Joint attention is pivotal to the development of complex social skills and language, and many individuals with Autism Spectrum Disorders display deficits in this domain. Behavioral interventions targeting joint attention are evidenced to be effective in teaching these skills to young children with autism, but these treatments have traditionally been implemented by adults in structured settings. Concerns regarding the generalizability of skills acquired under such conditions have been raised. Four typically developing children were trained to implement a joint attention intervention to their siblings with autism in the home. Joint attention was measured pre-treatment and post-treatment during play sessions and during a structured, adult-mediated assessment to evaluate maintenance and generalization. Gains in responding to joint attention were observed for all four participants; gains in initiations were observed in three participants. Rates of imitation and behavioral requests also increased in structured and naturalistic settings. This study supports the efficacy of siblings as interventionists to target complex social skills in the natural environment. The implications of these findings for treatments targeting joint attention and for siblings as interventionists are discussed. Copyright © 2011 John Wiley & Sons, Ltd.
with mental retardation, Down syndrome, and other developmental disabilities (Baron-Cohen, 1989; Charman et al., 1997; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Leekam, Baron-Cohen, Perrett, Milders, & Brown, 1997; Lewy & Dawson, 1992), suggesting a JA deficit specificity in individuals with ASD.

Deficits in JA have been correlated with overall ASD severity (Turner LM, unpublished). The literature also indicates that acquisition of JA skills in children with ASD is related to ancillary gains in other social abilities including social initiations, positive affect, imitation, and expressive language (Jones, Carr, & Feeley, 2006; Whalen, Schreibman, & Ingersoll, 2006).

There is a swiftly growing literature on training JA in children with autism through a variety of approaches, which may differ on several dimensions. For example, treatment methodologies may comprise elements of structured teaching, child-directed teaching, or a combination of strategies (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Martins & Harris, 2006; Naoi, Tsuchiya, Yamamoto, & Nakamura, 2007; Taylor & Hoch, 2008; Whalen & Schreibman, 2003). Interventions may also target initiations, responding, or both; however, there is strong evidence suggesting that a systematic breakdown of social interaction components into smaller skill units (MacDonald et al., 2006) best facilitates increases in targeted JA behaviors (Hwang & Hughes, 2000; Isaksen & Holth, 2009). For example, in their randomized controlled trial comparing JA and symbolic play interventions, Kasari, Freeman, and Paparella (2006) differentially targeted not only initiations and responding but subunits of each (e.g., coordinated joint looking, showing, distal pointing). These procedures were found to improve initiating and responding on a structured measure for the JA group, compared with play and control groups.

Because a lack of intrinsic motivation to engage in social behavior is implicated in JA deficits (Dube, MacDonald, Mansfield, Holocomb, & Ahearn, 2004; Koegel & Koegel, 1995; Mundy, 1995), some interventionists have incorporated more naturalistic strategies, such as pivotal response training (PRT) to teach a variety of social behaviors, including JA. Pivotal response training has evoked positive outcomes in children with ASD regarding imitation (Ingersoll & Schreibman, 2006) and play skills (Stahmer, 1995), in addition to JA (Pierce & Schreibman, 1995; Whalen & Schreibman, 2003).

Although JA training has been successfully demonstrated in both laboratory and naturalistic settings, choices regarding the treatment environment may also differentially affect skill gains, particularly when assessing maintenance and generalization. One approach to addressing these challenges is to include individuals in the child’s natural environment, such as parents, as interventionists (Kasari et al., 2010; Rocha, Schreibman, and Stahmer, 2007). Outcomes demonstrating the efficacy of parents as interventionists are particularly important because they illustrate the success of pyramidal training techniques in generating effective dissemination.

Evidence favoring strategies to train interventionists in the natural environment are not limited to parents; the positive effects of using peers as models or trainers for social
skills in children with ASD are also well documented. Peer training can lead to increases in both social initiation frequency and quality of social interactions (Kamps et al., 2002; McGrath, Bosch, Sullivan, & Fugua, 2003). In fact, peer-trained social skills have been suggested to be more robust and more generalizable than adult-centered training (Kamps et al., 2002).

As siblings are the most familiar peers to a child with ASD, they have the potential to evoke increases in social behavior from children with ASD. Training siblings as teachers may benefit the typical siblings as well as the children with ASD. Sibling relationships in families of children with ASD also show a trend toward less intimacy, prosocial behavior, and nurturing than those relationships between siblings and children with Down syndrome and other typically developing children (Kaminsky & Dewey, 2004). Although coping strategies and knowledge of ASD do not correlate with sibling adjustment, involvement in the autistic child’s life may enhance positive feelings of typical children toward their sibling with ASD (Celiberti & Harris, 1993).

Children with ASD are more likely to respond to their siblings than to other children and may find these interactions more reinforcing than interactions with parents or peers (Knott, Lewis, & Williams, 1995; El-Ghoroury & Romanczyk, 1999). Children with ASD also tend to generalize peer-trained social skills to their typically developing siblings (Belchic & Harris, 1994; Taylor, Levin, & Jasper, 1999). Researchers have capitalized on the benefits of sibling interactions to teach children with ASD a variety of social skills, including play, engagement, social initiation, social responsiveness, and JA (Baker, 2000; Celiberti & Harris, 1993; Colletti & Harris, 1977; Jones & Schwartz, 2004; Reagon, Higbee, & Endicott, 2006; Tsao & Odom, 2006).

The current study addresses two gaps in the literature. To date, siblings have not been utilized to deliver interventions specifically targeting JA. The current study’s first goal was to systematically replicate an established, adult-mediated intervention with typically developing sibling teachers, and evaluate the program’s efficacy in teaching JA skills to children with autism. The second contribution is to address a recent emphasis in the literature on the need for training in more natural environments and to evaluate gains in those settings (Taylor & Hoch, 2008).

**METHOD**

**Participants**

Four sibling dyads were recruited from the Outreach Division of the Douglass Developmental Disabilities Center, a program based out of Rutgers, The State University of New Jersey. Classroom teachers and consultants identified potential
candidates, and letters were distributed to those parents whose children qualified for the study. Because this study aimed to evaluate teaching JA skills in young children, recruitment was targeted toward pairs in which the younger sibling was diagnosed with ASD. Interested parents contacted the first author, who screened for eligibility and willingness to participate. Each enrolled dyad consisted of one child with ASD (participant) and his or her typical sibling (sibling). According to inclusion criteria, all participants required a diagnosis of ASD according to Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, criteria, as determined by an unaffiliated professional. Siblings with an ASD diagnosis or other significant developmental disability were excluded from the study. Written parental consent was given for both siblings to participate, in addition to verbal assent from the typical siblings. As an incentive to participate, the siblings were offered points for each session completed, which they could exchange for a gift card at the end of treatment.

The dyads included Julia and her brother Todd, Trevor and his brother Luke, Brian and his brother Jack, and Michael and his brother Alex. Julia, Trevor, Brian, and Michael were all diagnosed with Autistic Disorder; none of the siblings had a diagnosis. Participant characteristics can be found in Table 1.

The first author administered the Mullen Scales of Early Learning, a standardized, developmental measure that assesses motor, perceptual, and language skills (Mullen, 1997), to obtain mental ages. She also acted as the interventionist and primary data collector, conducting the sibling training sessions and pre-treatment/post-treatment assessments.

### Procedure and Setting

Siblings received individual training sessions in how to implement an intervention to teach JA skills to their sibling with ASD. The intervention targeted two skills: (a) responding to JA, which included six training sets, and (b) initiating JA, which

<table>
<thead>
<tr>
<th>Table 1. Demographic characteristics for sibling dyads.</th>
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<tbody>
<tr>
<td><strong>Child</strong></td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td><strong>Participants</strong></td>
</tr>
<tr>
<td>Trevor</td>
</tr>
<tr>
<td>Julia</td>
</tr>
<tr>
<td>Brian</td>
</tr>
<tr>
<td>Michael</td>
</tr>
<tr>
<td><strong>Siblings</strong></td>
</tr>
<tr>
<td>Luke</td>
</tr>
<tr>
<td>Todd</td>
</tr>
<tr>
<td>Jack</td>
</tr>
<tr>
<td>Alex</td>
</tr>
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</table>

included two training sets, and is described in more detail below. The participant’s engagement in JA, social orienting skills, and imitation were assessed pre-treatment and post-treatment. All assessments, training, and follow-up sessions were conducted in the participants’ homes (i.e., playroom or participants’ bedrooms). Parents were not present during treatment. The chronology of the project included (1) semi-structured, JA play probes (baseline); (2) sibling training and administration of the intervention (6–8 weeks); (3) post-treatment JA play probes (immediately following intervention); and (4) 3-month follow-up JA play probes.

Sibling Training

Prior to each new set, and on each new day, the experimenter described/reviewed the procedures of the intervention with the sibling alone. The sibling then participated in a brief interactive instruction with the experimenter, including modeling and role-plays, with experimenter feedback. The sibling was required to provide the correct components of the intervention across two opportunities in a role-play with the experimenter before bringing the participant into the session. All siblings were able to master the instructions within one training session (approximately 10–15 min). Additional prompts were delivered throughout the teaching sessions for the siblings to deliver all components of the intervention. When necessary, additional review was provided after the end of teaching sessions, with modeling and role-play. Other strategies to promote positive play interactions (i.e., getting the target’s attention, identifying preferences, using reinforcing toys) were discussed during the sibling training sessions; when necessary the experimenter provided the sibling with reminders of these skills during teaching sessions.

Sibling-Mediated Intervention

Design and Procedure

A single-subject, multiple probe design across participants was utilized. Baseline for each dyad ranged between 2 and 12 weeks. Follow-up data were collected 3 months after each dyad’s completion of training. Sibling dyads engaged in two to three 15-min training sessions per day, 1–2 times per week. Sessions run in the same day were separated by a 10-min break, during which the children were encouraged to play with their own toys or leave the room.

Intervention

The JA intervention (see Table 2) was a systematic replication of the procedures described by Whalen and Schreibman (2003) and encompassed components of both
Table 2. Procedural outline of the sibling-mediated intervention.

<table>
<thead>
<tr>
<th>Set</th>
<th>Goal/correct response</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Response to hand on toy: (1) gaze shift to the new toy for at least 5 s; (2) manipulation of the toy for at least 5 s (including non-functional play); or (3) initiating a gesture to the new toy (e.g., pointing, reaching).</td>
<td>The sibling will wait until the target child engages with one item and will then place the target’s hand on another toy. If the target child does not respond, all toys will be removed for 10 s. The sibling will then repeat the process with a novel toy. After two consecutive incorrect responses, the sibling will physically prompt the target child’s hand on the newly presented toy for 5 s.</td>
</tr>
<tr>
<td>2</td>
<td>Response to tap toy: identical to that described previously.</td>
<td>Set 1 procedures will be replicated except that when presenting a new toy to the target child, the sibling will tap the toy five times.</td>
</tr>
<tr>
<td>3</td>
<td>Response to show toy: identical to that described previously.</td>
<td>The previous procedure will be replicated, except that when presenting a new toy to the target child, the sibling will show the toy. A show is defined as holding the toy within the target’s line of vision for at least 5 s, without accompanying verbalizations.</td>
</tr>
<tr>
<td>4</td>
<td>Eye contact: direct gaze sustained for at least 3 s.</td>
<td>Eye contact will be shaped by having the sibling offer a preferred item and requiring the target child to make eye contact for at least 3 s before granting access to the toy. The sibling will use a physical prompt to the target child’s head (e.g., gentle finger to the chin) to direct his gaze.</td>
</tr>
<tr>
<td>5</td>
<td>Follow point: a correct response is defined as a full-head orient (not just gaze shift) in the same direction as the sibling.</td>
<td>While the target child engages with an object, the sibling trainer will establish eye contact with the target child and then turn his or her head and point to a preferred item across the room, without accompanying verbalizations.</td>
</tr>
<tr>
<td>6</td>
<td>Follow gaze: identical to that described previously.</td>
<td>The same procedure will be used as in Set 5, except that instead of pointing to the object the sibling will shift his or her gaze toward the item.</td>
</tr>
<tr>
<td>7</td>
<td>Coordinated gaze shift: gaze shift from toy to sibling for at least 3 s.</td>
<td>Opportunities for coordinated gaze shifting will be counted whenever the target child is engaging with a toy. Each 20-s interval that elapses without a coordinated gaze shift will be counted as an incorrect response, and the toy will be removed for 10 s. After two consecutive incorrect responses the sibling teacher will prompt a coordinated gaze shift. Prompt-fading procedures will then be used. During each interval, the target child will spontaneously point to an object in the room for a correct response. Correct responses will be reinforced by the sibling acknowledging the object (e.g., “Wow! What a cool picture!”). Following one incorrect response, the sibling will follow the same training steps outlined in Set 1.</td>
</tr>
<tr>
<td>8</td>
<td>Protodeclarative point: unprompted distal (i.e., more than 2 inches) point to an object in the room.</td>
<td></td>
</tr>
</tbody>
</table>
PRT (i.e., using child-chosen objects as reinforcers, providing opportunities for turn-taking, teaching in a naturalistic environment) and discrete trial teaching (i.e., prompting, error correction procedures, task interspersal, repeated trials). Mastery criteria were modified from the Whalen and Schreibman study, in which 80% across four of five consecutive sessions was delineated. Because of the young age of the typical siblings in this study, there was some concern that the more stringent mastery criteria would prolong the intervention past a threshold of tolerance and efficacy for 6- to 8-year-olds. Therefore, the current research defined mastery as 80% of independent opportunities across two consecutive sessions. If a participant did not master the skill within seven sessions, the set was discontinued and the dyad proceeded to the next skill set (during observations of the first dyad, the typical sibling began to express frustration with the task after seven sessions). After failing one set, dyads were allowed to move onto a subsequent set to provide information on the relative importance of teaching individual units of JA. Progress within and mastery of the sibling-mediated training components were measured as the participant’s percent response to JA opportunities.

**Outcome Measures**

*Semi-Structured Play Probes*

Dyads were videotaped pre-treatment and post-treatment playing together with toys for 15-min samples. Materials included toys that were appropriate for both the developmental and chronological ages of the participants and that were suitable for both genders. During this time, siblings were asked to administer JA probes, including tapping a toy, showing a toy, initiating a distal point, and initiating a gaze shift. Data were collected on target responses to JA presses, participant initiations of JA (protodeclarative pointing or alternating gaze shift), behavioral requests (protoimperative pointing, giving), and rates of spontaneous imitation. These probes were identically administered pre-treatment and post-treatment and comprise the main outcome measure. Data on rates of imitation were also collected, to assess for ancillary gains in an untargeted behavior.

*Early Social Communication Scale*

The *Early Social Communication Scale* (ESCS) is a semi-structured, interaction-based measure of non-verbal communication and shared attention, comprising items of responding to JA probes (e.g., following examiner’s point), initiating JA with assessment materials (e.g., wind-up toys), and responding to requests (e.g., “give me”). Although the ESCS is not a standardized measure, it is reported to have strong reliability and validity (Mundy, Sigman, Ungerer, & Sherman, 1986).
Interobserver Agreement

Interobserver agreement (IOA) was collected for 33% of pre-treatment and post-treatment assessments and 15% of teaching sessions. Exact agreement was calculated for sessions that were divided equally among participants. For training sessions, IOA averaged 93.9% for all sessions and ranged from 80% to 100%. For JA probes, IOA averaged 91.4% and ranged from 65% to 100%. Reliability scores on the ESCS were calculated using an alpha statistic. Adequate reliability was obtained on the ESCS (alpha = .91, range = .83–.97).

Treatment Fidelity

Treatment fidelity ratings were obtained for 20% of each sibling’s treatment sessions. Data were collected upon the sibling’s provision of (1) a clear discriminative stimulus; (2) praise for correct responding; (3) access to the toy for correct responding; and (4) no premature prompts. All siblings attained acceptable treatment fidelity for the overall intervention (Todd, 91.5%; Luke, 80%; Jack, 84%), with the exception of Alex (71%). High integrity (above 80%) was observed for every component of the intervention except for providing differential praise (Todd, 76%; Luke, 55%; Alex, 44%; Jack, 35%).

Social Validity

A brief sibling interview was conducted pre-treatment and post-treatment and included questions about the quality and quantity of time spent playing with the participant. Upon completion of the training program, siblings also answered questions on their perceptions of the treatment package and whether they found it helpful for themselves and their brother or sister. Parents completed an additional questionnaire regarding the acceptability, appropriateness, and perceived effectiveness of the treatment package. Both sibling and parent questionnaires were scored on a Likert scale from 0 to 5, with 5 indicating high levels of satisfaction.

RESULTS

Joint Attention Training Program and Semi-Structured Play Probes

Julia

Julia mastered all eight skills within the seven-session criterion and completed the intervention package over 32 sessions (approximately 7 weeks; Figure 1).
Regarding probes administered by a sibling during the play probes, Julia’s responding (presented as percent of opportunities) improved from 21.8% (pre-treatment) to 69% (post-treatment; see Figure 5 and Table 3). She also demonstrated an increase in spontaneous initiation of JA from 0.5% (pre) to 11.3% (post). At 3-month follow-up, Julia maintained responsiveness at similar levels observed immediately post-treatment. Her initiation of JA also continued to increase after the post-treatment assessment period, from 19.7% (post) to 36% (follow-up).

Table 3. Average percentages of joint attention during semi-structured play sessions in pre-treatment, post-treatment, and at 3-month follow-up.

<table>
<thead>
<tr>
<th></th>
<th>Julia</th>
<th>Trevor</th>
<th>Mike</th>
<th>Brian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Follow-up</td>
<td>Pre</td>
</tr>
<tr>
<td>Respond to show/tap</td>
<td>27.0</td>
<td>70.7a</td>
<td>100</td>
<td>26.8</td>
</tr>
<tr>
<td>Respond to gaze/point</td>
<td>16.6</td>
<td>66.7a</td>
<td>75a</td>
<td>16.8</td>
</tr>
<tr>
<td>Initiate behavior request</td>
<td>1</td>
<td>3a</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Initiate joint attention</td>
<td>0</td>
<td>19.7a</td>
<td>36a</td>
<td>0</td>
</tr>
</tbody>
</table>

*aIndicates at least 10% change.
Trevor mastered four skills (response to hand on object, response to tapping an object, eye contact, following a point) within seven sessions, and according to progression criteria moved past sets 3, 6, 7, and 8 without achieving mastery. On two of these skills (show a toy, respond to gaze), Trevor’s data showed a consistent increasing trend; however, he did not demonstrate skill acquisition for sets 7 and 8 (initiating gaze shift and pointing). The entire intervention package was delivered over the course of 36 sessions (approximately 8 weeks) (Figure 2).

Trevor’s responding to sibling-administered probes during play sessions improved from 21.8% (pre) to 64.3% (post), as illustrated in Figure 5 and Table 3. He did not show increased initiations of JA following treatment. Although he maintained an overall increase in responsiveness compared with baseline at the 3-month follow-up, these rates were lower than those observed post-treatment.

Mike mastered seven skills within the set criterion, with completion of the training package over 36 sessions (approximately 9 weeks; Figure 3). He did not achieve mastery on the final set (protodeclarative pointing), although he did demonstrate some emerging pointing skills.
Teaching joint attention to children with autism

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

Figure 4. Percentage of opportunities with correct response for Brian during training.
Figure 5. Percentage of opportunities with independent responding (open data paths) and initiating (closed data paths) for all four participants during joint attention probes in baseline, post-treatment, and 3-month follow-up.
Mike’s responding to probes initiated by his brother during the play sessions increased from 12.6% (pre) to 65.1% (post), as shown in Figure 5 and Table 3. In addition, Mike exhibited an increase in unprompted JA initiations, from 0.9% (pre) to 3.8% (post). Mike maintained similar levels of responsiveness to a sibling at post-treatment and 3-month follow-up.

Brian

Brian mastered six skills within the set criterion and completed the training package in 37 sessions (approximately 7 weeks; Figure 4). He was advanced from sets 2 (tap a toy) and 6 (respond to gaze) after seven sessions below mastery. For both these sets, Brian’s data were showing an increasing trend by the seventh session.

Brian’s responding increased from 17.6% (pre) to 54.5% (post) to probes initiated by his sibling during play, and he demonstrated increased spontaneous JA initiations, from 0% (pre) to 5% (post). Brian also maintained similar levels of responsiveness to a sibling at post-treatment and 3-month follow-up (Figure 5 & Table 3).

Early Social Communication Scales

All four participants demonstrated improvement on their ESCS scores post-treatment (Figure 6). Differential effects on aspects of JA were observed across participants. Julia exhibited a substantial increase in JA initiations but no change in responding to behavioral requests or imitation. For Trevor, increases in imitation were observed, but he did not demonstrate any change in initiating or responding to behavioral requests. For Mike, increases in imitation and behavioral requests were observed, but there were no significant changes in initiations. Brian demonstrated an increase in behavioral requests and responding to JA, but no gains were observed in initiation JA. A paired t-test was used to statistically evaluate changes in ESCS scores from pre-treatment to post-treatment. Changes in total ESCS scores were statistically significant ($t = -6.21; p = .008$).

Imitation

Three of the four participants (Trevor, Mike, and Brian) demonstrated an increase in the rate of imitation during the semi-structured play probes, as averaged across all pre-treatment and post-treatment probes (Figure 7). Trevor’s average rate increased from 0.3 to 0.9 responses; Mike’s average rate increased from 0 to 0.06 responses; Brian’s average rate increased from 0 responses to 0.4 responses.
Social Validity

The siblings showed no changes on their pre/post questionnaires. On most items, siblings assigned the most positive ratings pre-treatment and maintained those ratings post-treatment. However, their overall ratings indicated moderate satisfaction with the intervention ($M = 3.4$). Sibling responses to the post-treatment interview indicated that they found the treatment package acceptable and that they learned about interacting with the participants. Parents indicated high levels of satisfaction with the treatment.

Figure 6. Participant scores on the Early Social Communication Scales, pre-treatment and post-treatment.

Figure 7. Rates of spontaneous target imitation for all four participants during semi-structured play probes in baseline and post-treatment.
package as it related to their children with ASD, to their typically developing child, and with the treatment as a whole ($M = 4.3$). They also reported observing improvements on various dimensions of their children’s interactions, including cooperative play, shared enjoyment, amount of time spent together, and improved interaction quality.

**DISCUSSION**

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

The results of this study suggest that a short-term behavioral intervention for teaching JA skills evoked meaningful change in the responding skills of children with ASD. It is unclear whether their success on this dimension of the dependent variable was related to pretreatment characteristics because the participants’ responding percentages were similar to each other in baseline. Although we are unable to identify the effects of pre-treatment responding on post-treatment responding, it seems clear that pre-treatment initiation was not related to the responding outcome (i.e., despite individual differences in pre-treatment initiations, all participants made similar gains in responding). However, the presence of social initiations pre-treatment may have affected the later acquisition of initiating skills in a naturalistic setting. For example, all four participants demonstrated some minimal JA and behavioral initiations on the ESCS, but Julia exhibited more consistent initiations. Following treatment, only Julia showed a significant increase in social initiations on the structured measure, and these skills generalized to the naturalistic play setting. These findings support the specificity of JA domains. In this sample, the presence of pre-treatment initiations was related to later gains in initiations but not responding because all participants demonstrated post-treatment increases in responsiveness. Pre-treatment responding may have related to gains in responding, but this cannot be determined without individual differences in initial responding rates. The total ESCS scores pre-treatment and post-treatment indicate gains across participants, but only an examination of the individual JA components yields these more detailed findings. Future researchers may therefore find it beneficial to systematically measure and address these component skills rather than evaluate JA as a single construct.

Differences in post-treatment outcomes may also be because of each participant’s performance during the intervention phase. Trevor did not improve on initiations, but
he also did not respond to either of the initiating sets, whereas the participants who increased on initiations mastered one (Mike) or both (Julia and Brian) initiation sets. This pattern of results supports the validity of the intervention’s initiation phase; teaching responding skills to mastery is not sufficient for exacting improvements in initiation skills. That initiations must be uniquely targeted strengthens the case for the specificity of individual JA skills and is consistent with previous literature (Hwang & Hughes, 2000; Martins & Harris, 2006; Taylor & Hoch, 2008). Considering Trevor did not enter the intervention with emerging initiations skills, a more extended treatment may have been necessary to teach JA as a new behavior rather than a developing skill (i.e., Julia, Mike, and Brian).

Although only Julia demonstrated increases in initiations, increases in responding by all four children can also be considered a meaningful outcome. Responding to JA has been associated with the development of language, whereas initiating JA has not (Murray et al., 2008; Siller & Sigman, 2008). The ability to respond to JA can also be seen as a first step to establishing successful social exchanges between a child with autism and another individual—particularly during interactions with peers, who may be sensitive to the rejection of social bids.

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

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

Gains in imitation were observed for three of the participants, a finding that is consistent with previous literature on the collateral effects of JA on other skills (Whalen, Schreibman, & Ingersoll, 2006). Interestingly, the participants who demonstrated these improvements (Trevor, Mike, and Brian) also made the fewest gains in
initiating JA; this suggests that imitation may serve as a compensatory mechanism for the lack of other, more complex social skills.

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

Follow-up probes indicated the maintenance of acquired skills for responding (all four participants) and initiating (Julia and Brian). Because siblings may have continued using their teaching skills, maintenance data may not have been collected in the complete absence of the intervention. However, this is encouraging support for the continuation of JA skills in the natural environment.

The typically developing siblings in this study implemented the intervention with high fidelity for most components, although it was difficult for them to remember all components without prompts (e.g., providing differential praise). Low fidelity on the social reinforcement component did not appear to affect the treatment as a whole, possibly because an adult provided praise when the sibling did not. Siblings were generally able to understand and apply concepts of obtaining and maintaining attention, providing tangible reinforcement, and persisting. All the siblings found the treatment acceptable by indicating during interviews that teaching was fun and that they would continue using the skills after the conclusion of the study.

Limitations and Future Directions

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

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

The positive outcomes obtained by the current dyads are sufficient to warrant additional research in the area of siblings as mediators of behavioral treatment. Future studies should provide a more thorough analysis of the specific effects of siblings as compared with parents or teachers. Designs comparing the rate of acquisition, generalization, and maintenance of skills when treatment is delivered by various individuals would provide useful information on the effectiveness of training siblings as teachers. If siblings are effective as or more effective than adults as teachers, it will become important to weigh the potential risks and benefits of participating to both the participant and the sibling. Parents may also be a useful resource in sibling training procedures, especially as they already have an established relationship with the child on the spectrum and potential sibling teachers. Future research targeting JA training for parents would address issues of dissemination (from the parent to sibling teachers) and generalization (from parents to siblings and vice versa). With growing evidence in favor of siblings as interventionists, research on the effects of sibling characteristics (e.g., age, gender, maturity) on outcome will also become important when identifying the best candidates for these approaches.

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Teaching joint attention to children with autism


