A lack of joint attention skills may constitute a core impairment in autism. In the present study, a training protocol was developed, based on the literature on joint attention and on behavioral interventions. The training was organized into a sequence of three main parts respectively aimed at establishing each of the following skills: (1) responding to joint attention bids, (2) engaging in turn-taking activities based on joint attention skills, and (3) initiating joint attention. Two novel components were incorporated in the training: (a) a discrimination training procedure aimed at establishing the adult's nods as conditioned reinforcers and (b) tasks based on turn-taking, where joint attention skills were targeted and reinforced. The study was conducted according to a single-subject experimental design, in which joint attention skills were measured before and after intervention, using the "behavioral assessment of joint attention." Four 3.5–5.5 year-old children diagnosed with autism participated in the study. All four children completed the training successfully and made significant progress in engaging in joint attention and in initiating joint attention skills. Following the completion of training and at 1 month follow-up, parents reported that their children used their skills in different settings. Moreover, at follow-up, all four children were reported to engage in joint attention behaviors and to enjoy doing so. Copyright © 2009 John Wiley & Sons, Ltd.

During the last few decades, joint attention has been investigated for several reasons. One main reason for the growing interest in joint attention stems from the identification of the lack of such skills as a major problem in autism. Deficits in this area of functioning are correlated with later deficits in other skills for these children. Hence, early joint attention skills are predictive of later developing skills summarized as "symbolic abilities" (Hobson, 1993; Mundy, Sigman, & Kasari, 1993), "language abilities" (Baldwin, 1995; Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Bruner, 1975; Tomasello, 1988), and "general social-cognitive processes in children" (Baron-Cohen, 1995; Bruner, 1975; Mundy, 1995; Tomasello, 1988). Second, a lack of joint attention skills can be an early predictor of autism (Adrien et al., 1993; Mundy & Crowson, 1997; Osterling & Dawson, 1994). Third, measured changes in joint
attention skills can constitute a more valid measure of the gains of traditional early intervention programs for children with autism, compared to the IQ measures commonly used (Holth, 2005; Mundy & Crowson, 1997). Yet, early intervention programs for children with autism (Lovaas, 1987; McEachin, Smith, & Lovaas, 1993) have typically neither measured nor specifically targeted joint attention skills.

Joint attention has been described as two persons actively sharing attention to an object or an event, while they are monitoring each other’s attention to that object or the event (Adamson & Bakeman, 1984; Bruner, 1975). Joint attention is first seen in the interaction between the child and his caregivers, and later on between the child and his peers (Adamson & Bakeman, 1984; Adamson & Chance, 1998).

Joint attention is often divided into two more or less functionally distinct subclasses: responding to joint attention bids (RJA) refers to the child’s ability to respond appropriately to others’ pointing, gaze shifts and gestures, while initiating joint attention (IJA) refers to the child’s ability to engage in pointing, gaze shifts and other gestures, to direct the attention of another person to an interesting object or event (e.g., Mundy & Gomes, 1998). Children with autism seem to display the most profound and consistent impairment in IJA skills (Leekam, Lopez, & Moore, 2000; Sigman, Mundy, Sherman, & Ungerer, 1986), whereas at least some children with autism may begin to develop RJA skills (Charman, 1998; Mundy, Sigman, & Kasari, 1994). In typically developing 10- to 11-month-old infants, Corkum and Moore (1995) showed that gaze following could be established using conditioning procedure in which visual reinforcers, such as moving toys, were presented contingent upon looking in the same direction as the experimenter. Thus, at least some simple RJA skills may not require social reinforcers, whereas at least some types of IJA seem to require some sort of “social motivation” (Mundy & Gomes, 1998; Tomasello, 1995).

A distinction has also typically been made between “protoimperative” and “protodeclarative” gestures. While “protoimperatives” are “requests intended to make another person do something for one’s benefit” (Sarria, Gómes, & Tamarit, 1996, p. 51), “protodeclaratives” are characterized by “the purely social motive of sharing attention to something” (Tomasello, 1995, p. 111). Like simple RJA skills, requests (or protoimperatives) can clearly occur without “social motivation.” Hence, some studies have indicated that children with autism are relatively unimpaired in protoimperatives (Baron-Cohen, 1989; Mundy, Sigman, Ungerer, & Sherman, 1986), whereas these children typically do not show any progress in protodeclaratives (Mundy, Sigman, & Kasari, 1990).

The first study that systematically used behavior principles to train joint attention skills in children with autism was reported by Whalen and Schreibman (2003). They described their intervention as a naturalistic behavior modification technique which consisted of a pivotal response training procedure combined with discrete trial training. Their training procedure included the following components: (1) prompts
and prompt fading, (2) interspersed easier or already mastered tasks between instruction tasks, (3) child-chosen tasks and training materials, (4) teacher and child turn-taking, (5) reinforcement contingent upon the child’s correct responses, whether prompted or not, and (6) natural consequences as reinforcers. Corresponding to their interpretation of findings in normative studies of the emergence of joint attention skills in typically developing children, they split their training procedure into two main phases, teaching RJA skills first, and IJA skills second. The results showed that RJA skills were successfully established in all five children. There were significant improvements from pre- to post-tests, and RJA skills generalized to unstructured environments. Next, the IJA training established the targeted IJA skills, gaze shifting and pointing, in four of the five children. These improvements were also generalized to different settings, including in the presence of the child’s parent. Three of the four children who completed training still demonstrated RJA skills well above baseline level at 3-month follow-up. However, during follow-up, there was a marked decrement in IJA skills, compared to skills displayed immediately following the intervention. Whalen and Schreibman discussed two variables that might explain the lack of maintenance of IJA skills following training. First, they suggested that the follow-up results might have been substantially improved if the parents had been taught how to maintain the acquired skills. However, a recent study that focused on the establishment of parent training skills showed similar maintenance problems for those parents’ training skills (Rocha, Schreibman, & Stahmer, 2007). Yet, even if not alone sufficient for maintenance, such caretaker involvement may constitute an important element of a successfully sustainable training protocol. The second variable mentioned by Whalen and Schreibman was their use of “extrinsic” rewards in the IJA training procedure, whereas IJA is often characterized as “intrinsically motivated.” The “intrinsic motivation” (or “sharing”) that is often a part of the IJA definition may still be lacking to the extent that the children’s performances were reinforced by “characteristic” (or “extrinsic”) reinforcers. Hence, the skills established in the Whalen and Schreibman study may have been IJA-like requests rather than “true” IJA behavior. In any case, their study was a clear demonstration of the fact that different joint attention skills, including gaze and point following, and pointing and gaze alternating as involved in IJA skills, could be successfully taught to children with autism.

Dube, MacDonald, Mansfield, Holcomb, and Ahern (2004) aimed for a more detailed contingency interpretation of IJA skills and identified three broad classes of potentially reinforcing consequences that seem likely to occur particularly frequently following the mother’s attention to the interesting event: the first of these classes consists of “adult-generated generalized social reinforcers such as smiling, signs of approval, affectionate gestures and verbalizations, and so forth.” A second class consists of the mother assisting the child with supplemental responses whenever needed, for instance during play and, hence, maximizing other reinforcing events.
Third, when the interesting event is novel and, possibly startling, other behavior occurring while the mother is attending to that event, such as putting on a particular facial expression, may have reliably predicted the absence of danger.

The contingency analysis of Dube et al. suggests that two basic types of problems could give rise to the joint attention deficiencies observed in children with autism. First, the child may fail to respond differentially to others’ gaze direction. In the Whalen and Schreibman (2003) study, the participants failed to demonstrate such discrimination skills prior to training, but they could be taught through a stepwise prompt-fading procedure. In addition, four of the five subjects in their study moved on to also learning specifically targeted IJA skills. Hence, the establishment of such gaze direction discrimination is likely to be a core component of interventions to teach joint attention skills to children with autism. Second, adult-mediated social consequences may fail to function as reinforcers. If contrived non-social reinforcers have been used during IJA training, the learned skills may simply extinguish when those non-social consequences are no longer delivered following training, unless relevant social stimuli, such as smiles, changes in gaze direction, etc. have been effectively conditioned as reinforcers. Dube et al. suggested that an effective establishment of the relevant social stimuli as reinforcers might be accomplished using a differential observing response procedure in which, for instance, unconditioned reinforcers are delivered contingent upon the child’s overt response that verifies discrimination of those social stimuli.

As pointed out by Jones and Carr (2004), joint attention is more than just a repertoire of gestures and gazing skills, and although recent intervention programs have effectively taught children the forms, they have not effectively taught the function of joint attention skills. Referring to the literature on generalized reinforcement and on pivotal skills training, Jones and Carr recommended several components for a joint attention training program to successfully address the social motivation deficit. First, like Whalen and Schreibman (2003), they suggested a pivotal skills training technique. However, two of the three components they described (i.e., the use of child-chosen activities and, and the interspersal of easier tasks) seem to boil down to ways of ensuring effective sources of reinforcement, and the third (i.e., the use of natural reinforcers), only underscores the basic problem that the natural consequence for joint attention is precisely the type of social interaction that, “unfortunately, is typically not reinforcing to children with autism” (Jones & Carr, 2004, p. 22). Another option suggested by Jones and Carr was the use of alternative, idiosyncratic types of social reinforcement that can sometimes be very effective even when normal social consequences do not work (Green et al., 1988). Smaby, MacDonald, Ahern, and, Dube (2007), followed up on this idea and developed an assessment protocol for identifying preferred social consequences. They suggested that such assessment might be particularly relevant for teaching joint attention skills.
attention skills, because such skills are maintained by social consequences in natural environments. However, because such idiosyncratic social consequences may not be very likely to follow behavior in any natural environment, it seems unlikely that such reinforcers will be better suited than other contrived reinforcers when it comes to maintaining joint attention skills.

In a recent study, Taylor and Hoch (2008) set out to establish JA skills in three children with autism, using social (and no tangible) reinforcers. The JA skills were gaze shifting between a novel object and an adult’s eyes, vocal responses to the adult’s bids for JA, and vocal IJA bids. The results showed that RJA skills were effectively taught without tangible reinforcers, but the results of the test probes for IJA bids were more varied. For one of the three participants, IJA performances were effectively maintained only when using a checklist and access to a preferred item as a consequence. The second participant initiated minimum five (out of six) JA bids during the last four trials after JA training, and the third participant initiated JA bids approximately during 50% of the test probes. An important question, however, is whether the normal social stimuli delivered contingent upon the children’s performances in this study functioned as reinforcers at all. During training, physical prompts were used when no correct responses occurred, and it is possible that the children’s performances were negatively reinforced through escape from (and later avoidance of) prompts rather than, or in addition to, being reinforced by presumed social reinforcers. Taylor and Hoch commented that “future studies may want to determine whether tangible rewards can be paired with social interaction to create a conditioned reinforcer” to be used for the purpose of establishing IJA skills in children with autism whose behavior is not effectively reinforced by normal social consequences.

A similar strategy suggested by Jones and Carr (2004) was “repeatedly pairing the presence of the adult with a wide variety of highly preferred reinforcers” in order to “establish the presence of the adult as a generalized reinforcer.” If joint attention requires that particular social stimuli function as reinforcers, and these particular social stimuli do not have this function for behavior in children with autism, it follows logically that the solution should consist of arranging contingencies that effectively establish conditioned reinforcers. A somewhat more detailed contingency analysis may be needed, because “the presence of an adult” can hardly be what is turned on and off such as to function as a reinforcer for joint attention behavior in typical social interactions. As an example, the child points to a plane in the air, shifts gaze between the mother and the plane, until the mother smiles, nods and, possibly comments upon the object or event: “Yes, that’s a plane,” “It’s a red plane,” or “It’s flying high” (i.e., a generalized social reinforcer is delivered). This strongly suggests that such comments or other forms of feedback from other persons constitute the reinforcement that characterizes the joint attention function (Holth, 2005). The autism-specific deficits in this function suggest that a main treatment goal must be to teach the child...
with autism to respond to the same types of social reinforcers as typically developing children do, including nods, smiles, gaze shifts and a range of stimuli arising from others’ vocal verbal behavior.

Like Jones and Carr, most texts on conditioned reinforcement seem to recommend the “pairing” procedure (e.g., Cooper, Heron, & Heward, 2007; Grant & Evans, 1994; Martin & Pear, 1996; Pryor, 1984; Schlinger, 1995). However, even if there is evidence to suggest that such pairing can suffice to establish conditioned reinforcers (Kelleher & Gollub, 1962), it has sometimes been found to be useless. For instance, Lovaas et al. (1966), wrote that, “although empirical evidence shows (Kelleher & Gollub, 1962) that one can sometimes establish a previously neutral stimulus as an acquired reinforcer, via the classical conditioning paradigm (consistently associating a neutral stimulus with one which already has reinforcing properties), we failed to observe such effects in the two children with whom we worked” (p. 111). In fact, there is a evidence to suggest that another procedure, an S^D- or observing response procedure, might be more effective (Dinsmoor, 1950, 1983, 1995).

A procedure that effectively establishes the social consequences of IJA behavior as conditioned reinforcers may certainly be more likely to contribute to the maintenance of IJA skills outside the clinic following treatment. The purpose of the present study was to investigate if children with autism can learn joint attention skills as a result of a training protocol that was based on a combination of the procedures described in Whalen and Schreibman (2003) and in Jones and Carr (2004). In addition, the training protocol included specific procedures for the establishment of conditioned reinforcers described by Holth (2005) and extensions of those procedures into a format that could easily also be arranged under natural circumstances as incidental teaching episodes. Thus, the main research questions of the current study were:

(1) To what extent can children with autism learn joint attention skills through ABA-based training that includes treatment components specifically designed to establish normal social reinforcers? and (2) Can maintenance of acquired joint attention skills be enhanced, compared to previous studies, by adding training components that explicitly target the establishment of typical social consequences as conditioned reinforcers?

METHOD

Participants

Four children participated in the study (Table 1). All the children received training based on early intervention programs and received more than 25 h a week of intensive behavioral treatment. The treatment met the criterion for quality treatment described
Table 1. Overview of gender, age, diagnosis, and baseline duration for each of the four participating children.

<table>
<thead>
<tr>
<th>Child 1</th>
<th>Child 2</th>
<th>Child 3</th>
<th>Child 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Boy</td>
<td>Girl</td>
<td>Boy</td>
</tr>
<tr>
<td>Age</td>
<td>3 years and 8 months</td>
<td>4 years and 6 months</td>
<td>3 years and 10 months</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Childhood autism</td>
<td>Childhood autism</td>
<td>Childhood autism</td>
</tr>
<tr>
<td>Baseline duration (weeks)</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

All the participants met the inclusion criteria: (1) the diagnosis of childhood autism according to ICD 10, (2) basic cooperation skills with an adult and being able to follow simple messages without making protests, and (3) language test scores, above 12–14 months of age on instruments like Reynell developmental language scales, or equivalent. The third criterion was included because children typically show consolidated joint attention skills at this age. In addition, the person responsible for the supervision of the daily behavioral treatment of the child had to find this training appropriate to the child’s instructional program at the time. The parents were required to sign informant consent in order for the child to take part in the intervention.

Child 1 was a boy aged 3 years and 8 months, diagnosed with childhood autism. He had been receiving intensive behavioral treatment for 6 months when this project started. Skills acquired during this period were: non-vocal imitation, vocal imitation (single words, and short sentences up to 4–5 words), matching to sample, so-called expressive and receptive labeling of 50–100 objects, actions and persons, instruction following with respect to abstract concepts as colors, shapes, sizes, and prepositions, mands consisting of short sentences. He was able to use simple toys in a proper way, he could undress and was able to eat with a spoon or a fork, but showed no social interaction with other children in play. The boy also displayed some self-stimulatory behavior (spinning objects).

Child 2 was a girl aged 4 years and 6 months, diagnosed with childhood autism. She had been receiving intensive behavioral treatment for 1 year and 11 months when this project started. Skills acquired during this period were: non-vocal imitation, vocal imitation of phrases up to 5–6 words, matching to sample, so-called expressive and receptive labeling of most objects, actions and persons in his regular environment, so-called expressive and receptive labeling of abstract concepts as colors, shapes, sizes, prepositions. She uttered functionally adequate sentences, asked questions and made comments, discriminated presence and past tense, was able to dress and undress...
independently, but she was still using diapers. The girl displayed some self-stimulatory behavior (flapping hands and simultaneously looking at different light sources).

Child 3 was a girl aged 3 years and 10 months, diagnosed with childhood autism. She had received intensive behavioral treatment for 9 months when this project started. Skills acquired during this period were: non-vocal imitation, vocal imitation of approximately 100 words, and some 2–4 word sentences, matching to sample, so-called expressive and receptive labeling of about 60 objects and receptively about 100 objects, labeling colors and sizes, manding 7–8 preferred objects, mostly edibles. The girl uttered few spontaneous sentences and did not initiate interactive play with other children (although occasional parallel play was reported to occur).

Child 4 was a boy aged 5 years and 4 months, diagnosed with childhood autism. He had been receiving intensive behavioral treatment for 1 year and 7 months when the current project started. Skills acquired during this period were: non-vocal imitation, vocal imitation (single words, and short sentences up to 4–5 words), matching to sample, expressive and receptive labeling of most daily life objects, actions and persons, receptive labeling of abstract concepts as colors, shapes, sizes, prepositions, functions categories etc., uttering of short sentences, asking questions and making comments. He was able to use toys in a proper way, but no social, interactive play with other children. He could dress and undress independently and was able to complete other daily life actions. The boy displayed some self-stimulatory behavior (he was making up routines in many situations and reproduced all of the speech from his DVD’s), which was also occupying his attention during the training.

Setting/Staff

Both training and tests were administered in the child’s kindergarten. The test setting was arranged as described in MacDonald et al. (2006). The senior supervisor, who knew the child, administered the tests. The training procedures were implemented by the therapist, employed in the child’s kindergarten, and by the parents, who were also supervised by the senior supervisor. Parents’ involvement was considered important in order to make sure that the child got as many learning opportunities as possible throughout training phases. Therapists in kindergarten were implementing 1 h a day of JA- treatment according to this protocol. All the parents conducted training procedures at home. Data on the exact amount of involvement were not collected.

Interobserver Agreement

Each child’s test performance was scored by one observer during the assessment session. In addition, each test was video taped. The videotapes were presented in
random order to a second observer, such that this second observer did not know the order of the tests. Interobserver agreement was assessed in more than 25% of the material. The observers had been trained to administer the test and to score samples, and a point-to-point interobserver agreement was calculated by using a standard formula: Agreement/(agreement + disagreement) × 100 (Kazdin, 1982). Interobserver agreement for each child was between 90 and 95%. All subscores met the criterion set at above 90%.

Design

The plan was to adhere to a multiple baseline design across children, and repeated baseline tests were conducted with each of the four children as they were included in the study. However, in order to avoid potential changes in test scores as a function of an increasing number of tests during baseline, only the duration of the baseline period was allowed to differ, while the number of tests was held constant, at three. For Child 1 and Child 3, baseline tests were carried out at 1-week intervals, while for Child 2 and Child 4, 2-week intervals passed between tests.

Procedure

Tests

Behavioral assessment of joint attention (MacDonald et al., 2006) was used to evaluate the outcome of the joint attention training. The test is a simplified version of early social communication scale (ESCS; Mundy et al., 2003). We chose to call the test a modified ESCS, or ESCS-m, which purpose was to give an objective measure of joint attention skills in a structured setting. High rate of inter-observer agreement (IOA) on the scores shows that this assessment tool is suitable to measure such skills (MacDonald et al., 2006).

The ESCS-m was divided into two main parts: (1) responding to joint attention and (2) initiation of joint attention. The responding part consisted of two subtests which assessed the occurrence of (a) following a proximal point (pictures in folder) and (b) following a distal point (e.g., pictures on wall), respectively. The initiation part consisted of two subtests, which assessed alternated looking, pointing, and vocal responses in (a) a toy activation task, proximal (dog), (b) a book presentation task and, (c) a toy activation task, distal (tiger). The maximum score possible was 12 points on the responding part and 9 points on the initiating part.

Completion of the ESCS-m took approximately 10 min, and the scoring was conducted either in vivo or from videotapes. All tests were administered in the child’s kindergarten. During testing, the test administrator gave positive comments
contingent upon other responses than those tested, to make sure the child was motivated to stay properly seated (“It’s nice of you to sit here with me,” “Good coming to the table” etc.). The child did not receive response-specific feedback contingent upon joint attention behavior during testing. Every test session ended with the adult praising the child for good work.

**Intervention/Training Overview**

All four children received the same intervention, even though some of the children mastered some of the targeted skills during baseline assessment. The intervention consisted of three main phases:

1. First phase aimed at teaching the children to respond to joint attention bids.
2. The second phase consisted of trials aimed at the establishment of normal conditioned reinforcers, such as other persons smiling and nodding.
3. The purpose of the third phase was to teach the children to use joint attention skills in tasks based on turn taking, where switching between responding to and initiating joint attention behaviors was targeted and reinforced.

The intervention was delivered for approximately 1 h each working day. The details of each phase of the intervention are outlined below.

**Responding to Joint Attention, Tasks 1–4**

Prior to joint attention training, a structured interview was conducted with the parents of the participants. The purpose of the interview was to assess the child’s interest for objects and pictures to use as material in the training. Five to ten preferred toys were placed in a bin from which the child could choose which toy to play with. Toys that the child never picked up and played with were designated “not interesting” to that particular child and removed from the bin. In responding to joint attention tasks, while the child was engaged in playing with a preferred toy, the trainer made attention bids by tapping on a new toy while pointing and gazing. The child was required to gaze shift between the toy and the trainer and play with the new toy for at least 3 s. If the child failed to respond or responded incorrectly, prompts were presented in the form of increased tapping on object, more obvious pointing, or a combination of these. The prompt was faded over subsequent trials. If the child failed to respond without a prompt within 5 s, the trainer kept on introducing new toys to the child up to five times. If the child responded correctly (i.e., when the child gaze shifted between the trainer and the toy and played with the toy for at least 3 s), the child was again allowed to choose which toy to play with. Mastering was achieved on each task.
when the first response was correct in five consecutive sessions. Each training session consisted of five presentations of the task.

Task 1: the child and the trainer were seated on the floor with some attractive toys in a bin, as identified in the procedure described above. While the child was playing with a toy, the trainer moved the child’s hand to another toy.

Task 2: the child and the trainer were seated on the floor, with some attractive toys in a bin. While the child was playing with a toy, the trainer introduced a new toy. Trainer tapped with his finger on the object (to make a sound).

Task 3: the child and the trainer were seated on the floor, with some attractive toys in a bin. While the child was playing with a toy, the trainer introduced a new toy by just showing it to the child by pushing the item on the floor into the child’s visual field.

Task 4: the child and the trainer were seated on the floor, with some attractive toys in a bin. The trainer controlled the toys, and the child was required to look at the adult to get a toy. If the child tried to take the toy without looking at the trainer, the attempt was stopped, by softly leading the child’s hands off the object.

Establishing Adult Social Responses as Conditioned Reinforcers for the Child’s Behavior

The procedure was designed to establish adult social responses as discriminative stimuli for positively reinforced responses in the child, based on the assumption that such discriminative stimuli will also function as conditioned positive reinforcers for behavior that produces them.

Task 5: the child and the teacher were seated face-to-face at a table. Some preferred objects, edibles etc. were placed on the table in front of the child. The child was only allowed to take one item from the table when the teacher was smiling and nodding. When the teacher did not smile and nod, all attempts to take items from the table were physically blocked by the trainer. The time between instances of the teacher’s smiling and nodding varied from about 5 to 30 s.

Task 6: the child and the teacher were seated at a suitable table. The trainer was seated in front of the child (on the opposite side of the table). There were two preferred objects placed on the table, one to the left and one to the right, out of reach of the child. The trainer pointed to one of the objects. If the child then looked in the right direction, he received the object to play with for approximately 10 s. If the child responded incorrectly, prompts (i.e., increased tapping on object, excessive pointing, or a combination of these) were presented. The prompt was faded over subsequent trials. The training was conducted with both preferred and neutral objects. Contingent upon the child’s looking in the same direction as the adult, the teacher nodded and smiled, and the child was allowed to continue engaging in ongoing play activity.
Task 7: the child and the teacher were seated on the floor, with some attractive toys in a bin. When the child was playing with one of the objects, the trainer established eye contact with the child and then turned his head and looked toward another object in the room. As in Task 6, contingent upon the child’s looking in the same direction as the adult, the teacher nodded and smiled, and the child was allowed to continue engaging in ongoing play activity. If the child did not respond or responded incorrectly on the first trial, for two consecutive sessions, the previous task (Task 6) was reintroduced and trained to mastering, before Task 7 was reintroduced.

Task 8: the child and the teacher were seated, facing each other. Two objects were placed on a table, about 3 m away from them. The child was instructed to obtain one of the objects: “give me that one, please” combined with trainers pointing. Upon picking up an object, the child was supposed to look back to the trainer for confirmation. If the child did not look to the trainer, the trainer said “ah-ah” to give a reminder to the child. When the child turned toward the trainer, the trainer smiled, nodded, and confirmed that the object was correct, and contingent upon the child returning and delivering the object, the trainer nodded and smiled and gave behavior-specifying praise.

Turn-Taking/ Initiating JA

Turn-taking tasks were introduced because they seem to have the characteristics of natural play situations which require both RJA and IJA skills. Tasks based on block building and puzzle activities were designed to train turn-taking in which both responding to a playmate’s JA bids and initiating bids are required. A correct response on the responding tasks was defined as the child taking the correct block and starting the construction. A correct response on the initiation tasks was defined as the child initiating a JA response during the first 10 s of the session. The child was supposed to show an IJA response so that the trainer was actually able to copy the child’s block construction. If the child did not respond correctly, the training materials were removed for 10 s and then reintroduced. If the child showed two consecutive incorrect responses, a prompt was presented. On Tasks 9a and 10a, the prompt consisted of exaggerated pointing, and on Tasks 9b and 10b, a model was introduced as a prompt. The second trainer, placed adjacent to the child, modeled a correct response to the given task and received positive feedback from the first trainer. Then, the task was presented to the child again. Mastering was achieved on each task when the first response was correct in five consecutive sessions. One training session consisted of five completions of the task.

Task 9a: the child and the trainer were seated at a suitable table, and each of them had three building blocks in three different colors available. The blocks were placed in an identical pattern for both of them (mirrored). On the table between them there was
an “artificial wall” to hide the product of the block building or puzzle activity from the other person’s view.

The trainer took, for example, the yellow block and started the construction of a building close to the wall so that the child could not see the resulting construction directly. Next, by gazing and pointing, the trainer directed the child to take the corresponding block and start the building. In this way, they completed each step of the construction with the three blocks. Finally, the wall was removed and the trainer made a point out of the two puzzles being identical by pointing to them while simultaneously nodding, smiling, and praising the child. A correct response was defined as consisting of the child taking the direction from the adult, looking at the blocks and back to the trainer for confirmation (smiling and nodding).

Task 9b: this task was arranged similarly to Task 9a, except that in this task there was a second trainer, seated next to the child to assist the child in directing the trainer’s attention to the correct block by modeling the behavior to the child.

Task 10a: the child and the trainer were seated at a suitable table. They had a puzzle consisting of three to four pieces, showing heads of familiar persons, animals’ feet, and bodies illustrating apples, sausages, meatballs etc. On the table between the two, there is an “artificial wall” (again so they could not directly observe each other’s constructions). The pieces were spread out in an identical pattern for both of them (mirrored).

The trainer took, for example, the piece of puzzle showing mum’s head and, by gazing and pointing, directed the child to take the corresponding piece of puzzle and start the puzzling. In this way, they completed the puzzle with the three or four pieces. Then, the wall was removed and the trainer made a point out of the two puzzles being identical by pointing to them while simultaneously nodding, smiling, and praising the child. A correct response was defined as the child following the adult’s direction, looking at the puzzles and back to the trainer for confirmation (smiling and nodding).

Task 10b: this task was similar to Task 10a, but in this task, there was a second trainer seated next to the child. This second trainer assisted the child by modeling the behavior of directing the first trainer’s attention to the correct piece of puzzle.

RESULTS

All four children who participated in this study had stable scores on the modified ESCS during the pre-test period, and their scores were relatively higher on the RJA tasks than on the IJA tasks. The largest difference from one test to another was 2 points. Following baseline, the children completed the training in 31–61 days (Table 2). It was a common understanding of how a training session would look like. A training session consisted of 5 trials, and guidelines for how to do 1:1 intensive
treatment formed the basis. All trainers were supervised according to the guidelines. The number of training sessions (Table 3) shows no correlation with outcome data on Escs-m.

Visual inspection of Figures 1 and 2 shows increased RJA and IJA scores, respectively, from pre-test to post-test for each of the four children. Moreover, all children had the same or increased scores on the follow-up test 1 month after completion of the intervention.

Results for Each Child

Child 1 scored 2, 3, and 3 points (in average 2.67) of maximum 12 on the RJA test during the pre-test period. Immediately after completion of intervention he scored 11 on the same test (Figure 1). On Test 2 (IJA), he scored 0, 1, and 0 points (in average 0.33) of maximum 9 points during the pre-test period. Immediately after completion of the intervention, he scored 3 points on the same test and 4 points at follow-up 1 month later (Figure 2).

Child 2 scored 5, 5, and 6 points (in average 5.33) on the RJA test during the pre-testing. Immediately after completion of intervention she scored 10 points on the same subtest (Figure 1), and 11 points on 1 month follow-up. On the IJA pre-test, she scored 1, 2, and 1 points (in average 1.33). Immediately after completion of

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Figure 1. ESCS-m responding to joint attention (RJA) test scores for each child during baseline, post-intervention, and at 1 month follow-up. The stippled lines indicate average scores for normally developing 2-year-old children (8.5 points) and for 4-years-olds (11 points).
Figure 2. ESCS-m initiation to joint attention (IJA) test scores for each child during baseline, post-intervention, and at 1 month follow-up. The stippled lines indicate average scores for normally developing 2-year-old children (4.8 points) and for 4-years-olds (6 points).
intervention she scored 5 points on the same subtest and 6 points on follow-up 1 month later (Figure 2).

Child 3 scored 4, 4, and 3 points (in average 3.67) during the RJA pre-test. Immediately after completion of the intervention, she scored 9 points on the same test (Figure 1), and 11 points at 1 month follow-up. On the IJA pre-test, she scored 2 points on all three tests during the baseline period. Immediately after completion of intervention, as well as at 1-month follow-up, she scored 6 points on the IJA tests (Figure 2).

Child 4 scored 7, 8, and 8 points (average 7.67) during the RJA pre-test. Immediately after completion of intervention as well as at 1 month follow-up, he scored 12 points on the same tests (Figure 1). On the IJA test, he scored only 1 point each of the three times during pre-testing. Immediately after completion of intervention, he scored 4 points on the same test, and 5 points at follow-up 1 month later (Figure 2).

DISCUSSION

The purpose of the present study was two-fold: first, we wanted to study whether the effective establishment of joint attention skills demonstrated by Whalen and Schreibman (2003) could be replicated using a modified version of their ABA-based training protocol. Second, we were interested in whether the modified training protocol would lead to the maintenance of directly trained joint attention skills at follow-up. The modified procedure included (1) the establishment of normal social behavior consequences as discriminative stimuli for positively reinforced responses and (2) turn-taking tasks that required RJA and IJA responses and were similar to natural interaction opportunities.

All four children who participated in the present study completed the training successfully and made significant progress in responding to joint attention (RJA) and in initiating joint attention (IJA) skills from baseline to post-training. All children demonstrated some RJA skills prior to the intervention, although with lower scores on the ESCS-m than typically developing children. This finding is in accord with previous studies that have found that children with autism may show some RJA skills prior to, or in the absence of, explicit training (e.g., Leekam et al., 2000). However, IJA skills, and particularly protodeclaratives, typically remain severely impaired in these children (Mundy et al., 1990). In the present study, none of the children showed any significant improvement on RJA or IJA performances during the baseline period of either 2 or 4 weeks. Therefore, the progress from pre- to post-tests is likely to have resulted from the explicit training. The progress in both RJA and IJA skills
demonstrated following training in the present study is also consistent with the results reported by Whalen and Schreibman (2003).

Moreover, the results of the current study showed that both RJA and IJA skills were generally maintained or improved from immediately post-training to the follow-up test 1 month after termination of specifically programmed joint attention training. This finding seems to be in contrast with the follow-up results reported by Whalen and Schreibman (2003). One important difference is that Whalen and Schreibman collected their follow-up results 3 months after training, whereas the follow-up results in the present study were collected only 1 month after training. It is clearly possible that the decrement of IJA skills that were found after 3 months in the Whalen and Schreibman study would have been less evident after 1 month.

Alternatively, or in addition, a maintenance problem of IJA skills the study by Whalen and Schreibman may have resulted directly from features of the training protocol that they used. The authors, themselves, discussed two such potentially important variables. First, the protocol did not involve teaching the parents how to maintain the acquired joint attention skills. In contrast, the training procedures of the current study were designed such that the parents took part and received training in how to implement the training procedures. Moreover, the children then received a lot of practice in how to use the joint attention skills in different environments, across settings, and persons.

Second, IJA training protocol of Whalen and Schreibman explicitly included what they referred to as ‘extrinsic’ reinforcers, such as the removal of toys contingent upon the lack of IJA responding. As Matson, Matson, & Rivet (2007) pointed out, children with autism in general only seem to respond when they are asked to cooperate and do not initiate joint attention. In this sense, the children in the Whalen and Schreibman study were “asked” or required to cooperate. Their IJA-like performances may not have involved any interest in ‘social sharing’ in the sense that their behavior was reinforced by typical social consequences, such as other people’s nodding, smiling, and other types of approval. Indeed, that was exactly why the present study included explicit training directed at the establishment of such stimuli as discriminative stimuli for positively reinforced responses (assuming that these social stimuli would then also function as conditioned reinforcers for responses that produce them), and the specific training targeting normal social reinforcers may have contributed to a more effective maintenance of IJA skills in the present study.

The possibility that a failure to develop conditioned and generalized reinforcers might constitute a core problem in children with autism was first suggested by Ferster (1961). In order to establish other people’s nods and smiles as positive reinforcers, it is important that the training protocol includes elements that can most effectively establish such stimuli as conditioned reinforcers. Almost 60 years ago, Schoenfeld, Antonitis, and Bersh (1950) wrote that, “The principle of secondary reinforcement
holds that a neutral stimulus acquires reinforcing power when it is correlated with the occurrence of a reinforcing stimulus.” This broad statement is as much as is usually found in the literature, although occasionally a writer may add that the correlation must be “close and consistent” (p. 40). At the same time, Dinsmoor (1950) proposed the discrimination hypothesis of conditioned reinforcement, suggesting that in order to become a conditioned reinforcer, the stimulus would have to be established as discriminative for a response that produces a reinforcer. Fred Keller (1954) quite confidently stated this view: “It is now quite certain that if a stimulus is to become a secondary reinforcer it must become a discriminative stimulus” (p. 58). Lovaas et al. (1966) concluded that even after several hundreds of trials of pairing the word “good” with food delivery to children with autism, “subsequent tests of ‘good’ for secondary reinforcing properties were negative; there were no modifications in the child’s behavior when that behavior was accompanied by ‘good’” (p. 111). Yet, even today, the broad statement regarding correlation or association between a to-become-conditioned stimulus and some other reinforcer is what is typically prescribed in the literature on conditioned reinforcement (e.g., Catania, 2007; Martin & Pear, 1996; Pryor, 1984; Schlinger, 1995). However, in accord with the findings of Lovaas et al. (1966) preliminary data from work with children in our laboratory suggest that when the pairing procedure is compared directly with a procedure in which stimuli are established as discriminative for responses that produce positive reinforcers, the discriminative stimulus procedure more effectively than the pairing procedure establishes new stimuli as conditioned reinforcers. Hence, we implemented an $S^D$ procedure in which the trainer’s nods and smiles were occasions upon which the child was allowed to help itself taking goods from the table. Next, this principle was maintained in more naturalized training situations in which the child was given the instruction, “get that one,” and the trainer’s nods and smiles constituted occasions upon which bringing a particular thing back would be reinforced. Similarly, the trainer’s nods and smiles were established as $S^D$s for the child’s reinforced responses during the turn taking tasks. Thus, to ensure generalization as well as maintenance, nods and smiles were maintained as $S^D$s for positively reinforced responding across naturally occurring training situations.

There are a number of reasons why a pairing procedure may not work very well to establish the relevant social stimuli as conditioned reinforcers. First, if the child’s behavior is under aversive control or the training is heavily teacher controlled, it is likely that to the extent that praise, for instance, obtains a conditioned reinforcing effect, it depends on its relation to escape from an aversive training situation. Hence, to be effective, it will continue to depend on teacher-initiated interactions and will not foster child-initiated positively-reinforced “sharing.” Second, in training situations that involve the use of tangible stimuli as reinforcers, those stimuli may typically be kept visible to the child. This may result in the visual appearance of those stimuli
being established as conditioned reinforcers and, thus, may block the subsequent conditioning of other (e.g., social) stimuli as reinforcers (Kamin, 1969). Finally, many opportunities to strengthen social stimuli as conditioned reinforcers may go untapped if social stimuli are simply paired with reinforcement of the child’s mands without making reinforcer deliveries contingent upon the child’s request only when the child has first initiated joint attention.

In the present study, the effects of smiling and nodding as generalized reinforcers seemed to be maintained in daily life cooperation between the children and their closest caretakers. Following the completion of training and at 1 month follow-up, parents spontaneously reported that their children used their skills in different settings. After the completion of this study all four children were reported to engage in joint attention behaviors and showing enjoyment when doing so.

REFERENCES

Joint attention training


