Using Perseverative Interests to Elicit Joint Attention Behaviors in Young Children With Autism:

Theoretical and Clinical Implications for Understanding Motivation

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Abstract: Various explanations have been offered in the literature on the underlying cause of joint attention deficits in autism. One possible explanation is that children with autism are capable of producing joint attention but lack the social motivation to share their interests with others. The current study used a single-subject reversal design with alternating treatments to examine whether joint attention initiations for social sharing would occur as a collateral effect of utilizing the motivational techniques of Pivotal Response Treatment (PRT) in conjunction with perseverative interest stimuli for three young nonverbal children with autism. Results indicated an immediate increase in joint attention initiations when perseverative, or highly preferred, interests were incorporated within the motivational techniques of PRT. Additional findings included collateral increases in joint attention initiations toward less preferred interests, as well as improvements in the quality of interaction between the children and caregivers. Findings are discussed in terms of theoretical and clinical implications for understanding the role of motivation in the development of joint attention in autism.

Joint attention refers to the capacity of young children to coordinate attention among self, other, and an object or event to share an interest or an experience (Adamson & McArthur, 1995; Bakeman & Adamson, 1984; Wetherby & Prutting, 1984). This protodeclarative behavior typically unfolds between 6 and 18 months of age (Bakeman & Adamson, 1984) and is regarded as an important developmental milestone in terms of promoting language and social development (Wetherby, Prizant, & Schuler, 2000). Children learn most of their first words during joint attention interactions with objects and adults (Tomasello, 1995). This process of learning object labels is facilitated particularly when adults follow their child's already established attentional focus (Akhtar, Dunham, & Dunham, 1991; Tomasello & Farrar, 1986). However, children quickly learn to discriminate between labels for objects that are tied to an adult's focus of attention rather than to their own (Baldwin, 1991, 1993). The ability to follow another person's focus of attention, as well as direct that person's focus of attention, allows children to establish a common topic with the communicative partner and thus to make sense of language. In addition to facilitating language development, joint attention interactions also help children understand how to act in a social world, interpret the perspectives of others, and participate in the back-and-forth nature of social exchanges (Schertz & Odom, 2004). The purpose of the current study was to determine whether joint attention initiations may occur as a collateral effect of motivational variables delivered within a naturalistic behavioral intervention program for children with autism.

Children who are typically developing first learn to engage in joint attention by following the line of visual regard of a social partner. However, by the end of the first year of life, they are capable of initiating episodes of joint attention with eye contact and gestures (e.g., pointing) to share the experience of an interesting object or event with another person (Dunham & Moore, 1995). This later emergence of initiated joint attention is thought to reflect the child's growing understanding of the surrounding world and his or her increasing motivation to interact with adults about interesting objects or events (Bruner & Sherwood, 1983; Mundy, 1995; Tomasello, 1995). Furthermore,

the initiation of joint attention allows typically developing children to share their affective experiences with their caregivers. Consequently, the ability to initiate joint attention has early developmental implications for the child's ability to establish states of shared emotional meaning (i.e., intersubjectivity) with caregivers and for his or her ability to develop social relationships with others (Trevarthen & Aitken, 2001).

In contrast, young children with autism initiate fewer joint attention behaviors (e.g., looking, pointing) than comparison groups and do not respond consistently to adults' bids for joint attention (Curcio, 1978; Landry & Loveland, 1988; Sigman, Mundy, Sherman, & Ungerer, 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby & Prutting, 1984). These studies, which have examined joint attention in older children with autism, indicate that the impairment may change over the course of development. The results of these studies suggest that whereas skills in initiating joint attention usually remain impaired, some children with autism with higher cognitive development begin to respond to others' joint attention bids (Charman, 1998; Mundy, Sigman, & Kasari, 1994). In general, studies have demonstrated the uniqueness, in terms of level of impairment, of these deficits compared to other types of communicative functions (i.e., object requesting, social interaction) as well as the specificity with which children with autism are impaired in exhibiting joint attention compared to typically developing and developmentally delayed children (Curcio, 1978; Loveland & Landry, 1986; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman et al., 1986).

Many theories have been proposed to explain the underlying cause of joint attention deficits in autism. The most commonly held theories have suggested that difficulties in higher-order cognitive skills, such as working memory (McEvoy, Rogers, & Pennington, 1993; Ozonoff, Pennington, & Rogers, 1991; Rogers & Pennington, 1991), symbolic functioning (Baron-Cohen, 1995), and the regulation of attention (Courchesne et al., 1994; Dawson & Lewy, 1989), are responsible. However, these particular cognitive factors alone may not be enough to explain these deficits (Stahl & Pry, 2002). It may also be important to consider motivational processes in understanding why joint attention behaviors are severely impaired or nonexistent among children with autism, while other triadic forms (i.e., child–other–object) of social–communicative behaviors, such as requesting (i.e., protoimperatives; Bates, Camaioni, & Volterra, 1975), are less impaired (Mundy, 1995; Mundy & Crowson, 1997; Mundy et al., 1994).

The distinction between requesting and joint attention and the differing degrees to which these behaviors are exhibited by children with autism may relate to different motivational parameters (Mundy, 1995; Tomasello, 1999). For example, requesting behaviors may be relatively unimpaired because of the immediate reward value of obtaining a preferred object or activity. However, given that children with autism exhibit difficulty in participating in affective exchanges, the reward outcome of joint attention (i.e., affective social sharing) may be less salient and reinforcing to them. In particular, initiating (compared to responding to) joint attention may present specific challenges to children with autism because of the greater social motivation necessary to elicit expressions of positive affect about an object or interest. For example, the mutual joy and reciprocal interest that occur when a typically developing child initiates joint attention with an adult is thought to provide the intrinsic reinforcement needed for the child to attend to and participate in social exchanges (Dawson et al., 2004). However, if children with autism have difficulty understanding and relating to the social function of joint attention, they may be less likely to initiate social behaviors and experience interactions that are critical for language, social, and cognitive development (Bono, Daley, & Sigman, 2004; Markus, Mundy, Morales, Delgado, & Yale, 2000; Sigman & McGovern, 2005; Sigman & Ruskin, 1999). Unfortunately, this deficit in social motivation is likely to persist throughout development for children with autism (L. K. Koegel, Koegel, & Carter, 1998). Given that this joint attention impairment reflects a core symptom of autism and that joint attention facilitates other areas of development, it has been suggested that joint attention become a priority in early intervention (L. K. Koegel, 2000; Mundy & Crowson, 1997).

Furthermore, teaching only the behaviors (or forms) of joint attention may not be sufficient to enhance motivation to the degree needed for children with autism to spontaneously and consistently enter a joint attention interaction (Jones & Carr, 2004). Instead, intervention programs may need to incorporate strategies that address the function of joint attention in order for children with autism to interact socially and appreciate the meaningful and rewarding properties of social stimuli (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Therefore, unless the social motivation component of joint attention is addressed through intervention, children with autism may never learn to develop more sophisticated social–communicative behaviors.

The literature has provided some curricular recommendations for teaching joint attention. For example, Reichle (1991) proposed that increasing the salience of the adult's attention-directing behavior and associating the social interaction with a stronger reinforcer could be used to teach nonverbal joint attention behaviors, such as gaze alternation. In Reichle's example, a father develops a routine of consistently shifting his gaze to the door just before the child's mother enters the room carrying a treat for the child. Reichle explains that over time the child will respond to the father's joint attention bid and shift his or her gaze to the door in anticipation of the reinforcer. One limitation to this approach, however, is that the child may not

develop an understanding of the social function of joint attention; rather than targeting the social sharing component, which serves as the reinforcing agent for typically developing children, the just-described scenario only offers a nonsocial reward (the treat).

Other researchers have begun to teach joint attention by using comprehensive behavioral approaches and general social skills training. Whalen and Schreibman (2003) used a behavior modification procedure (with components of discrete trial training and pivotal response treatment [PRT]) to teach young children with autism to respond to and initiate joint attention. Results indicated that while all the children improved in responding to joint attention, only four out of the five participants demonstrated improvements in their initiation of joint attention gestures. Three months later, at follow-up, responses to joint attention continued to occur for all of the children, but joint attention initiations were not maintained. Furthermore, generalization of the behaviors to interactions with an untrained parent occurred for only two of the children. In their discussion, Whalen and Schreibman questioned whether the children understood the social function of joint attention (social sharing). In the training protocol, the authors noted that toys were removed if the child did not initiate joint attention. It is possible that this component may have inadvertently taught the child to initiate requesting gestures to maintain access to a nonsocial reward rather than to initiate joint attention gestures for shared enjoyment. It could be argued that this behavioral approach neither addresses the child's lack of motivation to respond to environmental and social stimuli to share affective experiences during joint attention interactions (Dawson et al., 2004) nor guarantees that the child will develop joint attention, as defined by its social function, out of such general requesting skills (Wetherby, 1986).

Kasari, Freeman, and Paparella (2006) employed a randomized design comparing three types of treatment approaches, one of which taught joint attention behaviors to 3- and 4-year-old children with autism. Thirty-minute intervention sessions were conducted daily for 5 to 6 weeks and involved a combined developmental and behavioral intervention approach in which target behaviors were initially primed at a table using discrete trial training for several minutes and then taught on the floor using naturally occurring opportunities, similar to milieu teaching. Specific techniques included following the child's lead and interest in activities, describing what the child was doing, repeating and expanding on what the child said, providing appropriate feedback, maintaining close proximity to the child, establishing eye contact, and making environmental changes to engage the child. Children in the joint attention group demonstrated greater improvement in responding to joint attention and initiating showing. Child-initiated joint attention behaviors also generalized from the highly individualized treatment sessions with the experimenter to play interactions with untrained caregivers. The study demonstrated that interactive approaches could be used to teach joint attention in a short period of time with generalization of these skills to new contexts and people.

In recent years, a growing body of literature has documented the success of using naturalistic, motivational procedures, namely PRT (R. L. Koegel, O'Dell, & Koegel, 1987; R. L. Koegel et al., 1989), to facilitate the development of social communication behaviors (L. K. Koegel, Koegel, & Carter, 1998; R. L. Koegel, O'Dell, & Dunlap, 1988; R. L. Koegel, O'Dell, et al., 1987; Laski, Charlop, & Schreibman, 1988). By targeting the pivotal area of motivation, studies have demonstrated collateral, untargeted effects on other behaviors related to joint attention, such as self-initiations, eye-gaze alternation, and cooperative play (Charlop-Christy, Carpenter, Loc, LeBlanc, & Kellet, 2002; L. K. Koegel, Koegel, Shoshan, & McNerny, 1999; Pierce & Schreibman, 1995). For example, Pierce and Schreibman demonstrated that peer-implemented PRT was effective in producing positive changes in a variety of social behaviors, including verbal statements, complex play behaviors, and joint attention, in children with autism. In addition, Baker (2000) demonstrated collateral changes in joint attention as a result of incorporating motivational variables (highly reinforcing and individualized games) to improve social play interactions between children with autism and their siblings. Results from these studies suggest that certain intervention strategies targeted at enhancing motivation may indirectly lead to positive changes in joint attention.

In addition, the use of highly preferred materials, topics, activities, and toys in learning opportunities has been found to increase the child's intrinsic motivation to participate in social interactions (Gaylord-Ross, Haring, Breen, & Pitts-Conway, 1984; R. L. Koegel, Dyer, & Bell, 1987). For example, Baker, Koegel, and Koegel (1998) found that highly preferred topics (those in which children with autism showed perseverative interest) could be used to create intrinsically reinforcing and socially appropriate play activities with typically developing peers and siblings. Similarly, other researchers have been successful in using children's perseverative interests to improve task performance (Charlop, Kurtz, & Casey, 1990; Charlop-Christy & Haymes, 1998) and correct responding (Wolery, Kirk, & Gast, 1985) without encouraging off-task, stereotypic, aggressive, and/or tantrum behaviors. These findings suggest that perseverative interests, which are difficult to eliminate, may be used as intrinsically motivating rewards to teach new pivotal responses (Charlop et al., 1990). Thus, perseverative interests might be effective in engaging the child in interaction and tapping into his or her motivation to share interesting objects with other people. If so, the natural consequence for joint attention, that is, socially in-

teracting with another person and maintaining attention to the mutual object of interest, would serve as the reinforcers for joint attention.

The purpose of the present study was to extend the research on motivation in autism by assessing whether joint attention can occur as a collateral effect of using children's perseverative interests within the naturalistic behavioral principles of PRT. Specifically, the study proposed that children with autism would be more likely to enter a social interaction with their caregivers if the interaction focused on their perseverative interests. Two PRT conditions, both using the same motivational procedures, were compared. One condition used topics or themes on which the children with autism perseverated, while the other used other preferred topics or themes unrelated to the children's perseverative interests. We hypothesized that (a) during the perseverative-based PRT condition, children with autism would initiate joint attention and improvements would be observed in the quality of the interaction with adults; and (b) as intervention continued, these improvements would generalize to the non–perseverative-based PRT condition.

Method

PARTICIPANTS

The participants in this study were three children with autism and their primary caregivers. The children received an independent diagnosis of autism by an outside agency and were referred for early intervention services by a local regional center to the Koegel Autism Center at the University of California, Santa Barbara. All children demonstrated behaviors consistent with autism based on the diagnostic criteria specified in the *Diagnostic and Statistical Manual of Mental Disorders–Fourth Edition, Text Revision* (*DSM–IV–TR;* American Psychiatric Association [APA], 2000), including qualitative impairments in social development, qualitative impairments in verbal and nonverbal communication, and a restrictive repertoire of activities and interests.

Child 1 was 34 months old at the start of the study. He was East Asian and lived with his parents and older brother at home, where English was the primary spoken language. He was *nonverbal*, defined as making no intentful verbal communicative attempts. His mother reported that he seemed overly interested in letters and numbers and preferred to play alone with toys and activities involving this theme. In particular, he showed an excessive interest in lining up magnetic letters and numbers. His preintervention age equivalences on the *Vineland Adaptive Behavior Scales* (VABS; Sparrow, Balla, & Cicchetti, 1984) communication and social domains were 11 and 16 months, respectively. He attended a preschool program with typically developing children 5 days per week for 3 hrs per day but did not receive any support (e.g., paraprofessional) or resource services.

Child 2 was 26 months old at the start of the study. He was Caucasian and lived with his parents and older brother at home, where English was spoken. His mother reported that although he had a vocabulary of at least 50 words, he did not respond to initiations directed toward him but would instead engage in disruptive behaviors (e.g., screaming, crying, hitting, throwing objects) when presented with language demands. During baseline probes, he used fewer than 10 different words functionally and spontaneously and frequently ignored his parents' questions. Moreover, he demonstrated an excessive interest in letters and numbers. Although he made verbal attempts to recite the alphabet and count up to the number 10 (e.g., "se" for *six*, "ah" for the letter A), he demonstrated no social sharing of these subjects with others and preferred to play by himself with toys and activities related to this preoccupation. His preintervention age equivalences on the VABS communication and social domains (Sparrow et al., 1984) were 16 and 15 months, respectively. Child 2 received no other early intervention services prior to or during his involvement with this study.

Child 3 was 38 months old at the beginning of the study. He was also Caucasian and lived at home with his parents and younger sibling. English was the primary language spoken at home. At the beginning of the study, his mother reported that he occasionally initiated single-word requests, but during baseline probes he used fewer than 10 different words functionally and spontaneously and frequently ignored his mother's questions. In addition, he exhibited a restricted area of interest in that he played almost exclusively with toys and games containing letters and numbers. Although he was capable of reciting the entire alphabet and counting up to 20, he practiced these routines in a scripted manner and did not make any social attempts to engage others in this perseverative interest. Socially, he preferred to play alone and often hid behind tables and chairs with preferred objects and toys. He exhibited frequent disruptive behavior, which included screaming, crying, and hitting. His preintervention age equivalences on the communication and social domains of the VABS (Sparrow et al., 1984) were 19 and 17 months, respectively. He attended a regular preschool 3 days per week and a special education preschool 2 days per week. Prior to his involvement with this study, he had been receiving 30 min each of speech and occupational therapy once a week for approximately 2 months.

DESIGN

Following a baseline condition without any treatment, the motivational techniques of PRT were implemented within

a phase reversal design for a condition employing stimuli related to the children's perseverative interests (PI) versus a condition employing other stimuli not related to those interests (NP). For Children 1 and 2, stimuli were introduced in the order PI, NP, PI, while for Child 3, stimuli were introduced in the order NP, PI, NP, PI. In addition, in the final PI condition, an alternating treatments design was employed for all participants, with PI and NP stimuli randomly alternated. The details are specified in the next sections.

SETTING

For each participant, baseline and intervention sessions were conducted either in the clinic at the Koegel Autism Center or in the child's home. Parent education intervention sessions lasted approximately 2.5 hrs and occurred twice per week. Materials in indoor settings consisted of a room containing a table, chairs, a video camera, several stimuli related to the child's perseverative interest, and several stimuli that were not associated with it.

PROCEDURE

Stimuli

A large variety of highly preferred age-appropriate board games, activities, and toys were used in the study. Games and toys that related to the child's perseverative interests were rotated with others that were not. We defined the term *perseverative interests* according to the definition in the fourth edition of the *DSM*, that is, "encompassing preoccupations with one or more stereotyped and restricted patterns of interest that are abnormal either in intensity or focus" (APA, p. 71). Operationally, we defined a *perseverative interest* as an intense preoccupation with an object or concept that the child continually sought out, talked about, or wrote about and whose interruption caused the child to become extremely agitated (Charlop et al., 1990). Prior to the start of the intervention, objects, toys, and activities that were considered perseverative to the children and thus could be used as intrinsically motivating stimuli, as well as other child-preferred stimuli unrelated to the perseverative interest, were determined by parent interviews and informal child observations. Table 1 lists some examples of stimuli used during the PI and NP conditions of the intervention.

Table 1. Examples of Stimuli Used During Intervention

PI stimuli	NP stimuli
ABC/123 book	Story book (e.g., *Helping Hector*)
ABC puzzle	Transportation puzzle
Caribou	Don't Break the Ice
Twister using letters/numbers	Twister
Magnetic letter board	Connect Four
Uno	Bowling

Note. PI = perseverative interest; NP = nonperseverative interest.

Baseline

During the baseline condition, the caregiver was asked to play and interact with the child as usual for 10 min with the intention of attempting to elicit as many expressive verbalizations as possible. However, to ensure that interactions were similar across participants, the caregiver was asked to refrain from using food-related activities or engaging in physical games, such as tickling or wrestling. Instead, the caregiver was instructed to use two specific sets of toys: PI stimuli, consisting of toys and activities related to the child's perseverative interest, and NP stimuli, consisting of age-appropriate toys and activities that did not relate to the perseverative interest.

In addition, approximately half of the NP stimuli were similar to the PI stimuli in terms of the type of toy or activity used during the probes, while the remaining half differed in function and appearance from the PI stimuli. For example, both PI and NP stimuli included puzzles, books, and board games, but the NP stimuli also included other types of toys, such as a ramp toy with cars, balls, and a musical piano. The two sets of toys were used at different times during sessions and randomly alternated to control for order effects. The baseline condition occurred for four sessions for all three participants.

Motivational (PRT) Intervention

The intervention sessions were attended by the primary caregiver (usually the mother, but in some cases the father), the child, and the first author, who was the principal investigator. The primary goal of the intervention program was to provide the caregiver with an overview of and training in PRT, a well-documented behavioral treatment program (National Research Council, 2001). The intervention sessions occurred for 12 weeks and were similar across participants in that the caregivers were taught to implement specific strategies aimed at motivating children with autism. These motivational procedures included (a) following the child's lead and interest in the choice of stimulus materials, (b) interspersing maintenance (i.e., previously mastered) tasks and acquisition (i.e., new) tasks, (c) consistently varying tasks to maintain the child's interest, (d) reinforcing correct responses in addition to reasonable attempts made by the child, (e) administering rewards immediately and contingently following the child's demonstration of the target behavior (e.g., a verbalization), and (f) providing direct and natural reinforcers that relate to the child's response. For example, if the child wanted to

play with an object related to his perseverative interest (e.g., a letter puzzle) and made an appropriate vocalization to obtain that object (e.g., saying "b"), the child was rewarded with an opportunity to play with the item (L. K. Koegel et al., 1999; R. L. Koegel, Bimbela, & Schreibman, 1996; Schreibman, Kaneko, & Koegel, 1991).

Each intervention session began with the principal investigator's modeling the use of PRT techniques with the child for 1 hr and then gradually including the caregiver as therapist for the remainder of each 2.5-hr session. The sessions focused on teaching the caregiver to implement strategies aimed at increasing the child's motivation to engage in verbal communication, his appropriate social interactions, and his learning interactions with the natural environment; however, no direct teaching of joint attention occurred. The principal investigator pointed out opportunities and provided each caregiver with immediate and specific feedback on his or her implementation of the procedures from *How to Teach Pivotal Behaviors to Children With Autism: A Training Manual* (R. L. Koegel et al., 1989) while the caregiver was working with his or her child.

In addition to these weekly intervention sessions, each caregiver was encouraged to implement PRT on an ongoing basis as situations and opportunities arose in the context of daily activities with the child (e.g., playing with toys and games, eating meals, playing in the park, riding in the car). Specific measures were used to evaluate whether the caregivers could demonstrate mastery of the PRT techniques presented during the intervention sessions (see the "Fidelity of Implementation" section for further details).

All intervention probes were collected at the end of every session, resulting in two representative video probes per week. Although these probes were collected in a manner similar to those collected for baseline, the period of intervention was divided into three conditions for all participants: PI stimuli, NP stimuli, and alternating treatments.

Perseverative Interest (PI) Stimuli Condition. This condition consisted of using the PRT techniques in conjunction with stimuli (objects, toys, and activities) related to the child's PI. For all three participants, the condition lasted for four 2.5-hr sessions, resulting in approximately 10 hrs of intervention. To ensure fidelity of implementation, PI stimuli consisting of letters and numbers were the only stimuli provided to the children during this condition. In addition, caregivers were interviewed weekly to verify that to the best of their ability, only PI stimuli had been used in other teaching opportunities outside of the intervention sessions for the length of this condition; however, consistent with the techniques of PRT, the caregiver was reminded to follow the child's choice in the selection of PI stimuli. If a situation arose in which the caregiver could not implement PI stimuli, such as during meal times, the caregiver was instructed to continue to follow the teaching strategies of PRT.

Nonperseverative Interest (NP) Stimuli Condition. This condition consisted of using PRT in conjunction with stimuli that were chosen by the child but did not relate to his PI. This condition lasted for four 2.5-hr sessions for Children 1 and 2 and eight 2.5-hr sessions for Child 3, who received the NP stimuli condition first and for two phases to minimize order effects. This resulted in approximately 10 and 20 hrs, respectively, of intervention. To ensure fidelity of implementation of this condition, only NP stimuli were provided during these intervention sessions, and caregivers were once again interviewed weekly to verify that to the best of their ability these were the only stimuli used in other teaching opportunities outside of the intervention sessions; the caregiver was again reminded to follow the child's choice in the selection of NP stimuli. If a situation arose in which the caregiver could not implement NP stimuli, the caregiver was instructed to continue to follow the teaching strategies of PRT.

Alternating Treatments. This final condition involved PI stimuli interspersed randomly with NP stimuli within each intervention session to assess whether generalization would occur for joint attention initiations toward NP stimuli. Each 2.5-hr session was divided in half so that both PI and NP stimuli were used for the same amount of time; the order of presentation of PI and NP stimuli was rotated to control for order effects. At the end of each session, two probes were collected from the caregivers and children using each set of stimuli. This condition lasted for 16 sessions for Children 1 and 2, and 12 sessions for Child 3 because of the order in which the intervention conditions were presented, resulting in approximately 40 and 30 hrs of intervention, respectively. In addition, the caregivers were allowed to use both types of stimuli in other teaching opportunities with the children outside of the intervention sessions.

Fidelity of PRT Implementation. Fidelity of PRT implementation was assessed during baseline, at Week 4 during intervention, and at Week 12 (end of intervention) to determine whether the caregivers were implementing the PRT techniques correctly. Consistent with other studies assessing the caregiver's use of the PRT techniques (R. L. Koegel, Symon, & Koegel, 2002; Symon, 2005), representative video probes of PRT implementation by the caregivers, across all conditions, were segmented into ten 1-min intervals. Each interval was scored on consistent use by the caregiver of the six motivational components of PRT, resulting in a percentage of intervals where procedures were implemented correctly. Criterion was considered met when each of the PRT components scored 80% or higher. At the end of intervention, all three caregivers

scored above 80% in the use of each of the motivational techniques.

Dependent Measures

The following types of data were collected for dependent measures using The Observer software (Noldus Information Technology, 1997–2007) during the baseline and intervention conditions: (a) number of joint attention initiations, (b) contingencies to joint attention initiations, and (c) qualitative measures of child–caregiver interaction. *Joint attention initiations* were defined as verbal and nonverbal behaviors initiated by the child and used to direct the caregiver's attention to an object, event, or topic of a communicative act (Bakeman & Adamson, 1984; Wetherby & Prutting, 1984) for the purpose of sharing enjoyment during the interaction. Thus, only those initiations associated with positive affect (e.g., smiling, laughing) and not used for behavior regulation purposes (i.e., request, protest) were included in the analysis. For example, any behavior initiated by the child to obtain an out-of-reach item or to request assistance in activating an object followed by the termination of contact with the adult was not considered an initiation for joint attention and thus was excluded from the analysis. Similarly, any behavior initiated by the child associated with negative affect (e.g., whining, crying, aggressive behavior) was also excluded. Table 2 lists specific joint attention behaviors coded in the analysis, including gaze alternation, pointing, showing, giving, and commenting on objects and/or actions, as well as clinical examples of each behavior taken from the analysis (Wetherby, Cain, Yonclas, & Walker, 1988).

Representative probes from all baseline and intervention sessions were also examined to ensure that joint attention initiations occurred as an indirect result (a collateral effect) of implementing the intervention program rather than as a direct result due to specific prompting and/or reinforcement of joint attention from an adult. Thus, baseline and intervention probes were analyzed to determine whether the child was prompted to initiate joint attention and/or received direct reinforcement from the adult for initiating joint attention. For example, if the clinician asked the child to point at the toy and then look at the caregiver to obtain access to the toy and/or verbally praised the child for doing so, this behavior was excluded from the analysis and instead marked as a direct prompt for joint attention.

Baseline and intervention sessions were also analyzed to determine whether the quality of interaction between each child and the caregiver was influenced by the type of stimuli (PI or NP) used in each condition. An observer unfamiliar with the experimental hypotheses or conditions gave a global rating of the target child's interest, happiness, and behavior toward the caregiver during representative videotape probes from each baseline and intervention session. As seen in Table 3, the measure was adapted from the scales used in studies that have investigated child affect during typical play interactions (e.g., R. L. Koegel & Dunlap, 1980; R. L. Koegel & Egel, 1979).

Table 2. Definitions and Examples of Joint Attention Initiations

Type of joint attention initiation	Definition	Examples using perseverative interest
Eye gaze alternation	Child looks between object and caregiver in conjunction with positive affect (e.g., smiling, laughing).	Child and caregiver are reading an ABC book. As caregiver turns the page, child sees the letter C on the page and alternates eye contact between the letter and the caregiver.
Pointing	Child extends finger toward object in conjunction with gaze alternation and positive affect to the caregiver.	Child and caregiver are completing a number puzzle. Child requests the puzzle number 2. After inserting the number, child points at the number and alternates eye contact to the caregiver.
Showing	Child holds activated object in hand and extends it toward caregiver in conjunction with gaze alternation and positive affect.	Child and caregiver are drawing letters on paper. Caregiver draws the letter P and hands the paper to child. Child then holds the paper with coordinated eye contact in front of caregiver's face.
Giving	Child extends object in hand toward caregiver in conjunction with gaze alternation and positive affect.	Child and caregiver are placing magnetic numbers on a board. Child hands caregiver a magnetic number 9 to place on his or her side of the board.
Commenting	Child vocalizes a word or words about the object to caregiver in conjunction with eye contact and positive affect.	Child and caregiver are singing a song about the phonetic sounds of each letter in the alphabet. For the letter A, child sings along with caregiver, vocalizing the sound *aah* while making eye contact with caregiver.

Table 3. Qualitative Measures of the Interaction

Negative affect (0–1)	Neutral affect (2–3)	Positive affect (4–5)
Child looks bored, uninvolved, and not curious or eager to participate in the activity or activities with the adult. Appears to be sad, angry, or frustrated. Spends little time attending to the task and adult and may be noncompliant (fidget, squirm, show inappropriate vocal or motor behavior unrelated to task, not respond to task). May engage in disruptive behavior (throw tantrum, attempt to leave room, interrupt adult's instructions/prompts, show aggression toward adult/self/objects).	Child is neither particularly interested nor uninterested in the task or adult. May smile or frown occasionally, but overall seems neutral. May fidget and appear inattentive, but is not aggressive or rebellious. Generally complies with instructions or responds to prompts, but may not do so readily.	Child readily attends to adult or task and seems to be enjoying him- or herself. May smile, laugh, or show other positive emotional behavior under appropriate circumstances. Child is alert and involved in tasks with the adult. Responds to prompts or instructions (is compliant and appears to try to perform successfully).

Reliability of Dependent Measures

Two observers per measure, at least one of whom was naive to the purpose of the study, independently counted each child's joint attention initiations, rated the quality of the interaction, and counted the number of contingencies to joint attention. Interobserver reliability was collected and reported for 90% of sessions. Reliability was calculated using the standard formula (agreements divided by agreements plus disagreements multiplied by 100%). In scoring joint attention, an agreement was counted when both of the observers coded the onset and termination of an initiation within 1 s of each other, while a disagreement was counted when one observer coded different times (i.e., more than 1 s apart) or different functions (i.e., initiation for behavior regulation rather than social sharing). Interobserver reliability was 93%, 96%, and 96% for Children 1, 2, and 3, respectively.

For affect ratings, *category agreement* was defined as both observers rating the affect in the same category (positive, neutral, or negative) of the observed measure on a probe-by-probe basis. Category agreement was 86%, 89%, and 83% for Children 1, 2, and 3, respectively. In addition, kappa was calculated to reflect percentage agreement corrected for chance agreement. Kappa was 0.73, 0.70, and 0.70 for Children 1, 2, and 3, respectively.

For contingencies to joint attention initiations, agreements were scored when both observers agreed about whether the children's joint attention initiations had been prompted and about whether they had been reinforced by an adult. Interobserver reliability was 100% for all three participants.

Results

Figure 1 shows the effects of using PRT in conjunction with PI and NP stimuli on the number of joint attention initiations for the three participants across baseline and intervention sessions. In the baseline condition (Sessions 1–4), all children showed zero joint attention initiations toward their caregivers. The absence of joint attention initiations continued for each child despite using PI and NP stimuli during this condition.

The data for the PI condition (Sessions 5–8) suggest that in their first session Children 1 and 2 immediately began to initiate joint attention toward PI stimuli and continued to demonstrate higher levels of initiations during the remaining sessions of this condition than they had in baseline sessions. Child 1 initiated 7 joint attention behaviors in Session 5 and averaged 14 initiations (range = 9–23) in Sessions 6 through 8, while Child 2 initiated joint attention twice in the first session and averaged 6 (range = 5–6) initiations in the remaining sessions. When intervention changed to the NP condition in Sessions 9–12, both children's rate of joint attention initiations per session began to drop to baseline levels. Across all four sessions, Child 1 made a total of 1 joint attention initiation, while Child 2 averaged 2 initiations (range = 0–3). During the alternating treatments condition (Sessions 13–28), both children quickly resumed initiating joint attention behaviors related to PI stimuli. Child 1 averaged 11 joint attention initiations per session (SD = 5.45, range = 3–21), and Child 2 averaged 5 initiations (SD = 2.72, range = 0–10 initiations), in Sessions 13 through 28. In addition, increases occurred in both children's use of joint attention initiations toward NP stimuli during the alternating treatments condition, with an average of 5 (SD = 4.37, range = 0–13) and 3 (SD = 3.07, range = 0–9) initiations for Children 1 and 2, respectively.

For Child 3, intervention started in the NP condition in Sessions 5 through 8. During these four sessions, Child 3 never initiated joint attention to engage in social sharing with his caregiver. Once intervention changed to the PI condition in Sessions 9 through 12, Child 3 made 1 joint attention initiation in the first 2.5-hr session and averaged 2 initiations per session during the remaining three sessions (range = 0–7). When intervention changed back to

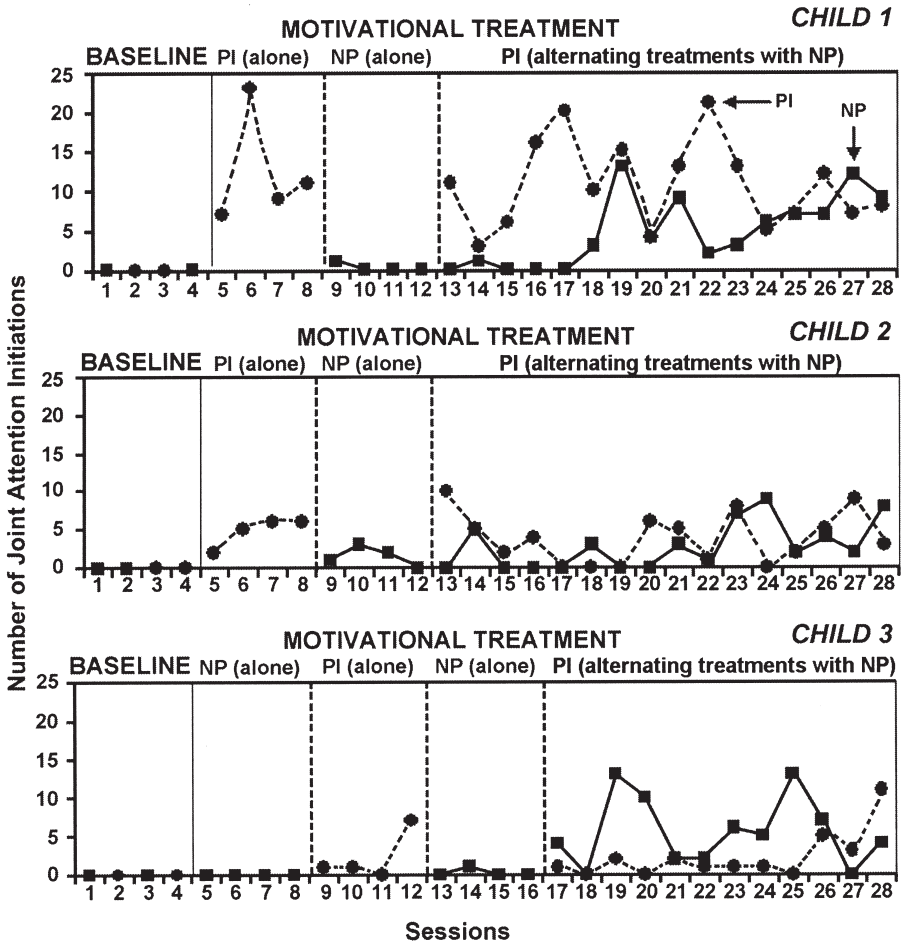

Figure 1. Number of joint attention initiations to share enjoyment. *Note.* PI = perseverative interest; NP = nonperseverative interest.

the NP condition in Sessions 13 through 16, Child 3 quickly returned to showing low levels of joint attention initiations (range 0–1). During the alternating treatments condition (Sessions 17–28), Child 3 averaged 2 joint attention initiations per session (SD = 3.11, range = 0–11) toward PI stimuli and 6 initiations (SD = 4.52, range = 0–13) toward NP stimuli.

To help assess the extent to which generalization of joint attention occurred during the final alternating treatments condition, a series of within-subjects ANOVAs were calculated separately for each child, with the number of joint attention initiations serving as the dependent variable. One set of analyses examined individual differences in joint attention initiations toward PI stimuli from the first half of the alternating treatments condition compared to that from the second half. A second set of analyses made the same comparison for NP stimuli.

For Children 1 and 2, there were no significant differences in the number of joint attention initiations for PI stimuli in the first half (Sessions 13–20) compared to the second half (Sessions 21–28) of the alternating treatments condition: Child 1: $F(1, 7) = .001$, $p > .90$; Child 2: $F(1, 7) = .005$, $p > .90$. In contrast, significant differences were observed in the number of joint attention initiations for NP stimuli in the first half compared to the second half of the condition: Child 1: $F(1, 7) = 13.76$, $p < .01$; Child 2: $F(1, 7) = 5.28$, $p < .05$. Both children showed a greater number of initiations related to NP stimuli in the second half, suggesting that some generalization may have occurred. As for Child 3, significant differences were not observed in the number of initiations for either PI or NP stimuli in the first half of the condition compared to the second half: PI: $F(1, 7) = 2.01$, $p > .20$; NP: $F(1, 7) = .31$, $p > .60$. This may have been due to the fact that relatively high joint attention initiations occurred with the NP stimuli throughout both phases of the condition and therefore generalization toward NP stimuli may have occurred at a more rapid rate for Child 3 than for the other two participants (see Table 4).

Figure 2 shows the results for the qualitative measures of interaction between the participants and their care-

givers, specifically, the ratings of child affect during play interactions with the caregiver across baseline and intervention sessions. During the baseline condition, the children primarily received scores in the neutral to negative range with respect to PI versus NP stimuli. In the case of Child 2, though, his affect ratings were relatively higher in the last two baseline sessions when only the PI stimuli were used compared to the first two baseline sessions that used NP stimuli.

The data on the PI condition (Sessions 5–8) suggest that at the start of intervention, Children 1 and 2 exhibited higher levels of affect during child–caregiver interactions associated with PI stimuli. When intervention changed to the NP condition in Sessions 9 through 12, both children's affect ratings went from positive to negative. During the alternating treatments condition (Sessions 13–28), in which PI and NP stimuli occurred in the same session, the affect levels of Children 1 and 2 primarily remained in the positive range during the child–caregiver interactions associated with PI stimuli. In addition, while both children received neutral ratings throughout the majority of NP sessions, they exhibited an increase in affect levels to the positive range during child–caregiver interactions associated with NP stimuli during the last two or three sessions of the alternating treatments condition.

Child 3, who started intervention in the NP condition, primarily received affect ratings in the neutral range. When intervention changed to the PI condition in Sessions 9 through 12, his ratings quickly increased to the positive range for three consecutive sessions. When intervention changed back to the NP condition in Sessions 13 through 16, his affect ratings primarily returned to the negative range, reflecting disinterest, unhappiness, and disruptive behavior during child–caregiver interactions associated with NP stimuli. During the alternating treatments condition (Sessions 17–28), in which PI and NP stimuli occurred in the same session, each type of stimuli received some affect ratings in the neutral range, but the majority of sessions related to each type of stimulus received affect ratings in the positive range.

To help assess the extent to which generalization of positive affect occurred during the alternating treatments condition, within-subject ANOVAs were performed separately for each child, with the quality of child–caregiver interaction serving as the dependent variable. One set of analyses compared individual differences in affect scores toward PI stimuli from the first and second halves of the alternating treatments condition. A second set of analyses made the same comparison for NP stimuli.

The first half of the alternating treatments condition consisted of Sessions 13 through 20 for Children 1 and 2 and Sessions 17 through 22 for Child 3, while the second half of the condition consisted of Sessions 21 through 28 for Children 1 and 2 and Sessions 23 through 28 for Child 3. Although all children showed improvements in affect, as evidenced by smaller differences in levels of affect between the two types of stimuli, none of the children's affect levels reached statistical significance in either the PI or NP stimuli condition: Child 1, PI stimuli: $F(1, 7) = 1.00$, $p > .30$; Child 1, NP stimuli: $F(1, 7) = 1.40$, $p > .30$; Child 2, PI stimuli: $F(1, 7) = .08$, $p > .80$; Child 2, NP stimuli: $F(1, 7) = 2.54$, $p > .20$; Child 3, PI stimuli: $F(1, 7) = .00$, $p = 1.00$; Child 3, NP stimuli: $F(1, 7) = .30$, $p > .60$ (see Table 5).

Table 4. Means and Standard Deviations for Joint Attention Initiations During the Alternating Treatments Condition

	1st half		2nd half	
Child/stimuli	***M***	**(*SD*)**	***M***	**(*SD*)**
Child 1				
PI stimuli	10.63	(6.09)	10.75	(5.15)
NP stimuli	2.63	(4.47)	6.88	(3.27)**
Child 2				
PI stimuli	4.88	(3.04)	5.00	(2.56)
NP stimuli	1.00	(1.93)	4.50	(3.07)*
Child 3				
PI stimuli	1.00	(0.89)	3.50	(4.09)
NP stimuli	5.17	(5.15)	5.83	(4.26)

Note. PI = perseverative interest; NP = nonperseverative interest.
*$p < .05$. **$p < .01$.

Data for contingencies were examined to ensure that gains did not occur inadvertently through the direct prompting and reinforcement of joint attention initiations but rather were the collateral result of using PI stimuli and PRT. Results indicated that none of the children received contingent prompting of joint attention initiations. In addition, none of the children were contingently reinforced by an adult for initiating joint attention.

Discussion

This study sought to analyze whether joint attention initiations for social sharing would occur as a collateral effect of using PRT in conjunction with PI stimuli with three young nonverbal children with autism. The findings of this study suggest that joint attention initiations for social sharing may increase as a collateral gain when incorporating children's PI stimuli as natural reinforcers within the motivational procedures of PRT. This finding supports other evidence that positive, collateral changes in joint attention may occur when a social interactive intervention program structures the environment in a particular way (Lewy & Dawson, 1992; Pierce & Schreibman, 1995). Furthermore, the results suggest that all children ultimately exhibited some degree of generalization of joint attention initiations to other preferred objects unrelated to their perseverative interests. Last, all children demonstrated im-

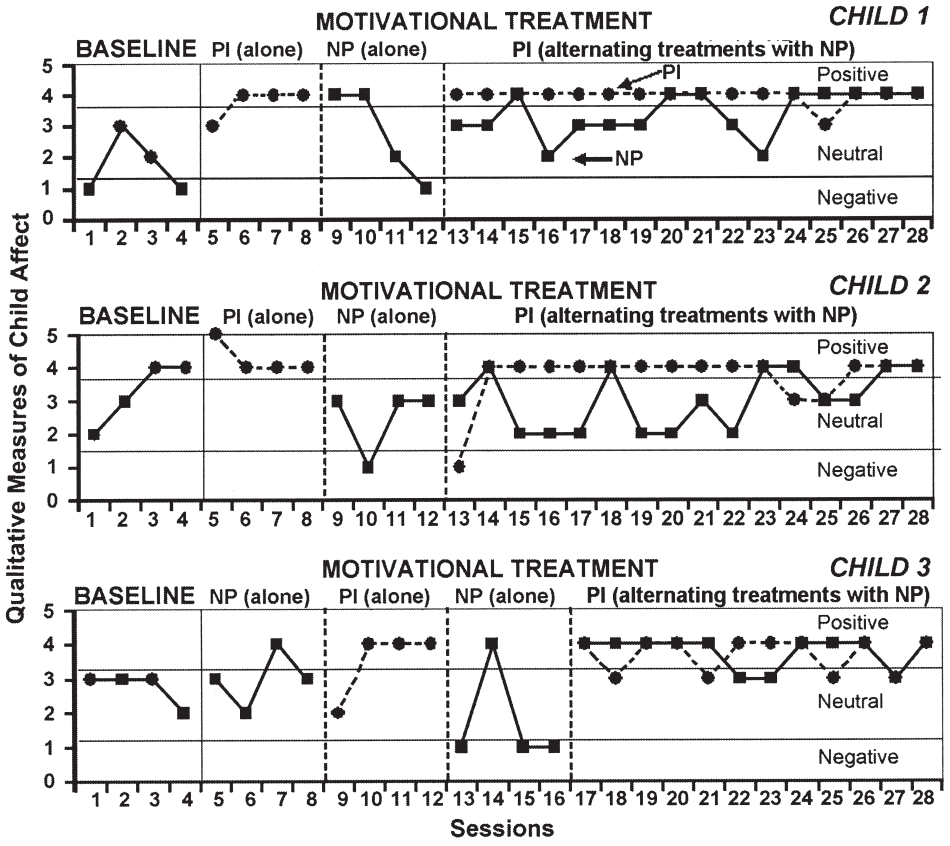

Figure 2. Qualitative measures of the interaction. *Note.* PI = perseverative interest; NP = nonperseverative interest.

provements in qualitative measures of interaction (i.e., child happiness, interest, overall behavior) with their caregivers in response to using perseverative and nonperseverative interests within the PRT methods. The findings have a number of significant theoretical and clinical implications.

Although other studies have employed naturalistic behavioral strategies to teach joint attention (Kasari et al., 2006; Whalen & Schreibman, 2003), the current study incorporated a different approach in the sense that joint attention was not directly targeted in intervention. Instead, the primary goal was to increase children's motivation to respond to environmental and social stimuli by using highly preferred interests to facilitate opportunities for social sharing. The fact that joint attention initiations immediately increased for all children suggests that motivation may serve as a pivotal variable for the acquisition and maintenance of treatment gains (L. K. Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998; L. K. Koegel, Koegel, & Brookman, 2005; L. K. Koegel et al., 1999). Further, the strategies derived from PRT, including the use of perseverative or highly preferred interests, appeared to increase the children's interest in and engagement with the task. This may have allowed reciprocal activities to develop between the child and caregiver that would be likely to elicit and support joint attention. Furthermore, it appears that the children's motivation to initiate joint attention stemmed from a desire not to obtain an object (or to prevent losing access to it) but rather to engage in intrinsically rewarding social sharing with their caregivers (Mundy, 1995). This reasoning seems particularly evident based upon the children's immediate display of joint attention initiations by the end of the first 2.5-hr PI intervention session and their continued presentation of social sharing of PI stimuli, via joint attention, during subsequent PI intervention sessions.

In addition, generalization of joint attention initiations occurred to other types of stimuli during the alternating treatments condition. Each child eventually began to interact with and share new, nonperseverative interests with their caregivers. Generalization for Child 3 may have occurred at a slightly higher rate compared to the other two participants because of the order in which intervention was delivered. Child 3 was the only participant to receive the NP stimuli condition first during intervention and to alternate back to the NP condition for additional sessions. The assessment of the quality of child–caregiver

interaction episodes suggests that Child 3 may have been less motivated to interact socially with others during sessions in which only NP stimuli were used as natural reinforcers, as evidenced by higher incidence of neutral to negative affective scores. However, the interspersal condition suggests that treatment effects began to occur when PI stimuli were randomly alternated within the sessions. The use of PI stimuli as natural reinforcers may have enhanced Child 3's motivation to approach and enter the child–caregiver interaction, thereby creating opportunities for social engagement and joint attention to occur. Perhaps as Child 3 experienced the positive consequences of interacting socially with another person, intervention was then able to incorporate other interests with which the child was already familiar and that he tolerated (as a result of prior NP sessions) but which had never served as the focal point of social sharing. Similar to the results for the other two participants, these other interests appeared over time to develop into socially motivating stimuli, increasing opportunities for social engagement and positive child–caregiver interactions.

In addition to examining the quantity of joint attention, this research also demonstrated social significance by assessing the quality of interaction between the participating children and their caregivers. Specifically, the results suggest that the use of PI stimuli within the motivational framework of PRT may decrease the likelihood of social avoidance and/or aloofness, which is often described in children with autism (McGee & Morrier, 2003; Mundy & Sigman, 1989). Therefore, it appears that this intervention package may target the social motivation necessary for children with autism to find interactions with others enjoyable and reinforcing. For example, improvements in social-communicative behaviors as a result of intervention may increase children's motivation to share their perseverative interests with caregivers and allow the children to experience the social reinforcement that is characteristic of typical adult–child interactions firsthand (Bates, Camaioni, & Volterra, 1975; Bruner, 1983). Therefore, while the participating children may have learned to associate the caregivers' presence with the reinforcing properties of the perseverative interest, the improvements in positive affect suggest a high desire by the children with autism to use the PI stimuli in a mutually reinforcing and reciprocal manner. Furthermore, as the children gained additional opportunities for social learning, this may have increased their motivation to continue interacting with their caregivers in a positive manner during other social-communicative situations and as such may have contributed to the generalization of joint attention initiations toward nonperseverative interests.

Although the very young and minimally verbal children in this study showed rapid skill acquisition in joint attention and increased motivation to sustain child–caregiver interactions, additional research is needed to examine whether specific child, family, and environmental characteristics may affect intervention outcome. Not all children with autism may benefit from the procedures used in this study. Although the participating children had perseverative interests that were accessible (letters and numbers), some children with autism may not have perseverative interests, may have highly inappropriate interests (e.g., body parts), or may have interests of limited accessibility within an intervention program (e.g., weather reports). Also, the extent to which caregivers are able to learn the motivational techniques of PRT and incorporate perseverative interests within the social interaction, as well as the level of resources available, may affect the children's response to intervention. Last, that autism encompasses a large degree of heterogeneity suggests the need for additional replications of these findings with a larger sample size. Therefore, additional studies are needed to identify what specific types of motivational procedures may be helpful for addressing the varying needs of children within the autism spectrum and their families.

Additional limitations of this study involve the extent to which joint attention gains maintained over time and generalized to other settings and with other social partners. It is important to note that the current findings were only observed to occur in one natural context, the child's home, and with one trained social partner, the caregiver. Future studies should evaluate intervention effects across several natural environments and untrained social partners to assess the generalization of treatment gains, as well as whether changes in joint attention maintained over time. Furthermore, no data other than those relating to fidelity of implementation were collected in this study. Additional measures of social validity might include caregivers' perceptions of child improvement, educational benefits, and treatment limitations. Normative data on

Table 5. Means and Standard Deviations for Child Affect During the Alternating Treatments Condition

	1st half		2nd half	
Child/stimuli	*M*	(*SD*)	*M*	(*SD*)
Child 1				
PI stimuli	4.00	(0.00)	3.88	(.35)
NP stimuli	3.13	(0.64)	3.63	(.74)
Child 2				
PI stimuli	3.63	(1.06)	3.75	(.46)
NP stimuli	2.50	(0.93)	3.38	(.74)
Child 3				
PI stimuli	3.67	(0.52)	3.67	(.52)
NP stimuli	3.83	(0.41)	3.67	(.52)

Note. PI = perseverative interest; NP = nonperseverative interest.

joint attention should also be included to guide intervention programs on the desired topography (i.e., what the behavior should look like), context (i.e., in which situations is it appropriate for this behavior to occur), and frequency of typical social behaviors (McGee & Morrier, 2003).

Finally, it may be worthwhile for future research to evaluate the specific effects of joint attention improvements on other child and family variables. For example, while increases in joint attention initiations appeared to improve the children's affect during their interactions with the caregivers, child variables such as language function (e.g., social versus nonsocial function) and play should also be examined. Because the current study did not include standardized language or play measures to examine either developmental area, future studies should incorporate these measures to evaluate a broader range of related outcome effects. In addition, future studies should examine the social partner's behaviors, such as affect and amount of time spent in reciprocal engagement with the child, and variables related to family dynamics, such as parental stress levels and sibling interactions.

In summary, the findings suggest that using PI stimuli in conjunction with PRT appears to increase a child's motivation to share his or her perseverative interest socially with another person and consequently to improve the quality of initiations and interactions. In addition, this study indicates that children in this type of intervention use their perseverative interest in a socially appropriate and controlled manner without the presence of negative side effects (e.g., disruptive behaviors; Charlop et al., 1990). The results are also promising in terms of providing an approach that utilizes learning mechanisms that may be similar to those used in typical development. Furthermore, this highly effective PRT format continues to educate and support caregivers to interact with their children in meaningful ways. Although additional research is needed to address the limitations of this study, the intervention and its findings offer important clinical and theoretical insights into the treatment and understanding of joint attention development in young children with autism.

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