

## Parent Implemented Joint Attention Intervention for Preschoolers with Autism

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### Abstract

The identification of deficits in joint attention skills in children with autism has resulted in the recent development and demonstration of intervention procedures to remediate such impairments. In this study parents utilized behavioral intervention procedures (i.e., discrete trial instruction and pivotal response training strategies) to teach 3 preschoolers with autism to respond to others' joint attention directives and to initiate joint attention. Results replicate previous research using discrete trial instruction and pivotal response training strategies while demonstrating parents could effectively utilize the intervention procedures to teach joint attention skills. Given the extent to which autism can drastically impair social and communicative behaviors, it is important to develop interventions that specifically address early developing skills such as joint attention and can be effectively utilized by parents within the home environment.

**Keywords:** Joint attention, autism, behavioral intervention, parents, pivotal response training, discrete trial instruction

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### Introduction

The absence of joint attention is one of the earliest symptoms of autism, reflecting the hallmark social disturbance that characterizes the disorder (Mundy & Crowson, 1997). Joint attention, first seen in infants between 9 and 12 months of age, involves two people sharing attentional focus on interesting objects and events (Bakeman & Adamson, 1984). Early joint attention behaviors involve children's use of eye gaze and conventional gestures. For example, a child might *initiate* joint attention, directing his mother's attention to a toy on the floor, by looking from the toy to his mother and back to the toy (i.e., gaze alternating) while simultaneously pointing at the toy. Alternatively, a mother might direct her child's attention by pointing and looking at an object while commenting on the object (e.g., "What a fun toy!") to which the child *responds* by looking from the object to his mother and back to the object (i.e., gaze alternating). These joint attention interactions are considered uniquely social in that they result in an interaction between adult and child about the object/event. Joint attention is also related to social and language skill development, playing a significant role in typical development (Mundy & Gomes, 1998; Mundy, Sigman, & Kasari, 1990; Travis, Sigman, & Ruskin, 2001).

Deficits in joint attention are evident in children with autism from very early in development (Baron-Cohen, Allen, & Gillberg, 1992; Charman et al., 1998; Osterling & Dawson, 1994). Infant screening and diagnostic instruments for autism, such as the *Checklist for Autism in Toddlers (CHAT)* (Baron-Cohen et al., 1992) and the *Autism Diagnostic Observation Schedule (ADOS)* (Lord, Rutter, DiLavore, & Risi, 1999), include assessment of deficits in joint attention as a marker for autism. In comparison to children with mental retardation or specific language delay (matched for developmental level), preschool children with autism show significant deficits in both responding to others' joint attention directives and initiating joint attention (Charman et al., 1998; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman, Mundy, Sherman, & Ungerer, 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997). This impairment in joint attention discriminates 80% to 90% of children with autism from those with other developmental disabilities (Lewy & Dawson, 1992; Mundy et al., 1986). Because of the social nature of joint attention, its absence reflects the core social disturbance that characterizes autism (Mundy & Crowson, 1997). Joint attention is also related to two of the areas, social and communication development (Mundy & Gomes, 1998; Mundy et al., 1990; Travis et al., 2001), that are significantly impaired in individuals with autism (American Psychiatric Association, 2000). Thus, the development of

effective intervention procedures to address joint attention deficits in young children with autism is of utmost importance.

A handful of studies have examined intervention procedures to address joint attention deficits in children with autism with at least some improvement in targeted joint attention skills (e.g., Hwang & Hughes, 2000; Kasari, Freeman, & Paparella, 2001, 2006). Using a behaviorally based intervention, Whalen and Schreibman (2003) examined pivotal response training strategies (Koegel, Koegel, Harrower, & Carter, 1999; Pierce & Schreibman, 1995) with an emphasis on the use of child preferred materials, interspersing difficult tasks among easier ones, and using natural reinforcers as consequences for appropriate behavior to teach joint attention skills to 5 participants with autism (all 4 years of age). All participants acquired responding to others' joint attention directives and 4 of the participants acquired skills to initiate joint attention. More recently, we (Jones, Carr, & Feeley, 2006) also examined the use of a behavioral intervention consisting of discrete trial instruction and pivotal response training strategies to teach five 2-3 year old children with autism to both respond to others' joint attention directives and initiate joint attention. All participants acquired both joint attention skills and extended those skills to a variety of objects within their school environment. This research demonstrates the existence of effective intervention procedures when implemented primarily by teachers/therapists to address joint attention deficits in children with autism.

Given the diagnosis of autism at increasingly younger ages when many children spend the majority of their time at home with their parents (and other significant caregivers), it is increasingly necessary to develop effective interventions for this young group of children that parents/caregivers can easily and effectively implement within their home environment. The importance of parent involvement in interventions for children with autism is well documented (e.g., Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Campbell et al., 1998; Harris, Wolchik, & Milch, 1983; Lovaas 1987). In only three studies have parents been involved in the examination of joint attention intervention procedures. Whalen and Schreibman's (2003) study of behaviorally based intervention (specifically, pivotal response training strategies) involved examination of generalization of joint attention skills from the treatment setting, materials, and therapists to parents during a structured observation. Results indicated that 2 of 4 participants demonstrated coordinated joint attention (i.e., shifting gaze between object and parent during a social interaction) with parents post intervention. Jones et al. (2006) included parents in the implementation of intervention procedures. After participants were taught joint attention skills by their teachers at their preschool program, 2 participants were involved in an extension of acquired joint attention skills with their parents. After acquisition of joint attention skills with their teachers, both participants acquired joint attention skills with their parents when parents utilized the same intensive intervention format (i.e., discrete trial instruction and pivotal response training strategies) with similar materials (i.e., toys) as had been used by the children's teachers at their preschool. Both children also demonstrated joint attention with their parents at home with novel materials (such as cars and birds during a walk outside). Recently, Rocha, Schreibman, and Stahmer (2007) taught parents to implement a behavioral based intervention to teach 3 children with autism (26, 27, and 42 months of age) to respond to parents' joint attention bids. For comparison, typically developing children (4 typically developing children matched on developmental age and 4 typically developing children matched on chronological age) were also evaluated during an unstructured assessment of joint attention in which an experimenter made repeated joint attention directives and during a play interaction with their parent (conducted in the same manner as baseline assessment for the children with autism). Results indicated that parents, having been taught intervention procedures during visits to a clinic (three times per week), effectively utilized the strategies to increase their children's responses to joint attention bids. Although initiating joint attention was not targeted for intervention, some improvement in initiating joint attention was observed, however, not to levels comparable with typically developing children.

These studies suggest parents can utilize joint attention intervention procedures. The purpose of the present study was to examine the effectiveness of parent implemented joint attention intervention (the same behaviorally based intervention that we previously demonstrated to be effective when implemented by teachers [Jones et al., 2006]) to address both responding to others' joint attention directives and initiating joint attention interactions, within the home environment.

### *Method*

#### *Participants*

Three young children with autism spectrum disorders attending a preschool program serving children with autism participated in this investigation. Criteria for participation included a diagnosis on the autism spectrum, parent(s)' willingness to teach this particular skill, and an established prompt for eye contact (e.g., calling the child's name and/or using a primary reinforcer to direct eye gaze).

Justin was 3 years 5 months of age and diagnosed with PDD-NOS (American Psychiatric Association, 2000). Rebecca was 4 years of age and diagnosed with autism. Danny was 3 years 9 months of age and diagnosed with autism. All diagnoses were made by doctors (e.g., psychologist) not associated with this research. On testing conducted prior to the start of joint attention intervention, Justin scored in the mildly delayed range (standard score = 79) on the Bayley Scales of Infant Development-Second Edition (BSID-II; Bayley, 1993). On the Preschool Language Scale -Fourth Edition (Zimmerman, Steiner, & Pond, 2002), Justin showed delays in both receptive (standard score = 67) and expressive (standard score = 73) language. Rebecca scored in the significantly delayed range (standard score = 65) on the BSID-II and showed delays in both receptive (standard score = 71) and expressive (standard score = 68) language on the PLS-4. Danny also scored in the significantly delayed range (standard score = 50) on the BSID-II with delays in his overall language abilities (standard score = 55) on the PLS-4 (separate receptive and expressive language scores were not available from Danny's evaluation).

#### *Interventionists and Setting*

Each participant's parent(s) served as interventionists. For Danny and Justin, both their mothers and fathers implemented joint attention intervention. For Rebecca, her mother implemented joint attention intervention. An integral part of the preschool program attended by all three children was extensive training for all parents to support implementation of instructional procedures in the home setting. During their child's first year in the program, parents attended biweekly didactic parent training meetings conducted by preschool program personnel. Training covered a variety of topics related to behavioral intervention and autism (e.g., behavior principles, teaching communication skills, etc.). Throughout the remainder of their child's enrollment at the preschool program, parents attended monthly training sessions in which parents and preschool teachers worked together with the child to practice implementing specific intervention programs. In addition to this training, parents whose children were enrolled in this study were also specifically taught to implement joint attention intervention procedures. In an initial 30-60 minute meeting in each participant's home, the first author and a student research assistant presented information regarding the importance of joint attention skills, the two types of joint attention skills, and the intervention procedures. The first author then modeled joint attention intervention with both the parent and child, followed by feedback as the parent practiced implementing intervention with the first author acting as the child. Subsequently, parents implemented intervention with the child and received feedback from the first author and/or research assistant. Ongoing feedback was provided as needed if parents had questions. When changes were made in intervention (e.g., prompting was faded), the first author and/or research assistant provided additional modeling of the new procedures and feedback. Parents implemented intervention within their home, in rooms in which the child usually received intervention and/or spent time with his/her family (e.g., bedroom, play room).

### Materials

The objects of joint attention were toys selected to highlight characteristics that tend to elicit joint attention, including interest, novelty, and salience (Jones & Carr, 2004; Jones et al., 2006). Capitalizing on child interest, we chose toys consistent with each child's preferences as reported by parents. To increase novelty, teaching opportunities were spread across a large number of toys (i.e., 30) divided into six sets of five toys, rotated weekly. During each week, families alternated joint attention intervention sessions between two sets of five toys. To increase salience, we chose toys that could be activated (i.e., made noise, lit up, and/or moved) such as a singing stuffed Elmo™, piano with lights, or toy car. Each toy was rigged with a remote control button so the interventionist could activate it (i.e., turn on the noise, lights, or movement) without touching the toy as part of the discriminative stimuli ( $S^D$ ) or the consequences for joint attention. Activating the toy without touching it is important because touching is considered a gesture that could influence the child's engagement in joint attention, thus, the remote button allowed for teaching opportunities that did not involve directly touching the toy. Toys were also activated via the remote button during the consequences for both joint attention skills. The buttons allowed for placement of toys at varying distances without the parent moving to activate the toy as part of the consequences.

A set of five novel toys (i.e., toys not used for joint attention intervention) were used to assess generalization. These toys made noise, lit up, and/or moved, but were not rigged with a remote button (as remote buttons are not commonly attached to objects in the natural environment) and were chosen to represent a variety of interests appropriate for preschoolers. For all children, the generalization toys included a musical stuffed Care Bear™, a musical stuffed Baby Einstein™ bunny, an interactive push button Blues Clues™ toy, a musical Barney™ car, and a talking stuffed Tigger™.

### Response Definitions

Two joint attention skills were taught: responding to others' joint attention directives and initiating joint attention. *Responding to another's joint attention directive* consisted of the child independently (i.e., without prompting) alternating his/her gaze between the object and adult (i.e., child looked at object, back at adult, and back at object for at least 1 second) within 4 seconds of the adult's joint attention directive (e.g., pointing and saying, for example, "Look at that toy!"). *Initiating joint attention* consisted of the child independently directing the adult's attention by alternating his/her gaze and pointing at the object within 4 seconds of the presentation of the interesting object/event (i.e., activated toy). Pointing could occur simultaneously with gaze alternation or at the end of gaze alternation when the child's gaze returned to the object. Performance data (recorded as either independent or prompted responses) were collected by the child's parent following each intervention opportunity.

### Design

To examine parents as effective interventionists, a multiple probe design across two joint attention skills (responding to others' joint attention directives and initiating joint attention) was conducted with all 3 participants. *Responding to others' joint attention directives* was taught first, followed by *initiating joint attention*, mirroring typical developmental patterns in which responding to others' joint attention directives emerges earlier than initiating joint attention (Corkum & Moore, 1995).

### Procedure

**Baseline.** Baseline opportunities were conducted to determine if each child already demonstrated either of the two joint attention skills. For responding to others' joint attention directives, one baseline opportunity was provided for each of the 30 toys, conducted across six sessions (each consisting of five opportunities) for each of the participants. The same was done for initiating joint attention. When both mother and father planned to teach joint attention, each conducted half of the baseline sessions (i.e., each

parent conducted three baseline sessions of responding to others' joint attention directives and three baseline sessions of initiating joint attention). When only one parent planned to teach joint attention, she conducted all baseline sessions. Baseline opportunities were conducted across at least two days. After intervention was introduced for responding to others' joint attention directives, probe sessions for initiating joint attention involved a different subset of 5 of the 30 toys (with one opportunity provided for each of the five toys).

During baseline opportunities, the child's parent presented the discriminative stimulus ( $S^D$ ). The child was provided 4 seconds following the presentation of the  $S^D$  to engage in the joint attention behavior. If the child demonstrated a correct response, his/her parent delivered the typical joint attention consequences (e.g., smile and comment on the object). If an incorrect response or no response occurred within 4 seconds of the  $S^D$ , the opportunity was terminated (i.e., the parent removed the toy) and the parent did not respond further. The child's response was recorded.

*Intervention.* Intervention procedures, the same as those used in previous research (Jones et al., 2006), followed a discrete trial format (i.e., repeated opportunities provided in close succession with high rates of reinforcement) (e.g., Lovaas, 1987) involving the use of pivotal response training strategies (Koegel et al., 1999). Parents conducted one session of intervention each day with 10 opportunities delivered per session. During each opportunity, parents presented the  $S^D$  for joint attention, prompted the correct response when necessary, and delivered the appropriate consequences. Responding to others' joint attention directives was taught first, followed by initiating joint attention. Mastery criterion was 90% independent (correct) responding across two consecutive sessions conducted over two days of intervention. Intervention procedures are outlined in Table 1 and discussed in detail for each joint attention skill next.

Table 1.

*Components of Joint Attention Intervention*

|                                   | Respond   | Initiate  |   |
|-----------------------------------|---|---|---|
| Discriminative Stimulus ( $S^D$ ) | In the presence of an interesting object or event less than 1.5 meters away from the child, the child's parent turns, looks, points at the object/event, and makes an exclamatory verbalization.  | A toy is activated less than 1.5 meters away from the child.  |   |
| Response                          | Gaze alternating:<br>Child alternates gaze (i.e., looks at the object, back at his/her parent, and back at the object for at least one second).   | Gaze alternating and pointing:<br>Child alternates gaze and points (after or simultaneously with gaze alternation).   |   |
| Prompts                           | Gaze alternating  | Gaze alternating  | Pointing  |
|                                   | 1. Say the child's name or "Look."<br>OR<br>2. Trace visual path with primary reinforcer.   | 1. Say the child's name or "Look."<br>OR<br>2. Trace visual path with primary reinforcer.   | 1. Physically form child's hand into a point.<br>OR<br>2. Model point with instruction "Do this." |
| Consequences                      | Parent meets child's gaze, provides an idiosyncratically reinforcing social response, smiles, comments on, and looks back at the object of joint attention. The child and adult engage in activity related to the object/event for 2-5 seconds. | Parent meets child's gaze, provides an idiosyncratically reinforcing social response, smiles, comments on, and looks back at the object of joint attention. The child and adult engage in activity related to the object/event for 2-5 seconds. |   |

*Responding to others' joint attention directives.* Responding to others' joint attention directives involved the child independently alternating his/her gaze between the object and parent within 4 seconds of his/her parent's joint attention directive (i.e., looking, pointing, and commenting [e.g., "It's Elmo™ singing!"]). During each intervention opportunity, a toy was positioned and the S<sup>D</sup> delivered (i.e., the toy was activated so that it made noise, lit up, and/or moved and simultaneously the child's parent turned, looked, and pointed to the toy, making an exclamatory comment, such as "Wow, it's Elmo™!"). If the child did not engage in the response (i.e., gaze alternating), a prompt (e.g., calling the child's name) was provided and faded across intervention opportunities using a most to least prompting procedure followed by implementation of a time delay (Halle, Marshall, & Spradlin, 1979). That is, at the start of intervention, the response was prompted using the highest level prompt (e.g., calling child's name) immediately following the S<sup>D</sup> (0 second time delay). Once one to two sessions occurred in which the child consistently responded to the immediate prompt, the prompt was reduced (e.g., the first part of the child's name [e.g., "Re"] was said [rather than "Rebecca"]) and a 4 second time delay was introduced. If participants grabbed preferred toys and then resisted parting with the toy, parents were instructed to gently remove the toy from the child's hands. On subsequent intervention opportunities, parents were instructed to move the toy farther from the child's reach and/or at the completion of the opportunity to pick up the toy for the child to see (prior to the child grabbing the toy).

Once the child emitted the correct response (i.e., gaze alternating), his/her parent delivered the consequences. The consequence procedure incorporated two pivotal response training strategies, namely, *natural consequences* (i.e., those functionally related to the target skill), followed by *activity interspersal* (i.e., easier or previously acquired activities are interspersed among the more challenging target skill) (Koegel et al., 1999). The natural consequences for joint attention involve a social interaction in which the adult and child look at the object while the adult comments on it (Bates, Camaioni, & Volterra, 1975), followed by continued activity related to the object (e.g., listening to the music playing on the toy piano) (Bakeman & Adamson, 1984). Idiosyncratic social reinforcers were incorporated into the natural consequences because the consequences inherent in the social interaction following joint attention are typically not reinforcing for children with autism. Idiosyncratic forms of social attention (e.g., loud "Wow!" or brief tickle), preferred by each child, were identified by parents. Activity interspersal involved alternating joint attention opportunities (the more difficult activity) with a play sequence related to the object of joint attention (the easier activity), a pattern that parallels that observed in typically developing children in which joint attention alternates with activity related to the object of joint attention. To illustrate, once the child demonstrated the correct response (i.e., gaze alternating) or was prompted to do so, his/her parent smiled, commented on the object of joint attention (e.g., "That's a neat toy!"), and provided idiosyncratic social reinforcement (e.g., tickle or loud "Wow!") (natural consequences including idiosyncratic social reinforcers) followed by activity interspersal in which both the parent and child looked at and/or listened to the toy (e.g., listening until the end of the song). If the child did not appear to enjoy the consequences (i.e., failed to smile, etc.), these consequences were paired with a food reinforcer and thinned, within and across sessions, from being delivered on each opportunity to being delivered intermittently (e.g., every 2-3 opportunities) until food was no longer used.

*Initiating joint attention.* After mastery of responding to others' joint attention directives (i.e., 90% independent correct responding on two consecutive sessions conducted on 2 days), initiating joint attention was taught. Initiating joint attention consisted of the child independently directing his/her parent's attention by alternating his/her gaze and pointing at the object following the S<sup>D</sup> (i.e., parent activated the toy). During each intervention opportunity, a toy was positioned, the parent delivered the S<sup>D</sup> for *initiate* (i.e., activated the toy), and the child was prompted to gaze alternate and point. The prompt for gaze alternating used during intervention targeting responding to others' joint attention directives was also used to prompt gaze alternating during intervention for initiating joint attention. Pointing was prompted (e.g., by modeling a point with the verbal instruction "Do this") as soon as the child looked up at his/her parent. Procedures for prompt fading and implementation of consequences were the same as

during intervention for responding to others' joint attention directives. That is, prompts were initially delivered immediately following the  $S^D$ , faded from most to least, and a 4 second time delay introduced. Consequences again consisted of natural consequences, involving idiosyncratic social reinforcers and activity interspersal. If participants grabbed preferred toys and then resisted parting with the toy, parents were instructed to gently remove the toy from the child's hands. On subsequent intervention opportunities, parents were instructed to move the toy farther from the child's reach and/or at the completion of the opportunity to pick up the toy for the child to see (prior to the child grabbing the toy). To illustrate, a toy (e.g., toy piano) was positioned within 1.5 meters of the child and his/her parent delivered the  $S^D$  for an opportunity to initiate joint attention by activating the toy. When the child initiated joint attention by gaze alternating and pointing at the toy, his/her parent then delivered natural consequences consisting of a comment (e.g., "Listen to the music!") paired with idiosyncratic social reinforcers (e.g., loud "Yay!") followed by activity interspersal consisting of the child and his/her parent listening to the piano for a few seconds.

For one participant, Danny, when first targeting initiating joint attention in the form of gaze alternating and pointing as described, his performance was variable with no consistent increase in initiating joint attention skills after 45 sessions. At the same time, results from ongoing research (Jones & Feeley, 2007) suggested the potential effectiveness of sequentially applying intervention procedures to the individual component forms of initiating joint attention. That is, the two component form of initiating joint attention was separated into its component parts (i.e., gaze alternating, pointing) with intervention applied to gaze alternating alone followed by intervention applied to the combined skill (i.e., gaze alternating and pointing) as was done initially and for the other 2 participants. Thus, to improve Danny's acquisition of the target initiating joint attention skills, the two component initiating joint attention response was separated into individual forms and intervention was sequentially applied.

When intervention procedures were implemented to target gaze alternating alone, the  $S^D$  was delivered (i.e., the toy activated), Danny *alternated his gaze* (so independently or in response to a prompt), and his parent delivered appropriate consequences. Following mastery (90% independent performance across two consecutive sessions and 2 days) of gaze alternating, intervention procedures were applied to teach gaze alternating combined with pointing (as was targeted for the other participants as well as initially for Danny), such that, the  $S^D$  was delivered (i.e., the toy activated), Danny *alternated his gaze and pointed* (or was prompted to do so), followed by delivery of consequences. Prompting and consequence procedures were the same as those used with the other participants (described previously).

*Generalization.* To examine generalization across materials, probe sessions were presented involving five generalization toys (i.e., those not used during intervention). Generalization probes prior to intervention were conducted at the same time as baseline. Generalization probes after mastery of joint attention skills were conducted within 1 month following mastery of both responding to others' joint attention directives and initiating joint attention. During opportunities with generalization toys, one opportunity to respond to others' joint attention directives and one opportunity to initiate joint attention was provided for each of five generalization toys. During baseline, opportunities with generalization toys were conducted in the same manner as baseline opportunities for the toys used during intervention (i.e., no prompting was provided and only typical joint attention consequences [smile and comment on the object] were provided contingent upon correct responses). Generalization opportunities following mastery of joint attention also did not involve prompting of a correct response, but joint attention consequences, as delivered during intervention, were utilized if the child produced an independent correct response (i.e., idiosyncratic reinforcement and activity interspersal for correct responses).

### *Reliability*

A graduate student recorded reliability data from videotaped recordings (obtained during weekly visits to participants' homes by the first author and/or research assistant) of a subset of joint attention opportunities (i.e., 10% of sessions for Rebecca, 19% for Justin, and 13% for Danny) distributed across each condition of the study.

The reliability coder independently recorded the child's joint attention responses, as per the definitions previously provided, as either independent or prompted. The number of agreements was divided by the total number of agreements plus disagreements and multiplied by 100 to obtain the percentage of agreements. An agreement was noted if both the reliability coder and parent scored the opportunity in the same way (as prompted or independent). For responding to others' joint attention directives, percent agreement cumulated across all opportunities was 100% of sessions for Rebecca, 100% for Justin, and 84% for Danny. For initiating joint attention, percent agreement cumulated across all opportunities was 86% of sessions for Rebecca, 90% for Justin, and 84% for Danny.

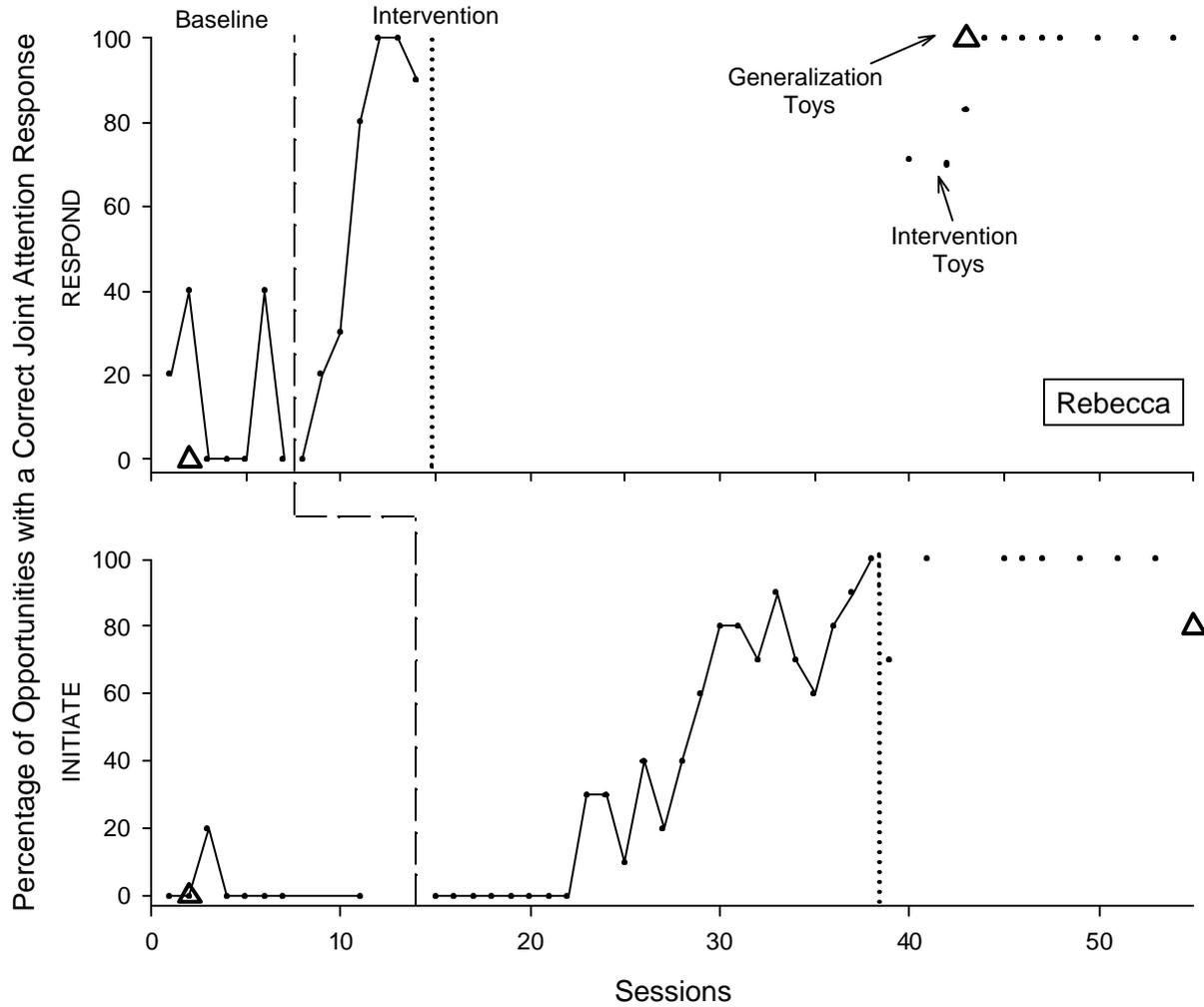
### *Fidelity of Implementation*

To examine whether parents implemented intervention as described, the same videotaped recordings used for reliability analyses were also examined for fidelity of implementation of intervention. Specifically, each joint attention opportunity was examined for the accurate presentation of each component of intervention (defined in Table 1); that is,  $S^D$ , prompting procedure, and provision of appropriate consequences. The number of times the parent correctly presented the intervention component was divided by the total number of correct plus incorrect presentations of that component, multiplied by 100, to obtain the percentage of correctly implemented intervention procedures. Across participants, procedural reliability ranged from 86-97% for the correct presentation of the  $S^D$ , 80-100% for the correct use of prompting procedures, and 77-96% for the delivery of appropriate consequences.

## *Results*

Figures 1-3 depict the percentage of opportunities during which a correct (independent) joint attention response (either responding to others' joint attention directives or initiating joint attention) occurred for each of the 3 participants. Performance for responding to others' joint attention directives is presented in the upper portion of each figure. Performance for initiating joint attention is presented in the lower portion of each figure for each participant. Mastery (i.e., 90% independent correct responding on two consecutive sessions conducted on 2 days) is indicated by the dotted vertical line. During baseline, the 3 participants exhibited 0% to 40% (i.e., 0-2 instances) correct (independent) responding to others' joint attention directives. Only Rebecca demonstrated initiating joint attention during baseline (0-20%, or 0-1 instance). Once intervention was introduced for responding to others' joint attention directives, Rebecca mastered this skill within 7 sessions, Justin within 54 sessions, and Danny within 107 sessions. All participants also mastered initiating joint attention. Rebecca and Justin mastered initiating joint attention within 24 and 117 sessions, respectively. Danny mastered initiating joint attention in the form of gaze alternating and pointing after a total of 107 sessions of intervention. Through 45 sessions of intervention procedures targeting joint attention in the form of both gaze alternating and pointing, Danny's performance (see Figure 3) of initiating joint attention remained variable with no clear improvement. At this time, the response taught to initiate joint attention was separated and each form taught sequentially. That is, after gaze alternating and pointing were taught for 45 sessions, gaze alternating alone was taught and, once mastered, the combination of gaze alternating and pointing was again taught. Danny acquired gaze alternating to initiate joint attention after 10 sessions of intervention.

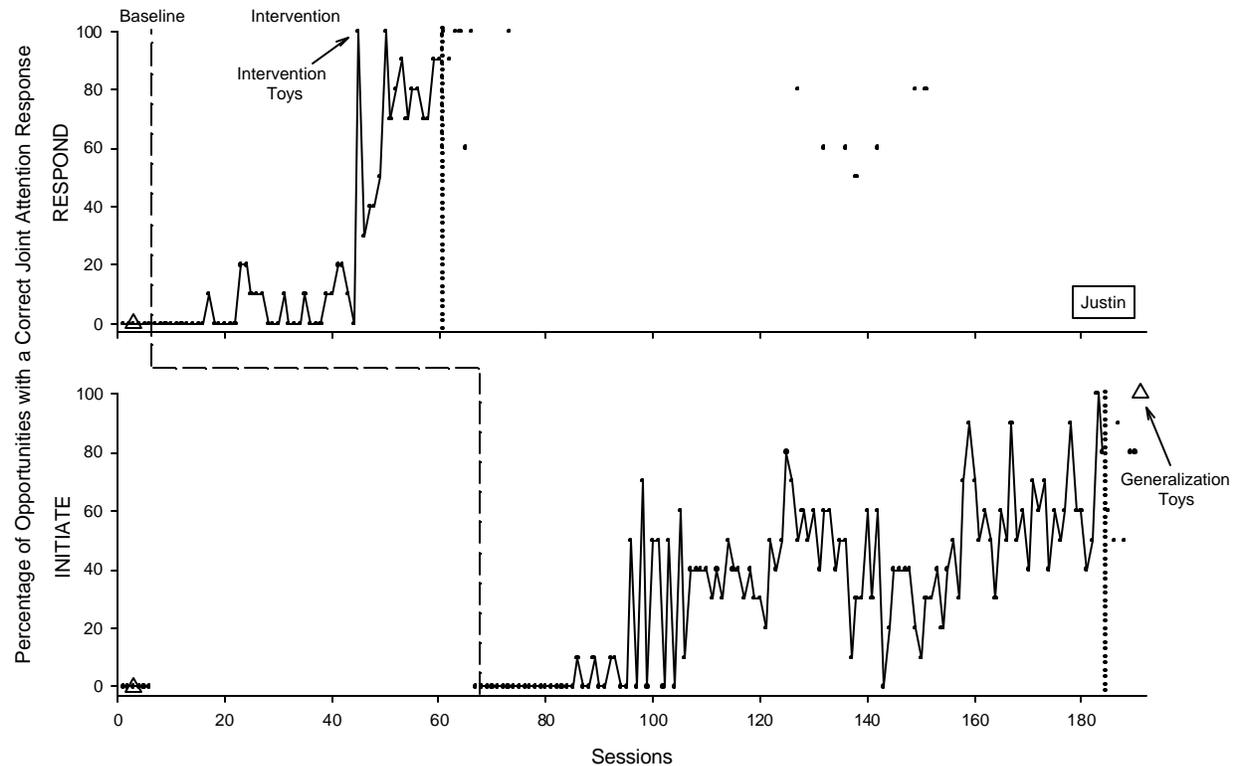
After another 52 sessions of intervention, he mastered gaze alternating and pointing to initiate joint attention.



**Figure 1.** Percentage of opportunities per session during which Rebecca produced a correct (independent) joint attention response during baseline and intervention with toys as well as during generalization probes involving novel toys. The upper panel shows data for respond and the lower panel, for initiate.

Figure 2, Next Page!

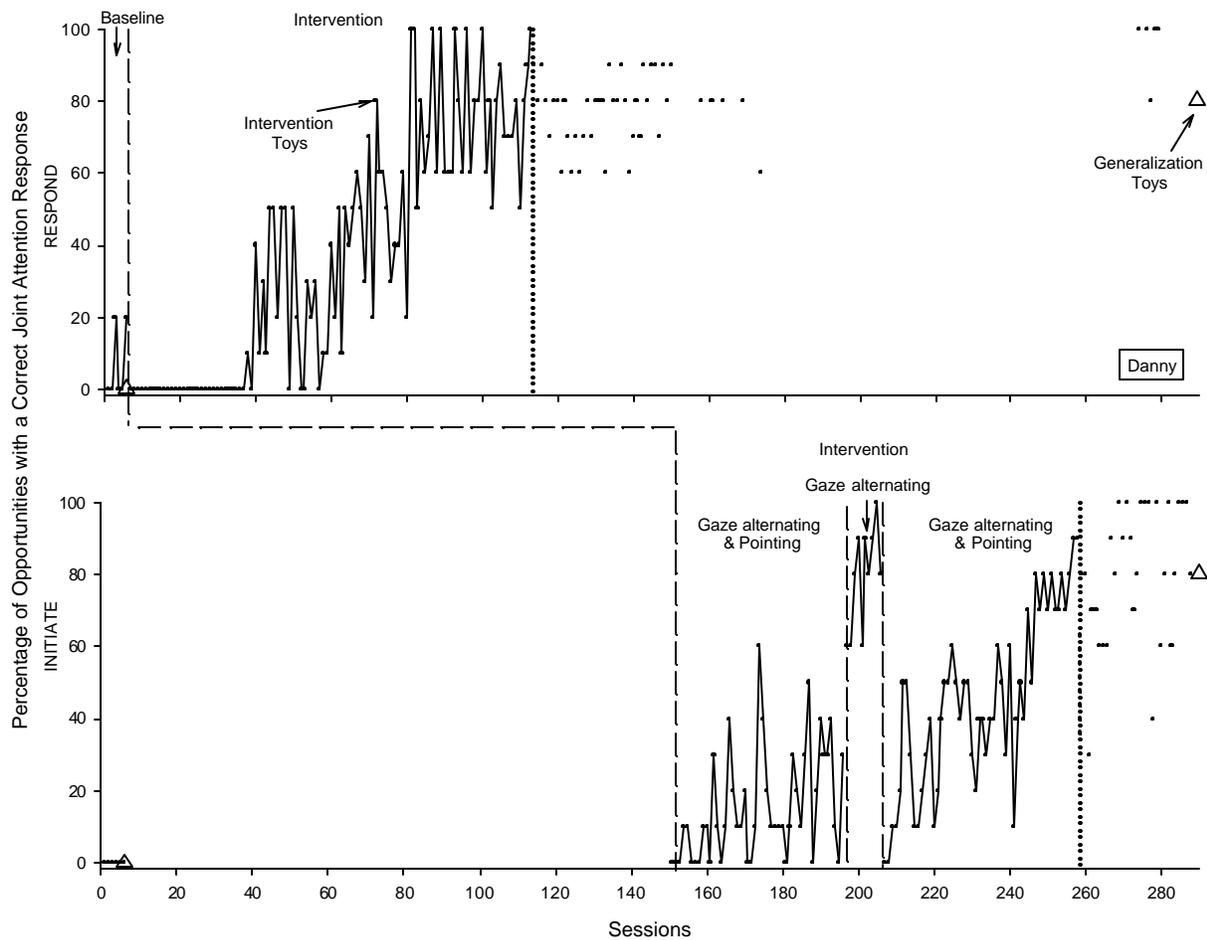
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**Figure 2. Percentage of opportunities per session during which Justin produced a correct (independent) joint attention response during baseline and intervention with toys as well as during generalization probes involving novel toys. The upper panel shows data for respond and the lower panel, for initiate.**

Across the 3 participants, once mastery of responding to others' joint attention directives was achieved (indicated by a dotted vertical line on Figures 1-3), intervention sessions continued for between 11 and 47 sessions conducted over 2 to 11 months. Performance continued to be high, ranging from 50-100% (mean 84%) across participants. Across the 3 participants, once mastery of initiating joint attention was achieved, intervention sessions continued for between 6 and 30 sessions conducted over 1 to 3 months. Performance again continued to be high, ranging from 30%-100% (mean 81%) across participants.

**Figure 3, Next Page!**



**Figure 3. Percentage of opportunities per session during which Danny produced a correct (independent) joint attention response during baseline and intervention with toys as well as during generalization probes involving novel toys. The upper panel shows data for respond and the lower panel, for initiate.**

Generalization (indicated by open triangles in Figures 1-3) was assessed with novel toys (i.e., those not used during intervention with no remote control adaptations). During baseline generalization probes, none of the 3 participants demonstrated either joint attention skill. Following intervention, all 3 participants demonstrated joint attention performance ranging from 80-100% during generalization probes. (Note that due to accidental loss of videotaped data no post-intervention generalization data were available for Justin.)

### Discussion

In this study, we extended intervention procedures addressing joint attention skill deficits in preschoolers with autism, to parent interventionists. Results indicate parents effectively implemented the intervention, successfully teaching joint attention skills to their preschoolers with autism. As well, participants demonstrated generalized performance. Results also indicate this package intervention can be used to efficiently teach both joint attention skills (i.e., responding to others' joint attention directives and

initiating joint attention) to children with autism, with additional evidence of differences in the two types of joint attention skills.

Replicating previous findings regarding the effectiveness of discrete trial instruction and pivotal response training strategies, in this study we taught parents (natural intervention agents) to implement these procedures in their homes (natural intervention environments), resulting in the acquisition of joint attention skills in their young children with autism. Parents play a vital role in intervention for their children with autism (e.g., Anderson et al., 1987; Birnbrauer & Leach, 1993; Harris et al., 1983; Lovaas 1987). As these results demonstrate, given effective methodology, parents can successfully intervene on key social-communication skills such as joint attention in their child's natural environment (i.e., home). The effectiveness of parent implemented joint attention intervention suggests that joint attention intervention can be an integral part of parent training programs, helping families address the key social-communicative deficits of autism.

Parent implemented joint attention intervention also resulted in joint attention performance that generalized to novel toys. The toys used during joint attention intervention were chosen based on their salience for each child, possessing specific characteristics likely to elicit joint attention for each child (Jones & Carr, 2004; Jones et al., 2006). In particular, joint attention intervention toys were highly preferred, presented with only one toy in view at a time, and presented in close proximity to the child. Although generalization toys were similar to intervention toys with respect to type of toy (e.g., stuffed animals, cars), auditory and visual features (i.e., illuminated, made noise, and/or moved), and were presented only one at a time, in close proximity, the generalization toys were not specifically preferred by each child (i.e., generalization toys were chosen based on their design for preschoolers, not on the idiosyncratic preferences of each child). Thus, the generalization toys were perhaps less salient than intervention toys. Nonetheless, participants demonstrated generalized performance with these less salient toys. Still at question is the extent of generalization to a wider variety of objects possessing a variety of auditory and visual features, at varying distances, within an array of other objects. Specifically, we did not examine performance when objects that do not make noise, light up, or move are presented amongst several other objects, across the room from the child (e.g., 3 meters away). Assessment of such performance, followed by systematic implementation of intervention across this range of stimuli, would ensure children with autism are taught joint attention skills in the full range of situations in which typically developing children demonstrate joint attention.

In addition to ensuring that joint attention skills are demonstrated within the full range of situations in which typically developing children demonstrate joint attention, it is important to establish joint attention to a similar level of frequency as seen in typically developing children. In future research it will be important to examine joint attention within naturalistic interactions (e.g., game playing activities), establish the frequency with which typically developing children demonstrate joint attention during such activities, and then teach children with autism to demonstrate initiating joint attention with the same frequency that typically developing children do.

Not only were parents able to implement intervention to teach joint attention skills, but they did so to successfully teach both types of joint attention (i.e., responding to others' joint attention directives and initiating joint attention). This is consistent with our earlier work in which teachers successfully utilized discrete trial instruction and pivotal response training strategies to teach both types of joint attention skills (Jones et al., 2006). The present results also indicate differences, as found in previous research (Jones et al.), in the rate of acquisition between the two joint attention skills. In our previous research (Jones et al., 2006), for 4 of the 5 participants, initiating joint attention required a larger number of intervention sessions to master than responding to others' joint attention directives. In the present study, differential rate of acquisition was also noted between responding to others' joint attention directives and initiating joint attention, with acquisition of responding requiring fewer sessions for Rebecca and Justin, and the same number of sessions for Danny.

The difference in rate of acquisition likely reflects differences in the two types of joint attention skills in terms of the role of social consequences (Dube, MacDonald, Mansfield, Holcomb, & Ahern, 2004). Differences may also be related to the multicomponent nature of initiating joint attention in contrast to responding to others' joint attention directives. Responding to others' joint attention directives consisted of gaze alternating, while initiating joint attention consisted of two behaviors, gaze alternating and pointing. Because the two component nature of initiating joint attention may result in longer acquisition, separating the two component response and teaching the forms sequentially, may result in an increase in the rate of acquisition.

In this study, intervention was applied sequentially to the component forms of initiating joint attention for one participant, Danny, after 45 sessions of intervention. This resulted in Danny rapidly acquiring gaze alternating alone, however, he continued to require a large number of intervention sessions to acquire the two component response (i.e., gaze alternating and pointing). It is not clear if separating the target response significantly improved Danny's rate of acquisition, as Danny continued to require many intervention sessions and the cumulative effects of first targeting the combined skill may have influenced the results. It is important to note that separating the component skills of initiating joint attention was not necessary for the other participants, most notably for Rebecca, who acquired initiating joint attention rather quickly. Whether the remaining participant's (i.e., Justin's), rate of acquisition of initiating joint attention, would have improved if the component forms of initiating joint attention had been targeted separately for intervention is not known (this strategy was not implemented with Justin because, at the time, results of our other research suggesting the utility of sequentially introducing intervention [Jones & Feeley, 2007] were not yet available). In future research it will be important to examine the relative benefits of separating initiating joint attention into component forms compared with teaching the combined form of initiating joint attention.

In this study we taught parents to implement joint attention intervention procedures. The nature of the preschool program that all participants attended also required regular parent involvement in parent training. The parents in this study had been an integral part of the intervention that their children received outside of their participation in this study. This may have affected the success of this intervention, because there was likely pre-established stimulus control on the part of the parents. It is also likely that the parent training provided at the preschool enhanced parent ability to implement the joint attention procedures, because they already possessed basic skills within their repertoire (e.g., effective delivery of reinforcement and use of prompts). We cannot determine the extent of the impact of existing stimulus control and/or sophisticated knowledge of intervention procedures on successful parent implementation of joint attention intervention and child acquisition of joint attention skills in this study. However, if existing stimulus control and/or knowledge of intervention procedures influenced outcome, this further provides a strong rationale for the inclusion of caregivers in the intervention protocols of young children with autism. The extensive parent training parents received outside of this study is not a prerequisite for joint attention intervention, but may facilitate parent implementation of joint attention intervention and is certainly in keeping with best practices.

In this study we demonstrated that, when parents are specifically taught effective intervention strategies, they can successfully intervene on key social-communicative deficits such as joint attention. In addition, given the high incidence of autism, with children diagnosed at increasingly younger ages, joint attention should be an area of focus, not only in programs where children have already been diagnosed with autism, but in parent training programs that target all new parents, those of typically developing infants as well. An awareness of joint attention, strategies to assess it, as well as strategies that can foster its development can easily be incorporated into parent training programs. Doing so has the potential to curtail the debilitating effects of the absence of the development of joint attention, if the child does in fact demonstrate an autism spectrum disorder.

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