings show age-appropriate cognitive skills, language, and social engagement (Yirmiya, Gamliel, Shaked, & Sigman, 2006; Pilowsky, Yirmiya, Shalev, & Varda, 2003; Yirmiya et al., 2006) and that siblings of children with autism are less likely to be impaired than siblings of children with other developmental disabilities (Yirmiya, Gross-Tsur, & Shalev, 2006). Thus, many siblings of children with autism are potentially fine peer models.

Using siblings as trainers for children with autism may benefit the typical siblings as well as the children with autism. Typical children exhibit more problem behaviors and general lack of coping strategies in families of children with autism than do other

children (Glasberg, 2000; Ross & Cuskelly, 2006). Sibling relationships in families of children with autism also show a trend toward less intimacy, prosocial behavior, and nurturing than those relationships between siblings and children with Down syndrome and typical children (Kaminsky & Dewey, 2004). Evidence also suggests that parents overestimate their typical child's understanding of autism and its implications (Glasberg, 2000). Although coping strategies and knowledge of autism do not correlate with sibling adjustment, involvement in the autistic child's life may enhance positive feelings of typical children toward their sibling with autism. For example, after teaching their brother or sister with autism appropriate play skills, typically developing siblings were likely to rate consequent playtime experiences as more enjoyable (Celiberti & Harris, 1993).

Children with autism appear to find interactions with their siblings reinforcing, and are more likely to respond to them than to other children. A study of 30 sibling pairs found that while children with autism engaged in fewer interactions than matched subjects with Down syndrome, they reliably reciprocated initiations made by typical siblings (Knott, Lewis, & Williams, 1995). The authors of a 1999 study observed children with autism playing with their parents and typical siblings (El-Ghoroury & Romanczyk, 1999). Although parents made significantly more attempts to interact with the children with autism, the children initiated more interactions with siblings than with their parents. Children with autism also tend to generalize peer-trained social skills to their typically developing siblings (Belchic & Harris, 1994; Taylor, Levin, & Jasper, 1999).

Researchers have capitalized on the benefits of sibling interactions to teach children with autism a variety of social skills, including play, engagement, social

initiation, social response, and joint attention (Baker, 2000; Celiberti & Harris, 1993; Colletti & Harris, 1977; Jones & Schwartz, 2004; Reagon, Higbee, & Endicott, 2006; Sullivan, 1999; Tsao & Odom, 2006). These studies evidence not only the ability of children with autism to learn from their siblings, but the ability of the typical siblings to reliably implement social skills intervention techniques. A variety of teaching strategies was employed by the sibling teachers; a brief review is appropriate to clarify the benefits of available approaches.

Training Approaches

It has been theorized that a lack of socially motivated behavior is implicated in joint attention deficits (L. Koegel & R. Koegel, 1995; Mundy, 1995). This is problematic when one considers that widely used evidenced-based treatments for children with autism may not directly address this issue. Since the late 1980s it has been standard practice to implement early intensive behavioral intervention (EIBI) for children with autism to facilitate recovery of lost skills and to teach new appropriate skills (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993). One commonly utilized approach of traditional EIBI methodology is discrete trial training (DTT), a technique in which a child is taught a skill that has been broken down into individual components, through a series of mass trials in a direct (1:1) instructional format. DTT techniques teach a repertoire of functional skills including language, communication, imitation, play, and academics. However, it has been suggested that the nature of this approach is to teach skills that are predetermined by an adult, and consequently the method does not address the motivational component of the child's learning (Koegel & Koegel, 1995; Seibert & Oller, 1981).

Pivotal response training (PRT) has been implemented as a more naturalistic approach than DTT to teach a variety of behaviors, including joint attention. PRT is hypothesized to be successful because it targets skills through enhancing motivation. While DTT primarily alters antecedents and applies consequences (e.g., prompting, error correction), PRT manipulates the establishing operations (Michael, 1993) that surround specific behaviors. The goal of PRT is to foster an environment (i.e., alter establishing operations) in which the reinforcing value of certain stimuli is augmented (Pierce & Schreibman, 1995). Therefore, PRT incorporates measures that may be appealing to the child, such as considerable choice over interaction type and materials, accessibility to a variety of tasks, and reinforcement of response approximations and attempts. PRT can be used to teach the same skills as DTT, but its focus on cultivating child motivation makes its application more ecologically valid, especially for young children. In addition, the promotion of child impetus helps build skills that are more generalizable across people and settings, and more robust across time.

Pivotal response training has elicited positive outcomes in children with autism regarding imitation (Ingersoll & Schreibman), play skills (Stahmer, 1995), and joint attention (Pierce & Schreibman, 1995; Whalen & Schreibman, 2003). A recent study of four preschool-aged children with autism used PRT in addition to discrete trial components to teach social skills (Whalen & Schreibman, 2003). Children were taught to both initiate and respond to joint attention bids and were then rated on comprehensive joint attention behaviors, empathic response, and play. Most participants received improved social initiation scores, and two children showed improvements in social response. Although significant gains in play behavior were not observed, all participants

demonstrated increased spontaneous speech immediately following treatment. At follow-up speech frequencies dropped, providing further evidence that these interventions should be ongoing.

Typical siblings have effectively implemented PRT to increase appropriate play skills and social behavior in children with autism (Sullivan, 1999). These changes were shown to maintain over several two-month follow-ups and gains were comprised of increased interaction frequency and social quality. However, the measures used to evaluate outcome varied and did not differentiate each component of joint attention (e.g., dyadic, triadic, bids, responses, etc.).

The Current Study

Considering the above findings in a general context, it becomes clear that an integration of techniques is in order. There are data indicating that children with autism learn joint attention skills from PRT implemented by typically developing siblings, but replications are needed. Regarding the specificity of joint attention components, it is yet unclear which elements (e.g., initiating versus responding, dyadic versus triadic) are best targeted by pivotal response training and for which components generalization is most likely to occur. A further deconstruction of joint attention raises questions about the interactions of these varied components. For example, will a child with autism be more likely to engage in dyadic joint attention during shared enjoyment or during a request? Does shared enjoyment foster more responses than initiations? The current study aims to examine what effect sibling-directed pivotal response training has on these individual units of joint attention.

Method

Participants

Three sibling dyads were recruited from the Outreach Division of the Douglass Developmental Disabilities Center, a Rutgers University-based program for the treatment of people of all ages with Autism Spectrum Disorder (ASD). Classroom teachers and consultants identified potential candidates, and letters were distributed to those parents whose children qualified for the study. Each dyad consisted of one child with autism (target child) and his/her typical sibling (sibling teacher). According to inclusion criteria, all target children required a diagnosis of and ASD, as determined by an outside professional, based upon DSM-IV criteria; siblings with an ASD diagnosis or other significant developmental disability were excluded from the study.

At entry into the study, Trevor had a diagnosis of Autistic Disorder, a chronological age of 4 years, 3 months, and a mental age of 1 year, 9 months. His brother Luke was 8 years, 4 months, and had no psychological diagnosis. Julia was a 3-year, 7-month-old girl with a diagnosis of Autistic Disorder and a mental age of 2 years, 5 months. Her brother Todd was 6 years old and had no diagnosis. Brian was a 3-year, 5-months-old boy with a diagnosis of Autistic Disorder and a mental age of 2 years. His brother Jack had no diagnoses and was 8-years, 2 months old. Mental ages were obtained

by the Mullen Scales of Early Learning, a standardized, developmental measure that assesses motor, perceptual, and language skills (Mullen, 1997). The Mullen has been standardized on typically developing children, ages 2 days to 69 months, and demonstrates high reliability and validity. That the Mullen shares a good proportion of variance with other widely used developmental measures, such as the Bayley Scales of Infant Development (Bayley, 2006b) and the Preschool Language Scale (Zimmerman, Steiner, & Pond, 2002), provides sufficient evidence in favor of its use. Written parental consent was given for both siblings to participate, in addition to verbal assent from the typical siblings. No parent or child was be pressured to give consent or continue with the study once it commenced.

Experimenter and Undergraduate Observer

The present author, a third-year graduate student in a Clinical Psychology program with seven years of intensive experience with children with autism, ran all sibling training sessions and videotaped the sibling-led teaching sessions. She also conducted all pre- and post-treatment assessments. A bachelor's-level researcher working at the DDDC was responsible for scoring the videotapes. The experimenter trained her to 80% IOA on all measures before having her score independently. These training tapes were not part of the data pool.

Procedure

Typical siblings received individual training sessions in how to implement an intervention to teach joint-attention skills to their sibling with autism. The intervention targeted two skills: 1) responding to joint attention, which included six training sets and 2) initiating joint attention, which included two training sets. Joint attention, dyadic

orienting skills, challenging behavior, and imitation of the target children were assessed pre- and post-treatment.

Setting

. All assessments, training, and follow-up sessions were conducted in the participants' home, in various rooms. The experimenter and both siblings were present for all sessions, and parents were invited to attend. Although the rooms were cleared for a working space, no special measures were taken to completely remove other toys from the area. This was intended to most accurately represent the distractions that occur during playtime in the natural environment.

Pre- and Post- Treatment Measures

Target children were assessed pre- and post-treatment on measures of social interaction and maladaptive behavior.

Joint Attention

The *Early Social Communication Scale* (ESCS, Mundy, Hogan, & Doehring, 1996) is a structured measure of non-verbal communication and shared attention, comprising items of responding to joint attention (RJA), initiation joint attention (IJA), and response to request (e.g., "give me"). Although the ESCS is not a standardized measure, it is reported to have strong reliability and validity (Mundy et al., 1988).

Dyadic Orienting

To measure dyadic orienting skills, the following four items from the Social Orienting Scale were also administered: name call, leg pat, snap, and hum. These human-made sounds were chosen over the other items, which involve the use of implements (i.e., telephone ring, car horn, whistle, timer). Two additional dyadic presses were delivered.

The "tickle game" (i.e., "I'm gonna get you") were administered using the procedure from the *Autism Diagnostic Observation Schedule* (ADOS) manual (ADOS: Lord, Rutter, DiLavore, & Risi, 1999) the experimenter also tapped the target child on the shoulder to see if s/he oriented to a physical stimulus.

Maladaptive Behavior

Data were collected on maladaptive behavior using a modification of the Ritvo-Freeman Real Life Rating Scale (Freeman, Ritvo, Yokota, & Ritvo, 1986). For the purposes of the present study, coders collected frequency data on the five overall categories of behavior, rather than on the individual 47 items. The categories followed those outlined in the Ritvo-Freeman and included: 1) Sensory-motor behaviors; 2) Social relationships to people; 3) Affectual reactions; 4) Sensory responses; and 5) Language. Reverse-scored items (e.g., uses objects appropriately, communicative use of language) were not included in the data collection; the remaining 40 items served as operational definitions for each category of maladaptive behavior (See appendix A). Because of varying lengths of pre- and post-probe tapings, these data were converted to rate.

Unstructured Assessment Probes

Dyads were videotaped pre- and post-treatment playing together with toys for 15-minute samples. During this time, siblings were asked to administer joint attention probes, including putting the target child's hand on a toy, tapping a toy, showing a toy, administering a distal point, and administering a gaze shift. Data were collected on target responses to joint attention presses, target initiations of joint attention (e.g., pointing, alternating gaze shift), initiations of behavioral requests (e.g., giving), imitation, and maladaptive behavior. The definitions for responding to and initiating joint attention are

listed in the intervention description. Imitation was defined as any motor or vocal response following a sibling or parent's action with point-to-point correspondence, within 2 seconds and without an explicit direction (e.g., "do this"). Siblings were given instructions to "play like you usually do" with their brother or sister, and the experimenter prompted them to administer the joint attention presses throughout the sessions. Parents were given the option to be present during these probes; parents who watched the initial probes were asked to also be present during the post-treatment sessions.

Sibling training

Prior to each new set, and on each new day, the experimenter described/reviewed the procedures of the intervention. The sibling then participated in a brief interactive instruction with the experimenter, including modeling and role-play, with experimenter feedback. Verbal, gestural, and physical prompts were delivered throughout the teaching sessions for the sibling teachers to deliver all components of the intervention. When necessary, additional review was provided after the end of teaching sessions, with modeling and role-play. Other strategies to promote positive play interactions (i.e., getting the target's attention, identifying preferences, using reinforcing toys) were discussed during the sibling training sessions; if necessary the experimenter provided the sibling with reminders of these skills during teaching sessions.

Sibling-mediated intervention

Design

A single-subject, multiple probe design across participants was utilized. The multiple probe design has the advantage of minimizing the number of baseline sessions

required for experimental control. Repeated toy sessions prior to the intervention were of particular concern for the sibling teachers, who may have become bored with the repetition or frustrated with the quality of the play sessions. This was especially pertinent for the siblings in the third and fourth dyads, who participated in up to 10 weeks of baseline. Baseline for each dyad ranged between 2 and 12 weeks, depending upon the order of randomization. Treatment was introduced to each dyad based upon the mastery of sets 1 and 2 of the previous dyad. Three pre-treatment probes were administered before each training set intervention, as is required for experimenter control (Cooper, Heron, & Heward, 2007). These ongoing probes were also intended to assess possible increases in joint attention skills as a result of exposure to prior baseline play sessions or of previously trained skill sets.

Treatment

Procedure

Sibling dyads engaged in between two and three 15-minute training sessions per day, 1-2 times per week. Sessions run in the same day were separated by a 15-min break, during which the children were encouraged to play with their own toys or leave the room.

Intervention

The joint attention intervention was a systematic replication of the procedures described by Whalen and Schreibman (2003) and encompassed components of both PRT (i.e., using child-chosen objects as reinforcers, providing opportunities for turn-taking, teaching in a naturalistic environment) and DTT (i.e., prompting, error correction procedures, task interspersal, repeated trials). For the purposes of the current intervention, joint attention was divided into two discrete skills: responding to joint attention (RJA)

and initiating joint attention (IJA). The RJA component included six training sets, and the IJA component included two training sets, which were taught consecutively.

Mastery criteria were modified from the Whalen and Schreibman study, in which 80% across 4 of 5 consecutive sessions was delineated. Due to the young age of the typical siblings in this study, there was some concern that the more stringent mastery criteria would prolong the intervention past a threshold of tolerance and efficacy for 6- to 8-year-olds. Therefore the current research defined mastery as 80% of independent opportunities across 2 consecutive sessions. If a target child did not master the skill within seven sessions, the set was discontinued and the dyad proceeded to the next skill set. Seven sessions was chosen based on observations of the first dyad, as the point at which the typical sibling began to express frustration with the task. After failing one set, dyads were allowed to move onto a subsequent set to provide information on the relative importance of each joint attention component.

Once a training set was complete, it was integrated into the next set as a maintenance task, to provide behavioral momentum for both siblings. The dependent variable for sibling-mediated training was the target child's percent response to joint attention opportunities.

Responding to joint attention

1. **Set 1 – Response to hand on object.** The dyad engaged in toy play with preferred items. The sibling trainer waited until the target child engaged with one item, and then placed the target's hand on another toy. A correct response was defined as one of the following: 1) gaze shift to the new toy for at least 5 seconds, 2) manipulation of the toy for at least 5 seconds (including non-functional play),

3) initiating a gesture to the new toy (e.g., pointing, reaching), or 4) orienting to the toy and appropriately indicating that it was not wanted (e.g., saying "no thank you"). If the target child did not respond, the sibling repeated the process and a physical prompt (holding the target's hand on the newly presented toy for 5 seconds) was provided. Prompts were ideally provided by the sibling; if the sibling could not provide consistent prompts, the experimenter, or a parent administered the prompt from behind the target. Verbal and physical praise were provided by the sibling for all correct independent and prompted responses. This prompting procedure was followed for all the remaining sets.

2. **Set 2 – Response to tapping an object.** Set 1 procedures were replicated except that when presenting a new toy to the target child, the sibling trainer tapped the toy at least three times. A correct response and prompting procedures were identical to those described above.
3. **Set 3 – Response to showing an object.** The previous procedure was replicated except that when presenting a new toy to the target child, the sibling trainer showed the toy. A show was defined as holding the toy within the target's line of vision for at least 3 seconds, without accompanying verbalizations. A correct response and prompting procedures were identical to that described above.
4. **Set 4 – Eye contact.** Eye contact was shaped by having the sibling trainer offer a preferred item and requiring the target child to make eye contact for at least 3 seconds before granting access to the reinforcer. Following an incorrect response, a physical prompt by the sibling trainer to the target child's head (e.g., gentle finger to the chin, hand to the side of the head) was used to direct his/her gaze.

5. **Set 5 – Following a point.** While the target child engaged with an object, the sibling trainer established eye contact with the target child. Upon eye contact, the sibling trainer turned his head and point to a preferred item across the room, without accompanying verbalizations. A correct response was defined as a full-head orient (not just gaze shift) in the same direction as the sibling trainer. Correct responding was reinforced with the preferred item; incorrect responding resulted in denied access to toys for 10 seconds. To prompt this response, a gentle physical prompt was applied by the sibling trainer to direct the target child's head in the correct direction.
6. **Set 6 – Following a gaze.** The same procedure was used as in Set 5, except that instead of pointing to the object the sibling trainer shifted his gaze toward the item. The same criteria were used for correct responding and prompting procedures.

Initiating joint attention

1. **Set 1 – Coordinated gaze shifting.** Opportunities for coordinated gaze shifting were counted whenever the target child was engaging with a toy. To be counted as a correct response a gaze shift was required to occur within 20 seconds of the target manipulating a new object, and during each subsequent 20-second interval. After a missed opportunity the experimenter prompted a coordinated gaze shift by 1) physically prompting the target child's hands on the toy, 2) moving the child's head in the direction of the sibling teacher and making eye contact, and 3) administering the verbal prompt "show". Prompt fading was used for each correct response following a prompt, such that the following hierarchy was followed: 1)

physical + verbal prompt; 2) gestural + verbal prompt; 3) verbal prompt; and 4) no prompt. The target child was required to meet the mastery criterion (30% of opportunities) with non-prompted responses. Sibling teachers provided social reinforcement for correct responding.

2. **Set 2 – Protodeclarative pointing.** Opportunities to point were counted any time the target child was engaging with a new toy. Correct responding was defined as an independent distal or proximal point within 20 seconds of engaging with a new toy and in each subsequent 20-second interval. Correct responses were reinforced by the sibling acknowledging the object (e.g., "Wow! What a cool picture!"). If the target child did not point within the interval, an incorrect response was scored. Following one incorrect response the experimenter followed the same training steps outlined in Set 1. In this set, the prompts included 1) physically manipulating the target child's hand to point, and 2) administering the verbal prompt "point". Spontaneous pointing to preferred items for the purpose of requesting were not scored. A mastery criterion was established at 15% of opportunities.

Treatment Fidelity

Treatment fidelity ratings were obtained for 20% of each sibling's treatment sessions. Sibling trainers were evaluated on four dimensions: 1) providing a clear discriminative stimulus, 2) providing differential praise for successful trials, 3) providing the toy for correct responses, and 4) providing the target with a chance to independently respond (i.e., no premature prompts). Components were considered to be correctly implemented if they were administered independently. If a sibling administered a

component following a prompt from the examiner, that component was scored as incorrect.

Social Validity

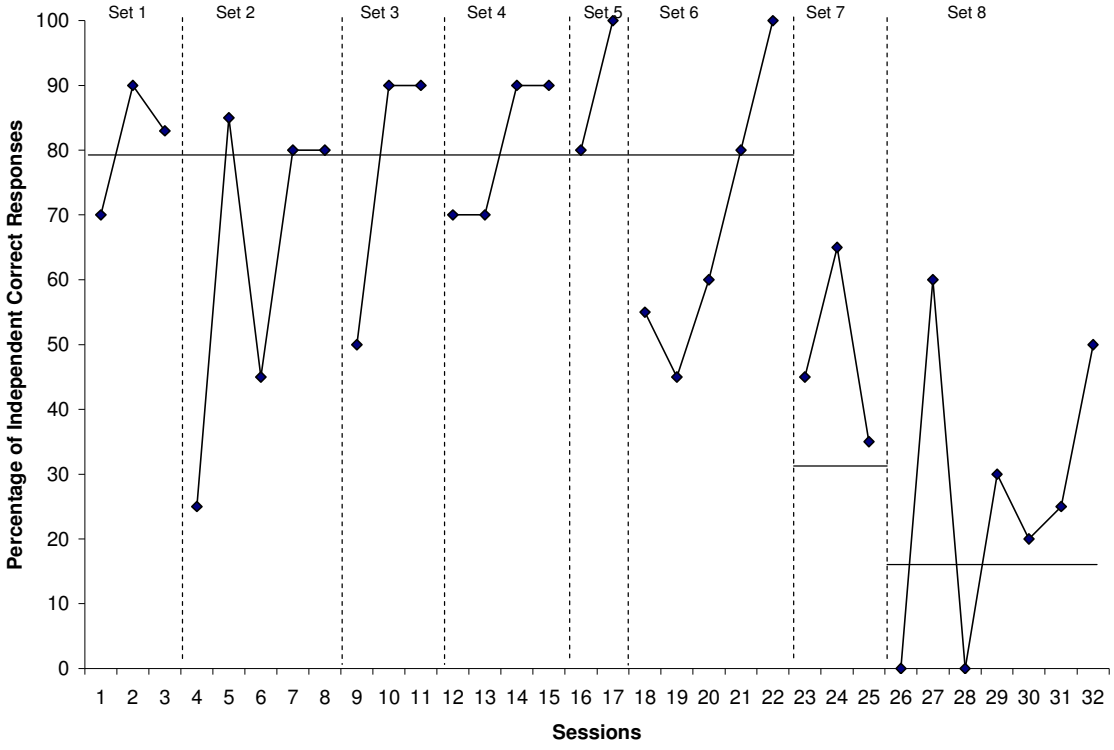
A brief sibling interview was conducted pre- and post-treatment and included questions about the quality and quantity of time spent playing with the target child. Upon completion of the training program, siblings also answered questions on their perceptions of the treatment package and whether they found it helpful for themselves and their brother or sister. Parents completed an additional questionnaire regarding the acceptability, appropriateness, and perceived effectiveness of the treatment package.

Results

Joint attention training program

All three dyads completed the joint attention training program. Julia mastered all eight skills within the seven-session criterion.

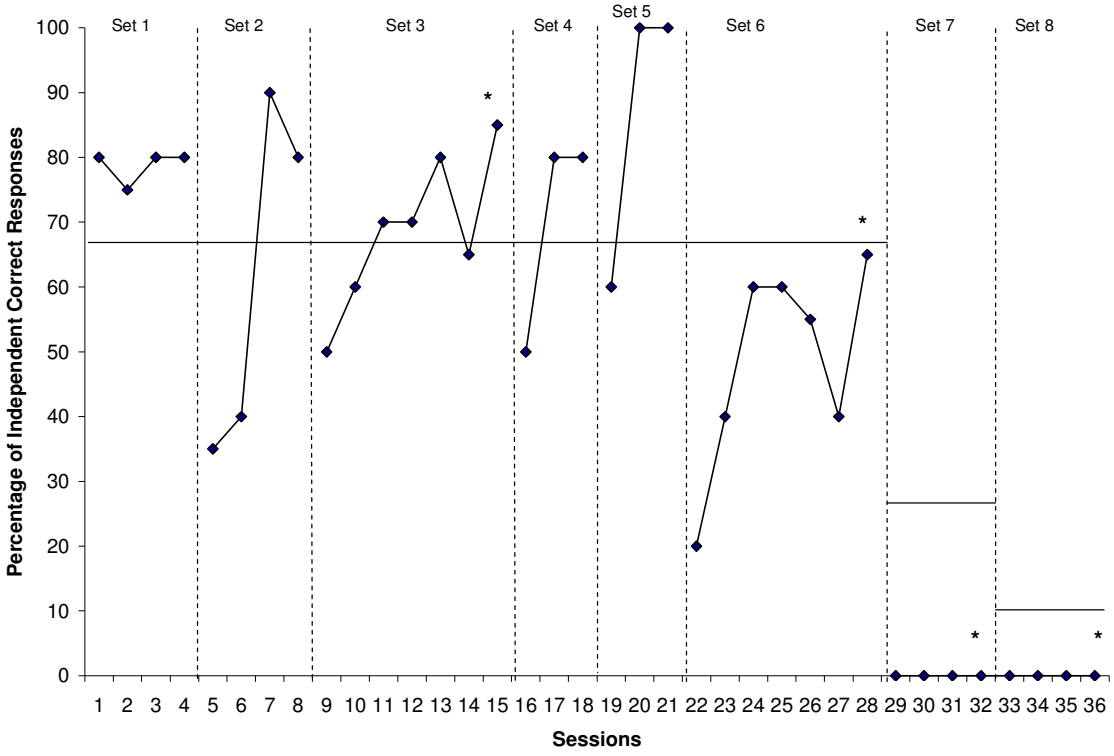
Figure 1. Percentage of opportunities with correct response for Julia during training.



Trevor mastered four skills within seven sessions, and according to progression criteria moved past sets 3, 6, 7, and 8 without achieving mastery. On two of these skills

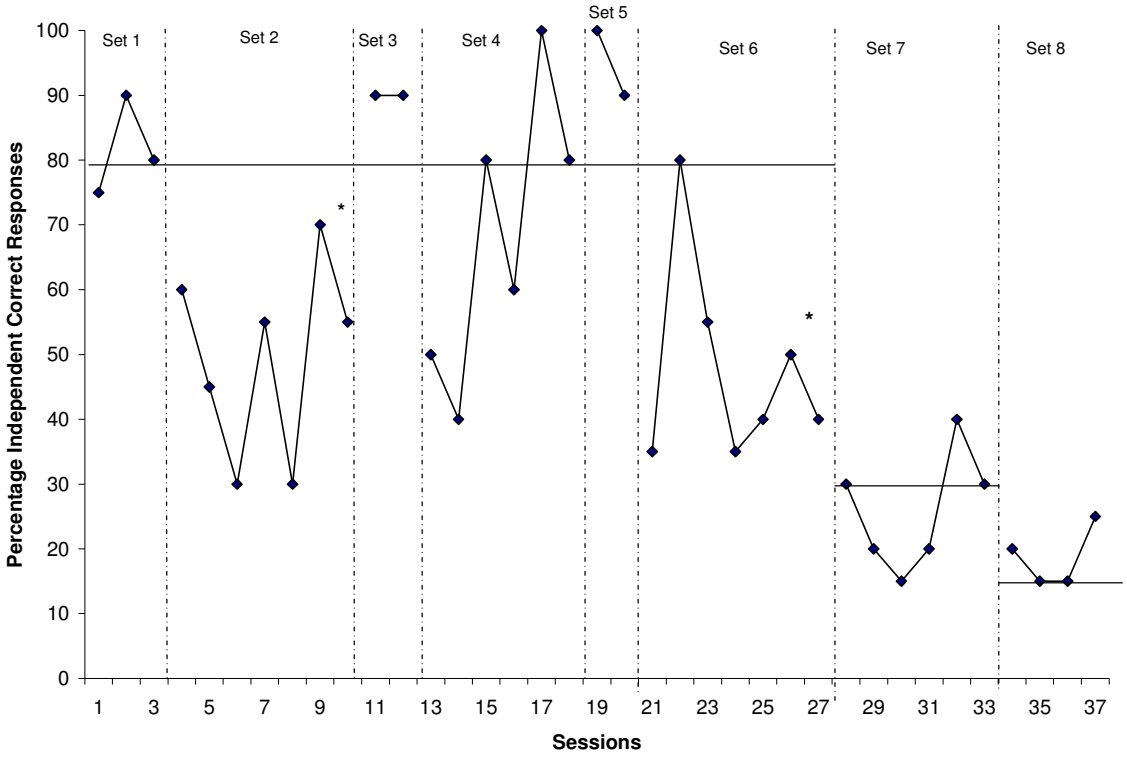
(3 – show a toy, 6 – respond to gaze) Trevor's data showed a consistent increasing trend; however he did not respond to sets 7 and 8 (initiating gaze shift and pointing).

Figure 2. Percentage of opportunities with correct response for Trevor during training.



Brian mastered six skills within the set criterion, and was advanced from sets 2 (tap a toy) and 6 (respond to gaze) after seven sessions below mastery. For both these sets Brian's data were showing an increasing trend by the seventh session.

Figure 3. Percentage of opportunities with correct response for Brian during training.

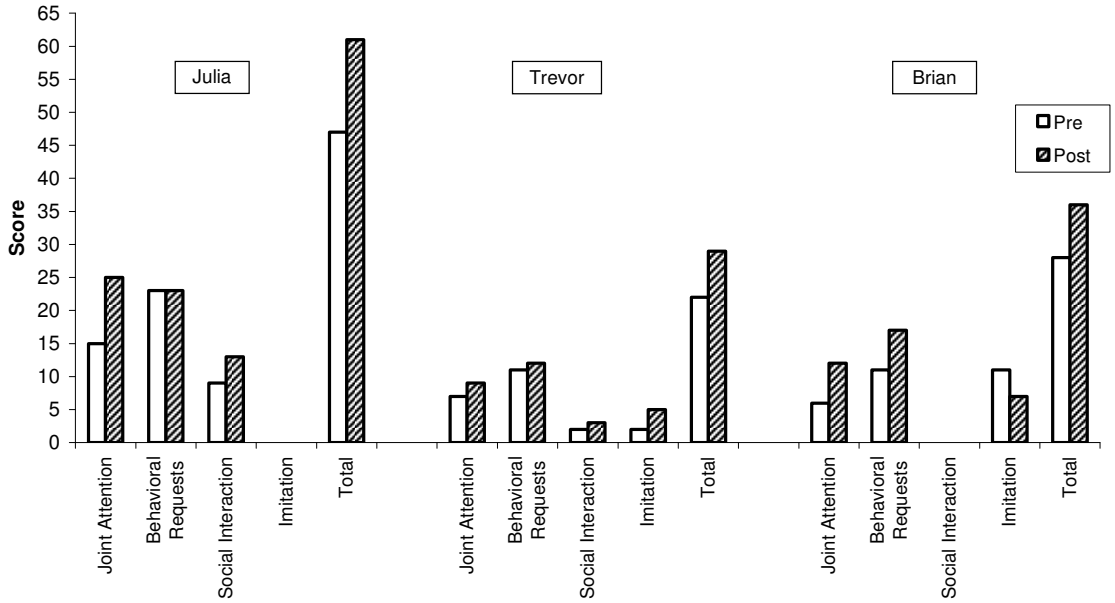


* Indicates sets on which mastery criteria were not achieved

Joint attention

All three targets demonstrated improvement on their ESCS scores post-treatment. Differential effects on aspects of joint attention were observed across participants. Julia exhibited a substantial increase in joint attention initiations, but no change in responding to behavioral requests or imitation. For Trevor, increases in imitation were observed, but he did not demonstrate any change in initiating or responding to behavioral requests. Brian demonstrated an increase in behavioral requests and responding to joint attention, but no gains were observed in initiation joint attention. A paired t-test was used to statistically evaluate changes in ESCS scores from pre- to post-treatment. Changes in total ESCS scores were statistically significant ($t = -4.42$; $p<.05$).

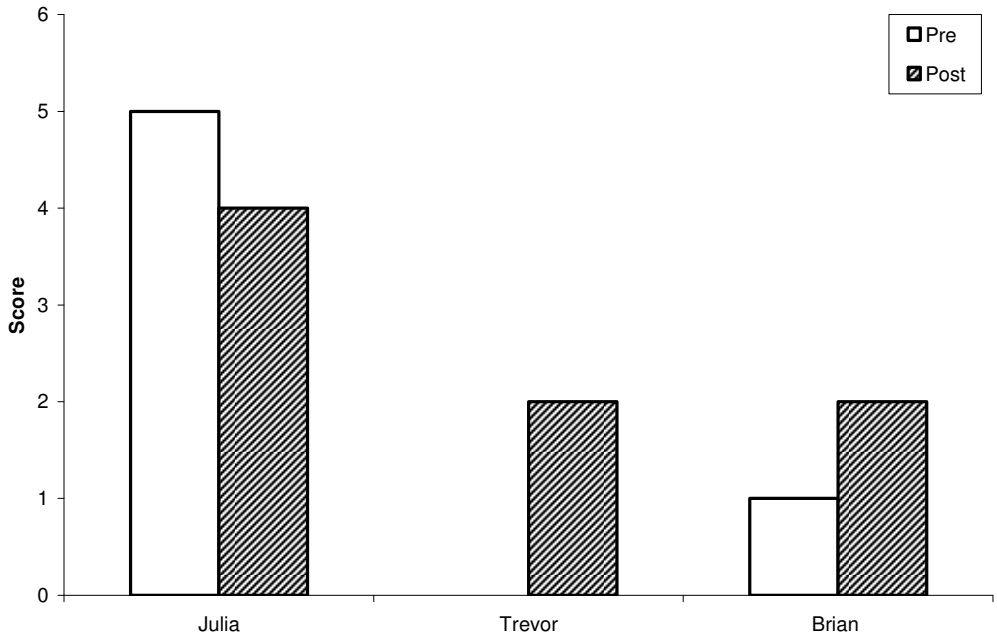
Figure 4. Target scores on the Early Social Communication Scales, pre- and post-treatment.



Dyadic Orienting

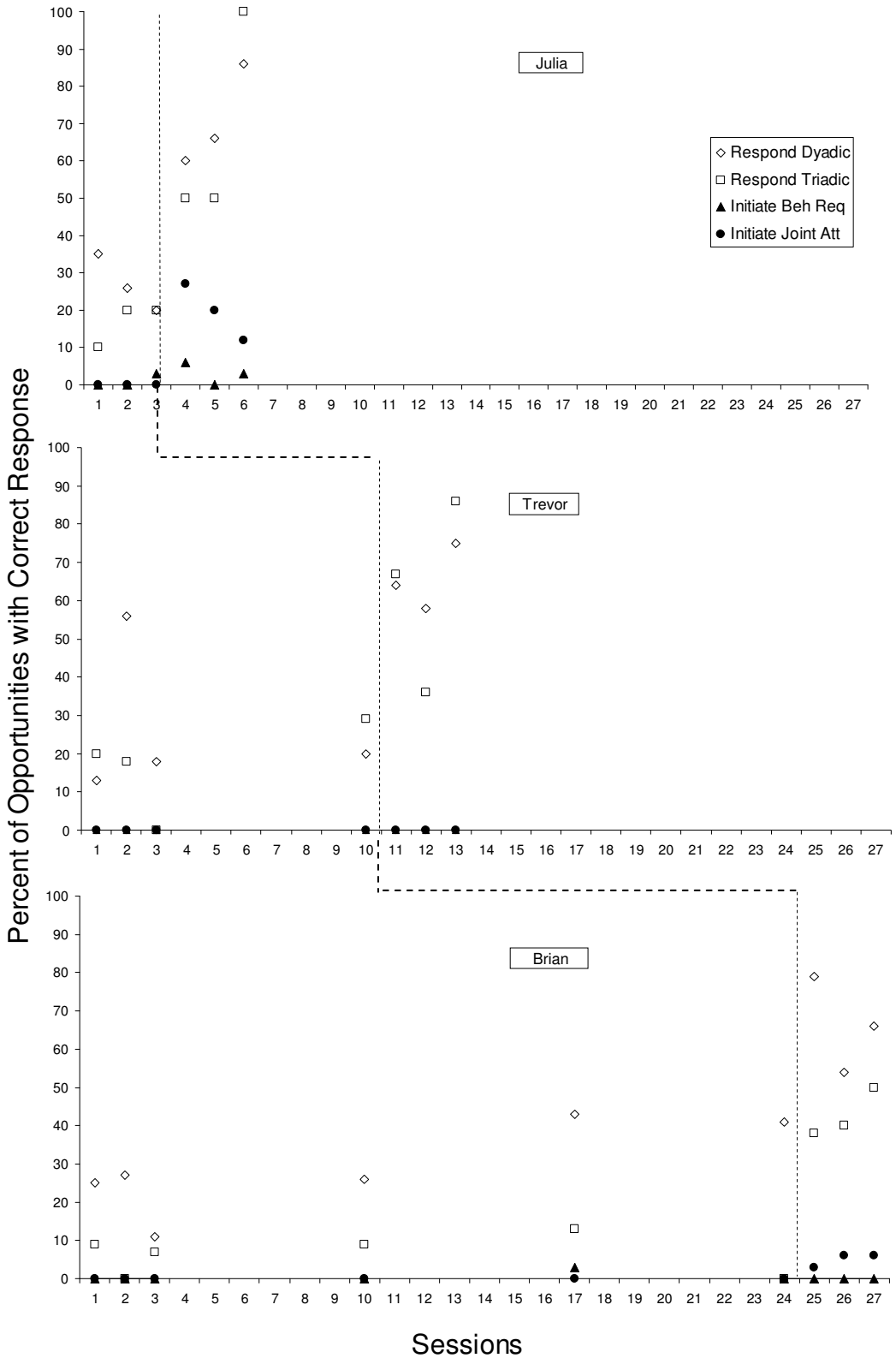
None of the targets demonstrated meaningful improvement on the Social Orienting Scale. One of the participants (Julia) oriented to one fewer stimuli (patting legs) during the post-treatment assessment. Trevor oriented to two presses post-treatment (name and tickle game), as compared to none before treatment. Brian responded to one additional press post-treatment (tickle game).

Figure 5. Target scores on the Social Orienting Scale, pre- and post- treatment.



Unstructured Assessments

Figure 6. Percentage of opportunities with independent responding (open data paths) and initiating (closed data path) for all three targets during joint attention probes, in baseline and post-treatment.


Julia
Trevor
Brian
Respond Dyadic
Respond Triadic
Initiate Beh Req
Initiate Joint Att
Percent of Opportunities with Correct Response
Sessions

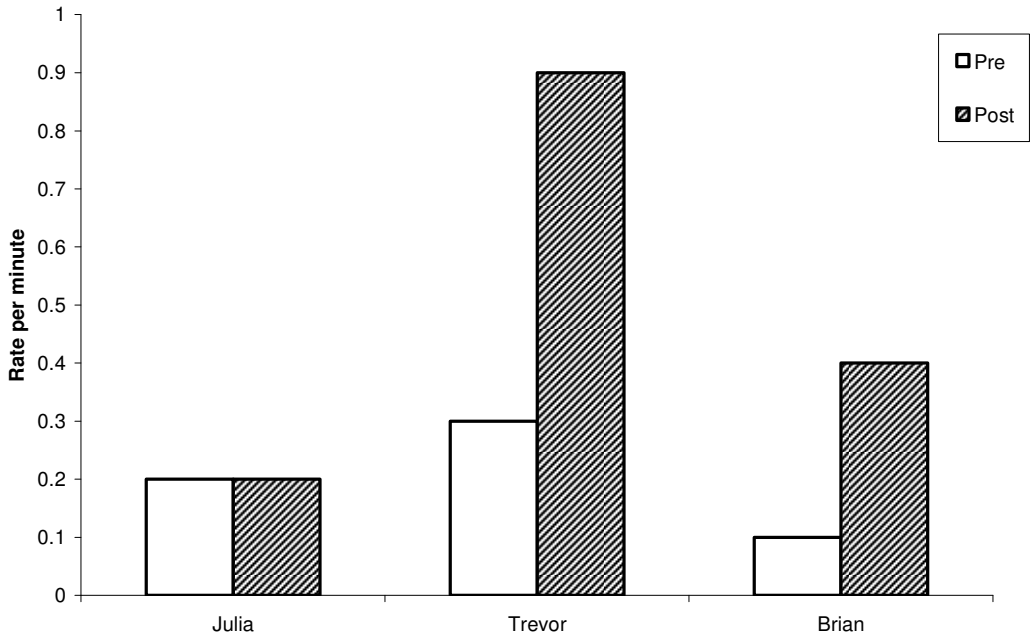
All three targets demonstrated an improvement in responsiveness to dyadic and triadic joint attention presses administered by a sibling. Averaged across all probes, Julia's responding (presented as percent of opportunities) improved from 21.8% (pre-treatment) to 69% (post-treatment). Trevor's responding improved from 21.8% (pre) to 64.3% (post). Brian's responding increased from 17.6% (pre) to 54.5% (post). Only two of the participants demonstrated an increase in spontaneous initiation of joint attention; Julia's initiations went from 0.5% (pre) to 11.3% (post), and Brian's moved from 0% (pre) to 5% (post). Table 1 contains these treatment data broken down by dyadic and triadic joint attention.

	Julia		**Trevor**		**Brian**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
Respond to Dyadic Joint Attention	27.0	70.7*	26.8	65.7*	28.8	66.3*
Respond to Triadic Joint Attention	16.7	66.7*	16.8	63.0*	6.3	42.6*
Initiate Behavioral Requests	1	3*	0	0	0.5	0
Initiate Joint Attention	0	19.7*	0	0	0	5*

* Indicates at least 10% change

Imitation

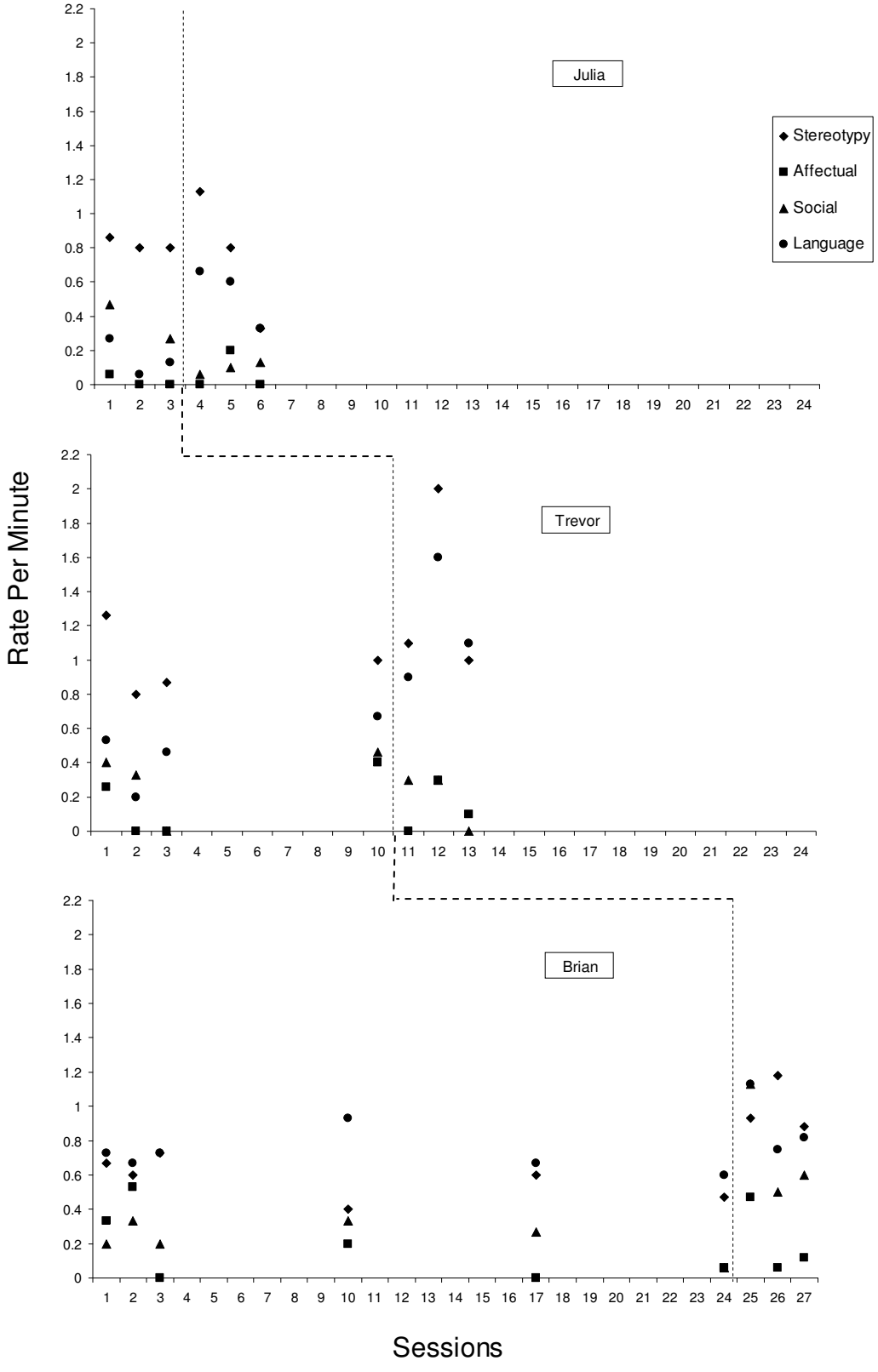
Figure 7. Rates of spontaneous target imitation for all three targets during joint attention probes, in baseline and post-treatment.



Two of the three targets (Trevor and Brian) demonstrated an increase in the rate of imitation during the unstructured joint attention probes, as averages across all pre- and post-treatment probes. Trevor's average rate per minute increased from 0.3 responses to 0.9 responses; Brian's average rate per minute increased from 0 responses to 0.4 responses.

Maladaptive Behavior

Figure 8. Rates of maladaptive behavior for all three targets during joint attention probes, in baseline and post-treatment.


Julia
Trevor
Brian
Stereotypy
Affectual
Social
Language
Rate Per Minute
Sessions

No differences in rates of maladaptive behavior were observed between pre- and post-treatment probes. The average rate per minute of maladaptive behavior for Julia was 0.56 (pre) and 0.36 (post); for Trevor the rates were 0.48 (pre) and 0.73 (post); for Brian the rates were 0.43 (pre) and 0.71 (post). There was also no observed change in the topography of maladaptive behavior exhibited by the targets (e.g., targets who engaged in high rates of stereotypy pre-treatment maintained high stereotypy rates post-treatment).

Interobserver Agreement

Measure	Percentage of sessions scored	Average IOA	Range
ESCS	37	$\alpha = 0.91$	0.83 – 0.97
Maladaptive behavior	30	80.1%	70 - 90
Joint attention probes	30	91.4%	65 – 100
Training sessions	20	93.8%	80 – 100

Interobserver agreement (IOA) was collected for 33% of pre- and post-treatment assessments and 15% of teaching sessions; sessions were divided equally among participants. The formula for exact agreement was used, and it was calculated by dividing agreements by agreements plus disagreements and multiplying the result by 100. IOA was calculated only for independent opportunities (i.e., prompted responses were not included in the formula). For training sessions, IOA averaged 93.9% for all sessions and ranged from 80% to 100%. For joint attention probes, IOA averaged 91.4% and ranged from 65% to 100%. IOA for maladaptive behavior was calculated using the formula for total agreement and averaged 80.1% (range 70% - 90%). Reliability scores on the ESCS were calculated using an alpha statistic. Adequate reliability was obtained on the ESCS (alpha = .91, range = .83 - .97).

Treatment Fidelity

Sibling	Overall fidelity	Range	Fidelity of reinforcement	Range
Todd	91.5%	79 – 100	76%	37 – 100
Luke	80.0%	63 – 100	55%	0 – 100
Jack	84.0%	82 – 87	35%	0 – 63

Treatment fidelity ratings were obtained for 20% of each sibling's treatment sessions. All siblings attained acceptable treatment fidelity for the overall intervention (Todd, 91.5%; Luke, 80%; Jack, 84%). High integrity (above 80%) was observed for every component of the intervention except for providing differential praise (Todd, 76%; Luke, 55%; Jack, 35%).

Social validity

The sibling teachers showed no changes on their pre/post questionnaires (see Table 4).

	Todd		**Luke**		**Jack**	
	Pre	Post	Pre	Post	Pre	Post
Ease	4	4	2	2	2	2.5
Frustration	2	2	3	2	1	1
Fun	4	4	4	3	4	4
Boring	2	2	2	2	1	1
Quantity	3	3	2.5	1	3	3

On most items, siblings assigned the most positive ratings pre-treatment and maintained those ratings post-treatment. Sibling responses to the post-treatment interview indicated that they found the treatment package acceptable and that they learned about interacting with their siblings. On Question #1 (What did you think about being a teacher to your brother/sister?) all three siblings reported that it was "fun". Todd and Jack indicated that they would continue being a teacher to their brother/sister, and Luke said "maybe" he would. A sample of other responses is included below.

Q: What did you think about being a teacher to your brother/sister?

Todd: I thought it was pretty fun. Sometimes when [Julia] wasn't listening it was frustrating. I kept trying.

Q: What was easy about being a teacher?

Jack: Learning about Brian, so I know how to do things.

Luke: Playing with [Trevor].

Q: What did you learn by being a teacher?

Luke: That Trevor is really smart.

Todd: How to play the right way with Julia by learning all the stuff you told me.

Jack: Learning what [Brian] likes and what he knows to do.

Parents indicated high levels of satisfaction with the treatment package (see Table 5) as it related to their children with autism (4.5 – very satisfied), to their typically developing child (4.2 – satisfied), and with the treatment as a while (4.2 – satisfied).

		Julia	**Trevor**	**Brian**	**Mean**
Treatment package as a whole					
	Question 1	4.5	5	5	4.8
	Question 2	5	5	5	5
	Question 3	2.5	1	1	1.5
	Question 4	2.5	3	2	2.5
	Question 5	4	5	5	4.7
	Question 6	4	3	4	3.7
	Question 7	5	4	5	4.7
	Question 8	3.5	3	4	3.5
Treatment components					
	Question 1	4.5	4	5	4.5
	Question 2	4.5	4	4	4.2
	Question 3	4.5	4	4	4.2

Additional benefits endorsed				
	Question 1	Yes	Yes	No
	Question 2	No	No	No
	Question 3	Yes	Yes	Yes
	Question 4	Yes	No	Yes
	Question 5	Yes	Yes	Yes
	Question 6	No	Yes	No

They also reported observing improvements on various dimensions of their children's interactions, including cooperative play, shared enjoyment, the amount of time spent together, and more positive interactions. All parents provided additional comments about the treatment, a sample of which is provided below.

Brian's mother: I have seen an increase in confidence in my teacher/child. He is now more apt to initiate interaction with his little brother.

Trevor's mother: I really feel that this has been a very positive experience for both Trevor and Luke.

Discussion

A sibling-mediated behavioral intervention was provided to three children with autism by their typically developing siblings. The performance of the targets post-treatment reflects individual variation in response. Julia demonstrated an increase in both initiating and responding to joint attention; Trevor and Brian demonstrated increases in responding to joint attention, but not initiations. Although all children showed significant deficits in joint attention upon entry to treatment, some were more marked than others; these pre-treatment characteristics seemed to moderate each individual's response to the treatment.

Julia

Pre-treatment, Julia demonstrated some emerging initiating skills on the structured assessment (ESCS), but not in the natural environment (unstructured joint attention probes). During the intervention phase, Julia mastered all sets within the seven-session limit. On post-treatment assessments she demonstrated an increase in both initiating and responding to joint attention, gains which were observed on the ESCS and during the joint attention probes. For Julia, the intervention appears to have contributed to the development of her emerging dyadic and triadic joint attention as well as the generalization of those skills to other settings. Interestingly, Julia did not exhibit any increases in her imitation rates, a finding which will be addressed in the general discussion.

Trevor

Trevor entered the study with fewer joint attention skills than the other two participants. With the exception of one responding data point, he engaged in relatively

low levels of joint attention during both the structured and unstructured assessments. Trevor achieved mastery on four of the eight sets. Post-treatment Trevor showed increases in responding to dyadic and triadic joint attention; no meaningful change in initiating joint attention or behavioral requests was observed. For Trevor, the intervention contributed to the continued development of responding to joint attention and to generalization. Of the three participants, Trevor demonstrated the greatest increase in post-intervention imitation rates.

Brian

At entry to treatment Brian was exhibiting some emerging skills in joint attention and behavioral requesting; these skills were observed during the ESCS and during the unstructured assessments. Brian achieved mastery on six of the eight treatment sets. Post-treatment he displayed increases in responding to joint attention and minimally in initiating. Gains in imitation skills were also observed following treatment. For Brian, the intervention appeared to contribute to the development of responding skills and the emergence of initiating skills.

General Discussion

The results of this study suggest that a short-term behavioral intervention for teaching joint attention skills evoked meaningful change in the responding skills of children with autism. It is unclear whether their success on this dimension of the dependent variable was related to pretreatment characteristics because the targets' responding percentages were similar in baseline. Although we are unable to identify the effects of pre-treatment responding on post-treatment responding, it seems clear that pre-treatment initiation did not moderate the responding outcome (despite individual

differences in pre-treatment initiations, all targets made similar gains in responding). However, the presence of social initiations pre-treatment may have moderated the later acquisition of initiating skills in a naturalistic setting. For example, both Julia and Brian demonstrated some minimal joint attention and behavioral initiations on the ESCS, whereas Trevor exhibited only behavioral requests, and at a much lower rate. Following treatment only Julia and Brian showed increases in social initiations on the structured measure, and these skills generalized to the naturalistic play setting. These findings provide some preliminary evidence for the specificity of joint attention domains. In this sample initiations predicted initiations but not responding. Responding did not predict initiations and may have predicted responding, although this cannot be determined without individual differences in initial responding rates. The total ESCS scores pre- and post-treatment indicate gains across participants, but only an examination of the individual joint attention components yields these more detailed findings. Future researchers may therefore find it beneficial to systematically measure and address these component skills rather than evaluate joint attention as a single construct.

Differences in post-treatment outcomes may also be due to each target's performance during the intervention phase. Trevor did not improve on initiations, but he also did not respond to either of the initiating sets, whereas the participants who increased on initiations (Julia and Brian) mastered both initiation sets. This pattern of results lends support to the validity of the intervention's initiation phase; teaching responding skills to mastery is not sufficient for exacting improvements in responding. That initiations must be uniquely targeted strengthens the case for the specificity of individual joint attention skills and is consistent with previous literature (Hwang & Hughes, 2000). Considering

Trevor did not enter the intervention with emerging initiations skills, a more extended treatment may have been necessary to teach joint attention as a new behavior, rather than a developing skill (i.e., Julia and Brian).

In the post-treatment phase, similar outcomes were observed in the naturalistic setting (probes) and on the semi-structured assessment (ESCS) for joint attention and imitation. As mentioned above, the differential improvement on joint attention components observed on the ESCS were consistent with those observed during the probes. The one exception was Brian, who imitated more in a naturalistic setting than during the ESCS. It appears, therefore, that generalization outcomes are also sensitive to the moderating effects of pre-treatment characteristics. In this study, treatment provided in a naturalistic setting generalized to a structured situation, with a different interventionist (examiner), a phenomenon that may be attributed to the naturalistic nature of the intervention (Kohler, Leslie, Steighner, & Hoyson, 2001), the use of the sibling teachers (Sullivan, 1999) or both.

No consistent gains in behavioral requests were observed during the joint attention probes, and only Brian demonstrated an increase in requesting during the ESCS. This is not surprising considering the intervention sets targeted protodeclarative and not protoimperative behavior. It is interesting that all three participants exhibited some requesting during the ESCS post-treatment, and none in the naturalistic setting. Most likely, it is easier to evoke this behavior in a contrived setting (i.e., at a work table) in which a history of reinforcement has already been established. Targets were also provided with toys during the probes, and the presence of any preferred object may have acted as an abolishing operation for any additional requesting. No gains in social

orienting were observed; again, this outcome measures may not be specifically linked to joint attention or to treatment as no exposure to noises or auditory orienting training were provided in this intervention.

Gains in imitation were observed for two of the participants, a finding which is consistent with previous literature on the collateral effects of joint attention on other sills (Whalen, Schreibman, & Ingersoll, 2006). Interestingly, the participants who demonstrated these improvements (Trevor and Brian) also made the fewest gains in initiating joint attention; this suggests that imitation may serve as a compensatory mechanism for the lack of other, more complex social skills. For Julia, who engaged in initiations post-treatment, imitation was no longer necessary to the social interaction.

The mastery criteria and rule for advancement through the sets provided a component analysis, of sorts, for this intervention. Although participants were automatically progressed past failed sets, they were still able to make gains further along in the program. This was true within and across joint attention domains (i.e., responding and initiating). For example, Trevor did not meet criteria for showing a toy, but was able to master eye contact (two responding sets). Brian failed to meet criteria for following a gaze (responding) but mastered the gaze shift and pointing sets (initiating). Individual differences render it impossible to determine exactly which sets were necessary for the development of joint attention in this small sample; however, it is apparent that mastery of all steps was not necessary for a positive outcome. Future research may examine which sets are pivotal to the intervention as a whole, although this study suggests that it may be highly individualized.

Maladaptive behavior was tracked as an ancillary dependent variable; no differences in rates of behavior were observed pre- and post-treatment. This is hardly surprising, considering the disconnect between the intervention goals and this particular outcome variable. Furthermore, the majority of the behavior coded in this study was stereotypic, and therefore more likely to be maintained by automatic reinforcement. Because such behavior is less likely to be affected by social reinforcement contingencies (e.g., attention, provision of tangible items) one would expect its rates to remain similar throughout an intervention targeting social skills (Piazza, Adelinis, Hanely, Goh, & Delia, 2000).

The typically developing siblings in this study were effective teachers to children with autism. They were able to implement the intervention with high fidelity for most components, although it was difficult for them to remember all components without prompts (e.g., providing differential praise). Low fidelity on the social reinforcement component did not appear to affect the treatment as a whole, possibly because an adult provided praise when the sibling did not. Sibling teachers were generally able to understand and apply concepts of obtaining and maintaining attention, providing tangible reinforcement, and persisting. Anecdotally, on several occasions parents reported seeing their typical children using these strategies spontaneously with their brothers and sisters during play (referring to the general behavioral strategies, not specific intervention components. All the siblings found the treatment acceptable by indicating during interviews that teaching was fun and that they would continue using the skills after the conclusion of the study.

A significant limitation to the current study is the failure to control for the increase in direct interactions between siblings. Increased proximity and attention of the sibling teachers without a specific intervention may potentially have led to similar gains in joint attention. Such results would indicate a non-specific effect of intense, semi-structured interactions with siblings, and therefore gains would not necessarily be attributable to the intervention procedures. This concern must be systematically addressed because it is unlikely that siblings would naturally have one-on-one interactions with the same frequency and intensity as was dictated by the study procedures. For example, future research designs could include high-attention play sessions during baseline across dyads to account for this potential confound.

A related concern is that the effects of treatment may be attributable to a newly established reinforcement history with the sibling teachers. Unlike therapists and parents, siblings are not always paired with social and tangible reinforcement for children with autism (as evidenced by siblings' difficulty providing consistent praise). Persistence was also highly emphasized throughout the study with all three sibling teachers, suggesting that they did not usually persevere in previous interactions with their brother or sister. The intervention procedures provided natural pairing sessions of the sibling with preferred toys and praise; this change may have been sufficient for increases in target attention to and responding to their siblings. The data on behavioral requesting suggests that this is unlikely. If the establishment of sibling reinforcement potential was central to behavior change, one would expect an increase in behavioral requests by the targets, directed to their siblings. As discussed above, no increases in requesting were observed.

However, a new or strengthened reinforcement history with siblings cannot be ruled out as a potential mechanism of change.

The positive outcomes obtained by the current dyads are sufficient to warrant additional research in the area of siblings as mediators of behavioral treatment. As an extension of the current study, the author will re-evaluate the targets on all outcome measures at a 3-month follow-up point to assess maintenance of these gains in the absence of treatment. Previous studies have found poor maintenance of joint attention gains; evidence in favor of maintenance would contribute greatly to the unique benefits of siblings as teachers. Another potential extension is to look at lasting generalization effects across people (e.g., parents, other siblings, peers) and settings (e.g., school).

Future studies should provide a more thorough analysis of the specific effects of siblings as compared to parents or teachers. Designs comparing the rate of acquisition, generalization, and maintenance of skills when treatment is delivered by various individuals would provide useful information on the effectiveness of training siblings as teachers. If siblings are effective as or more effective than adults as teachers, it will become important to weigh the potential risks and benefits of participating to both the target and the sibling. Parents may also be a useful resource in sibling training procedures, especially as they already have an established relationship with the child on the spectrum and potential sibling teachers. Future research targeting joint attention training for parents would address issues of dissemination (from the parent to sibling teachers) and generalization (from parents to siblings and vice versa).

Using children to mediate treatment raises some ethical concerns, particularly when siblings express frustration with the procedures. The examiner found it easy to

redirect the sibling teacher in the current study, but this may not be the case for all children. With growing evidence in favor of siblings as interventionists, research on the effects of sibling characteristics (e.g., age, gender, maturity) on outcome will become important when identifying the best candidates.

TABLE 1:

AVERAGE PERCENTAGES OF JOINT ATTENTION DURING UN-STRUCTURED OBSERVATIONS, PRE- AND POST-TREATMENT

	Julia		**Trevor**		**Brian**	
	Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**
Respond to Dyadic Joint Attention	27.0	70.7*	26.8	65.7*	28.8	66.3*
Respond to Triadic Joint Attention	16.7	66.7*	16.8	63.0*	6.3	42.6*
Initiate Behavioral Requests	1	3*	0	0	0.5	0
Initiate Joint Attention	0	19.7*	0	0	0	5*

* Indicates at least 10% change

TABLE 2:

INTEROBSERVER AGREEMENT FOR TRAINING AND PRE/POST

ASSESSMENTS

Measure	Percentage of sessions scored	Average IOA	Range
ESCS	37	$\alpha = 0.91$	0.83 – 0.97
Maladaptive behavior	30	80.1%	70 - 90
Joint attention probes	30	91.4%	65 – 100
Training sessions	20	93.8%	80 – 100

TABLE 3:

SIBLING TREATMENT FIDELITY

Sibling	Overall fidelity	Range	Fidelity of reinforcement	Range
Todd	91.5%	79 – 100	76%	37 – 100
Luke	80.0%	63 – 100	55%	0 – 100
Jack	84.0%	82 – 87	35%	0 – 63

TABLE 4:

SIBLING SOCIAL VALIDITY RATINGS

	Todd		**Luke**		**Jack**	
	Pre	Post	Pre	Post	Pre	Post
Ease	4	4	2	2	2	2.5
Frustration	2	2	3	2	1	1
Fun	4	4	4	3	4	4
Boring	2	2	2	2	1	1
Quantity	3	3	2.5	1	3	3

TABLE 5:

PARENT SOCIAL VALIDITY RATINGS

		Julia	Trevor	Brian	Mean
Treatment package as a whole					
	Question 1	4.5	5	5	4.8
	Question 2	5	5	5	5
	Question 3	2.5	1	1	1.5
	Question 4	2.5	3	2	2.5
	Question 5	4	5	5	4.7
	Question 6	4	3	4	3.7
	Question 7	5	4	5	4.7
	Question 8	3.5	3	4	3.5
Treatment components					
	Question 1	4.5	4	5	4.5
	Question 2	4.5	4	4	4.2
	Question 3	4.5	4	4	4.2
Additional benefits endorsed					
	Question 1	Yes	Yes	No	
	Question 2	No	No	No	
	Question 3	Yes	Yes	Yes	
	Question 4	Yes	No	Yes	
	Question 5	Yes	Yes	Yes	
	Question 6	No	Yes	No	

Figure 1. Percentage of opportunities with correct response for Julia during training.

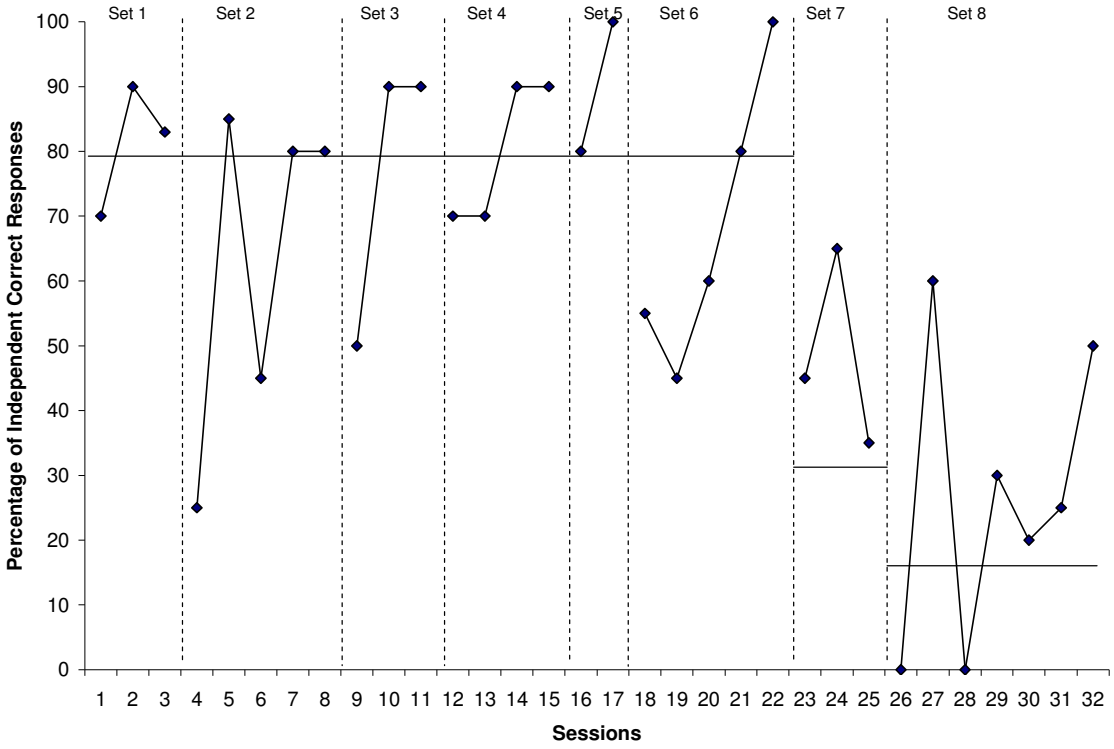
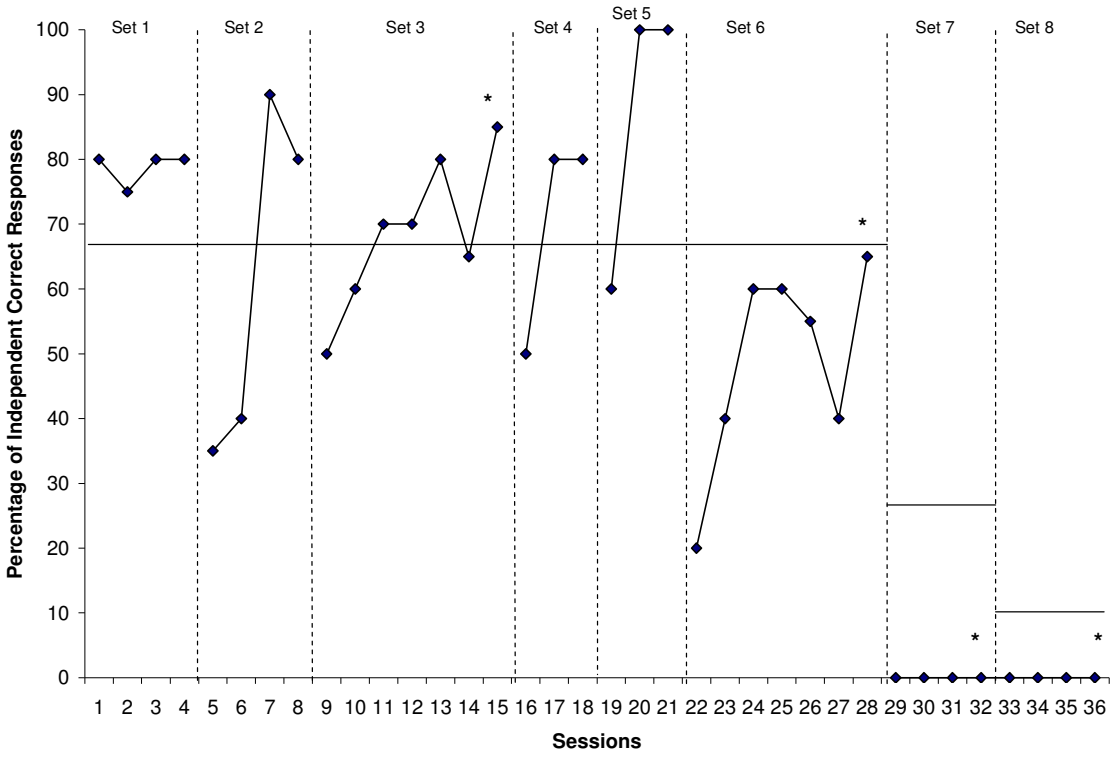
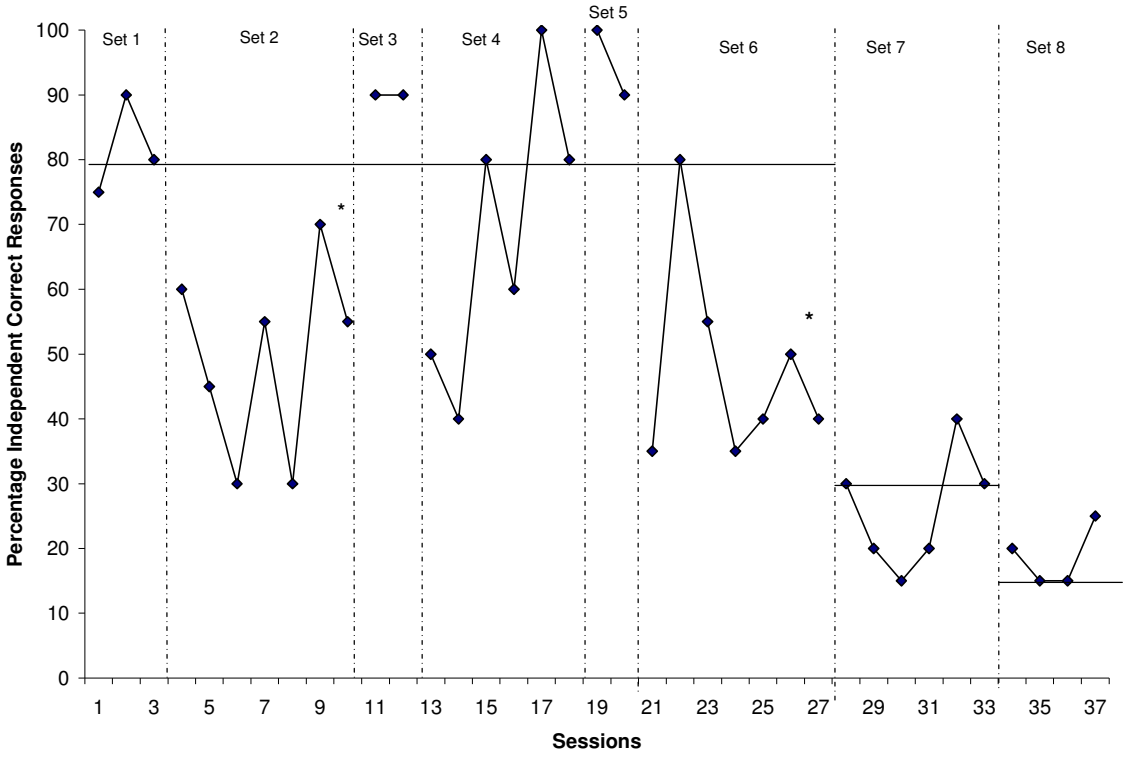


Figure 2. Percentage of opportunities with correct response for Trevor during training.



* Indicates sets on which mastery criteria were not achieved

Figure 3. Percentage of opportunities with correct response for Brian during training.



* Indicates sets on which mastery criteria were not achieved

Figure 4. Target scores on the Early Social Communication Scales, pre- and post-treatment.

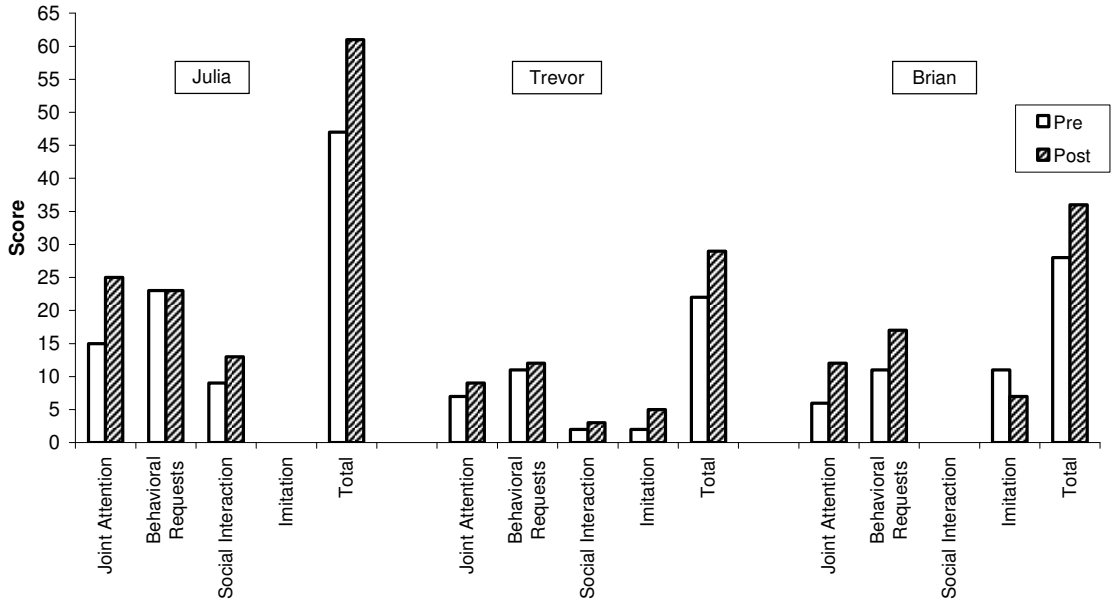


Figure 5. Target scores on the Social Orienting Scale, pre- and post- treatment.

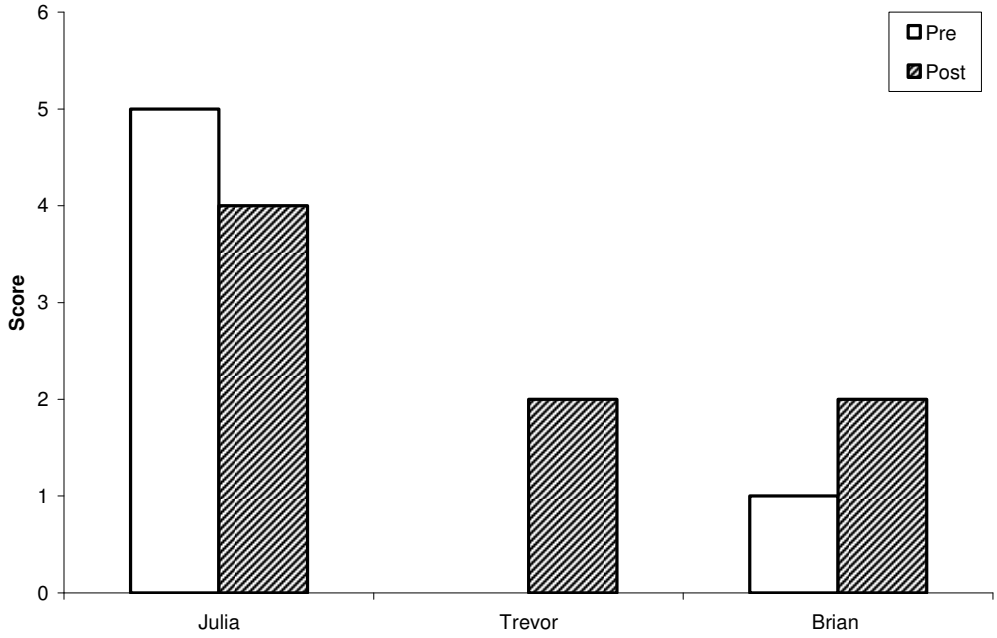


Figure 6. Percentage of opportunities with independent responding (open data paths) and initiating (closed data path) for all three targets during joint attention probes, in baseline and post-treatment.

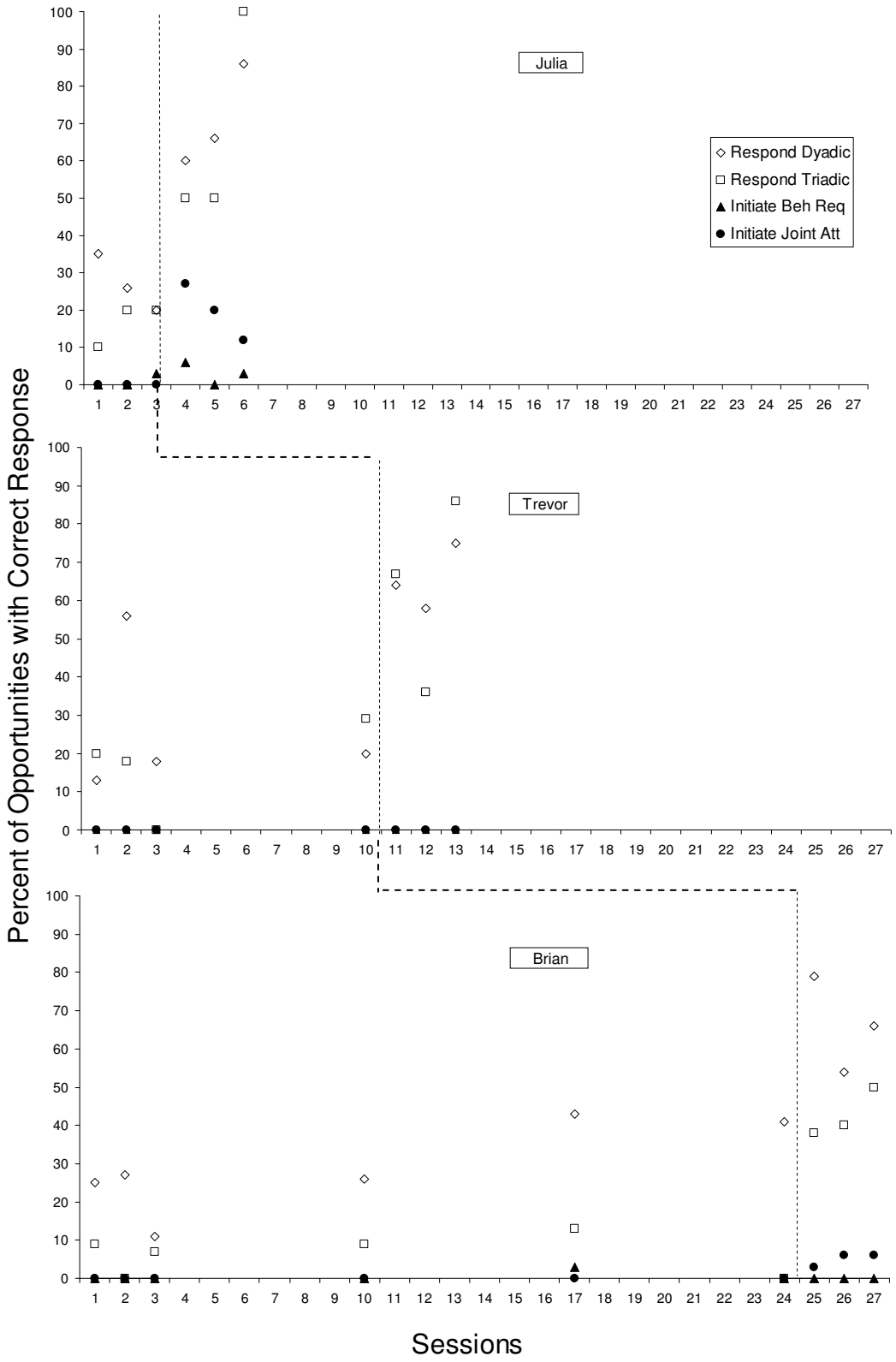


Figure 7. Rates of spontaneous target imitation for all three targets during joint attention probes, in baseline and post-treatment.

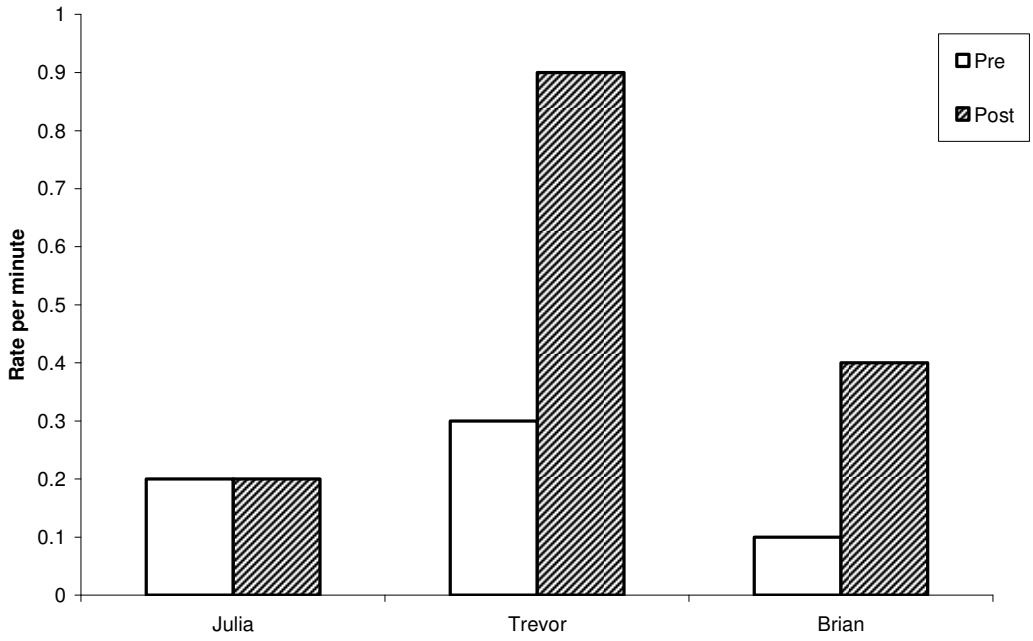
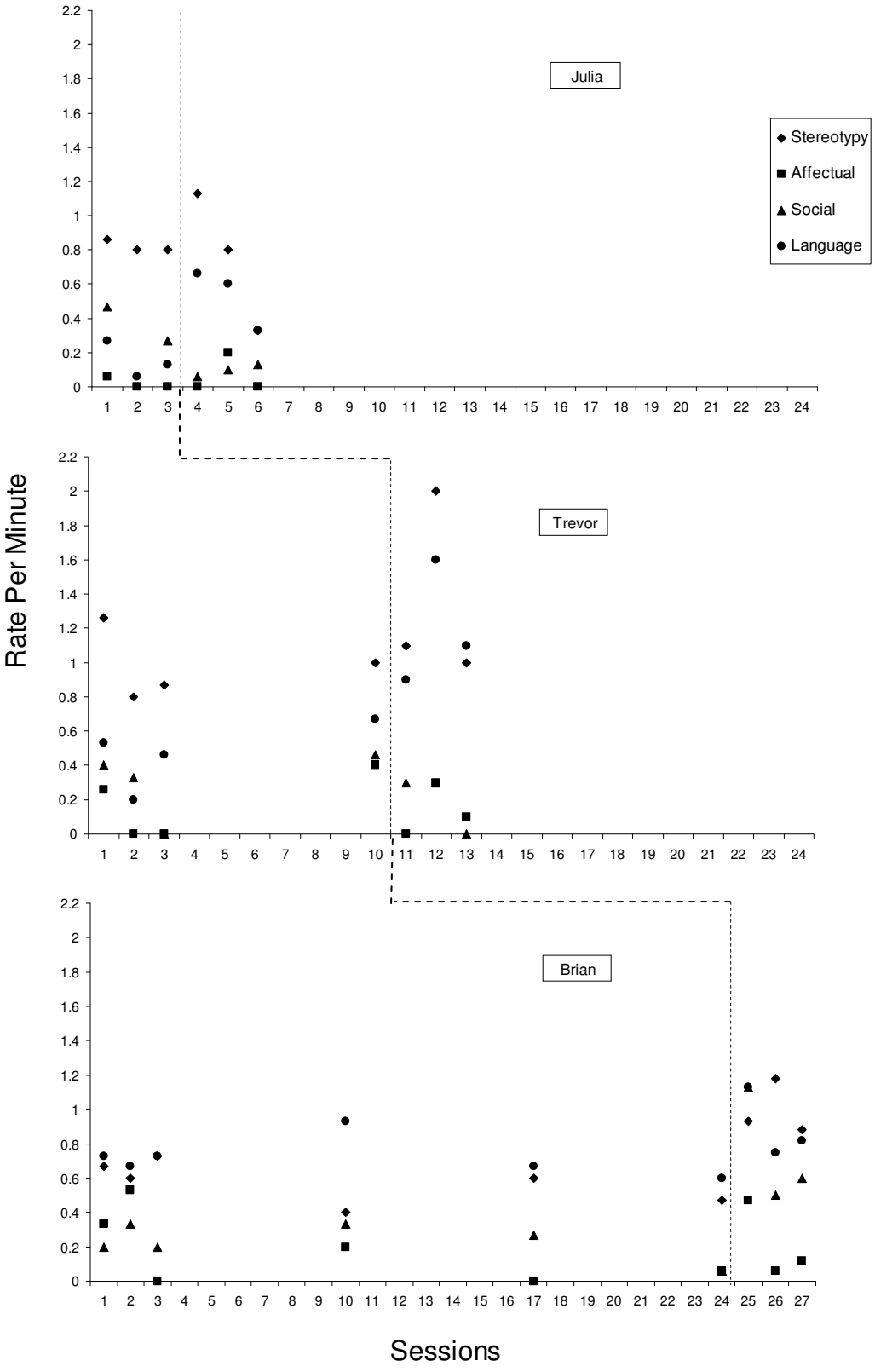


Figure 8. Rates of maladaptive behavior for all three targets during joint attention probes, in baseline and post-treatment.



APPENDIX A

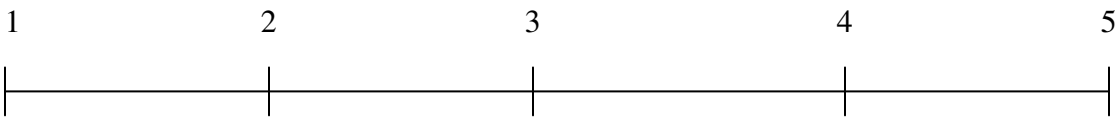
Codes for scoring maladaptive behavior

1. Sensory motor behaviors: any instance of whirling, flapping of hands or fingers, facing, banging or hitting self, rocking, or toe walking.
2. Social relationships to people: any instance of ignoring or withdrawing from an interaction attempt, disturbing others, changing activities abruptly, genital manipulation, isolating self, or responding to hugs/being held by rigidity.
3. Affectual reactions: any instance of abrupt affectual change, grimacing, temper tantrums without provocation, or crying.
4. Sensory responses: any instance of agitation by noises, whirling or spinning objects, rubbing surfaces, agitation by a new activity, watching hand/object motion, repetitive/stereotypic play, sniffing of self/objects/others, lining up objects, visual scrutiny, destruction to objects, repetitive vocalizations, staring, covering of eyes/ears, or flicking.
5. Language: any instance of noncommunicative use of delayed echolalia, immediate echolalia, noncommunicative vocalizations, or no/brief response to communication attempts.

APPENDIX B

Parent Questionnaire

Please rate the following items regarding the treatment package for your typical child (teacher) and your child with autism (learner) using the scale provided below.



1	2	3	4	5
Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree

1. The treatment steps were explained at an appropriate level for my child (teacher).

1 2 3 4 5

2. My child (teacher) received adequate reinforcement throughout the study.

1 2 3 4 5

3. My child (teacher) was frustrated with the treatment package.

1 2 3 4 5

4. My child (learner) was frustrated with the treatment package.

1 2 3 4 5

5. My child (teacher) gained skills as a result of the treatment package.

1 2 3 4 5

6. My child (learner) gained skills as a result of the treatment package.

1 2 3 4 5

7. The skills targeted during treatment were important to me.

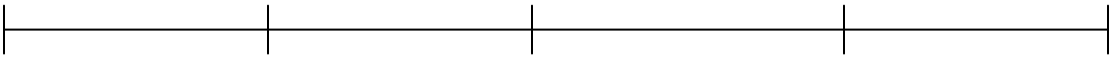
1 2 3 4 5

8. I have seen a change in my children's play together following this treatment.

1 2 3 4 5

How satisfied are you with the following components of the treatment package?

1 2 3 4 5



Not at all Satisfied | Neither satisfied nor dissatisfied | Somewhat satisfied | Satisfied | Very satisfied

1. The treatment as it related to my child without autism

1 2 3 4 5

2. The treatment as it related to my child with autism.

1 2 3 4 5

3. The treatment as a whole.

1 2 3 4 5

Have you noticed any of the following changes in your children' following treatment? (Check all that apply.)

More cooperative play _____

More parallel play _____

More shared enjoyment _____

Increased time spent together _____

More positive interactions _____

Other changes (please describe)

Do you have any other comments about the treatment?

APPENDIX C

Sibling Questionnaire

1. Is it easy or hard to play with your brother/sister?

Very hard Kind of hard Kind of easy Very easy

☹ ☺

2. Do you ever get frustrated while playing with your brother/sister?

A lot A little Never

☹ ☺

3. How much fun do you have playing with your brother/sister?

No fun A little fun Some fun A lot of fun

☹ ☺

4. Do you ever get bored while playing with your brother/sister?

A lot A little Never

☹ ☺

5. **How much do you play with your brother/sister?** 

A lot A little Never

APPENDIX D

Sibling Interview Questions

1. What did you think about being a teacher to your brother/sister?

2. What was easy about being a teacher?

3. What was hard about being a teacher?

4. Do you think you will still be a teacher to your brother/sister when you play?

5. What did you learn by being a teacher?

APPENDIX E

Social Orienting Tasks

1. Responds to name call
2. Responds to examiner patting legs
3. Responds to examiner snapping fingers
4. Responds to examiner humming
5. Responds to tap on the shoulder
6. Responds to social game (e.g., “I’m gonna get you!”)

APPENDIX F

Early Social Communication Scales

Initiating joint attention

Eye contact with examiner

Alternate between toy and examiner

Point

Point & Eye Contact

Show

Responding to joint attention

Follows point

Line of regard – follow gaze?

Trial 1	Left	Back left	Right	Back right
Trial 2	Left	Back left	Right	Back right

Point in imitation

Initiating behavioral requests

Eye contact with examiner

Reach

Appeal

Point

Point & Eye Contact

Give

Give & Eye Contact

Responding to behavioral requests

Without gesture pass/fail

With gesture pass/fail

Initiating social interaction

Initiates turn taking

- Car
- Ball

Low-level tease

High-level tease

Responding to social interaction

Turn-taking

- Car
- Ball

Response to invitation

- Comb
- Hat
- Glasses

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