Teaching Gaze Shifting in the Context of Requesting and Joint Attention to Toddlers with Autism Spectrum Disorder

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TEACHING GAZE SHIFTING IN THE CONTEXT OF REQUESTING AND JOINT ATTENTION TO TODDLERS WITH AUTISM SPECTRUM DISORDER

by

IVANA KRSTOVSKA-GUERRERO

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy,
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THE CITY UNIVERSITY OF NEW YORK
Abstract

TEACHING GAZE SHIFTING IN THE CONTEXT OF REQUESTING AND JOINT ATTENTION TO TODDLERS WITH AUTISM SPECTRUM DISORDER

by

IVANA KRSTOVSKA-GUERRERO

Advisor: Professor Emily Jones

Impairment in eye gaze, including gaze shifting (GS) and making eye contact in early social communication is severely impaired in children with Autism Spectrum Disorder (ASD). This study examined the effectiveness of prompting and reinforcement to teach GS in the context of responding to a request and initiating joint attention to four toddlers with ASD. Intervention lasted 3-9 weeks with all toddlers demonstrating GS to mastery across both contexts. Toddlers also showed generalization to a repertoire of social-communication behavior, including increases in smiling. Some improvements in symptoms of autism and overall functioning were observed. Results suggest a promising brief intervention to address the earliest form of social communication that remains a part of successful social-communication interactions throughout life.
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To my husband Alex, daughters Laura and Mia, and family
Thank you for your support and patience. Your wife/mom/daughter/sister/cousin was buried under piles of papers and articles for many years and although she was physically present, she was often absent-minded….This stops today! I promise you that I will not enroll to pursue another degree any time soon. I love you all (including my fluffy parrots Kiwi and Marley).

To Laura and Mia, my beautiful daughters
Never stop learning. Remember that the learning process should be interesting and fun. If learning is not interesting or fun, find better teachers, or become one!

To my friends and neighbors
I promise to become a more social person soon. You are very important to me.

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TEACHING GAZE SHIFTING IN THE CONTEXT OF REQUESTING AND JOINT ATTENTION TO TODDLERS WITH AUTISM SPECTRUM DISORDER

by

IVANA KRSTOVSKA-GUERRERO

Within the first year of life, typically developing children achieve a foundation of social-communication skills, involving eye gaze, gestures, and vocalizations (Bruner, 1977). Before they speak and use gestures, infants use their eyes to engage caregivers in social-communication interactions (Bruner, 1977; Emery, 2000; Kleinke, 1986). During the first week after birth, newborns make eye contact with their mothers 25% of the time (Als, 1977; White, 1975) and by the third month infants look at a social partner’s eyes more than at any other part of the face (Haith, Bergman, & Moore, 1977). When a mother asks her infant for the book he is holding so she can read it to him, he looks up at her eyes and hands it over; when an infant shifts her gaze from her mobile to her mother’s eyes, the mother responds with a comment (“I see that!”) about the mobile. In each context, the child shifted his/her gaze from an object to make eye contact with his mother; this is termed gaze shift (GS; MacDonald et al., 2006). Shifting gaze between an object and a partner’s eyes remains a part of social-communication behavior throughout life, though it often becomes coordinated with other forms such as hand gestures and vocalizations (Bruner, 1977; Crais, Douglas, & Campbell, 2004).

Perhaps one of the most striking characteristics of children with autism spectrum disorders (ASD) is the impairment in eye gaze, including eye contact and shifting gaze, during social-communication interactions. Infants later diagnosed with ASD show a decline in fixation on the social partner’s eyes from 2 to 6 months of age (Jones & Klin, 2013). By 12 months of age children with ASD show impairment in the coordination of eye gaze and action or gesture
(e.g., looking at an object and reaching for it) and impairment in visual tracking (e.g., following a partner’s point to an object/person) (American Psychiatric Association, 2013; Zwaigenbaum et al., 2005; Zwaigenbaum, Bryson, & Garon, 2013). The impairment in eye gaze in the first year of life in children with ASD is evident in social-communication contexts to both make requests and engage in joint attention (JA) (Zwaigenbaum et al., 2005, Zwaigenbaum et al., 2013).

At about 6 months of age, typically developing infants request preferred items by using GS that later becomes coordinated with gestures (e.g., reaching, pointing) and vocalizations (Bruner, 1977). Around 9 months, children begin to shift gaze to coordinate attention (JA) between an object or event and a social partner (Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Mundy, Sigman, Ungerer, & Sherman, 1986). While in a typical requesting situation children shift gaze to obtain a specific reinforcer (e.g., food, preferred toy, information) (Bruner, 1977), the purpose of a GS during JA is to obtain a generalized social reinforcer from their social partner (Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004; Holth 2006). Shifting gaze is a key part of the young child’s repertoire of social communication.

In children with ASD, deficits in eye gaze for the purpose of both communicative functions are evident within the first year of life (Zwaigenbaum et al., 2005). JA continues to be impaired in preschoolers and older children with ASD (Paparella, Goods, Freeman, S., & Kasari, 2011), though requesting is perhaps less so (Mundy et al., 1986). However, requesting may take unconventional forms (e.g., autistic leading, grabbing; Drasgow, Halle, & Ostrosky, 1998) and impairment in eye gaze continues to be a hallmark of learners with ASD throughout life (American Psychiatric Association, 2013).

Impairment in eye gaze in children with ASD is correlated with the degree of their social disability (Jones, Carr, & Klin, 2008). Eye gaze disturbance from early in life means that
children with ASD miss numerous opportunities to observe their social partners’ faces and affective expressions in both requesting and JA contexts. When children do not respond to caregiver requests, the interaction with the caregiver may easily break down; not shifting gaze to look up at the caregiver following her request for the child’s book clearly ends the interaction, and, in this case, may end the opportunity for the child and caregiver to read together. When children do not initiate requests, their needs may not be met and they may instead resort to problem behavior (Carr & Durand, 1985). Impairment in JA is linked to language and social development (Jones et al., 2008; Kasari, Paparella, Freeman, & Jahromi, 2008; Tomasello, 1995). The absence of GS during JA means children miss the opportunity to observe expressions of affect and the caregiver’s gestures and do not participate in the conversation and interaction with the caregiver and object that is part of JA.

Interventions Addressing GS during Requesting and JA

Eye contact has often been addressed as a form of compliance when responding to an adult’s request; for example, teaching children to look in response to the spoken instruction, “Look at me” (Foxx, 1977; Hamlet, Axelrod, & Kuerschner, 1984; Lovaas 1987). GS may also be taught as part of the response form to initiate requests (also termed manding; Skinner, 1957). A number of studies used prompting and reinforcement to teach requesting or manding (e.g., Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010; Ben Chaabane, Alber-Morgan, & DeBar, 2009; Jennett, Harris, & Delmolino, 2008; Williams, Donley, & Keller, 2000) though only a few specifically include eye gaze as part of the response form. For example, Thomas, LaFasakis, and Sturmey (2010) demonstrated the effectiveness of prompting and differential reinforcement to teach looking, pointing, and vocal approximations to request for three children with ASD (3.2 to 3.6 years old). Looking was defined as the child directing his/her gaze toward the instructor’s face.
(e.g., at the eyes, face or mouth). Importantly, looking or shifting gaze was included in the response form for requesting.

A separate literature on JA intervention demonstrates the use of prompting and reinforcement procedures to teach both responding to others’ bids for JA (RJA) and initiating JA (IJA) (Isaksen & Holth, 2009; Jones, Carr, & Feeley, 2006; Taylor & Hoch, 2008; Whalen & Schreibman, 2003). Responding and initiating refer to the different roles children can play in social-communication interactions. RJA refers to the child’s response to JA bids (i.e., partner’s gaze direction, gesture, pointing, and/or vocalization). RJA takes the form of looking at an object, following the partner’s JA bid, and shifting gaze to look back at the partner’s eyes. IJA refers to the child’s use of GS, gestures, pointing, vocalizations to initiate or begin an interaction, in this case, directing the attention of a social partner to some object or event (Mundy & Gomes, 1998). Children also respond to and initiate requests (e.g., responding to a mother’s request for a book or initiating a request for a toy car). In one example of JA intervention, Taylor and Hoch (2008) used prompting and social reinforcement to teach 3 children with ASD RJA in the form of shifting gaze and vocalizing a comment. Results showed that children acquired RJA. Probes conducted during the RJA phase showed limited improvement in IJA and so children were taught to initiate JA by pointing and commenting. The authors reported that GS was inconsistent across children and difficult to teach, suggesting that GS may need to be taught prior to addressing JA, perhaps in a different context than JA.

In a few studies, GS has been specifically addressed across social-communication contexts including both requesting and JA functions (Dawson et al., 2010; Yoder & Stone, 2006). Yoder and Stone (2006) compared two communication interventions, Responsive Education and Prelinguistic Milieu Teaching (RPMT) and Picture Exchange Communication System over the
course of 6 months (PECS; Bondy & Frost, 1994) in 36 children with ASD (18 to 60 months of age). GS for both requesting and JA was addressed in RPMT; the clinician first engaged a child in a play routine and used the least intrusive communication prompts (e.g., saying, “Look at me” or moving his/her head to engage in GS) to prompt the child to request the object. These prompts were later faded and interventionists modeled JA. In the PECS group, children were taught to exchange pictures to make requests and comments (GS was not specifically part of the response requirement). Children with very limited IJA skills prior to intervention demonstrated better requesting performance using PECS than RPMT. RPMT increased JA only for children who showed some IJA prior to intervention.

Dawson et al. (2010) examined the Early Start Denver Model (ESDM) with 48 children with ASD between 18 and 30 months of age using a randomized controlled trial. The ESDM is a comprehensive program with a curriculum that addresses all areas of development using behavior analytic strategies and with a strong parent role in intervention. Part of the curriculum focuses on developing nonverbal communicative gestures (e.g., reaching, pointing) for the purpose of requesting, social interaction (dyadic social activities), and JA (Rogers & Dawson, 2009). Following ESDM intervention, children showed significant improvement in their IQ and adaptive behavior when compared to the control group that received community intervention (i.e., intervention that children usually receive through agencies or schools). The authors used the ADOS (Lord et al., 2000) to evaluate changes associated with intervention and found no difference between groups in ADOS severity scores at 1- and 2-year follow up.

The Yoder and Stone (2006) and Dawson et al. (2010) studies highlight the importance of teaching communication forms across both functions. Both interventions occurred over long periods of time (6 months and 2 years), reflecting the comprehensive nature of the interventions
being studied. The ESDM curriculum addresses GS, verbal and non-verbal communication, requesting and JA, as well as imitation, cognitive skills, and play skills. Intervention addressed all the major forms and functions of social communication. It may be that targeting a select sample of forms and functions could result in more wide-ranging impact on social-communicative behavior if the forms and functions were chosen carefully. There is literature suggesting the possibility of teaching a response form for one function with generalization occurring across other functions of communication without specific instruction (Arntzen & Ålmas, 2002; Egan & Barnes-Holmes, 2009; Petursdottir, Carr, & Michael, 2005). The occurrence of such generalization would increase the efficiency of intervention. For example, Petursdottir et al. (2005) taught five typically developing children (2.6 to 3.8 years old) first to assemble two 4-piece activities. Four children were then taught to mand for the four pieces of the first activity and to tact the four pieces of the second activity. The fifth child was only taught to tact the four pieces of one activity. After teaching the words for one function, they tested whether children used the words for the other function. Teaching the words as mands resulted in children using the words as tacts, but only two children used words as mands after learning the words as tacts. The generalization across functions suggests that teaching a common response form across functions may result in generalization (Stokes & Baer, 1977).

**Present Study**

GS is an early form of social-communication that continues to be a part of social-communication interactions throughout life. GS is used across social-communication contexts reflecting requesting and JA functions and both responding and initiating interactions. GS is impaired from the first months of life in children with ASD, suggesting GS is an important form to target in intervention. The existing research suggests it is possible to teach GS across
requesting JA and functions, though it may be a difficult response form to teach (Taylor & Hoch, 2008). Both functions, including the roles of responding and initiating, should be examined to adequately address the needs in social-communication of children with ASD. The significant impairment in GS and its relevance to a social-communication repertoire further suggests that addressing GS in young children may impact overall functioning, especially in terms of social interaction and communication. The purpose of this study was to examine the effect of a brief intervention involving prompting and reinforcement to teach GS as a common response form for a sample of social-communication contexts (i.e., responding to a request [RR] and initiating JA [IJA]), and examine generalization to other social-communication contexts with preliminary exploration of collateral effects on symptoms of autism and overall functioning.
Method

Participants

**Toddlers with ASD.** Four 1-2 year old toddlers with ASD participated in this study. Criteria for participation included being under 3 years of age, signed parental informed consent, a diagnosis of Autistic Disorder using DSM-IV-TR criteria (American Psychiatric Association, 2000) by a psychologist or physician not associated with this study, and engagement in basic attending skills as assessed by the interventionist (described shortly). A trained graduate student administered the *Autism Diagnostic Observation Schedule* (ADOS; Lord et al., 2000) to assess the toddler’s diagnostic classification and evaluate changes associated with intervention. The interventionist conducted a brief play session to examine whether toddlers with ASD demonstrated basic attending skills necessary for intervention. Attending behaviors included sitting upon request, visually tracking moving objects, responding to auditory stimuli by looking in the direction from which the sound was coming, and reaching for preferred objects coordinated with looking at objects. Toddlers with ASD were able to turn their heads up and down and left and right (motor movements necessary for GS). Each of these behaviors was assessed during a semi-structured play session in which the interventionist presented 5 opportunities for the toddler to demonstrate each response. For example, to determine if the toddler visually tracked moving objects, the interventionist held a toy, identified as preferred by the parent, and moved it slowly in front of the toddler in all directions. Toddlers looked at objects offered by the interventionist within 2 s of the instruction (i.e., toy was held in front of the toddlers and out of reach) and toddlers also looked at the toy out of reach that was activated (moved and made a sound) by the interventionist. Toddlers demonstrated 80% to 100% correct
responding on each area assessed. Toddlers also demonstrated lack of or impaired (0% to 20% correct responding) GS during requesting and JA.

All toddlers had received evaluations as part of their participation in early intervention services. These evaluations were conducted by professionals not associated with this study. All toddlers came from bilingual, English and Spanish, households, with English as the dominant language only in John’s home. Therefore, bilingual evaluations were conducted with the other three toddlers, Ian, Jeff, and Robert. Consistent with recommendations for evaluating bilingual children (Mindt et al., 2008), only percentages of delay and percentiles were reported for Ian, Jeff, and Robert in addition to the total score on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Rochen-Renner, 1999) for all toddlers and the total score on the ADOS (Lord et al., 2000) for John. Table 1 shows toddlers’ characteristics from their existing assessments.

The toddlers had just begun receiving early intervention services. Those services focused on manipulating toys in a functional manner, increasing in-seat behavior, decreasing challenging behavior, and teaching basic cognitive skills. JA and GS were not yet addressed except for making requests by using signs and responding to name. The toddlers received 10 to 20 hr of home-based Applied Behavior Analysis (ABA) special instruction per week. John received 10 hours at home and an additional 10 hours in school. Children also received speech and language therapy, physical therapy, and occupational therapy 2 to 4 times per week in 30-minute sessions. At the beginning of this study, Jeff received 20 hours of ABA at home. Before the end of intervention (session 86), he started to attend a therapeutic nursery 10 hr per week and his home-based ABA decreased to 10 hr per week. John suffered from frequent ear infections and underwent 2 surgeries to insert tubes in his both ears to help with draining of the fluid behind the
eardrum. The first surgery occurred after the first session of the partially prompted phase of requesting intervention (Figure 1, session 47); the second surgery occurred 8 days before John’s 1-month follow-up session.

**Typically developing toddlers.** Three typically developing toddlers participated before the beginning of baseline with toddlers with ASD to provide comparative data to determine response criteria for the latency and duration of GS in the contexts targeted for intervention and for generalization. The toddler’s responding was assessed in the same way as baseline for toddlers with ASD (described shortly). Two girls (18 and 25 months old) and one boy (25 months old) were recruited. Criteria for participation included parent report of typical development and signed parental consent. The interventionist administered the *Developmental Assessment of Young Children* (DAYC; Voress & Maddox, 1998) to assess cognitive, language, social-emotional, adaptive, and physical functioning. Results confirmed functioning in the average range in all five areas of development assessed for each child (standard scores [SS] ranging from 100 to 102).

**Setting and Interventionists**

All sessions occurred at the toddler’s homes in rooms usually used for intervention (approximately 6 m x 6 m). The interventionist conducted intervention sessions. She is a special education teacher who provides early intervention services to toddlers with ASD and a doctoral student in the behavior analysis program in the psychology department.

**Materials**

Thirty toys were identified for intervention and generalization. Twenty-four toys were used for intervention and six toys for generalization. Toys were multiple piece puzzles and toys, blocks, or individual toys. The Autism Diagnostic Observation Schedule (ADOS; Lord et al.,
2000) and the Developmental Assessment of Young Children (DAYC; Voress & Maddox, 1998) were administered to participants. Data were recorded on data sheets and a video camera was used to record sessions.

**Dependent Variables**

**Gaze shift (GS).** The dependent variable was GS. The interventionist measured latency (time elapsed from the interventionist’s instruction to looking at the toy and from shifting gaze from the toy to the interventionist’s eyes) and duration (looking at the toy and looking at the interventionist’s eyes) of responding of the three typically developing toddlers. The average across toddlers and responses provided information to help define response latency and duration for GS for toddlers with ASD.

GS is defined as looking at the toy for 1 s and shifting gaze from the toy to the interventionist’s eyes (the interventionist must at the same time look at the toddler’s eyes for 1 s). Looking at the toy must occur within 2 s of the presentation of instruction. For all contexts, except RR (name) and IJA (toy in hand), toddlers started with their gaze not directed at the toy. GS must occur within 2 s of looking at the toy.

The interventionist recorded GS as either correct (independent or prompted) or incorrect on each opportunity. Performance data are reported as the percentage of correct (prompted) responses during the first two phases of intervention (i.e., full prompt [FP] and partial prompt [PP] phases) and correct (independent, unprompted) responses during baseline, time delay (TD), and follow-up phases.

**Collateral changes.** The ADOS (Lord et al., 2000) and DAYC (Voress & Maddox, 1998) were administered pre- and post- intervention to evaluate changes associated with this intervention. The ADOS is a 30 to 60 min semi-structured assessment used to diagnose ASD
across developmental levels, ages, and language skills. The ADOS includes an assessment of requesting skills, preverbal gestures, JA interactions, responding to name, and other areas of social communication that are part of the ASD diagnosis and also targeted in this intervention. Based on each toddler’s language and developmental level, Module 1 for children who are largely nonverbal and demonstrate little or no phrase speech was used with all toddlers. The ADOS was used to evaluate changes in specific symptoms and ASD diagnosis from pre- to post-intervention (Dawson et al., 2010). The ADOS yields scores in each of the five assessed areas (i.e., Language and Communication, Reciprocal Social Interaction, Communication and Social Interaction, Play, and Stereotyped Behaviors and Restricted Interests). The scores measure symptoms of autism, therefore, the higher the number, the more severe the impairment. The Reciprocal Social Interaction is the area most related to this intervention because it includes items on eye gaze and gaze coordination with other behaviors (social smiling, response to name, requesting and JA). A standardized severity score is calculated based upon select items from the ADOS assessment areas (Gotham, Pickles, & Lord, 2009).

The DAYC (Voress & Maddox, 1998) is used to identify areas of impairment in five developmental domains (cognitive, communication, social-emotional, physical development, and adaptive behavior) in young children from birth through 5 years 11 months, and to determine eligibility for early intervention services. It is also used as part of early intervention services to evaluate changes over time (e.g., it is re-administered every 6 months), identify children’s strengths and weaknesses, and assist with the development of individual goals and objectives for each child. Each subtest requires 10 to 20 min to administer. The DAYC yields raw scores, age equivalents, standard scores, percentiles, and a general developmental quotient score.

**Experimental Design**
A multiple baseline probe design across four toddlers with ASD was used to evaluate intervention procedures to teach GS in the context of requesting and JA. After demonstrating steady responding in baseline, intervention began with teaching GS during responding to a request (RR). Baseline probes of initiating JA (IJA) continued and once RR was mastered, intervention was applied to teach IJA if children did not demonstrate GS to IJA. To avoid unnecessarily delaying intervention for the fourth child, intervention began at the same time for the third and fourth child. Generalization probes were conducted for all toddlers as well as 1- and 3-month post-intervention follow-up sessions.

**Procedure**

**Pre-assessment.** A doctoral student administered the ADOS (Lord et al., 2000) before intervention to describe the toddler’s ASD symptoms and severity. She was trained to administer this assessment for research purposes. The DAYC (Voress & Maddox, 1998) was used to evaluate developmental functioning of the toddlers with ASD across communication, cognitive, social-emotional, adaptive behavior, and physical development domains. The interventionist administered the DAYC.

**Preference Assessment.** Before baseline and intervention began, the interventionist identified 24 toys based on parent/teacher report. Sixteen toys were used to teach responding to a request (RR) and 8 remote control toys were used to teach initiating joint attention (IJA). At the beginning of each session, the interventionist randomly selected 5 toys out of the 16 toys (for RR intervention) or 5 of the 8 toys (for IJA intervention) identified previously and allowed the toddler to choose 3 (without replacement) for use during that specific session (DeLeon & Iwata, 1996). The interventionist then selected one of the three toys to begin the session and replaced it with the second toy if the toddler lost interest (e.g., did not reach, looked away for 2 s) in the first
toy during the session and replaced the second toy with the third if the toddler lost interest in the second toy. If the toddlers did not show interest in the 3 toys offered, the interventionist presented 5 different toys and allowed the toddler to select another 3 toys. Toys not used in one session were presented again after all other toys had been used. This way the interventionist presented and rotated all preferred toys during baseline, intervention, and follow-up.

**Baseline.** Baseline sessions began with the preference assessment. An opportunity began with the presentation of an instruction.

To assess GS in the RR context, the interventionist sat on the floor facing the toddler who was seated on the floor or in a booster seat. The interventionist offered a preferred toy by holding it out of reach below the toddler’s eye level (no other gestures or vocalizations were used). If the toddler did not look and reach for the toy, the interventionist presented this opportunity one more time before replacing the preferred toy. This occurred only a few times for each toddler.

According to Halle (1987), there is a continuum of spontaneity of communicative responses with initiations of communication that occur in the presence of contextual (e.g., no access to water) or interoceptive stimuli (e.g., water deprivation) on one end and responses that clearly reflect responding to other’s instructions that occur in the presence of prompts, on the other end. In between learners may communicate in the presence of questions or mands from a partner (less of an initiation) or objects or events (more of an initiation). Since the interventionist held the preferred toy in front of the toddler, we considered this a gestural prompt that places the toddler in the role of a responder, though clearly, this falls in the continuum perhaps leaning to the initiation end.

To assess GS in the IJA context, the interventionist placed a remote control toy on the floor on the toddler’s left/right side, out of his reach and hid the remote control behind her back.
so that the toddler could not see it. She then engaged the toddler in play (e.g., building a tower with blocks, stringing beads, etc.) for a short time (10-15 s) and used the remote control to make the toy on the floor produce a sound and move for 2 s (no gestures or vocalizations were used). If the toddler did not look at the activated toy, the interventionist presented this opportunity one more time before replacing the preferred toy.

No prompts or error correction procedures were presented during baseline sessions. Natural consequences were provided for GS. For example, if the toddler reached for the object and shifted his gaze to the interventionist’s eyes (during a requesting opportunity), the interventionist provided the toddler with the object. If the toddler looked at the remote control toy and shifted his gaze to the interventionist’s eyes (during an IJA opportunity), the interventionist smiled and commented (e.g., That’s a funny toy!”). Regardless of the toddler’s response (i.e., correct, incorrect, or no response), the interventionist terminated the opportunity after 2 s and presented another opportunity. Baseline sessions lasted approximately 5 min and consisted of 5 opportunities each.

Each toddler completed a minimum of five baseline sessions and demonstrated steady responding during baseline before proceeding to intervention. Baseline probe sessions for toddlers and responses remaining on baseline occurred corresponding to approximately every fifth intervention session of the response for which intervention had been introduced (e.g., approximately once a week for each toddler).

**Intervention.** Intervention involved the presentation of 10 repeated opportunities during one session, in close proximity, with prompting and reinforcement. The number of sessions varied between 1-3 per day, 2-4 times per week, depending on each toddler’s availability. Mastery criterion was at least 80% correct independent responses across 2 consecutive sessions.
during 2 days of intervention. Consistent with previous JA research (e.g., Jones et al., 2006), the prompting procedure involved most-to-least prompting combined with a time delay (i.e., prompts were initially presented immediately following the instruction [0 s time delay] and then faded to a 2 s time delay). The specific procedures used for RR and IJA are described next.

**RR.** During this intervention step, each toddler was taught to shift his gaze to the interventionist’s eyes when the interventionist offered a preferred toy (no verbal instruction was used). Intervention began in the same manner as baseline; the toddler selected preferred toys and the interventionist offered one of the preferred toys in front of the toddler slightly out of reach and below the toddler’s eye level. If the toddler did not look and reach for the toy, the interventionist presented this opportunity one more time before replacing the preferred toy. This occurred only a few times during the RR intervention. Smaller toys (e.g., pieces of a puzzle, small blocks, etc.) were selected so they did not block the interventionist’s eyes.

Prompts, most-to-least prompt fading, and time delay procedures were used in the following sequence. Once the toy was presented and the toddler looked at it and reached for it for 1s (all toddlers looked at and reached for the toys as per screening criteria), the interventionist immediately (i.e., 0 s delay) provided the highest-level prompt (i.e., full gesture prompt, FP). She slowly brought the toy up to the level of her eyes. The toddler visually tracked the toy and looked in the interventionist’s eyes for 1 s. The interventionist immediately handed the toy to the toddler and provided a natural instruction (e.g., “Here you go,” or, “Take it.”). Once the toddler responded to the highest-level prompt with at least 80% accuracy across 2 sessions, the prompt was faded to a lower-level prompt (i.e., partial gesture prompt, PP) presented immediately after the toddler looked at and reached for the toy presented by the interventionist. For the lower-level prompt, the interventionist slowly brought the toy up only halfway between the original position.
of her hand and her eye level. The toddler visually tracked this movement and continued to look up until he looked in the interventionist’s eyes for 1 s. The interventionist immediately handed the toy to the toddler and provided a natural instruction (e.g., “Here you go,” or, “Take it.”). If the toddler did not GS with the lower-level prompt, the highest-level full gesture prompt was introduced to ensure the toddler completed the GS. Once the toddler responded correctly with at least 80% accuracy across 2 sessions to the lower-level prompt, a 2 s time delay (TD) was introduced to provide the toddler with the opportunity to respond without additional prompting. If the toddler did not independently shift his gaze to the interventionist’s eyes, she used the previous prompt level. Consequences for GS were obtaining the preferred toy paired with a natural instruction using a continuous schedule of reinforcement (i.e., every correct response was reinforced).

**IIA.** This intervention step differed from the previous one in two important ways. First, the function of the behavior changed from requesting to JA. During requesting, the toddler obtained the preferred toy as a consequence; during JA, the toddler obtained social consequences only. Second, the toddler’s role changed from *responder* during the requesting phase of intervention to *initiator* during the JA phase; that is, the toddler initiated interaction with the interventionist.

As in baseline, the interventionist placed a remote control toy (when the toddler was not looking) selected by the toddler on the floor out of reach, but positioned the toy so that the toddler could easily see it (i.e., the toy was positioned to the right of the child and interventionist, but closer to the interventionist). The interventionist hid the remote control behind her back so that the toddler could not see it. She engaged the toddler in play (e.g., building a tower with blocks, stringing beads, etc.) for a short time (10-15 s) and then used the remote control to make
the toy on the floor produce a sound and move for 2 s (no verbal instruction was used). After the toddler turned his head toward the toy on the floor and briefly looked at it (e.g., 1 s) (all toddlers looked per screening criteria), the interventionist immediately (i.e., 0 s delay) provided the highest-level prompt (i.e., FP). She used another preferred toy (not selected by the toddler for this particular session) to slowly trace the path from the toy to the level of her eyes. Smaller toys (e.g., pieces of a puzzle, small blocks, etc.) were selected to prompt the toddler’s GS so they were easy to hold and did not block the interventionist’s eyes. When the toddler looked at her eyes, she immediately smiled and provided a social comment (e.g., “Yes, I see that!” etc.) and the toy she was holding (not selected by the toddler for this particular session) was given to the toddler. If the toddler did not look at the toy after it made a sound and moved, the interventionist activated the toy again. If the toddler still did not respond, the interventionist replaced that remote control toy with another toy selected for this session. This occurred only a few times during IJA intervention. Once the toddler responded to the highest-level prompt with at least 80% accuracy across 2 sessions, the prompt was faded to a lower-level prompt (i.e., PP). After the toddler turned his head toward the toy on the floor that produced the sound and briefly looked at it (e.g., 1 s), the interventionist immediately provided (i.e., 0 s delay) the lower-level prompt (i.e., PP). She used a preferred toy (not selected by the toddler for this particular session) to slowly trace the path halfway between the toy and her eyes and, when the toddler looked at her eyes, she immediately smiled and provided a social comment (e.g., “Yes, I see that!” etc.) and gave the toddler the toy she was holding to play with. If the toddler did not GS with the lower-level prompt, the highest-level full gesture prompt was used to ensure the toddler completed GS. Once the toddler responded correctly with at least 80% accuracy across 2 sessions to the lower-level prompt, a 2 s time delay was introduced to provide the toddler with
the opportunity to respond without additional prompting. If the toddler did not respond independently, the previous prompt level was used to ensure that the toddler made GS. Consequences for GS to IJA consisted of social praise combined with a smile and the delivery of a toy not used during the IJA session. Consequences were provided on a continuous schedule (i.e., every response was reinforced) during the first prompted level (i.e., FP) of teaching GS to IJA. When toddlers reached the first session of 80% correct responding during the second prompted level (i.e., PP), toys were provided on a FR-2 schedule (i.e., every second response was reinforced by a toy and social praise remained continuous). During the time delay phase of intervention, toys were no longer used to prompt the GS and as reinforcement, but the interventionist continued to provide a smile and a social comment on a continuous schedule.

**Post-assessment.** The ADOS (Lord et al., 2000) and DAYC (Voress & Maddox, 1998) assessments were re-administered post-intervention to evaluate changes associated with this intervention.

**Generalization and Maintenance**

Five opportunities were provided during a generalization session to assess each type of generalization. Generalization sessions occurred during initial baseline sessions, when responding reached mastery level for GS to RR and IJA, and during 1- and 3-month follow-up sessions. No prompts or error correction procedures were provided during generalization probes. As in baseline, natural consequences were provided for correct responses. Performance of GS is reported as percentage correct.

**Generalization across partners.** Generalization with each toddler’s mother was examined for GS in both RR and IJA contexts with the same toys that were used during baseline and intervention.
**Generalization across contexts.** The interventionist assessed GS across six social-communication contexts not targeted in intervention with preferred toys selected for generalization (not used for intervention). The interventionist conducted probes during one session and recorded if performance reached 80% or above. These contexts reflected a repertoire of social-communication behaviors across both roles and functions that are often part of assessments of social-communication (ESCS; Mundy et al., 2003) and symptoms of autism (e.g., ADOS; Lord et al., 2000) and that have been shown to be impaired in children with ASD (Klein MacDonald, Vaillancourt, Ahearn, Dube, 2009; Paparella et al., 2011; Zwaigenbaum et al., 2013).

**Responding to a request (RR [clean up]).** The purpose of this generalization probe was to examine GS for responding to a different request than that taught in intervention, but one often presented to children. In this case, the interventionist requested the toddler to clean up his toys. The interventionist engaged the toddler in play (e.g., with blocks or puzzles), said, “Let’s clean up now,” and moved a plastic bag/box in front of the toddler holding it slightly out of reach. All toddlers looked at the bag/box for 1 s and extended their hand with toys toward the bag/box (as per screening criteria) and the interventionist recorded if each toddler shifted gaze from the toy to the interventionist’s eyes within 2 s. If the toddler did, the interventionist provided natural consequences, moving the plastic bag/box within the toddler’s reach to allow the toddler to complete the response to the interventionist’s request.

**Responding to name (RR [name]).** The purpose of this probe was to examine responding to name, something children with ASD often do not demonstrate (Zwaigenbaum et al., 2005). This context involved GS when responding to a request, in this case the toddler’s name being called. The interventionist engaged the toddler in play and called the toddler’s name when he
was looking at some toy. If the toddler shifted his gaze from the toy to the interventionist’s eyes within 2 s, she provided a natural consequence, commenting on the toy with which the toddler was playing (e.g., “Yes, this block is red,” or, “Do you want another block?”).

**Initiate a request (IR [toy out of reach]).** The purpose of this probe was to examine GS in a situation that reflects initiating a request, something we did not directly teach and that children with ASD are less likely to do compared to their typically developing peers (Winder, Wozniak, Parladé, & Iverson, 2013). This context involved GS when initiating a request with the interventionist, in this case when a preferred toy was placed out of the toddler’s reach. The interventionist placed a preferred toy (e.g., a piece of a puzzle the child was playing with) in front of the toddler and out of reach when the toddler was not looking (the toy was not directly offered by the interventionist). According to Halle’s (1987) continuum of spontaneity of communicative responses, this context would not be considered a pure initiation (mand) because the adult and object are present, but it could be considered a more spontaneous response on the continuum between less to more spontaneous responding. Toddlers reached for the toy and looked at it. If the toddler shifted his gaze from the toy to the interventionist’s eyes, the interventionist provided a natural consequence by handing the toy to the toddler to play with for several seconds.

**Respond to JA (RJA [head turn]).** The purpose of this probe is to assess the responder role of JA. RJA is also impaired in children with ASD (Mundy et al., 1986; Charman et al., 1998). RJA involves adult bids for JA that can take several forms, one of which is the adult partner shifting her gaze and turning her head to look at an object (e.g., a mother turns her head and shifts her gaze toward a fast approaching car). Following a social partner’s GS and head turn is problematic for children with ASD and has itself been the target of direct intervention (Klein
et al., 2009). The typically developing toddlers in the present study demonstrated GS in this context inconsistently. They followed the head turn by looking at the toy between 40% and 100% of the presented opportunities, but not all of those responses were coordinated with GS. Paparella et al. (2011) also found that RJA (head turn) emerged around 18 months of age in 83% of the typical children and, in children with ASD, was only seen when children’s expressive language age was above 47 months. This context involved GS when responding to the interventionist’s JA instruction consisting of her turning her head toward a toy on the floor. No additional gestures (pointing) or vocalizations were provided. If the toddler looked at the toy within 2 s and shifted his gaze back to the interventionist’s eyes within 2 s after looking at the toy, she smiled and provided a natural comment about the toy (e.g., “Wow, it’s Elmo!”).

**Respond to JA (RJA [head turn, point, vocalization]).** Another form of adult bid for RJA is when the adult turns her head, points, and vocalizes. This context involved GS when responding to the interventionist’s JA instruction, in this case her head turn toward a preferred toy on the floor combined with pointing at the toy and vocalizations (“Wow, it’s Elmo!”). If the toddler looked at the toy within 2 s and shifted his gaze back to the interventionist’s eyes within 2 s after looking at the toy for 1 s, she smiled and provided a natural comment about the toy (e.g., “I see Elmo too!”).

**Initiate JA (IJA [toy in hand]).** IJA is known to be impaired in children with ASD (Mundy et al., 1986; Winder et al., 2013) and has been difficult to teach (e.g., Jones et al., 2006; Whalen & Schreibman, 2003). The purpose of this probe was to examine if teaching GS in one IJA context generalizes to another untrained IJA context. This context involved GS to IJA with the interventionist, in this case when a preferred toy was within reach. The interventionist placed a preferred toy in front of the toddler and within his reach. Assessing this context is important in
order to see if the toddler engaged in IJA with the interventionist even if he did not need help accessing preferred toys. If the toddler shifted his gaze to the interventionist’s eyes for at least 1 s while manipulating the inactive toy within 12 s of obtaining it, the interventionist provided a natural comment (e.g., “What a cool car!”).

**Response Generalization.** The purpose of this measure of generalization was to examine changes in a related response form that is often part of social-communication interactions, smiling. GS is an important part, but not the only part of the response form of social communication. Smiling is often coordinated with GS, especially in the context of JA (Kasari, Sigman, Mundy, & Yirmiya, 1990). As children begin to observe their partner’s faces when they engage in GS, they have an opportunity to observe other behaviors in which social partners engage, including smiling. Therefore, smiling was coded from the video recorded sessions during baseline and time delay phases of intervention for RR and IJA. Smiling was defined as the corners of the toddler’s mouth turned up. The interventionist scored both the sessions during which the toddler smiled at the toys, but did not shift his gaze to her eyes and sessions during which the toddler smiled at the toys and interventionist when shifting gaze. Performance is reported as percentage of RR and IJA opportunities in which toddlers smiled.

**Maintenance.** One- and three-month post-intervention follow-up sessions were conducted to assess maintenance of GS across trained and generalization contexts. The interventionist conducted all follow-up sessions in the same way as baseline sessions. If toddlers responded correctly, the interventionist provided natural consequences. For example, if the toddler reached for a preferred object and GS, he obtained that object. If he initiated JA by GS, the interventionist smiled briefly and commented on the object (e.g., “I see that!”). She did not provide any prompts or correction procedures.
Social Validity

The toddler’s primary caregiver completed a questionnaire about their perception of their toddler’s social communication skills at pre- and post-intervention (Appendix). Another post-intervention questionnaire examined the appropriateness of the intervention procedures. Questions included: 1) Was this intervention appropriate to address gaze behavior, especially eye contact during social interactions? 2) Are you satisfied with the type of intervention used to address gaze behavior and eye contact? 3) Are you satisfied with the results of the intervention? and 4) Will you continue to implement intervention to maintain your child’s requesting and joint attention skills?

Interobserver Agreement

A trained undergraduate student and the interventionist independently scored each toddler’s performance for 30% to 35% of the video recorded sessions to examine interobserver agreement (IOA). The student and interventionist independently recorded the toddler’s response to each opportunity as independent correct or prompted. The same data sheet used for intervention was used to record IOA. Mean percentage agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100%. For all children, overall IOA for GS during baseline, intervention, and generalization probes was 100%.

During intervention, the interventionist sat directly in front of the toddler. The camera was positioned so that both the interventionist and the toddler could be seen, providing a different angle for observation of the toddler’s responses during IOA. To ensure that there were not large differences in coding of GS during the session and from the video recorded sessions, the interventionist also calculated IOA between the toddler’s performance data that she obtained
from video recorded session and live recoded sessions during intervention. Mean percentage agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100.

For Ian, John, Jeff, and Robert, overall IOA between baseline and intervention sessions scored from video recorded session and live recoded sessions was 99%, 99%, 100%, and 98%, respectively. For Ian, John, Jeff, and Robert, IOA between generalization sessions scored from video recorded session and live recoded sessions was 98%, 98%, 99%, and 98%, respectively.

The same trained undergraduate student and the interventionist also scored smiling from the video recorded sessions. Percentage of GS sessions with smiling was calculated. For Ian, John, Jeff, and Robert, overall IOA for GS coordinated with smiling during baseline and time delay phases of intervention for RR and IJA was 100%.

**Intervention Integrity**

At the same time that the trained undergraduate student recorded a toddler’s performance for IOA, she also assessed intervention integrity. To determine the percentage of correctly implemented intervention components (i.e., presentation of instructions, prompts, and consequences), the number of correctly implemented components was divided by the total number of correct plus incorrect presentations, multiplied by 100.

For all children, overall intervention integrity for the presentation of instructions, prompts, and consequences was 100%.
Results

RR and IJA Intervention

Figure 1 shows participants’ performance during baseline, intervention, 1-month and 3-month follow-up sessions with the interventionist as well as generalization with each toddler’s mother.

With the interventionist each toddler showed 0% independent responses during baseline of GS across both RR and IJA contexts with the exception of one session of IJA each for Ian and Jeff. After intervention for RR began for Ian, he reached mastery criterion in 13 sessions. During intervention for RR, baseline probes of IJA increased with variable performance between 0% to 60%. After intervention began for IJA, Ian reached mastery criterion in 6 sessions.

After intervention for RR began for John, he reached mastery criterion in 10 sessions. John’s performance of IJA increased from 0% to 80% during the first prompted phase of intervention for RR and remained within mastery level through the end of intervention for RR.

After intervention for RR began for Jeff, he reached mastery criterion in 16 sessions. Jeff’s performance of IJA fluctuated between 0% and 20% during the intervention phase for RR. After intervention began for IJA, Jeff reached mastery criterion in 13 sessions.

After intervention for RR began for Robert, he reached mastery criterion in 18 sessions. Robert’s baseline performance of IJA slightly increased for 0% to 20% after the end of intervention for RR. After the intervention began for IJA, he reached mastery criterion in 15 sessions.

Table 1 shows the toddlers’ characteristics at the start of intervention, ages, and diagnoses; Table 2 shows frequency of toddler’s services, time between diagnosis and intervention, and
duration of intervention. Ian, John, Jeff, and Robert competed intervention in 13, 6, 18, and 19 days, respectively, reflecting 3-9 weeks of intervention.

**Generalization and Maintenance**

**Generalization across partners.** Figure 1 also shows performance for GS in RR and IJA contexts during generalization probe sessions with each toddler’s mother. Each toddler’s performance with his mother was at 0% for RR and IJA. Ian’s performance with his mother increased to 100% during the last session of intervention for each context. John’s generalization performance of RR and IJA with his mother increased 80% or above during the last session of intervention for RR. Jeff’s generalization performance with his mother increased to 80% or above during the last session of intervention for RR and IJA. Robert’s generalization performance with his mother increased to 40% during the last session of intervention for RR and 60% during the last session of intervention for IJA. His performance of IJA increased to 80% during the last session of intervention for IJA.

**Generalization across contexts.** Figure 2 shows Ian’s and John’s performance during intervention and generalization probes to different social-communication contexts. The first and third panels of Figure 2 show Ian’s and John’s performance during baseline, intervention, and 1-month and 3-month follow-up sessions, respectively as shown in Figure 1. The second and fourth panels show Ian’s and John’s performance during probes of generalization across contexts, respectively.

Figure 3 shows Jeff’s and Robert’s performance during intervention and generalization probes to different social-communication contexts. The first and third panels of Figure 3 show Jeff’s and Robert’s performance during baseline, intervention, and 1-monh and 3-month follow-
up sessions, respectively as in Figure 1. The second and fourth panels show Jeff’s and Robert’s performance during probes of generalization across contexts, respectively.

During baseline across all six contexts, participants showed 0% independent correct responding with the exception of one instance of RR (name) (20%) for Ian and one instance of IJA (toy in hand) (20%) for each Jeff and Robert. For Ian (Figure 2), generalization probes at the end of IJA intervention showed increases in performance to or above 80% for all probes except for RJA (head turn) that remained at 20%. For John (Figure 2), generalization probes recorded during the last session of intervention for RR (John did not receive IJA intervention because his performance increased to mastery at the end of RR intervention) showed an increase in performance above baseline levels, but only IJA (toy in hand) increased to 80%. For Jeff (Figure 3), generalization probes recorded at the end of IJA intervention showed increases in performance above baseline levels with RR (clean up), IR (toy out of reach), and IJA (toy in hand) increasing to or above 80%. For Robert (Figure 3), generalization probes recorded at the end of IJA intervention showed increases in performance above baseline levels with RR (clean up) and IR (toy out of reach) increasing to or above 80%.

Table 3 shows a summary of performance across generalization contexts reflecting contexts in which toddlers showed one probe with performance at or above 80% and contexts in which toddlers showed no probe with performance at or above 80%. All toddlers showed generalization to RR (clean up) and IR (toy out of reach). Ian and John showed generalization to RR (name) and only Ian to RJA (head turn). Ian, John, and Jeff showed generalization to RJA (head turn, point, and vocalization) and IJA (toy in hand).

**Response generalization.** Table 4 shows the percentage of GS in RR and IJA contexts coordinated with smiling during baseline and time delay phases of intervention for each toddler.
with ASD, averages across the four toddlers with ASD, and averages across the three typically developing toddlers.

Smiling at the toy without shifting gaze to RR did not occur at all in the typically developing toddlers. In contrast, during baseline, three toddlers with ASD showed 2% to 20% smiles without GS (John showed none); these percentages did not change much during intervention (range 5% to 17%). Smiling coordinated with GS occurred on 13% of opportunities for typically developmental toddlers. In contrast, toddlers with ASD did not demonstrate GS coordination with smiling at all during baseline. However, during intervention, the percentage of opportunities in which toddlers with ASD shifted gaze and smiled increased for each toddler within or exceeding the range of the percentage of opportunities with GS without smile, compared to that observed in typically developing toddlers.

Smiling at the toy without shifting gaze to IJA occurred on 7% of opportunities for typically developing toddlers. Similarly, during baseline, two toddlers with ASD showed 3% to 9% average smiles without GS (John and Jeff showed none); these percentages did not change much during intervention (range 5% to 10%). Smiling coordinated with GS occurred during 40% of the opportunities for typically developing toddlers. In contrast, three toddlers with ASD did not demonstrate GS coordination with smiling at all during baseline and Jeff did so only for 2% of opportunities. The percentage of opportunities per session in which toddlers with ASD shifted gaze and smiled increased for each toddler approaching or exceeding the range of the percentage of opportunities with GS with smile, compared to that observed in typically developing toddlers.

**Maintenance.** 1- and 3-month follow-up sessions were conducted after intervention ended with each toddler to assess response maintenance with the interventionist, with the
participants’ mothers, and of generalization across contexts. Follow-up performance is shown in Figures 1, 2, and 3.

Ian, John, and Jeff (Figure 1) demonstrated performance at or above 80% for GS in both RR and IJA contexts with the interventionist and the child’s mother during both follow-up sessions. Robert (Figure 1) demonstrated performance at or above 80% for RR with the interventionist and his mother during both follow-up sessions. Robert’s performance of IJA with the interventionist decreased to 20% at a 1-month follow-up and remained the same at a 3-month follow-up. Robert’s performance of IJA with his mother decreased to 0% at a 1-month follow-up with a slight improvement to 40% at 3-month follow-up.

For the probes of generalization across contexts, Ian showed GS across all probes at or above 80% at the 3-month follow-up.

John’s performance (Figure 2) at the 1-month follow up was at or above 80% for RR (clean up), RJA (head turn, point, vocalization), and IJA (toy in hand). RR (name) and IR (toy out of reach) remained at 40% and RJA (head turn) was 0%. By the 3-month follow up, RR (clean up) and IJA (toy in hand) performance remained at or above 80% and RR (name) and IR (toy out of reach) also increased. However, RJA (head turn, point, vocalization) decreased to 40% and RJA (head turn) remained 0%.

Jeff’s performance (Figure 3) at a 1-month and 3-month follow up reflected similar performance as John. By the 3-month follow up, Jeff scored at or above 80% for RR (clean up), IR (toy out of reach), RJA (head turn, point, vocalization), and IJA (toy in hand). RR (name) increased to 40% and RJA (head turn) remained 0%.

At a 1-month follow up, Robert (Figure 3) performed at or above 80% for RR (clean up), IR (toy out of reach) and IJA (toy in hand) were 60% and the other probes were 0%. By the 3-
month follow up, RR (clean up) remained at 100% and IR (toy out of reach) increased to 80%, but RJA (head turn, point, vocalization) and IJA (toy in hand) were 40%, and RR (name) and RJA (head turn) remained 0%.

**Characteristics of ASD and Overall Development**

**ADOS.** Table 5 shows pre- and post-intervention scores on Module 1 of the ADOS assessment, severity scores, and severity classifications for all toddlers. The ADOS yields scores in Language and Communication, Reciprocal Social Interaction, Language and Communication and Social Interaction, Play, and Stereotyped Behaviors and Restricted Interests. The Reciprocal Social Interaction section is most related to this study because it assesses eye gaze and gaze coordination with other behaviors (social smiling, response to name, requesting and JA). Results from the post-intervention ADOS assessment reflect decreases in scores on the Reciprocal Social Interaction section for all children. Examination of severity scores at post-intervention shows that Ian’s severity score decreased, changing his ADOS diagnostic classification from autism to non-spectrum. John remained in the autism spectrum classification, and Jeff and Robert remained in the autism diagnostic classification. An average severity score was calculated from both pre- and post-assessment scores (i.e., 6 and 4.7 respectively; Gotham et al., 2009).

**DAYC.** Table 6 shows pre- and post-intervention standard scores on the DAYC assessment across the cognitive, communication, social-emotional, physical development, and adaptive behavior domains. The Communication and Social emotional domains include items most directly related to the scope of this study. All toddlers showed improvements from pre- to post-intervention in those domains as well as the General Developmental Quotient, with the exception of Jeff whose score in the Communication domain remained unchanged.

**Social Validity**
On the questionnaire about perceived changes from pre- to post-intervention, all mothers indicated improvement in their child’s social-communication skills between 5-7 (i.e., 7 being the highest score). On the questionnaire about the outcome and appropriateness of this intervention, caregivers rated their satisfaction as 7 (i.e., 7 being the highest score).
**Discussion**

The present study demonstrated the effectiveness of a brief intervention with toddlers with ASD that resulted in widespread effects on social-communication skills. Children were taught to shift gaze within two social-communication contexts and showed generalization across partners, time, other social-communication contexts, and the smiling response as well as some improvements in areas assessed on the ADOS and DAYC related to GS.

This is one of only a few studies with toddlers with ASD (e.g., Dawson et al., 2010; Schertz, Odom, Baggett, & Sideris, 2013) and with intervention occurring within the first few months of diagnosis. Not only was this one of the first interventions the toddlers received, but it resulted in widespread changes despite being relatively brief. Acquisition of GS occurred over the course of 3 to 9 weeks. Such rapid acquisition of GS for RR and IJA with generalization across functions and roles suggests a promising efficient and effective intervention to address the most profound impairments evident in toddlers with ASD soon after they receive the diagnosis. Increasing the intensity of intervention (e.g., multiple sessions per day, every day) (Warren, Fey, & Yoder, 2007) could result in even faster acquisition of foundational social-communication skills that better prepare toddlers for home- and school-based therapy.

Toddlers were specifically taught GS in two contexts. Impairment in GS is evident in very young children diagnosed with ASD and those who later receive a diagnosis (Zwaigenbaum et al., 2005). GS is a common response form in both requesting and JA contexts, social-communication functions that are also impaired in children with ASD. Intervention began with GS in an RR context for several reasons. In this context the interventionist offered a preferred toy by holding it in front of the toddler. This allowed the interventionist to easily prompt GS by simply moving the toy to the level of her eyes. GS resulted in immediate access to a preferred
toy, which functioned as a reinforcer. Access to the toy was paired with the interventionist’s eye contact and social praise. Perhaps this resulted in the social partner’s eye contact becoming a conditioned social reinforcer, enhancing GS across social-communication contexts (Dube et al., 2004).

Aside from the requesting function, intervention also involved specifically teaching the JA function, though we probed for IJA while teaching RR. Only one toddler showed generalization of GS to IJA after teaching RR. After teaching both RR and IJA, all children also showed generalization across other social-communication contexts reflecting both requesting and JA functions and both responding and initiating roles. Although performance did not reach a level consistent with our mastery criterion in every context, increases above baseline levels mean that toddlers are engaging in different social-communication interactions and have the opportunity to access reinforcement and further improve performance. This is evident when examining changes in responding between the end of intervention and the 3-month follow-up. Overall toddlers showed maintenance or increases in responding from the end of intervention to the 3-month follow-up, except for Robert whose performance of GS across two contexts decreased. Since improvement to 80% or above across all contexts occurred only with one toddler, replication and continued investigation is warranted.

Importantly, toddlers showed improvements in initiations across both functions, a notoriously impaired role (Mundy et al., 1986; Winder et al., 2013). Perhaps these improvements occurred due to the similarity in response topography in the RR and IJA contexts. Moreover, the distance of the toy was similar in both contexts; during RR and IJA intervention, the preferred toy was either held by the interventionist in front of the child or placed on the floor next to her. The consequence for GS in the RR context was giving the toy to the child to play with for a brief
moment during which the child could manipulate the toy. During IJA intervention, the child also received a preferred toy in both prompted phases of intervention.

Across the generalization contexts, toddlers showed less improvement in some contexts than in others. Only two toddlers showed generalization to RR (name) and one toddler showed RJA (head turn). Jeff’s and Robert’s mothers reported some disturbance in their children’s responding to auditory stimuli. It may be that other environmental auditory stimuli interfered with the auditory antecedent (i.e., the interventionist calling the toddler’s name) in the RR (name) context. RJA (head turn) is demonstrated by about 18 months in typically developing children (Paparella et al., 2011). The typically developing toddlers observed in this study also showed lower performance of GS in this context. Ian, the only child who acquired RJA (head turn), showed higher overall performance on the DAYC post-intervention. This finding is consistent with research findings about the relationship between performance of RJA (head turn) and overall functioning in toddlers with ASD (Paparella et al., 2011). It maybe that RJA (head turn) warrants direct instruction.

These results suggest we can teach GS in specific contexts with generalization to select other contexts. Given our findings, we can more carefully sample antecedent and consequence stimuli for GS across roles and functions to increase the likelihood of more extensive generalization without teaching each role and function. For example, teaching GS in RR context allows for pairing of preferred toys with the interventionist’s eye contact and results in immediate access to toys. Teaching responding to pointing, a skill necessary in typical learning situations (not targeted or probed in our study), may later serve as a prompt to teach RJA (head turn). Three of the four toddlers in this study did not show generalization of GS to RJA (head turn) and two of four did not show generalization to responding to name, suggesting these
contexts may require direct instruction. Although all toddlers acquired IJA, the performance for one toddler decreased at 1- and 3-month follow-up sessions both with the interventionist and the mother, therefore IJA may also require direct teaching to ensure that it maintains across partners and time. Teaching RR, RJA, responding to name, and IJA samples both roles (initiating and responding) across visual (e.g., the offer in RR, the head turn in RJA, toy activation in IJA) and auditory (e.g., responding to name) antecedent stimuli, some of which are very subtle stimuli (RJA head turn, IJA) to which other stimuli could later be added (e.g., RJA head turn, point, and vocalization) and result in continued responding as observed in this study. Teaching RR, RJA, responding to name, and IJA also samples both functions, requesting and JA, beginning by pairing known preferred items with social consequences (eye contact, comment, social praise) that are less likely to function as reinforcers for children with ASD. Addressing GS across these contexts and conducting probes of performance in related contexts with similar antecedent and consequent stimuli may result in more extensive generalization and help toddlers acquire foundational skills necessary to observe socially important stimuli needed for learning.

All toddlers also demonstrated increases in responding at or above 80% during generalization sessions with their mothers. All mothers were very satisfied with the intervention and outcomes. After intervention ended, each mother received instructions about the intervention procedures to help maintain GS. Three out of four toddlers showed maintenance with their mothers. Additional guidance (e.g., parent training) may have supported generalization and maintenance for Robert.

Although we examined generalization across natural partners (mothers), the situation was still relatively structured. It will be important to examine performance in even more natural interactions (e.g., mother and child playing in the living room, visiting the zoo, etc.) where
children should be engaging in such social-communication interactions. Ensuring such generalization may also help with maintenance of changes.

Beyond demonstrating GS across social-communication contexts and partners, toddlers showed increases in smiling. Social-communication interactions, especially JA, are characterized by the expression of positive affect, such as smiling (Kasari et al., 1990). Children with ASD show impairment in the expression of affect (Clifford & Dissanayake, 2008; Zwaigenbaum et al., 2005) and may require direct intervention to address it (Krstovska-Guerrero & Jones, 2013). The fact that smiling increased following GS intervention, without direct instruction, is promising. Interestingly, while typically developing toddlers did not smile at toys at all without engaging in GS to RR, toddlers with ASD showed some smiling without GS when they looked at toys. This behavior is often seen in children with ASD who may show some enjoyment when looking at toys, but this enjoyment is not shared with others. On average, the percentage of smiles coordinated with eye gaze increased from baseline to the time delay phase of intervention for toddlers with ASD, exceeding the levels in typically developing toddlers in the RR context and approaching the levels in IJA context. Even for toddlers who showed less improvement (not to typical levels), once smiling occurs at all (over 0 in baseline), it can be reinforced and increased. It may be that when the toddler looked at the interventionist as a result of learning to shift gaze, he observed the interventionist’s smile and then began to imitate the expression. If toddlers began smiling as a result of imitation, not only have we observed changes in the expression of affect that is often impaired in learner with ASD, but these results suggest, perhaps, improvements in imitation, another area of impairment (Rogers, 1999). Future research may test for imitation as another outcome.
In addition to generalization, toddlers showed some improvements in symptoms of ASD and overall functioning from pre- to post- intervention in sections of both assessments directly relevant to this study (e.g., sections with items in which GS was a required part of the target response). The ADOS is the gold standard assessment used in the diagnostic evaluation for ASD and it has also been used to examine changes associated with intervention. For example, Dawson et al. (2010) used the ADOS to evaluate the Early Start Denver Model (ESDM). ADOS severity scores did not differ between the group of children who received ESDM and the control group, after 1 or 2 years of intervention. In the present study, only Ian’s ADOS classification changed from autism to non-spectrum. Interestingly, several months later, a psychologist not associated with this study re-evaluated Ian and concluded he no longer met the diagnostic criteria for autism or autism spectrum, confirming our post-intervention ADOS results. All toddlers showed improvements in the Reciprocal Social Interaction section of the ADOS and the Communication and Social-Emotional sections of the DAYC from pre- to post- intervention.

Results from both the ADOS and DAYC must be interpreted with caution due to repeated administration and possible practice effects. The ADOS evaluator was not otherwise involved in this study, but was aware of the type of intervention the toddlers were receiving and no reliability of her scoring was conducted. The interventionist administered the DAYC. Use of blind evaluators is warranted in future research. Toddlers all received other intervention and may have improved on these measures as a result of the passage of time and other intervention. Further exploration of collateral changes would be bolstered by the use of a between groups design to control for changes associated with other interventions.

An intervention may be efficient because it results in skill acquisition within a relatively short period of time as in this study. An intervention may also be efficient because it results in
more widespread changes as observed in the assessment of generalization in this study. Widespread change may also be observed through more global measures of overall functioning and symptoms of ASD. This preliminary exploration of more global changes suggests that continuing to explore changes associated with intervention on more global measures may be important in determining the breadth of impact. Carefully sampling GS across contexts might also result in greater generalization on these measures.

Summary

Toddlers acquired GS for RR and IJA, showed generalization across several social communication contexts, smiling, and interactions with their mothers, largely maintained changes over 3 months, and showed some improvements on a measure of symptoms of ASD. Teaching GS in the context of RR and IJA may be rather efficient in addressing the social-communication needs of toddlers with ASD. The occurrence of generalization also supports GS as a pivotal skill that, once taught, results in changes in related areas (Koegel, Koegel, Harrower, & Carter, 1999). Focusing early intervention with toddlers with ASD on teaching GS in social-communication contexts as a first step in early intervention may begin to build a foundation for successfully observing the opportunities for learning presented by social partners and increase the chances for children’s independence and inclusion with typically developing peers.
Table 1

*Toddlers’ Characteristics from their Existing Early Intervention Evaluations*

<table>
<thead>
<tr>
<th></th>
<th>Ian</th>
<th>John</th>
<th>Jeff</th>
<th>Robert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in months</td>
<td>25</td>
<td>20</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td>Bayley-III®</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social/Emotional Scales</td>
<td>&gt;25% delay</td>
<td></td>
<td>&gt;33% delay</td>
<td>&gt;33% delay</td>
</tr>
<tr>
<td>VABS-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socialization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subdomain SS (percentile)</td>
<td>68</td>
<td></td>
<td>(2nd percentile)</td>
<td></td>
</tr>
<tr>
<td>Communication Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subdomain SS (percentile)</td>
<td>60</td>
<td></td>
<td>(1st percentile)</td>
<td></td>
</tr>
<tr>
<td>HELP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>not assessed</td>
<td>not assessed</td>
<td>&gt;33% delay</td>
<td>&gt;33% delay</td>
</tr>
<tr>
<td>Autism severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CARS</td>
<td>37</td>
<td>31</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>ADOS</td>
<td>not assessed</td>
<td>15</td>
<td>not assessed</td>
<td>not assessed</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Autism</td>
<td>Autism</td>
<td>Autism</td>
<td>Autism</td>
</tr>
</tbody>
</table>

Table 2

*Time between Diagnosis and Intervention and Duration of Intervention for all Toddlers*

<table>
<thead>
<tr>
<th></th>
<th>Ian</th>
<th>John</th>
<th>Jeff</th>
<th>Robert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Months between diagnosis and intervention</td>
<td>2.5</td>
<td>2.5</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>Number of weeks of intervention</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Number of days of intervention</td>
<td>13</td>
<td>6</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Number of sessions to mastery</td>
<td>19</td>
<td>10</td>
<td>29</td>
<td>33</td>
</tr>
</tbody>
</table>

*Note.* Baseline sessions are not included in the number of weeks and days of intervention.
Table 3

*Summary of Performance across Generalization Contexts*

<table>
<thead>
<tr>
<th></th>
<th>Ian</th>
<th>John</th>
<th>Jeff</th>
<th>Robert</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR (clean up)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>RR (name)</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>IR (toy out of reach)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>RJA (head turn)</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>RJA (head turn, point, vocalization)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>IJA (toy in hand)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>

*Note.* ✓ = contexts in which child showed one probe with performance at or above 80%, ✗ = contexts in which child showed no probe with performance at or above 80%.
Table 4

Percentage of RR and IJA Opportunities Coordinated with Smiling

<table>
<thead>
<tr>
<th></th>
<th>Ian</th>
<th>John</th>
<th>Jeff</th>
<th>Robert</th>
<th>Average across children with ASD</th>
<th>Average across typical children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BL</td>
<td>INT</td>
<td>BL</td>
<td>INT</td>
<td>BL</td>
<td>INT</td>
</tr>
<tr>
<td>RR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smile at toys</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>(0-20)</td>
<td>(0-10)</td>
<td>(0-20)</td>
<td>(0-10)</td>
<td>(0-80)</td>
<td>(0-40)</td>
</tr>
<tr>
<td>GS with smile</td>
<td>0</td>
<td>15</td>
<td>0</td>
<td>80</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(0-30)</td>
<td>(60-100)</td>
<td>(0-30)</td>
<td>(0-10)</td>
<td>(0-10)</td>
<td>(0-60)</td>
</tr>
<tr>
<td>IJA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smile at toys</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0-20)</td>
<td>(0-10)</td>
<td>(0-20)</td>
<td>(0-10)</td>
<td>(0-20)</td>
<td>(0-60)</td>
</tr>
<tr>
<td>GS with smile</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>90</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>(0-10)</td>
<td>(80-100)</td>
<td>(0-10)</td>
<td>(0-20)</td>
<td>(0-10)</td>
<td>(0-60)</td>
</tr>
</tbody>
</table>

Note: Mean percentage of opportunities (range in parentheses) during which the child smiled at the toy and smiled during gaze shift (smiled at the toy and at the interventionist) during responding to a request (RR) and initiating joint attention (IJA) at baseline (BL) and the time delay phase of intervention (INT). BL includes all baseline sessions before INT for RR began; INT includes all sessions in time delay.
Table 5

**ADOS**

<table>
<thead>
<tr>
<th></th>
<th>Ian</th>
<th>John</th>
<th>Jeff</th>
<th>Robert</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-</td>
<td>Post-</td>
<td>Pre-</td>
<td>Post-</td>
</tr>
<tr>
<td>Language and Communication</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Reciprocal Social Interaction</td>
<td>8</td>
<td>1</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Communication and Social Interaction</td>
<td>13</td>
<td>3</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Play</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Stereotyped Behaviors and Restricted Interests</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standardized Severity Score</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Severity Classification based on Standardized Scores</td>
<td>autism</td>
<td>non-spectrum</td>
<td>autism</td>
<td>spectrum</td>
</tr>
<tr>
<td>Decrease in Classification Severity</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

*Note.* Language and Communication Total: autism cut off = 4, autism spectrum cut off = 2; Social Interaction Total: autism cut off = 7, autism spectrum cut off = 4; Communication and Social Interaction Total: autism cut off = 12, autism spectrum cut off = 7.
Table 6

*DAYC*

<table>
<thead>
<tr>
<th></th>
<th>Ian</th>
<th>John</th>
<th>Jeff</th>
<th>Robert</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-</td>
<td>Post-</td>
<td>Pre-</td>
<td>Post-</td>
</tr>
<tr>
<td>Cognitive</td>
<td>85</td>
<td>105</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Communication</td>
<td>72</td>
<td>92</td>
<td>63</td>
<td>64</td>
</tr>
<tr>
<td>Social-Emotional</td>
<td>89</td>
<td>93</td>
<td>74</td>
<td>89</td>
</tr>
<tr>
<td>Physical Development</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>91</td>
</tr>
<tr>
<td>Adaptive Behavior</td>
<td>84</td>
<td>89</td>
<td>70</td>
<td>71</td>
</tr>
<tr>
<td>General Developmental Quotient</td>
<td>82</td>
<td>92</td>
<td>72</td>
<td>78</td>
</tr>
</tbody>
</table>

*Note.* Standard scores across five areas of development and general developmental quotient.
Figure 1. Participants’ performance during baseline, intervention, 1-month and 3-month follow-up with the interventionist as well as generalization with each participant’s mother.
Figure 2. Ian’s and John’s performance during intervention and generalization probes to different social-communication contexts during baseline, intervention, and 1-month and 3-month follow-up.
Figure 3. Jeff’s and Robert’s performance during intervention and generalization probes to different social-communication contexts during baseline, intervention, and 1-month and 3-month follow-up.
Appendix

Social Validity Questionnaire Pre- and Post-Intervention Evaluation

Please answer the following questions by circling the number most closely corresponding to each question:

1. Does your child respond to requests in an age-appropriate manner?

1 2 3 4 5 6 7

Never. My child does not respond to my requests in an age-appropriate manner. For example, my child does not reach for toys/items I try to give to him/her and/or look at my eyes when reaching.

Sometimes. My child occasionally responds to my requests in an age-appropriate manner. For example, my child sometimes looks at the toy/item I try to give to him/her, reaches for it, and looks at my eyes or reaches but does not look, but this is not consistent.

Always. My child responds consistently to my requests by looking at the toy/item that I try to give to him/her, reaching for it, and looking at my eyes.

2. Does your child initiate requests in an age-appropriate manner?

1 2 3 4 5 6 7

Never. My child does not initiate requests to obtain preferred toys/items in an age-appropriate manner. For example, my child does not reach for toys/items in his/her environment and look at my eyes as a form of a nonverbal request to obtain the object/item.

Sometimes. My child occasionally initiates requests to obtain preferred toys/items in an age-appropriate manner. For example, my child sometimes looks at a preferred toy in his/her environment, reaches for it, and looks at my eyes or reaches for it but does not look as a form of a nonverbal request to obtain it, but this is not consistent.

Always. My child initiates requests to obtain preferred toys/items. For example, my child consistently looks at a preferred toy/item in his/her environment, reaches for it, and looks at my eyes as a form of a nonverbal request to obtain the object/item.

3. Does your child respond to joint attention direction in an age-appropriate manner?

1 2 3 4 5 6 7

Never. My child does not respond to my joint attention direction. For example, my child does not follow my pointing to interesting objects/events and he/she does not look back at my eyes to share attention.

Sometimes. My child occasionally responds to my joint attention directions. For example, my child sometimes follows my pointing to interesting objects/events and he/she looks at my eyes to share attention or follows my pointing but does not look back at me, but this is not consistent.

Always. My child responds to my joint attention directions. For example, my child consistently follows my pointing to interesting objects/events and he/she looks back at my eyes to share attention.

4. Does your child initiate joint attention in an age-appropriate manner?

1 2 3 4 5 6 7

Never. My child does not initiate joint attention with me. For example, my child does not look at interesting objects/events in the environment and then look at my eyes to share attention.

Sometimes. My child occasionally initiates joint attention with me. For example, my child looks at some interesting object/event in the environment and then looks at my eyes to share attention, but this is not consistent.

Always. My child initiates joint attention with me. For example, my child consistently looks at some interesting object/event in the environment and then looks at my eyes to share attention.
Bibliography


cognition, joint attention, and communicative competence from 9 to 15 months of age.


