Research in Autism Spectrum Disorders

This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier’s archiving and manuscript policies are encouraged to visit:

http://www.elsevier.com/copyright
Establishing response and stimulus classes for initiating joint attention in children with autism

Emily A. Jones*

Department of Psychology, C. W. Post Campus of Long Island University, 720 Northern Boulevard, Brookville, NY 11548, United States

ARTICLE INFO

Article history:
Received 11 August 2008
Accepted 15 August 2008

Keywords:
Autism
Initiating joint attention
Response class
Stimulus class

ABSTRACT

The absence of the fundamental skill of initiating joint attention reflects the social-communicative impairment characterizing autism. Initiating joint attention is related to social and communication development as well as intervention outcomes for children with autism. A behaviorally based intervention was used to teach an expanded class of responses for initiating joint attention consisting of combinations of nonverbal and verbal forms. The class of stimuli was also expanded to include routine activities involving a diverse array of events that occasion joint attention initiations during interactions with both adults and peers. The importance of addressing sophisticated forms of initiating joint attention within the context of a variety of stimuli ensuring children with autism possess skills similar to their typically developing peers is discussed.

© 2008 Elsevier Ltd. All rights reserved.

Initiating joint attention is one type of joint attention in which a child directs another person’s attention for the purpose of sharing attention with that person about objects/events in the environment (Mundy, Sigman, Ungerer, & Sherman, 1986). Joint attention is a uniquely social skill, resulting in social consequences, in contrast to other communicative behaviors, for example requesting, for which the function is to obtain something (such as an object) (Dube, MacDonald, Mansfield, Holcomb, & Ahern, 2004; Mundy, 1995; Mundy & Neal, 2001). The form of a child’s initiation of joint attention involves the coordination of several behaviors including gaze alternation (i.e., child looks at the object, back at his/her partner, and back at the object), gesture (e.g., pointing), and/or verbalization (i.e., commenting). Children initiate joint attention about a nearly endless

* Present address: Department of Psychology, Queens College, City University of New York, 65-30 Kissena Blvd., Flushing, NY 11367, United States. Tel.: +1 718 997 3054; fax: +1 718 997 3257.

E-mail addresses: Emily.jones@liu.edu, emily.jones@qc.cuny.edu.

1750-9467/$ – see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.rasd.2008.08.004
number of different stimuli that arise during the natural course of interactions including specific objects (e.g., balloon) and events (e.g., barking dog), some within the child’s hand (e.g., a leaf he/she picked up) and others at a distance (e.g., a person riding on a bicycle). The acquisition and coordination of such behaviors as gaze alternation, gesture, and verbalization is especially challenging for young children with autism, particularly for the purposes of sharing attention with another person (Mundy et al., 1986). Even for those children with autism who acquire sophisticated repertoires, the stimuli that occasion joint attention may be very limited.

The deficit in initiating joint attention appears to be the hallmark of the social-communicative impairment that characterizes autism (Mundy & Crowson, 1997). Joint attention, in particular initiating joint attention, is related to both language (Bono, Daley, & Sigman, 2004; Loveland & Landry, 1986; Mundy & Gomes, 1998; Smith, Mirenda, & Zaidman-Zait, 2007; Toth, Munson, Meltzoff, & Dawson, 2006) and social development (Sheinkopf, Mundy, Claussen, & Willoughby, 2004; Travis, Sigman, & Ruskin, 2001; Vaughan et al., 2003). Recent studies show that the presence of joint attention skills positively influences intervention outcomes in children with autism (Kasari, Paparella, Freeman, & Jahromi, 2008; Yoder & Stone, 2006). In comparison to interventions that do not focus on joint attention, specifically teaching joint attention is related to greater improvements in language (Kasari et al., 2008).

A number of recent studies have examined interventions to address this fundamental skill (Hwang & Hughes, 2000; Jones, Carr, & Feeley, 2006; Kasari, Freeman, & Paparella, 2006; Whalen & Schreibman, 2003) providing evidence-based strategies for teaching some joint attention skills to children with autism. Although initiating joint attention has been addressed in several intervention studies, it appears to be a difficult skill to establish. In Jones et al., all participants acquired skills to initiate joint attention; however, some required a substantially larger number of intervention sessions than to acquire responding to others’ joint attention directives (another type of joint attention in which children respond to another person’s bid for joint attention about an object/event). In other studies, some, but not all, participants acquired initiating joint attention (Whalen & Schreibman, 2003) or only limited improvement was observed (Hwang & Hughes, 2000). Thus, further examination of procedures to specifically address the acquisition of initiating joint attention is warranted.

The studies in which children with autism were taught to initiate joint attention sampled a limited number of forms of the class of responses typically developing children use to initiate joint attention. Specifically, single forms of initiating joint attention have largely been targeted for intervention; for example, gaze alternation (i.e., child looks at object, at adult, and back at the object) or gesture (e.g., point, show) (e.g., Hwang & Hughes, 2000; Kasari, Freeman, & Paparella, 2001, 2006; Whalen & Schreibman, 2003). Only three studies (Jones et al., 2006; Jones & Feeley, 2007; Warren, Yoder, Gazdag, Kim, & Jones, 1993) examined teaching combinations of forms (e.g., gaze alternating and pointing), and only one study examined vocal aspects of joint attention (Warren et al., 1993). The combination of multiple forms (e.g., gaze alternating, gesture, and verbalization) reflects the increasingly sophisticated class of response forms of initiating joint attention characteristic of typically developing children.

Not only do typically developing children possess multiple response forms to initiate joint attention, but they initiate joint attention in the presence of a wide and varied stimulus class (i.e., a wide range of materials and corresponding events that cue joint attention initiations, with a variety of communicative partners) including objects/events that occur within everyday activities or routines (e.g., playing games or walking in the neighborhood) which have not been systematically examined in the intervention literature (Jones et al., 2006). Typically developing children also engage in joint attention with both adult caregivers and peers (Bakeman & Adamson, 1984). Peer relations are a particular area of difficulty for children with autism. However, no studies specifically teaching joint attention skills have involved peers.

In the present series of two exploratory studies, intervention was first applied to establish an increasingly sophisticated response class including both nonverbal (i.e., gaze alternating and pointing) and verbal (i.e., commenting) forms of initiating joint attention (Study 1). Intervention was then applied to address an expanded class of stimuli than in previous research including routine activities and multiple joint attention partners (i.e., both adults and peers) (Study 2).
1. Study 1: a sophisticated response class for initiating joint attention

1.1. Method

1.1.1. Participants

Two children participated in this study following their parents’ permission for involvement. Luke and Seth were diagnosed with autism spectrum disorders by doctors not associated with this research. Criteria for participation included an effective prompt for eye contact and proficiency in responding to others’ joint attention bids (i.e., following another’s bid to share attention on an object/event by alternating gaze between the object and adult), but the absence of initiating joint attention (i.e., failing to draw another’s attention to objects/events in the environment by alternating gaze, gesturing, and/or verbalizing). Luke spontaneously demonstrated responding to others’ bids for joint attention and Seth had previously been taught (using procedures similar to those in Jones et al. (2006)) to respond to others’ joint attention bids.

Luke, age 3 years 2 months at the start of intervention, spent his full day (5 days per week) within a center-based program. Evaluations conducted prior to beginning joint attention intervention included the Stanford-Binet 5th edition (SB5; Roid, 2003), Preschool Language Scale 4th edition (PLS-4; Zimmerman, Steiner, & Pond, 2002), and Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla, & Cicchetti, 1984) (obtained from records at Luke’s center-based program). On the SB5, Luke demonstrated a standard score of 66 (1st percentile). On the PLS-4, Luke’s overall (standard score = 53), auditory comprehension (standard score = 57), and expressive language (standard score = 58) scores fell at the 1st percentile. On the VABS, Luke’s composite score was in the low range (standard score = 68, 2nd percentile) with his communication score also falling in the low range (standard score = 64, 1st percentile) and socialization score falling in the moderately low range (standard score = 75, 5th percentile).

Seth was 4 years 11 months at the start of this study and, at the time, attended the center-based program all but two mornings each week when he attended a community preschool program with his teacher assistant. Seth’s teacher had conducted an evaluation prior to beginning joint attention intervention using the Preschool Evaluation Scale (a rating scale of major developmental domains for children from birth through 72 months of age; McCarney & Anderson, 1992). Seth’s overall composite score fell in the low average range (3rd percentile) with both his expressive language and social emotional subscale scores falling in the below average range (standard scores of 1 and 2, respectively).

1.1.2. Setting and interventionists

Joint attention intervention was implemented in a small instructional room by each child’s teacher (who had certification in special education) and at least one teacher assistant at the center-based program. Teachers and teacher assistants (both referred to as “interventionists”) participated in ongoing training (didactic and practical) in the principles of applied behavior analysis at the preschool. Data were collected by the interventionist following each opportunity.

1.1.3. Materials

For Luke, joint attention was taught using toys as the objects of joint attention, as had been done in previous research (Jones et al., 2006; Jones & Feeley, 2007). Toys were selected to highlight characteristics that elicit joint attention, namely, interest (i.e., preferred toys as reported by Luke’s interventionists), novelty (i.e., 20 different preferred toys), and salience (i.e., could be activated [made noise, lit up, and/or moved] such as a singing stuffed Elmo™ or a piano with lights) (Jones & Carr, 2004). Toys were rigged with a button attached to a wire (approximately 1.5 m in length) so the interventionist could activate the toy as part of the discriminative stimulus (SD) for initiating joint attention without touching it (because touching the toy could be considered a gesture directing the child’s attention to the toy).

When asked about preferred materials for use during joint attention intervention, Seth’s interventionists suggested games because of Seth’s age (almost 5 years) and because Seth had acquired extensive game playing skills, enjoyed playing games, and did so regularly with his
interventionists. To increase novelty, several preferred games were used during intervention including Boggle Jr.™ (players chose a picture card with the corresponding word that they spelled with letter cubes), Mighty Mind® (players chose a picture card and used different shaped blocks to create the picture design), opposites cards (players matched pieces depicting pictures of opposites such as wet/dry and big/little), and Sesame Street™ 123 Number Jumble (players spun a spinner to identify the corresponding numbered piece creating various characters). Seth was able to play the games with minimal prompting.

1.1.4. Design

A multiple baseline probe design across three increasingly sophisticated combinations of forms of initiating joint attention replicated across two participants was conducted. Intervention was first applied to teach gaze alternating, then gaze alternating and pointing, and finally gaze alternating, pointing, and verbalizing.

1.1.5. Response definitions

**Gaze alternating** consisted of the child independently alternating his gaze (i.e., looking at the target object, at the interventionist, and back at the target object) within 4 s of the presentation of the discriminative stimulus (SD). **Gaze alternating and pointing** consisted of the child independently, within 4 s of the SD, alternating his gaze and pointing (i.e., extending his arm and index finger in the direction of the object/event), either simultaneously with, or immediately following, gaze alternating.

**Gaze alternating, pointing, and verbalizing** consisted of the child independently, within 4 s of the SD, alternating his gaze, pointing, and verbalizing (either simultaneously with, or immediately following, gaze alternating and pointing). Verbalizations were chosen consistent with each child’s existing verbal repertoire. Luke’s verbalizations consisted of single words: either a generic comment (i.e., “Wow!”) or, for toys of which Luke knew the names, a specific object label (e.g., “Bird!”). For Seth, verbalizations consisted of two different multiword phrases used dependent upon the discriminative stimulus (SD) associated with the corresponding component of the routine: for example, “I made ___.” (e.g., in the presence of the completed materials on his turn) or “I got a ___.” (e.g., in the presence of the card for his turn).

1.1.6. Procedure

1.1.6.1. Baseline. To determine each participant’s performance of initiating joint attention, opportunities were presented in which the child was provided with a 4 s interval to initiate joint attention (i.e., alternate his gaze; alternate his gaze and point; alternate his gaze, point, and verbalize) following the SD. If the child demonstrated a correct response, the interventionist delivered the typical joint attention consequences (e.g., smile and comment on the object). If an incorrect response or no response occurred within 4 s of the SD, the opportunity was terminated (i.e., the toy was removed or the next step in the game was presented), and the interventionist did not respond further. For Luke, who was taught joint attention with toys, one baseline opportunity to initiate joint attention was conducted for each of 20 toys distributed across three sessions conducted over 2 days. For Seth, the Boggle Jr.™ game was introduced during one baseline session consisting of five opportunities to initiate joint attention.

1.1.6.2. Intervention. Intervention procedures were similar to those used in previous research (Jones et al., 2006; Jones & Feeley, 2007). A session of joint attention intervention occurred approximately one time per day and involved 10 opportunities for Luke and between 3 and 16 opportunities (depending on the game) for Seth. During each opportunity, the SD occurred, a correct response prompted as necessary, and corresponding consequences delivered. For Luke, the interventionist positioned between one (only one toy was presented initially) and five toys (up to five toys were presented as Luke demonstrated proficiency with gaze alternating) less than 1.5 m away (to ensure the toys were close enough to elicit interest and attention). The SD for initiating joint attention was defined as a toy being activated (i.e., with sound, light, and/or movement). For Seth, he and the interventionist sat at a table on which a game was placed. The natural course of the game dictated the
occurrence and number of opportunities rather than the interventionist controlling the delivery of an SD (i.e., the activated toy for Luke). Several different S^D^s for initiating joint attention were identified. For example, during the Sesame Street™123 Number Jumble game, the S^D^s included the character card to be completed, the spinner stopping on a number, and the completed character.

The consequences for initiating joint attention incorporated two pivotal response training strategies (i.e., natural consequences and activity interspersal) to increase children’s motivation (Koegel, Koegel, Harrower, & Carter, 1999; Pierce & Schreibman, 1995). Natural consequences consisted of praise, preferred social attention (e.g., clapping or brief tickle), and the interventionist’s comment on the object of joint attention, followed by activity interspersal consisting of a period of interaction (e.g., 2–5 s) with the object of joint attention (i.e., the easier activity interspersed between the more difficult initiations of joint attention). For example, following an initiation of joint attention, the interventionist said “Nice looking!” (i.e., delivered praise), briefly tickled (i.e., provided preferred social attention), and commented “It’s Elmo™!” and then she and Luke danced with Elmo for a few seconds (i.e., activity interspersal). Specific prompting procedures for each form of initiating joint attention are described next.

Gaze alternating. The interventionist prompted gaze alternating by gently touching the child’s chin (directing his gaze to the toy, to the interventionist, and back to the toy). For Luke, prompts were faded across intervention opportunities using a most to least prompting procedure followed by implementation of a time delay. That is, the response was prompted using the highest level prompt (i.e., touching Luke’s chin) immediately following the S^D^ (0 s time delay), then faded to a partial prompt (i.e., interventionist moved her finger toward Luke’s chin, but did not touch his chin), and a 4 s time delay was introduced with a minimal prompt consisting of an expectant look (i.e., looking at child with raised eyebrows; e.g., Hwang & Hughes, 2000; Kozielski, 1991). For Seth, the prompt was faded by implementation of a time delay (i.e., a prompt delivered immediately [0 s time delay] followed by the introduction of a 4 s time delay).

Gaze alternating and pointing. Once initiating joint attention in the form of gaze alternating was mastered (i.e., 80% independent initiating across two consecutive sessions conducted over 2 days), intervention procedures were applied to teach a combination of forms involving both gaze alternating and pointing to initiate joint attention. Intervention opportunities were implemented in the same manner as in teaching gaze alternating to initiate joint attention, however, in this condition, while alternating their gaze, participants were also specifically prompted to point.

For Luke, when he looked at the interventionist, the interventionist prompted him to point by providing a model and physical (i.e., hand over hand) assistance. The prompt was faded using a most to least prompt hierarchy followed by a time delay in which pointing was physically prompted and modeled, faded to a quick model of a point (instead of maintaining the model until Luke pointed) delivered at the interventionist’s side (rather than extended outward toward the toy), and then a 4 s delay was introduced. For Seth, hand over hand assistance was faded using a most to least prompt hierarchy followed by implementation of a time delay (i.e., the physical prompt was faded to a physical model, and then a 4 s delay was introduced). (If Luke or Seth did not engage in the previously taught response [i.e., gaze alternating], he was prompted to alternate his gaze and then prompted to point.) Consequences were the same as during intervention addressing gaze alternating, but only delivered once the child emitted the combination of both forms (i.e., gaze alternating and pointing) to initiate joint attention.

Gaze alternating, pointing, and verbalizing. Once initiating joint attention in the form of gaze alternating and pointing was mastered, intervention procedures were applied to teach a more sophisticated combination of forms involving gaze alternating, pointing, and verbalizing. Verbalizations were chosen consistent with each child’s existing repertoire and were prompted as soon as the child alternated his gaze and pointed. For Luke, the interventionist provided a verbal model (i.e., “Say ‘Wow’” or “Say [name of toy]”) to prompt the verbalization. The verbal model was faded using a most to least prompt hierarchy paired with a time delay (i.e., the interventionist’s verbal model [e.g., “Say ‘Wow’”] was faded to mouthing the initial consonant [e.g., “W”] without any sound, followed by the introduction of a 4 s delay).

Seth’s verbalizations were prompted using a stimulus prompt consisting of a printed script (e.g., Krantz & McClannahan, 1993). Each target phrase (i.e., “I got a ___” or “I made ___.”) was written on a
white index card (7.5 cm x 12.5 cm). Because scripts had been used successfully with Seth in the past to teach a variety of other social-communicative skills, Seth readily read the phrase on the card with minimal prompting (i.e., modeling on occasion). As soon as Seth looked at the interventionist (while gaze alternating), the interventionist presented the script in front of Seth with the phrase visible. She faded the script by presenting the card facedown so the phrase was not visible, and finally a time delay (i.e., 4 s delay) was introduced before presenting the card. (If Luke or Seth did not engage in the previously taught responses [i.e., gaze alternating and pointing], he was prompted to emit those target responses and then prompted to verbalize.)

Consequences were the same as those used previously, but were only delivered once the child initiated joint attention using the combination of all three forms (i.e., gaze alternating, pointing, and verbalizing). Again, mastery criterion was 80% independent (correct) initiating across two consecutive sessions conducted over 2 days of intervention.

1.1.7. Reliability
The first author and a graduate student coded reliability data from videotaped recordings for a subset of joint attention opportunities (i.e., 15% of opportunities for Luke and 17% for Seth) distributed across each condition of the study. Videotaped recordings were obtained on approximately weekly visits to the center-based preschool. To examine response reliability, an agreement was noted if the reliability coder and interventionist scored the child’s performance on each opportunity in the same way (as prompted or independent). Reliability is reported as mean percent agreement. The number of agreements was divided by the total number of agreements plus disagreements and multiplied by 100 to obtain the percentage of agreement. Mean percent agreement cumulated across all opportunities was 84% for Luke and 87% for Seth.

1.1.8. Fidelity of implementation of intervention
To examine fidelity of implementation of intervention, videotaped recordings (the same recordings coded for reliability) were examined for the accurate presentation of each component of intervention, that is, S0, prompting procedure, and provision of appropriate consequences. The number of times the interventionist correctly presented the instructional 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, correct delivery of the S0 was 100% for both Luke and Seth, correct use of prompting procedures was 97% for Luke and 84% for Seth, and delivery of appropriate consequences was 90% for Luke and 100% for Seth.

1.2. Results and discussion
Figs. 1 and 2 depict the percentage of independent joint attention initiations for Luke and Seth, respectively. During baseline, Luke demonstrated between 1 and 3 instances (25–60%) of the first form of initiating joint attention (i.e., gaze alternating), however, not to criterion (i.e., 80% independent gaze alternating). He also demonstrated one instance of pointing paired with gaze alternating, however, he never verbalized. Following the introduction of intervention applied to gaze alternating, Luke acquired gaze alternating to initiate joint attention within 15 sessions. Mastery (80% independent initiations of joint attention across two consecutive sessions conducted over 2 days) is indicated by an asterisk (*) in Fig. 1. Luke acquired the second form of initiating joint attention (i.e., the combination of gaze alternating and pointing) within another 19 sessions of intervention and the final form of initiating joint attention (i.e., the combination of gaze alternating, pointing, and a one word verbalization [e.g., “Wow!”]) within another 22 sessions.

During baseline, Seth did not demonstrate the first target joint attention response (i.e., gaze alternating), nor did he demonstrate pointing or verbalizing. Following the introduction of intervention, Seth acquired gaze alternating to initiate joint attention within five sessions, the combined form of gaze alternating and pointing within six sessions, and the combined form of gaze alternating, pointing, and verbalizing within another five sessions of intervention. Seth’s performance of the three-component response (i.e., gaze alternating, pointing, and verbalizing) following mastery continued to be high (range: 60–100% with only 3 of 13 sessions falling below criterion).
The results of Study 1 demonstrate that intervention procedures used in previous research (Jones et al., 2006; Jones & Feeley, 2007) to address joint attention deficits can be applied to establish a response class of increasingly sophisticated combinations of forms (including verbal and nonverbal components) for initiating joint attention that mirror those shown by typically developing peers. These results should be interpreted with caution given that only one initial baseline session (albeit with the absence of any of the joint attention behaviors) was conducted for Seth. Interestingly, intervention procedures were applied within a game routine for Seth. Due to child preferences, this was only done for Seth.

Fig. 1. Percentage of opportunities per session in which Luke produced an independent joint attention initiation during baseline and intervention with toys. Mastery is indicated by an asterisk (*).
The purpose of Study 2 was to explore the application of joint attention intervention to expand the class of stimuli occasioning joint attention initiations including different materials (and their corresponding SDs) representative of diverse routines with two types of partners (adult interventionists and peers). Because different response forms are appropriate with different materials, the response class was further expanded to include gaze alternating combined with multiple gestures (i.e., pointing and showing) and more complex verbalizations (i.e., saying “[Name], [comment]”).

**Fig. 2.** Percentage of opportunities per session in which Seth produced an independent joint attention initiation during baseline and intervention with games. Mastery is indicated by an asterisk (*).

2. **Study 2: class of stimuli that occasion joint attention initiations**

The purpose of Study 2 was to explore the application of joint attention intervention to expand the class of stimuli occasioning joint attention initiations including different materials (and their corresponding SDs) representative of diverse routines with two types of partners (adult interventionists and peers). Because different response forms are appropriate with different materials, the response class was further expanded to include gaze alternating combined with multiple gestures (i.e., pointing and showing) and more complex verbalizations (i.e., saying “[Name], [comment]”).
2.1. Method

2.1.1. Participant

Luke, who had acquired skills to initiate joint attention with toys, but not routines, in Study 1, participated in Study 2. At the time that Study 2 began, Luke attended the center-based program 5 days per week and a community preschool with typically developing peers three afternoons each week (with an interventionist). Only Luke participated in Study 2 as Seth had transitioned to an elementary school program (with which I did not have a research relationship) soon after mastering initiating joint attention in Study 1, thus, he was not able to continue to participate in this research.

2.1.2. Setting and interventionists

2.1.2.1. Intervention with adults. Joint attention intervention was conducted within Luke's center-based program by the same interventionists who had implemented intervention in Study 1.

2.1.2.2. Generalization with peers. Generalization across joint attention partners was evaluated by examining Luke's initiation of joint attention, taught by and with adults during three routines (i.e., puzzles, games, and lunch), during interactions with his peers during the same types of routines. Generalization probes for the puzzle routine occurred during free play with peers at Luke's community preschool. Because game activities occurred infrequently at Luke's community preschool and lunch did not occur at the community preschool, generalization of joint attention skills to peer partners for both of these routines occurred with peers at Luke's center-based program.

2.1.2.3. Intervention with peers. Because Luke did not spontaneously initiate joint attention with his peers during generalization probes, intervention was introduced with Luke's peers. Intervention with peers occurred during lunch (for the lunch routine) and during play sessions (for both the puzzles and games routines) with Luke's peers at the center-based program. Luke was familiar with all of the peers as he was involved in play, circle time, and dyadic instructional sessions with them on a regular basis. Unfortunately, due to the ending of the school year for Luke's community preschool, neither additional intervention nor generalization probes with peers could be conducted at Luke's community preschool.

2.1.3. Routines and materials

Three typical preschool age routines (i.e., puzzles, games, and lunch) and their corresponding materials were used for intervention. Luke's teacher identified these three routines as age appropriate, of interest to Luke, and situations that would be enhanced by Luke's acquisition of joint attention skills. To increase novelty, two activities were used within the puzzle and game routines (i.e., two puzzles and two games). Luke was familiar with and readily played each puzzle and game. Each game and puzzle was also chosen because it was specifically preferred by Luke (as reported by his interventionists). The puzzle routine included a hand puzzle consisting of a picture of two hands with multicolored fingers (12 pieces in all) and Parquetry Blocks™ consisting of colored shapes used to create a picture following a model. The game routine included Candyland™ (players chose a card designating the corresponding space on the board to move their game piece to reach the end of the path) and Bingo™ (players placed chips over the number on their playing card corresponding to the one chosen from the pile of number cards). The lunch routine involved Luke eating lunch with his peers at the center-based preschool program. Generalization probes involved the same routines.

2.1.4. Design

A multiple baseline probe design across three routines (i.e., puzzles, games, and lunch time) was used to expand the class of stimuli occasioning joint attention initiations with interventionists. Following generalization probes with peers, intervention was simultaneously introduced across all three routines during interactions between Luke and his peers.
2.1.5. Response definition

In Study 1, Luke had acquired a combination of three forms (i.e., gaze alternating, pointing, and one word verbalizations) to initiate joint attention with toys. Due to the nature of the routine activities in Study 2 and Luke’s expanding verbal repertoire at the time, this three-component response was expanded to multiple gestures and more complex verbalizations. During games and lunch Luke was taught to show (i.e., holding an object with a bent arm up towards the face of another person) (Carpenter, Nagell, Tomasello, Moore, & Butterworth, 1998) the item in his hand (e.g., card he just picked). Otherwise, he was taught to point (e.g., to the finished puzzle). In addition, Luke was taught to say the name of the person with whom he was initiating joint attention in combination with a comment (e.g., “[Name], I got a ___!”). Therefore, Luke’s joint attention initiations involved gaze alternating, gesturing, and verbalizing within 4 s of the SD.

Teaching joint attention skills should not only reflect the forms used by typically developing children in the situations in which typically developing children engage in joint attention, but also the frequency with which typically developing children engage in joint attention. Therefore, criterion for mastery was identified through comparisons with typically developing children from our ongoing research (Jones & Feeley, 2008) on joint attention within routines that was underway as Study 2 commenced. Nine (three girls and six boys) typically developing preschoolers (ages 3 years, 8 months to 4 years, 3 months) were videotaped engaging in familiar routine activities (e.g., book reading, toy play) for 5 min with their mothers. A graduate assistant coded the interactions for the occurrence of initiating joint attention (i.e., gaze alternating, gesture, and/or verbalization). The average number of initiations of joint attention across children and routines was 3 (range 0–11). This was the criterion for mastery of initiating joint attention during routines for Luke. Reliability between the graduate assistant and author was examined for 4 (44%) of the typically developing children. Average agreement on the number of initiations per routine was 80% (an agreement was scored if the number of initiations within a routine counted by the graduate assistant and the first author was within one; agreement was calculated by dividing the number of agreements by the number of agreements and disagreements multiplied by 100).

2.1.6. Procedure

2.1.6.1. Baseline: initiating joint attention with adults. Prior to introducing intervention within routines, Luke’s demonstration of initiating joint attention (i.e., gaze alternating, gesture, and verbalization) during each of the three routines was examined. Luke was engaged in each routine for 5–10 min (depending on the routine; e.g., lunch tended to take closer to 10 min) and his spontaneous demonstration of initiating joint attention was recorded. No prompting occurred, however, if Luke had initiated joint attention (i.e., alternated his gaze, gestured, and verbalized), his interventionist would have delivered typical joint attention consequences (i.e., smiled and commented). Before intervention began, baseline sessions for each of the routines occurred on at least 2 different days.

2.1.6.2. Intervention: initiating joint attention with adults. Intervention followed similar procedures as described in Study 1. Because intervention occurred within routines, the natural course of the routine dictated the occurrence and number of opportunities (across routines, generally, between 3 and 10 opportunities were implemented during a session). During some lunch sessions, Luke ate very little resulting in the early termination of his lunchtime with only two joint attention opportunities having been conducted.

Intervention began with puzzles. Following the occurrence of the SD (e.g., correctly placed puzzle piece, completed puzzle), Luke engaged in the target response (either independently or following interventionist delivery of prompts) resulting in natural consequences including the interventionist delivering praise, social forms of attention (e.g., interventionist clapped), and a comment (e.g., “Ooh, you put the square on!”) along with activity interspersal (e.g., continuing the puzzle). Prompting and prompt fading procedures (i.e., most to least prompt hierarchy in conjunction with a time delay) were similar to those used when Luke was initially taught gaze alternating, pointing, and verbalizing with toys (described in Study 1). Once Luke mastered initiating joint attention with puzzles (i.e., achieved three correct independent initiations of joint attention across two consecutive sessions on 2
consecutive days), the second routine, involving games, was introduced for intervention, followed by the lunch routine.

2.1.6.3. Generalization with peers. Generalization with peers was assessed during baseline and again following mastery of the corresponding routine. No prompting was provided during generalization probes. If Luke had initiated joint attention with his peers, the reaction of his peer (whatever that was) would have served as the consequences.

2.1.6.4. Intervention: initiating joint attention with peers. Because Luke did not demonstrate spontaneous generalization of joint attention skills to interactions with peers, intervention was implemented. Because Luke did not eat lunch and they did not regularly play board games at his community preschool, all intervention with peers was implemented at Luke’s center-based program. Intervention was implemented in the same way as previously. That is, following the $S^D$ (e.g., a food item in Luke’s lunch bag), Luke initiated joint attention by gaze alternating, gesturing, and verbalizing (either independently or following prompts delivered by the interventionist). Once Luke initiated joint attention, the consequences were provided by both the peer and interventionist. The peer’s response to Luke’s initiation involved natural consequences (e.g., a smile and comment [“Cool!”] on Luke’s initiation) and continued activity (e.g., continuing to each lunch). If no peer comment was forthcoming, the interventionist prompted the peer (with a verbal model) to respond. The interventionist continued to deliver praise to Luke for initiating joint attention.

2.1.7. Reliability

Reliability data were calculated in the same manner as during Study 1. A graduate student collected reliability data from videotaped recordings for a subset of joint attention sessions (i.e., 14% of opportunities for Luke). Videotaped recordings were obtained during approximately weekly visits to the center-based preschool (unfortunately, videotaped recordings could not be made at the community preschool, therefore no reliability data were available for the generalization probes with puzzles at the community preschool). To examine response reliability, the child’s joint attention response was recorded, as per the definitions previously provided, as either independent or prompted. Reliability is reported as mean percent agreement. The number of agreements was divided by the total number of agreements plus disagreements and multiplied by 100 to obtain the percentage of agreement. Mean percent agreement cumulated across all opportunities was 97%.

2.1.8. Fidelity of implementation of intervention

To examine fidelity of implementation of intervention, videotaped recordings (the same recordings coded for response reliability) were examined for the accurate presentation of each component of intervention (calculated in the same way as in Study 1). Fidelity of implementation was 100% for the correct presentation of the $S^D$, 90% for the correct use of prompting procedures, and 95% for the delivery of appropriate consequences.

2.2. Results and discussion

Fig. 3 illustrates Luke’s initiations of joint attention during routines with interventionists and peers. Interestingly, during baseline sessions prior to introducing intervention within any of the routines, Luke spontaneously demonstrated some of the individual response forms during both puzzle and game activities with adult interventionists and peers, but not during lunch. That is, he alternated gaze or pointed during some opportunities and once emitted the target verbal response (including the adult interventionist’s name and a comment). However, he never emitted the entire combination of gaze alternating, gesturing, and verbalizing. When intervention was introduced, the frequency of joint attention initiations increased. Luke achieved mastery criterion (i.e., three independent joint attention initiations during the routine [indicated by a dashed horizontal line in Fig. 3]) within 13 sessions for the puzzles routine, 7 for games, and 8 for lunch. Luke maintained his performance, with only one session (for the games routine) dropping below criterion.
When Luke's responding in the presence of his peers was evaluated, there was no spontaneous generalization for any of the routines (within the community preschool or center-based program). Note that, although generalization performance with his peers at his community preschool was examined with puzzles, as a result of an oversight, no generalization probe with peers in Luke's center-based program was conducted prior to introducing intervention with those peers. When intervention was introduced with peers across all three routines, Luke increased his initiations of joint attention, achieving mastery criterion, within 2 sessions for puzzles and 12 sessions for games. Luke initially showed an increase in his independent initiations of joint attention with his peers at lunch. However, subsequent schedule changes for Luke and his peers (i.e., each attending different community schools) resulted in few opportunities (i.e., only one to two lunches per week) with a corresponding decrease in the frequency with which Luke independently initiated joint attention within this routine (either none

Fig. 3. Number of times Luke independently initiated joint attention per session during baseline and intervention across three preschool routines with adult interventionists and peers. Mastery is indicated by an asterisk (*).
or only one initiation). Although Luke demonstrated few independent initiations of joint attention, successful prompted initiations continued. Luke's performance with peers during lunch remained low (between 0 and 1 independent joint attention initiation) and there was no way to increase the number of opportunities provided to Luke to practice joint attention initiations during this routine. The study was terminated after 25 sessions when the other two routines had been mastered with peers.

In Study 2, intervention was successfully applied to multiple age appropriate routines during interactions with adults. Although spontaneous generalization of initiating joint attention to interactions with peers did not occur, when intervention was implemented, Luke initiated joint attention to criterion during two of three routines. The lack of acquisition with peers during lunch is likely a result of the few opportunities for Luke to practice initiating joint attention with peers. Only a single participant was involved in Study 2 and intervention was not successful during all peer interactions, therefore, further examination is warranted.

3. General discussion

The results of these two exploratory studies demonstrate the effectiveness of intervention to address an increasingly sophisticated class of responses (both verbal and nonverbal) with an expanded class of stimuli, specifically for initiating joint attention. Successfully establishing initiating joint attention is noteworthy as there have been inconsistent increases in performance of initiating joint attention in previous intervention research (e.g., Hwang & Hughes, 2000; Jones et al., 2006; Jones & Feeley, 2007; Kasari et al., 2006; Whalen & Schreibman, 2003). Not only did participants acquire skills to initiate joint attention, but they acquired a class of responses involving increasingly sophisticated forms (a combination of gaze behavior, multiple gestures, and verbalizations) of initiating joint attention seen in typically developing children. This extends previous work in which isolated forms (e.g., pointing or gaze alternating) (e.g., Hwang & Hughes, 2000; Kasari et al., 2006; Whalen & Schreibman, 2003) or combinations of nonverbal forms (e.g., gaze alternating and pointing) (Jones et al., 2006; Jones & Feeley, 2007) to initiate joint attention were taught.

In addition to the combination of three forms to initiate joint attention, there are also nuances to initiating joint attention that are seen in typically developing children and that may further refine joint attention initiations in children with autism. With respect to tone of voice, falling intonation is more often associated with joint attention verbalizations, while rising intonation is more often associated with verbalizations to request (Flax, Lahey, Harris, & Boothroyd, 1991; Halliday, 1975). The display of positive affect (e.g., smiling) is also characteristic of joint attention (Adamson & Bakeman, 1985) and discriminates joint attention from requesting behaviors (Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy, Kasari, & Sigman, 1992). Although there is limited research examining intervention specifically teaching affective behavior to children with autism, modeling and reinforcement have been used successfully to teach, for example, laughing at silly statements (Gena, Krantz, McClannahan, & Poulson, 1996). Some collateral changes in the expression of positive affect (e.g., Likert scale ratings of affect including enjoyment, interest, happiness, and enthusiasm) have been found in association with social skills interventions (e.g., Koegel, Werner, Vismara, & Koegel, 2005) and joint attention intervention (Jones et al., 2006; Whalen, Schreibman, & Ingersoll, 2006). Although some children with autism may show collateral improvements in affect and intonation associated with joint attention intervention, others may require specific instruction (e.g., via modeling).

In addition to expanding the forms of joint attention initiations, in these two studies intervention was applied to expand the range of stimuli that occasion joint attention initiations. Joint attention was taught with several different types of stimuli (i.e., toys, games, puzzles, and lunch), albeit these routines still sample just some of the many possible materials for joint attention. Luke was first taught joint attention with toys and then within routines, while Seth was first taught joint attention within routines. The stimuli with which to begin joint attention intervention may depend upon the child’s existing skill repertoire (e.g., game playing abilities) and/or interests. Typically developing children engage in joint attention about objects/events they find interesting (Bruner & Sherwood, 1983; McCathren, Warren, & Yoder, 1996). Therefore, child preference (i.e., interest) for materials is likely to be an important consideration in choosing joint attention stimuli (Jones & Carr, 2004; Jones et al., 2006).
As the diversity of materials used for joint attention expanded in these studies so did the specific cues that occasioned an initiation of joint attention. With toys, the SD was the activated toy, a very salient event, cuing the child to initiate joint attention. Within routines, the SDs involved natural events as the routines unfolded, such as a card indicating the action to take on one’s turn in the game, the letter cube needed to spell a word, etc. These cues were likely less salient than an activated toy, but reflective of the diversity of events that should occasion joint attention initiations.

Both Luke and Seth acquired skills to initiate joint attention with adult interventionists. When joint attention was examined with peers for Luke, he did not demonstrate spontaneous generalization to peers. When intervention was introduced with his peers, Luke required only two sessions to establish skills to initiate joint attention with puzzles and several sessions with games, but he never achieved mastery criterion during lunch. This novel application of joint attention intervention is of critical importance because peer interaction skills are a significant obstacle for children with autism. Given the importance of addressing both joint attention and peer interaction skills for children with autism, these inconsistent results, and the involvement of only one participant, additional research is warranted.

4. Summary

This research contributes to the growing body of literature demonstrating effective interventions to address core deficits such as joint attention in children with autism. In these two studies, intervention was used to establish a response class of the sophisticated combination of verbal and nonverbal forms of initiating joint attention. Intervention procedures were also effective in establishing these responses in the presence of a range of joint attention stimuli similar to those involved in joint attention initiations for typically developing children. The application of intervention procedures to address joint attention deficits across multiple forms involving a range of stimuli addresses a fundamental deficit in children with autism, providing children with similar joint attention skills to their typically developing peers.

Acknowledgements

Preparation of this manuscript was supported in part by a Grant from the Organization for Autism Research. I am grateful to the children and their teachers who dedicated their time to this project. I would like to thank Laura Athey-Lloyd who assisted with data collection and analysis and Dr. Kathleen Feeley for her insightful comments on previous versions of this paper.

References


