Research Article

Expanding Communication Modalities and Functions for Preschoolers With Autism Spectrum Disorder: Secondary Analysis of a Peer Partner Speech-Generating Device Intervention

Kathy S. Bourque^a and Howard Goldstein^b

Purpose: This study reports a secondary analysis of the nature of communicative functions and modalities used in initiations and responses of minimally verbal preschoolers with severe autism spectrum disorder (ASD) from a previously published study (Thiemann-Bourque, Feldmiller, Hoffman, & Johnner, 2018). This analysis focused on the final cohort ($n = 6$) from a group design study ($N = 45$) that examined a peer mediation and speech-generating device (SGD) intervention compared to an SGD-only condition.

Method: After teaching peers to use an iPad as an SGD within a modified stay-play-talk approach, school staff implemented SGD instruction in child–peer dyads during typical preschool activities. To investigate individual differences among children who demonstrated increased communication acts in the peer + SGD condition, changes in reciprocity, modalities used, and communicative functions were examined using a multiple-baseline design across children. Fidelity of implementation and social validity data were also collected.

Results: Six children with ASD and their peers demonstrated more balanced reciprocity, with individual differences in how and why children communicated during exchanges. That is, all children with ASD increased in SGD use as their primary communication mode; 3 children used different modalities including more speech, and 3 children used primarily gestures and SGD. The most frequent function expressed was requests for objects. More modest increases were observed in comments and requests for actions, with negligible changes in gaining attention. Social validity reports by naïve judges reflected clear improvements in communication interactions.

Conclusion: Findings are promising for a preschool SGD intervention that can expand children's modalities and communicative functions to engage in balanced exchanges with peer partners.

Supplemental Material: <https://doi.org/10.23641/asha.11374203>

The use of Apple iPads with voice output apps as speech-generating devices (SGDs) has surged in availability for young children with autism spectrum disorder (ASD) who have complex communication needs (Light & McNaughton, 2013; Still, Rehfeldt, Whelan, May, & Dymond, 2014). The iPad becomes an augmentative and alternative communication (AAC) system as children

learn to select symbols on a screen programmed for different communicative purposes. These advances in AAC options allow children greater access to social and academic activities and environments. Following SGD treatment, some children become more verbal and increase their spoken communication, and others who remain nonverbal demonstrate increases in augmented vocabularies (Kasari et al., 2014; Tager-Flusberg & Kasari, 2013). Despite reviews reporting successful communication outcomes (Ganz et al., 2012; Still et al., 2014), limited research exists with young children, particularly those with severe ASD (Schlosser & Koul, 2015), and there is a lack of reports on specific teaching strategies used in classrooms. Early educators need access to evidence-based strategies that will improve children's communication competence across a wide range of modalities and functions and ensure others in their environments, such as peers

^aJuniper Gardens Children's Project, The University of Kansas, Kansas City

^bCollege of Behavioral and Community Sciences, University of South Florida, Tampa

Correspondence to Kathy S. Bourque: thiemann@ku.edu

Editor-in-Chief: Sean M. Redmond

Editor: Sudha Arunachalam

Received May 21, 2018

Revision received August 1, 2019

Accepted September 12, 2019

https://doi.org/10.1044/2019_JSLHR-19-00202

Disclosure: The authors have declared that no competing interests existed at the time of publication.

without disabilities, have the skills to be able to communicate in turn (Thiemann-Bourque, Feldmiller, Hoffman, & Johner, 2018). This study seeks to improve understanding of effective strategies to enhance the social communication competence between preschool-age children with severe ASD and little to no spoken language and peers without disabilities.

AAC Interventions and Peer Partners

In the field of AAC, an appreciation of the complex process inherent in communicating with individuals who use AAC and the importance of instructing other communication partners in this process have been noted for many years (Kent-Walsh & McNaughton, 2005). This is referred to in the AAC literature as *communication partner instruction* and is recommended as a necessary ingredient of interventions designed to maximize an individual's communication competence and to ensure a supportive communication learning environment (Blackstone, Williams, & Wilkins, 2007; Light & McNaughton, 2013, 2014). Kent-Walsh and McNaughton (2015) recently conducted a systematic review on the effects of partner instruction on the communication of individuals using AAC. A total of 53 participants were included in 17 single-case design studies, and 17 (32%) were diagnosed with ASD. Averaged across a range of partners (i.e., educational assistants, parents, peers, and teachers), overall intervention effect sizes with all participants were moderate (improvement rate difference = .69), and instructional strategies included (a) describing and modeling skills or strategies, (b) verbal rehearsal, (c) practice and role play of skills, and (d) guided practice when interacting with the individual(s) using AAC. A closer examination of the communication partners in these 17 studies revealed only five with peer partners.

Much research has shown that peer-mediated interventions improve core deficits in communication and social interactions for children with ASD (Goldstein, Lackey, & Schneider, 2014; National Autism Center, 2015; Watkins et al., 2015; Zagana & Mastergeorge, 2016). Similar to communication partner instruction, peers are taught to be responsive social partners prior to entering into adult-supported interactions with classmates with ASD. Peers are guided to maintain proximity, prompt targeted social and communication behaviors, and respond to children's communication efforts within structured activities (Goldstein et al., 2014; Goldstein, Schneider, & Thiemann, 2007; Kamps et al., 2014; Thiemann & Goldstein, 2004). A growing body of evidence supports the benefits of integrating peer-mediated approaches into AAC interventions for children with complex communication needs (Thiemann-Bourque et al., 2018). A recent review summarizing 19 AAC intervention studies designed to promote peer interactions concluded that a multi-method approach may be most effective in supporting and improving peer interactions for this population (Therrien, Light, & Pope, 2016). Methods to enhance communication include teaching specific communication skills during AAC instruction, teaching peers to be responsive partners, and setting up a supportive environment.

Specific to preschool children with complex communication needs learning to use AAC, recent research findings support the positive effects of combining approaches (Therrien & Light, 2016, 2018; Thiemann-Bourque, Brady, McGuff, Stump, & Naylor, 2016; Thiemann-Bourque et al., 2018; Thiemann-Bourque, McGuff, & Goldstein, 2017). Therrien and Light (2016) introduced an iPad with GoTalk NOW (Attainment Company, 2012) with programmed storybooks to promote social interaction between two preschool children with complex communication needs and six peers. The authors combined child-centered and peer-mediated components (i.e., how to take turns and wait) and used the SGD as an environmental support. The intervention increased symbolic communicative turns for one child during interactions with three peers; however, results were not replicated for the second child. In a follow-up study, these authors examined effects of a similar intervention package for five preschoolers with characteristics of ASD and trained peers as well as measured rates of peer turns and joint engagement (Therrien & Light, 2018). Effects on peer behaviors have received less attention in the literature, which is a major concern given that changes in reciprocity are dependent on peer behavior changes. Results revealed that four of the five children showed more symbolic communicative turns with peers after intervention, with variable progress in joint engagement. Communication decreased in generalization settings, and recommendations were made for teaching skills and collecting data in more natural environments and training school staff as implementers.

Across a series of recent studies, Thiemann-Bourque et al. (2016, 2018, 2017) demonstrated the benefits of combining two teaching strategies to improve social communication of preschoolers with severe ASD and peers: (a) direct instruction on use of an AAC system and (b) training peers without disabilities to stay-play-talk, with the "talk" step focused on using the same AAC system combined with spoken words. The AAC systems included the Picture Exchange Communication System (PECS; Bondy & Frost, 1994), GoTalk 4+ (Attainment Company, 2012), and an iPad with a voice output app called TouchChat HD (Silver Kite, 2017). The stay-play-talk peer training strategies were developed based on the early work of Goldstein, English, Shafe, and Kaczmarek (1997), and two naturalistic behavioral approaches (Alpert & Kaiser, 1992; Koegel, Shirotova, & Koegel, 2009) were added to increase focus child responses. These two approaches included teaching the peer to (a) "Get Attention," that is, to recruit attention by tapping the child on the shoulder or saying their name prior to delivering a prompt or initiation, and (b) "Hold and Wait," that is, to create an expectant pause and an opportunity for communication. Teaching strategies included discussing skills (e.g., Stay: 1. Sit close; 2. If buddy moves, you move), role play, and practice with the AAC system prior to pairing one peer with a child with ASD in natural preschool activities with the AAC.

In the first study, the authors reported increased rates of peer-directed communication using PECS and higher levels of social engagement for four preschool children with

severe ASD and limited verbal skills (Thiemann-Bourque et al., 2016). Initiations (e.g., to request using PECS) were markedly higher compared to rates of responses for the children with ASD; conversely, rates of peer responses were higher than those of initiations. Results of the next study showed moderate increases in child and peer communication using GoTalk 4+ (Attainment Company, 2012) for three minimally verbal preschoolers with ASD and trained peers in routine activities (e.g., art, tabletop games, floor play; Thiemann-Bourque et al., 2017). Two key findings of this study were as follows: (a) The SGD intervention led to improved child and peer communication and social engagement in activities that incorporated preferred stimuli (i.e., snack and cause-effect toys), and (b) each child-peer dyad demonstrated greater reciprocal exchanges, with gains ranging from an average of nine to 17 back-and-forth turns during preferred activities.

In an effort to document effects for a larger number of children, Thiemann-Bourque et al. (2018) examined outcomes of incorporating the modified stay-play-talk peer-mediated approach into an iPad (SGD) intervention on communication exchanges between 45 nonverbal or minimally verbal preschoolers with ASD and 95 peers. To date, this is the largest group-randomized trial examining the effects of integrating SGD intervention and peer training, as implemented by trained school staff (e.g., speech-language pathologists [SLPs], paraprofessionals, and special education teachers). Significant increases in communication acts were found for the 23 children with ASD randomly assigned to the combined intervention, compared to a lack of significant changes for the 22 children in a business-as-usual SGD condition with untrained peers. Communication improvements were consistent across generalization settings, and the children maintained skill use 4–8 weeks after treatment. The trained peers showed similar communication increases across study phases, compared to limited changes noted for untrained peers. A noteworthy result was that only the children with ASD in the treatment group demonstrated improved communication with unfamiliar peers who had not been a part of the study, a clear confirmation of generalized skill use across partners. Together, the outcomes of these studies provide strong preliminary evidence on the benefits of integrating strategies to teach children with severe communication deficits to engage with and talk to peers and how to assist peers to reciprocate in turn.

Communication Outcomes of SGD Interventions

A lack of reciprocal interactions or social reciprocity is a core deficit for children with ASD (Diagnostic and Statistical Manual of Mental Disorders–Fifth Edition; American Psychological Association, 2013); however, limited intervention studies have reported effects on communication skills necessary to engage in back-and-forth exchanges with peers. Based on a transactional model of social communication development (Snyder-McLean & McLean, 1978), positive child-peer exchanges may trigger additional child and peer communication attempts, leading to improved reciprocal interactions. Thus, training peers to be more effective

communicators can reinforce communication attempts of their partners with ASD and, in turn, reinforce child and peer motivation to maintain interactions. Thiemann-Bourque et al. (2017) reported increased child-peer reciprocal exchanges between three preschoolers with ASD and trained peers; however, gains were primarily observed in preferred activities and snack with limited increases in center activities. In addition, rates of initiations were higher for two focus children, and responses were higher for all peers. In the Thiemann-Bourque et al. (2018) study, the 23 children with ASD and trained peers who received the combined peer partner SGD intervention showed more balanced levels of responses (vs. initiations) after baseline (i.e., 50:50 for children with ASD; 60:40 for peers). These data represent predicted mean responses at the group level based on combined data for all children in each experimental group. Although the outcomes highlight greater equality for the group as a whole, an examination of the nature of initiations and responses across phases (i.e., increases or decreases; types of modalities and functions used) between communication partners may reveal additional information on individual variation in the development of these important social communication skills.

By the end of their first year, typically developing children express a range of functions to regulate others' behavior and to engage in social interaction as well as joint attention (Shumway & Wetherby, 2009). It is well known that young children with ASD demonstrate a limited range of communicative functions, with the emergence of behavior regulation or requesting skills developing prior to functions to engage in joint attention (e.g., comments, greetings) and social interaction (e.g., requests for social routines; Travis, Sigman, & Ruskin, 2001). These limited functions focus on meeting needs rather than socially oriented experiences and, thus, can lead to difficulties in later peer interaction skills (Freeman, Gulsrud, & Kasari, 2015). Furthermore, as communication develops, the form changes, and children become more adept at expressing different and more complex vocalizations, gestures, and eventually words (Maljaars, Noens, Jansen, Scholte, & van Berckelaer-Onnes, 2011). To date, few AAC investigators have reported changes in different communicative functions, and even fewer have documented changes in how children communicate or what other modalities they learn to use (Logan, Iacono, & Trembath, 2017). In a systematic review of 30 AAC intervention studies, Iacono, Trembath, and Erickson (2016) concluded that targeted outcomes predominantly focus on requesting skills or improving children's ability to regulate the behavior of others. For children to have greater access to social and educational opportunities, more information is needed on how to increase communicative functions that, for example, lead to interactions for social and joint attention purposes. Thiemann-Bourque et al. (2018) reported on improvements in total communication acts for children who received the peer mediation + SGD intervention; however, they did not measure changes in the communicative "purpose" of each act or "how" children communicated to peers while initiating and responding. The authors recognized the need for future studies to measure these important outcomes.

This article addresses this need by measuring a range of communicative functions and modalities used within all initiations and responses for one cohort of children who participated in the Thiemann-Bourque et al. (2018) intervention. In the 2018 study, cohorts of $n = 12$ children with ASD were recruited each year for 4 years. At the start of each year, children were matched on cognitive skills, then six were randomly assigned to receive the peer partner SGD intervention, and six were assigned to the business-as-usual comparison group. Within each cohort, effects were examined using a multiple-baseline design across children with repeated observations in baseline, treatment, generalization, and maintenance. At the end of the 4 years, the authors examined group differences for all children ($N = 45$) using multilevel modeling to predict changes in rates of acts and proportions of responses over time. The low incidence of preschool children with ASD and complex communication needs restricts the option to recruit sufficient numbers all at one time for a larger randomized controlled trial (RCT) study; thus, this blended design allowed for examination of treatment effects for a larger group of children. However, group means can disguise variability and individual differences among participants; it is possible that the treatment may not have been effective for all children just because group effects were found. Based on secondary coding of communication data collected for the final cohort of $n = 6$ children, the primary research questions in this study were as follows: (a) What are the individual differences and nature of changes in rates of initiations and responses (i.e., reciprocity) for the children with ASD and trained peer partners across experimental phases? (b) Does teaching peers to be responsive SGD communication partners lead to increases in different communicative modalities and functions for these six children with ASD? (c) Do naïve judges perceive changes in the quantity and quality of social communication interactions postintervention?

Method

Participants

Six preschool children with ASD and 15 peers without disabilities participated (see Table 1 for demographic information). The children with ASD ranged in age from 3;7 to 5;1 (years;months) and included two boys and four girls. All children were participants of the larger peer-mediated SGD intervention study (Thiemann-Bourque et al., 2018), recruited in the last cohort during the final year of the study. This cohort was selected based on having the most complete data set, including measures of social validity, and having coders available to learn the new coding system. Children attended five preschools within four school districts in the Kansas City metropolitan area, 4 days per week for 3 hr per day. All children with ASD were recruited based on the following criteria: (a) diagnosis of ASD by a developmental pediatrician or clinical child psychologist using the Autism Diagnostic Observation Schedule–Second Edition (Lord et al., 2012), (b) nonverbal or minimally verbal (i.e.,

less than 20 functional, spontaneous words), (c) attending a preschool program with access to typically developing peers, (d) using an AAC system with the ability to discriminate between a minimum of two symbols to request items from adults, (e) English as primary language spoken in the home, and (f) limited peer interaction skills based on teacher and parent report. The Preschool Language Scale–Fifth Edition (Zimmerman, Steiner, & Pond, 2007) and the Mullen Scales of Early Learning (Mullen, 1995) were administered at the start of the study to describe individual language and cognitive skills (see Table 1 for ASD demographics). All children had an Individualized Education Program and received in-class and pull-out services based on identified speech-language, behavioral, or occupational therapy (OT) needs. Two children attended full-inclusion classrooms, and four children attended classrooms serving children with ASD and other developmental disabilities (DDs) as well as interacted with peers from other classrooms.

Kerry, aged 3;8, was in his second year of full-time preschool and attended a classroom for children with moderate-to-severe ASD. At the start of the school year, he could imitate some sounds, would hum along to songs, and used gestures to request preferred items and to protest. Prior to starting the study, he could accurately select symbols from a field of nine symbols on one page on the SGD to request objects from adults. He was not observed to initiate social overtures with other children, and parents reported limited peer-directed social behavior. He received 120 min of speech-language therapy and OT per week.

Kami, aged 4;11, was in her second year of half-time preschool and attended a classroom for children with moderate-to-severe ASD and other DDs. She had an expressive vocabulary of approximately 10 words to request and label objects; the majority of her speech consisted of echolalia and stereotyped phrases to sing songs. Kami had some experience using a PECS (Bondy & Frost, 1994). She could accurately select from a field of six symbols on the iPad to request objects at the start of the study. Kami was not observed to initiate social overtures to other children. She received 120 min of speech-language therapy per week, 1 hr of OT, and 18 hr of applied behavioral analysis therapy at an outside agency.

Milly, aged 4;10, was in her second year of preschool and was fully included in a regular education classroom. She followed classroom rules with moderate support and had difficulty engaging in nonpreferred activities. Milly had an expressive vocabulary of less than 15 spontaneous words to request preferred objects and to protest. She was able to use PECS to request preferred items. Just prior to baseline, she could accurately select symbols from a field of four symbols on the iPad to request objects from adults. Milly would occasionally initiate to a preferred peer; however, the majority of her social overtures were to protest and escape. She received in-class and pull-out speech-language therapy for 40 min per week.

Annie, aged 3;7, was in her first year of preschool and attended a classroom serving children with autism, and other DDs and typically developing peers (ratio of 7:2).

Table 1. Demographics of children with autism spectrum disorder (ASD) at the start of the study.

Participant	Gender	Age (years;months)	Diagnostic instrument	ASD severity	Total	PLS-5 SS		MSEL
						AC	EC	ELC
Kerry	M	3;8	ADOS-2	Mod-severe	54	50	64	49
Kami	F	4;11	ADOS-2	Mod-severe	50	50	54	49
Milly	F	4;10	ADOS-2	Moderate	52	50	62	49
Annie	F	3;7	ADOS-2	Mod-severe	53	50	63	49
Brody	M	4;5	ADOS-2	Severe	51	50	59	49
Bayley	F	3;10	ADOS-2	Mod-severe	58	57	64	49

Note. Ethnicity: three White; three African American. PLS-5 = Preschool Language Scale-Fifth Edition; SS = standard score; MSEL = Mullen Scales of Early Learning; AC = Auditory Comprehension; EC = Expressive Communication; ELC = Early Learning Composite; M = male; ADOS-2 = Autism Diagnostic Observation Schedule-Second Edition; Mod = moderate; F = female.

She had an expressive vocabulary of approximately five words that she used to request preferred objects and activities, and she was beginning to echo adult speech. She had some experience with PECS and had learned a few signs at home. At baseline, she could accurately select from a field of five symbols on the iPad to request objects from adults. Annie was not observed to initiate social overtures to the other children. She received individual and group speech-language therapy for 90 min per week.

Brody, aged 4;5, was in his second year of preschool in an inclusive regular education classroom with full-time paraprofessional support. He could follow predictable classroom routines with support. Brody primarily used gestures (e.g., pulling adult by the hand) and vocalizations to communicate and was not speaking words. Prior to baseline, he could accurately select from a field of two symbols on the iPad to request food items. Brody did not show an interest in initiating social overtures to peers, yet he would sit side by side for sensory play activities. He received up to 60 min of speech-language therapy and 15 min of OT per week.

Bayley, aged 3;10, was in her second year of preschool in a classroom for children with moderate-to-severe ASD. She expressed approximately seven spontaneous words and used jargon and gestures to communicate. She could exchange pictures to request preferred objects. Prior to baseline, Bayley could accurately select from a field of 10 symbols on the iPad to request preferred objects. She showed limited interest in initiating interactions with other children. When expected to attend to academic and non-preferred tasks, she would protest and try to escape. She received 60 min of speech-language therapy and 30 min of OT per week.

The 15 peers were recruited from each child's classroom or a classroom in the same building and ranged in age from 3;7 to 5;0. Teachers recommended peers based on (a) age-appropriate social skills, (b) consistent school attendance, (c) the ability to listen to small-group instruction for 20 min, and (d) willingness to participate. The peers took turns participating with their classmate with ASD in dyads (i.e., 1 peer:1 focus child), with two to three sessions scheduled per week for each dyad. Seven early education staff consented to participate as intervention implementers for each child with ASD, and two staff shared

responsibilities for one child (Annie). School staff included SLPs ($n = 3$) and early childhood special education teachers ($n = 4$), six with a master's degree and one with a bachelor's degree.

Settings

All baseline and treatment sessions took place within the special or regular education classrooms, and for one child in the SLP's office. The special education classrooms were staffed by a lead teacher and two to three paraprofessionals, depending on the student's needs and class size. The regular education classrooms were staffed by one lead teacher, one classroom paraprofessional, and one to two adult volunteers. All social activities were selected by the school staff implementers, with suggestions provided if requested. Activities were similar to those in preschool classrooms and varied across children based on preferences and interests. Activities included preschool games (e.g., Pop the Pig, Uno Moo), sensory/motion toys (e.g., hammer and ball toy, wheels with gears), fine motor/manipulatives (e.g., puzzles, Play-Doh), and pretend-play sets (e.g., dressing dolls, pizza or birthday party). Generalization sessions occurred in a different location than intervention settings (i.e., snack and/or toy play in centers).

School Staff and Peer Training Procedure

School Staff Trainings

In the fall, participating school staff attended a 2-hr training on the study timeline and expectations, use of the voice output app TouchChat HD (Silver Kite, 2017), programming vocabulary, and recruiting peers. Each staff participant was loaned an iPad with the voice output app installed to use with their focus child with ASD for the duration of the project. TouchChat was set at a grid size of 6×8 , and each page consisted of an active display of symbols that required no navigation. School staff was responsible for selecting and programming appropriate vocabulary based on their understanding of child language level and goals on the Individualized Education Program. Vocabulary was programmed to include one to three words written under the symbols and included a combination of nouns,

verbs, and photos of peer(s) and focus children (see Supplemental Material S1 for example vocabulary programmed for one activity per child). The number and combination of vocabulary symbols on each page changed based on individual child communication growth. Following baseline data collection, the staff implementers attended a second 1-hr training on (a) identifying preferred and socially motivating activities, (b) the peer partner SGD training procedure (i.e., stay-play-talk with iPad), and (c) SGD instruction strategies to elicit and guide child–peer communication within the planned weekly social activities following peer training.

Peer Partner SGD Training

Following baseline, each peer group was taught responsive play and communication skills using a modified version of stay-play-talk (Goldstein, English, Shafer, & Kaczmarek, 1997; Thiemann-Bourque et al., 2018, 2017) over three 20- to 30-min sessions (see Appendix). The first author and a research assistant implemented the training, and the school staff implementer for each group observed and assisted in role-play activities. Skills were taught to peers based on a standard protocol of (a) defining and modeling, (b) adult–child practice, (c) child–child practice, and (d) corrective feedback. All skills and steps were illustrated in a buddy book for each peer to take home. During the “talk” training, the iPad with TouchChat was introduced in similar activities planned for the SGD instruction with the child with ASD, and the peers were taught to select appropriate symbols to communicate to the adult. The start of training was staggered across each peer group assigned to a child with ASD, with two groups starting in the same week.

Experimental Design and Conditions

Six children from the last cohort who received the combined SGD and peer partner intervention in the study of Thiemann-Bourque et al. (2018) participated in a multiple-baseline design across participants to examine the effects of the intervention (Horner et al., 2005). Group-level data from the RCT are available in the 2018 published article. For this article, a more detailed presentation and graphic display of the multiple-baseline data reveal individual changes in total rates of communication acts for the six children with ASD and for the peers (see Supplemental Material S1). The communication acts data collected across four experimental conditions (i.e., baseline, treatment, generalization, and maintenance) were recoded post hoc to report effects on the nature of child and peer initiations and responses, type of communicative modalities, and type of communicative functions. These four conditions meet quality indicator recommendations for measuring change across multiple phases (Kratochwill et al., 2010). The six children with ASD were paired at the start of the study to form three pairs; each pair progressed through all phases of the study at similar time points. This decreased the time a child spent in baseline not receiving treatment. To fit the design into one school year, some limits were placed on the amount of data collected.

For example, four baseline sessions (instead of the standard recommendation of five; Kratochwill et al., 2010) were collected for two children, and three maintenance sessions were collected for five children (Kami left the study early). All children with ASD and their respective peer partners attended different classrooms.

Baseline

Baseline data were collected for 10 min of the social activity and ranged from four to 10 sessions, over 8–32 days. Peers for each focus child took turns participating in the weekly activities. After explaining the task, the staff implementer directed the children to “stay together and play nicely with your friend” and only intervened if a child left the group. An iPad with the voice output app TouchChat HD (Silver Kite, 2017) was programmed with vocabulary to match the social activity and placed between the children on a Big Grips stand. If the children became disinterested, the implementer switched to a new activity with matching vocabulary on the iPad. No adult prompts were provided, and there was no instruction on use of the iPad.

Peer Partner SGD Training

Following a stable baseline and no upward change in rates of acts over a minimum of four to six sessions, two children (Kerry and Kami) met criteria to begin the intervention phase. Peer partner SGD training was implemented for peers of these two children over the next week, while baseline data collection continued for the other four child–peer partners. Once peers were trained and after a minimum of three SGD instruction sessions per dyad, this component of the intervention started for peers of the next pair (Milly and Annie) based on stable rates. This continued until all peers were trained (final pair: Brody and Bayley).

SGD Instruction With Trained Peers

Following peer partner SGD training, one of the trained peers was paired up with their classmate with ASD for a 15-min activity to begin the SGD instruction phase. The start of SGD instruction was staggered across the children by three treatment sessions per child within each paired group. These groups met two to three times per week, and the peers took turns participating approximately one to two times each week. Activities were guided by the staff implementer. The first author or project coordinator was there to provide coaching as necessary. The implementer was provided with a list of steps for 5 min of instruction prior to starting the 10-min activity (i.e., coding interval) that included (a) review stay-play-talk steps with peer; (b) review symbols on the SGD representing objects, actions, or events for the activity; and (c) prompt child-to-peer SGD communication for practice. Following this introduction, the staff implementer was coached to sit back and prompt child–peer communication once every 30 s if no interactions were observed. The implementer was guided to prompt the peer first (e.g., “show Kerry what to push to ask for a turn”) and, if this was not successful, then to prompt the focus child using a least-to-most hierarchy (e.g., “Push a button,” “Push

it and ask for a turn,” hand-over-hand prompt to push “My turn”). Children received the SGD instruction over a period of 13–18 weeks (total intervention sessions: 144; range of 20–31 sessions per child). One child, Kami, moved to a different school after 13 weeks of intervention.

Generalization

Child and peer communication acts in a 10-min novel setting (e.g., snack, centers/free play on the floor) were collected toward the end of the intervention phase, over a period of 1–3 weeks. Five children had six generalization sessions, and one child (Kami) had three sessions due to moving out of the district. Staff implementers were asked to conduct these activities as they typically would during the dyadic SGD instruction sessions.

Follow-Up

Maintenance data were collected 5–6 weeks after the last SGD instruction session for five of the six participants (with the exception of Kami) at the end of the school year. The focus child and a trained peer interacted for 10 min during activities similar to the SGD instruction sessions. Each child had three maintenance data points, collected over 2 weeks.

Dependent Variables and Data Collection

The research questions were addressed by conducting an in-depth analysis of all child and peer communication acts, specifically individual rates of initiations or responses, and, for the children with ASD, what types of communicative modalities and functions were used to initiate or respond. Social validity and treatment fidelity measures were also collected.

All child and peer communication data were collected for 10 min, two to three times per week, for the four experimental phases: baseline, treatment, generalization, and maintenance. Dependent variables were coded within each 10-min interval of the social activity. All sessions were video-recorded using a Sony HDR-CX260 Handycam or Flip Mino Video Camera (first generation, Flip Video) set up on a tripod within 3–5 ft of the dyad. The primary coders of the data were the first author and the research project coordinator. The first author trained the project coordinator to code dependent measures to a minimum criterion level of 80% across three sessions using video recordings of child–peer dyads from previous studies. Coding was done on a personal digital assistant using Noldus The Observer XT 9.0 (Noldus Information Technology, 2009), and the data were collected live using Noldus Mobile Module software. This software allowed for coding of the communication partner (focus child or peer), the act (IN for initiation or RS for response), the function, and the modalities using a behavior coding system created within Noldus Observer on a desktop computer and downloaded to the personal digital assistants. After coding live, the primary coder uploaded the videos to a secure external server for coding

by a secondary coder to establish interobserver agreement (IOA).

Initiations and Responses of Children With ASD and Peers

All focus child acts directed to peers and peer acts directed to the focus children were coded using total rates for the 10-min interval during the social activity. To be coded as an intentional communication act, the child had to show clear direction to the other partner through body orientation, eye gaze, or gaining attention. Communication to adults was not coded. Initiations were coded based on who started communicating first and/or if a minimum of 3 s had passed since the last communication act (by either the focus child or the peer). Multiple initiations could be coded as long as each act was separated by a 3-s pause. A response was coded if the other communication partner responded to the previous initiation within 3 s or in response to a partner’s previous response within 3 s. Thus, sequential multiple responses could be coded if there were pauses less than 3 s between acts and when the other partner had expressed a minimum of one act (e.g., peer initiation + focus child response + peer response + focus child response).

Communicative Modalities of Children With ASD

Following the coding of an initiation or response, each act was then coded based on four possible modalities: gestures, speech, SGD, or combined speech + SGD. Gestures included gives, points, waves, head nod/head shake, or other conventional gestures. Speech was coded for all spoken acts that semantically matched the context and included a minimum of one consonant–vowel combination and/or approximation of a word that matched placement of a minimum of one consonant–vowel in the coder’s perception of the intended word. An act coded as SGD included intentional selection of a symbol to communicate to the peer. If a child repeatedly pushed a symbol three or more times without stopping to orient to the peer or if he or she appeared to be exploring the SGD by selecting different symbols, these were not coded as SGD. Imitative SGD acts that occurred within 3 s of a peer SGD act were coded to give children credit for imitating peer models that could serve an important role in communication development. Combined speech + SGD was coded if a child spoke a word and then, within 0–2 s, selected a symbol or, alternatively, if a child selected a symbol and then used speech within 0–2 s.

Communicative Functions of Children With ASD

Each focus child’s communication act was then coded for the type of function based on four possibilities: requests for objects (RQOb), requests for actions (RQAc), comments (COM), and requests for joint attention (RQJA). “Requests for objects” were coded to gain an object or item (e.g., piece of the game/activity) from a peer. “Requests for actions” included any acts to ask/direct a peer to perform (e.g., “Put it in,” “Spin it,” “High-five!”), to offer a turn (e.g., “You do it”), to ask for help, and to protest (e.g., “Stop!” “No don’t”). “Comments” included any labels of

object name, color, size, or other acts to describe toys or activities, acknowledgments (e.g., “Okay,” “Yes”), and socially encouraging or polite words (e.g., “You did it!” “Thank you,” “Yes, please”). “Requests for joint attention” were coded if the child’s gestural, spoken, or symbol selection was used to engage the peer in sharing focus on an event, object, or action. Examples included getting a peer’s attention (e.g., “Look!” “Watch this”), tapping on the arm, greetings (e.g., “Hi,” “Bye”), and expressing a child’s name. These functions were selected based on literature documenting early deficits in these skills for young children with ASD, and skills that may improve as they develop (Calloway, Myles, & Earles, 1999). If the focus child communicated one function and then selected a symbol to express a different function (e.g., child said “ball” and then pushed the symbol for “throw”), the spoken function was coded (e.g., RQOb and not RQAc), as spoken acts were designated as a higher level of communication independence.

Data Analysis

Analyses included a description of mean rates of initiations and responses, modalities, and functions across phases. The bar graphs in Figures 1–3 depict average rates of initiations and responses for children with ASD and peer partners, as well as the average number of communicative modalities and average rates of communicative functions expressed by children with ASD. Graphical displays

of total communication acts as the intervention was initiated across six children and their peers are provided in Supplemental Material S1. Supplemental Material S1 also includes a description of differences between phases in immediacy of effect at the onset of treatment, variability, and trends (Horner et al., 2005) and Tau-U effect sizes (Parker, Vannest, Davis, & Sauer, 2011) to measure changes in rate of communication acts for child and peer behaviors between baseline and treatment.

IOA

IOA was completed for initiations and responses for focus children and peers as well as communication modalities and functions for the focus children. From all sessions coded by a primary coder, a minimum of 20% of sessions were secondary coded by two research assistants who were blind to the research questions and goals. Across all child and peer participants, IOA data were completed for 21% of baseline sessions, 24% of treatment sessions, and 27% of generalization and maintenance sessions. Prior to coding sessions independently, the research assistants were taught to code all dependent measures to a criterion level of 80%, over three video-recorded sessions of similar child–peer social play activities. A Note Corder-DP-201 (Olympus) was programmed with a 15-s interval recording and placed next to the microphone on the camera for later viewing in the research lab. Point-by-point agreement was used, and an

Figure 1. Average rates of initiations and responses for children with autism spectrum disorder and peer partners across phases. INs = initiations; Sn = session; Generlzn = generalization; RSs = responses.

Figure 2. Average number of acts for four types of communicative modalities expressed by children with autism spectrum disorder across phases. SGD = speech-generating device; Gen = generalization.

Figure 3. Average rates of four communicative functions expressed to initiate and respond to peers by children with autism spectrum disorder across phases. INs = initiations; Sn = session; RQOb = requests for objects; RQAc = requests for actions; COM = comments; RQJA = requests for joint attention; Generlzn = generalization; RSs = responses.

agreement was scored when both observers coded the same act, initiation or response, modality, or function in the same interval. Disagreements were scored if one coder did not observe the same act or if they did not agree on the type of behavior expressed after coding the act. The total number of agreements was divided by the total number of agreements plus disagreements in each session and multiplied by 100. Mean IOA for focus child (FC) and peer (P) initiations was 100% for both in baseline, 89% (FC range: 73–100) and 94% (P range: 75–100) for treatment, 94% (FC range: 80–100) and 96% (P range: 89–100) for generalization, and 96% (FC range: 91–100) and 94% (P range: 90–100) for follow-up. Mean IOA for focus child and peer responses was 100% for both in baseline, 89% (FC range: 71–100) and 90% (P range: 71–100) for treatment, 92% (FC range: 80–100) and 91% (P range: 76–100) for generalization, and 96% (FC range: 88–100) and 97% (P range: 94–100) for follow-up. Mean IOA ranged from 92% to 97% across phases for focus child modalities and ranged from 95% to 97% for focus child functions. Sessions with reliability agreements less than 80% were mutually discussed, with examples added to the coding manual for future reference.

Teacher and Peer Fidelity of Implementation

After the peers joined their partner with ASD in the weekly dyadic social activities, staff implementers were

encouraged to follow a list of 12 steps to ensure fidelity of implementation across children. Research project staff completed the checklist for 34% of all treatment sessions (range: 26%–48% per teacher). The average fidelity of implementation was 89% (range: 67%–100%). A 10-item checklist was also developed to monitor peer implementation of strategies, with steps corresponding to staying close, playing together, getting attention, responding, and using the SGD to communicate. This checklist was completed for 41% of all treatment sessions, with an average of 83% across all peers (range: 60%–100%). If a peer was at 60% or below over two sessions, a 20-min refresher peer training session was provided. This occurred one time.

Social Validity

Thirty graduate students in speech-language pathology who were unfamiliar with the project goals viewed 1-min vignettes of pre- and posttreatment sessions and provided subjective ratings of changes in the social interactions between the children with ASD and their peer partner. Vignettes were selected based on identifying a high-quality video and audio recording and randomly from treatment sessions collected during the final month of the study. All pre- and posttreatment vignettes were randomly presented; thus, raters were blind to the study phase. They independently rated four social behaviors describing the focus child, followed

by a rating of four social behaviors describing the peer on a Likert scale of 1–5 (i.e., 1 = *never*, 3 = *sometimes*, and 5 = *Frequently*). Questions related to showing interest in the play partner, engaging by taking turns and sharing, talking using the iPad and/or words, and enjoyment.

Results

Results from the larger randomized study (Thiemann-Bourque et al., 2018) revealed significant increases in communication skills for $n = 23$ children with ASD and trained peers in the peer-mediated + SGD experimental group. As related to the cohort of $n = 6$ children selected for the current study, an embedded SCD design allowed us to examine individual differences in patterns of initiations and responses or the nature of reciprocal exchanges, as well as communicative functions and modalities not examined at the group level. In regard to total communication acts, results revealed strong evidence of experimental effects replicated across all focus children and their peers, as well as large effect sizes for both partners (see Supplemental Material S1 for graphs).

Reciprocal Changes for Focus Children and Peers

Figure 1 summarizes mean initiations and responses per 10-min session for the focus children and peers, showing the extent to which changes in the balance of acts were evident across experimental phases. Kerry showed a slightly higher rate of initiations ($M = 14$) than responses ($M = 12$) during treatment, whereas his peers showed higher responses ($M = 17$) compared to initiations ($M = 9$). This pattern of higher initiations for Kerry was also demonstrated in generalization and at follow-up. There was more equality in responses with peers across these latter two phases. During baseline, Kami demonstrated fewer initiations compared to her peers ($M = 3$ compared to $M = 7$), with low levels of responses noted for both partners. During treatment, Kami and her peers demonstrated similar rates of initiations ($M = 10$ and $M = 9$, respectively) and responses ($M = 20$ and $M = 22$, respectively); this pattern was also observed during generalization. The higher mean rates of responses in treatment and generalization suggest more sequential responsive acts following each Initiation (e.g., I-R-R-R). In baseline, Milly expressed fewer initiations than her peers ($M = 3$ compared to $M = 9$); however, her mean initiations became more equal with peers in treatment ($M = 8$ and $M = 10$, respectively) and in generalization ($M = 5$ for both). During follow-up, Milly expressed fewer initiations ($M = 2$) compared to her peers ($M = 17$), yet she maintained a high and comparable rate of responses ($M = 22$) to her peers ($M = 16$). This suggests that, although Milly did not initiate often during follow-up, her peers maintained this behavior, and she responded in turn within communication interactions. Compared to baseline, Annie and her peers expressed more initiations during treatment ($M = 7$ and $M = 11$, respectively); her responses to peers were markedly higher ($M = 18$) and comparable to average rates of peer

responses across all conditions. Brody and his peers rarely communicated during baseline ($M < 1$ act); he demonstrated similar rates of initiations ($M = 9$) as his peers ($M = 10$) during treatment and generalization ($M = 4$ for both). He expressed fewer initiations than his peers at follow-up ($M = 5$ compared to $M = 15$). Overall, his average rate of responses was comparable to peer responses across all conditions. Bayley and her peers showed more balanced initiations ($M = 7$ for both partners) in treatment, yet she initiated more than her peers during generalization ($M = 7$ compared to $M = 4$) and at follow-up ($M = 11$ compared to $M = 5$). More equal response rates were noted across all conditions.

To determine if child communication behaviors varied across different peers (range of 2–3 per group), we summed mean communication acts (initiations and responses) directed by each focus child to each peer in their group. Results showed that the focus children varied from one another, but not all that differently with each peer partner. One child (Kami) communicated a little lower to one of her three peers in treatment ($M = 23$ compared to $M = 29$ and 33), and Milly communicated a little higher with one peer ($M = 22$) than her other two peers ($M = 14$ and 15). Otherwise, there was a lot of consistency in peer communication for each of the focus children.

Communicative Modalities of Children With ASD

Figure 2 shows the average number of acts expressed for four types of communicative modalities (i.e., gestures, speech, SGD, and speech + SGD) for each experimental phase. In baseline, use of these four modalities ranged from 0 to 2 across all six children, with Milly and Bayley using solely speech. On closer examination, the speech acts coded for these two girls in baseline consisted mainly of protests to peers or attempts to avoid sharing (e.g., “No!” or “Mine!”). From baseline to treatment, three of the six children with ASD (Kerry, Milly, and Annie) demonstrated increased use of all four modalities to intentionally communicate with peers. Kerry, Milly, and Annie averaged 5, 2, and 5 gestural acts per treatment session; 3, 6, and 5 speech acts per treatment session; 14, 6, and 9 SGD acts per treatment session; and 5, 3, and 3 speech + SGD acts per treatment session, respectively. Kerry and Annie were observed to continue to use similar averages of all four modalities during generalization and follow-up, whereas Milly decreased her use of speech + SGD during generalization ($M = 0.2$ acts) and follow-up ($M = 1$ act).

In comparison, the other three children demonstrated increases primarily in gestures and SGD use, with minimal changes in speech and speech + SGD. During treatment, gestures improved to an average of 10, 4, and 3 acts for Kami, Brody, and Bayley, respectively. The greatest change was observed in the average number of SGD acts, with an average increase of 14, 13, and 10 acts, respectively. Kami maintained improvements in SGD use in generalization activities and increased her use of speech combined with SGD (i.e., increase from mean of 1 to 3 acts). Both Brody and Bayley decreased their average use of SGD by approximately

half in generalization (i.e., from 13 to 5 and from 10 to 6 acts), yet these averages were higher than baseline. In follow-up, Brody increased both gestures and SGD use (i.e., 4 and 9 acts) similar to his treatment averages; Bayley showed a slightly higher average number of gestures (i.e., increase from mean of 4 to 6 acts) and speech (increase from 0.4 acts in treatment to 3 at follow-up).

Communicative Functions of Children With ASD

Figure 3 shows the mean rate of four communicative functions expressed by children with ASD to initiate and respond to peers per session across phases. For all participants, consistent changes were noted from baseline to treatment in initiating requests for objects (range from an average change of 3.3 to 11.2 acts per session), with the greatest changes observed for Kerry, Kami, and Brody. Initiating requests for actions and initiating to comment also improved, although less noticeably and with variability across participants. Kerry showed the greatest growth in initiating comments to peers (average change of 0.9 acts), followed by Brody (change of 0.7 acts). Milly demonstrated the highest mean changes in initiating requests for actions (mean change of 1.6 acts), followed by Brody (mean change of 0.7 acts). In regard to changes in communicative functions to respond, lower overall means across participants were found for responding to peer requests for objects ($M = 3.9$) compared to initiations for the same function ($M = 6.3$), and higher overall means were noted for responding to peers with a comment ($M = 2.6$) compared to initiating comments ($M = 0.7$). For responding to peer requests for actions, overall mean changes were similar to changes for initiating requests for actions. Limited to no changes were noted in initiations or responses to request joint attention across all participants.

Social Validity Assessment

Outcomes of the 30 naïve judges' perceptions of changes in social interaction skills for the children with ASD and the peer partners are available for five of the six children, as one parent chose not to have his child participate in this assessment. Prior to treatment, all children with ASD were rated as demonstrating the social behaviors *less than sometimes* (overall mean of 2.6), with the exception of Milly who received a rating of 3.5. Following treatment, all raters consistently observed and reported improved social behaviors of the focus children, with ratings averaging 4.5 (range: 4.2–4.8). Similarly, pretreatment average ratings across peer partners for each focus child ranged from *less than sometimes* (range: 2.0–2.4) to *sometimes* (range: 3.1–3.4), with an overall mean of 2.6. Ratings of peer social behaviors averaged 4.6 at posttreatment for all partners (range: 3.9–4.9).

At the end of the study, we asked all implementers to complete a 20-item acceptability questionnaire to determine their perceptions of project expectations, the amount and level of training and support provided, time commitment,

the effectiveness of teaching strategies, and benefits to the children with ASD and to the peers. The questionnaire was rated on a 5-point Likert scale, with 1 = *strongly disagree*, 3 = *somewhat agree*, and 5 = *strongly agree*. Outcomes showed positive perceptions by the six implementers, with an average rating across all items of 4.7 (range: 3.0–5.0). Items rated most favorably related to learning to program the iPad as an SGD augmentative system to meet the child's communication needs, learning to use TouchChat as the voice output app to meet the child's needs, receiving necessary assistance from project staff throughout the project, and giving feedback to project staff to suggest changes or improvements.

Discussion

Thiemann-Bourque et al. (2018) reported on a larger study in which four cohorts of preschool children with severe ASD and minimal to no spoken language were randomly assigned to a peer-mediated intervention that included training on an iPad as SGD. Outcomes from that study filled a gap in communication partner instruction and AAC intervention research; children who participated in the intervention demonstrated increases in intentional communication acts to peers, with concurrent increases in peer communication. The current study further explored one cohort's results and revealed that, in addition to these increases, the children showed more balanced back-and-forth communicative turns, with varying equality in novel generalization settings and at 5–6 weeks of follow-up. One unique outcome of this study that adds to the SGD intervention literature was the observation of a wider use of and differential improvements in communicative modalities and functions. For example, half of the children with ASD increased in all four modalities (including more speech) to communicate to peers, and half increased primarily in two modalities (i.e., SGD and gestures). Furthermore, all children with ASD demonstrated improvements in their ability to request objects from peers; progress also was noted for some children in comments and requests for actions and was negligible for requests for attention. Finally, judges unfamiliar with the study goals reported positive changes in the quality and quantity of child–peer social behaviors, reflecting clear improvements in social communicative interactions.

The findings of this secondary analysis of previously reported data and other recent studies contribute to a growing body of research recognizing the importance of measuring partner engagement within communicative interactions in the context of common preschool social activities (DiStefano, Shih, Kaiser, Landa, & Kasari, 2016; Thiemann-Bourque et al., 2016, 2018, 2017). Treatment components, implemented with fidelity by a range of early special education staff, included a brief review of programmed words and symbols, child and peer practice using the iPad, and guidance to both partners to use the iPad as SGD to communicate for functional purposes. In their review of 17 single-case studies, Kent-Walsh and McNaughton (2015) reported similar instructional strategies within moderately effective communication partner interventions for AAC users.

Outcomes of the current study extend this review by documenting positive effects on a wider range of communication skills for preschool-age children with ASD and support recommendations for a multimethod AAC intervention approach to improve peer interactions for this population (Therrien et al., 2016).

Combining evidence-based strategies may be necessary to address the significant communication challenges of minimally verbal children with ASD, particularly if the goal is to observe generalized improvements and maintenance of gains independent of adult support. In this secondary analysis, individual data collected during generalization activities showed higher average treatment rates of initiations and responses for all focus children and peers, but somewhat lower rates in their ability to generalize either initiations and/or responses (variable across children) compared to treatment. These outcomes are noteworthy considering the significant hurdles this population of children experience using new skills across settings and activities; however, they also suggest the need for additional approaches or therapy time to increase children's ability to initiate and respond consistently across settings and activities. Thiemann-Bourque et al. (2017) reported preliminary findings on specific social contexts that produced more robust intervention effects. For example, the three preschoolers with ASD in their study showed marked increases in communication to peers during snack compared to centers and cause-effect toys. The authors suggested that children's level of interest and motivation are important considerations in treatment and that use of an SGD to obtain a reinforcing object (such as food) may lead to additional practice opportunities and observations of peer social models. A closer analysis of the generalization data for this cohort showed mixed results in snack and centers/free play. That is, one child (Kerry) was motivated to play games with his peers during centers more so than snack, whereas four children (Kami, Milly, Annie, and Bayley) communicated more often to peers during snack, and one child (Brody) communicated the same during snack and free play. These findings underscore the importance of individualizing communication interventions to meet children's needs and preferences (Huber & Carter, 2016).

A key strength of the current study was the equity in exchanges between children with ASD and peer partners in contextually relevant social activities. Deficits in social reciprocity are a core characteristic of individuals with ASD (Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition), yet intervention research to improve this more advanced communication skill for young children is sparse. Results of this study expand on the emerging reports of increased turn-taking and child-peer engagement following SGD interventions (Therrien & Light, 2018; Thiemann-Bourque et al., 2018, 2017) and demonstrate positive outcomes for children with severe ASD and limited spoken communication. Social communication is inherently reciprocal and reflects the dynamic nature of children's interactions with others. Continued exploration of specific approaches that best support children's participation in sustained play and social communication exchanges in

the preschool years may significantly change the course of development of social reciprocity.

To communicate successfully in peer interactions, children need to learn a diverse repertoire of modalities and communicative functions. Unique to this study was the reporting of intervention effects on communication modalities and functions, variables rarely reported in the AAC literature (Logan et al., 2017). All children with ASD increased in using the iPad as their primary mode to communicate to peers. Given the focus of the intervention on SGD instruction, this outcome was not surprising. Interestingly, three children increased their use of multiple modalities, most notably, more speech and speech combined with SGD. The other three children showed a pattern of using primarily the iPad and gestures. This outcome illustrates the need to provide multimodal communication options, as different children may respond in different ways to various communication modes. It may be that once children started using the iPad to communicate, they were reinforced by a responsive peer and by obtaining a desired object (or turn). This may have resulted in greater motivation to interact and greater opportunities to practice communicating with peers. Of the three children who used four modalities and increased speech, one (Kerry) did not use speech, and two (Milly and Annie) used minimal speech in baseline. Similarly, of the children who began to use primarily the SGD and gestures, one (Brody) was nonverbal, and two (Kami and Bayley) were minimally verbal. It is difficult to conclude why some children continued to struggle with oral communication, yet we know that approximately 30% of children with ASD do not develop functional speech (Tager-Flusberg & Kasari, 2013). For communicative functions, the greatest gains were observed in requests for objects followed by comments as well as requests for actions. The significance of this finding is that all children demonstrated zero or low rates across functions to communicate to peers in baseline, and although variable, they each learned a larger repertoire of functions for different social purposes. The increases in commenting are noteworthy, as few studies to date have reported changes in this skill, and even fewer have included preschool-age children with ASD (Iacono et al., 2016). The lack of change in requesting joint attention could be explained by the fact that once the children were engaged in an activity, there was little need to gain another's attention. Alternatively, deficits in joint attention are a characteristic of young children with ASD, and this has become a key target of early interventions (Kasari, Gulsrud, Freeman, Paparella, & Hellemann, 2012; Kasari et al., 2014). Future AAC research is needed to identify effective instructional strategies to elicit multimodality communication for a variety of social purposes and to compare effectiveness of different strategies across groups of children.

Limitations

Within single-case experimental designs, external validity is enhanced through replicating intervention effects across different individuals, with the goal of providing

strong experimental evidence of treatment efficacy and generality to similar children. One design limitation in the current study was collecting four baseline sessions for two children as well as collecting three follow-up sessions; the recommended minimum is five per phase (Kratochwill et al., 2010). Conducting this type of study in school settings puts limits on the amount of data that can feasibly be collected in one school year. These results from six children indicate individual variations in the response to this intervention. One can expand upon the generalizability of effects through systematic replications with refined procedures or with participants with different characteristics. Determining the broad applicability to the larger population of minimally verbal children with ASD can be accomplished through RCTs. Large samples are needed to begin to identify the myriad of factors that may moderate treatment effects.

Measuring exchanges between peers and children with ASD learning to use AAC who are not yet speaking, using limited spoken language, or just beginning to use vocalizations and gestures remains a challenge. A few concerns and improvements to the current coding system to measure these skills deserve mention. First, to determine if each act was an initiation or a response, the decision was made (primarily based on the author's previous research) to define each act on the timing versus the relatedness to the topic of the previous communication act. More information about the quality and substance of communication exchanges could be gleaned with a coding scheme that attended to responses related to a specific topic and a longer (maybe 5 s) interval to allow children more time to scan and select SGD symbols. Second, the approach of coding speech when presented with a situation where the child used both speech and SGD to communicate designates speech as a more superior skill. This may not be a valid approach. Recommended changes would be to value SGD and speech gains equally and to give credit for selection of two different modes to convey two concepts as a sign of growing linguistic complexity. In addition, future research could employ sequential analyses to better understand the extent to which different communication functions differentially affect the likelihood of responding and to elucidate how turn-taking and reciprocity are manifested in longer exchanges. In relation to coding, it also deserves mention that although a minimum of 20% of all sessions were coded by individuals blind to the goals of the study, the primary coders (first author and project coordinator) were not. Social validity assessments could capture information about changes in reciprocal interaction by asking judges to rate improvements in give-and-take or reciprocity perceived in dyadic interactions. Finally, it deserves mention that six of the seven implementers had a master's degree. Although this may suggest that higher education leads to positive child outcomes, the authors have provided similar trainings and observed improved child outcomes across early special educators (e.g., paraprofessionals, SLPs, special education teachers) with varying years of experience and education (Thiemann-Bourque et al., 2016, 2018).

Conclusion

Outcomes of this study demonstrate the promise of a peer partner SGD intervention on improving the amount of exchanges and quality of communicative interactions for preschool-age children with ASD. Findings show this intervention to be especially promising for expanding the social communicative functions and the reciprocal exchanges demonstrated by preschoolers with ASD using an SGD. Equity in communication reflects higher levels of engagement, a time when children can communicate about shared interests or objects/toys. The process of sharing communicative intent provides opportunities for children with ASD to follow a partner's reference and attend to modeled language, which may thereby support further language development (DiStefano et al., 2016). Furthermore, the extent to which children with ASD learn to interact with peers has been shown to be related to core deficits in communication, joint attention, and play (Freeman et al., 2015; Sigman, Ruskin, Arbelle, Corona, & Dissanayake, 1999). Future research is needed to document outcomes of peer-mediated and AAC interventions on these early skills as well as the long-term effects on children's relationships and social participation in elementary school.

Acknowledgments

This research was funded by National Institute on Deafness and Other Communication Disorders Grant 1R01DC012530, awarded to Kathy Thiemann-Bourque.

We would like to thank all of the early education service providers, the children, and their families who participated and lent support to the success of this study. We also would like to acknowledge Sarah Feldmiller and Stacy Johner who were instrumental in coordinating visits and collecting data, as well as Abigail Hartzell and Hannah Robinson for assisting with data coding and entry.

References

- Alpert, C. L., & Kaiser, A. P. (1992). Training parents as milieu language teachers. *Journal of Early Intervention*, 16(1), 31–52.
- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). <https://doi.org/10.1176/appi.books.9780890425596>
- Attainment Company. (2012). GoTalk NOW [Mobile application software]. Retrieved from <https://www.attainmentcompany.com/gotalk-now>
- Blackstone, S. W., Williams, M. B., & Wilkins, D. P. (2007). Key principles underlying research and practice in AAC. *Augmentative and Alternative Communication*, 23(3), 191–203.
- Bondy, A. S., & Frost, L. A. (1994). The picture exchange communication system. *Focus on Autism and Other Developmental Disabilities*, 9(3), 1–19.
- Calloway, C. J., Myles, B. S., & Earles, T. L. (1999). The development of communicative functions and means in students with autism. *Focus on Autism and Other Developmental Disabilities*, 14(3), 140–149.
- DiStefano, C., Shih, W., Kaiser, A., Landa, R., & Kasari, C. (2016). Communication growth in minimally verbal children

- with ASD: The importance of interaction. *Autism Research*, 9, 1093–1102.
- Freeman, S. F., Gulsrud, A., & Kasari, C. (2015). Brief report: Linking early joint attention and play abilities to later reports of friendships for children with ASD. *Journal of Autism and Developmental Disorders*, 45(7), 2259–2266.
- Ganz, J. B., Earles-Vollrath, T. L., Heath, A. K., Parker, R. I., Rispoli, M. J., & Duran, J. B. (2012). A meta-analysis of single case research studies on aided augmentative and alternative communication systems with individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 42(1), 60–74.
- Goldstein, H., English, K., Shafer, K., & Kaczmarek, L. (1997). Interaction among preschoolers with and without disabilities: Effects of across-the-day peer intervention. *Journal of Speech, Language, and Hearing Research*, 40(1), 33–48.
- Goldstein, H., Lackey, K., & Schneider, N. (2014). A new framework for systematic reviews: Application to social skills interventions for preschoolers with autism. *Exceptional Children*, 80(3), 262–286.
- Goldstein, H., Schneider, N., & Thiemann, K. (2007). Peer-mediated social communication intervention: When clinical expertise informs treatment development and evaluation. *Topics in Language Disorders*, 27(2), 182–199.
- Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, 71(2), 165–179.
- Huber, H. B., & Carter, E. W. (2016). Data-driven individualization in peer-mediated interventions for students with ASD: A literature review. *Review Journal of Autism and Developmental Disorders*, 3(3), 239–253.
- Iacono, T., Trembath, D., & Erickson, S. (2016). The role of augmentative and alternative communication for children with autism: Current status and future trends. *Neuropsychiatric Disease and Treatment*, 12, 2349.
- Kamps, D., Thiemann-Bourque, K., Heitzman-Powell, L., Schwartz, I., Rosenberg, N., Mason, R., & Cox, S. (2014). A comprehensive peer network intervention to improve social communication of children with autism spectrum disorders: A randomized control trial in kindergarten and first grade. *Journal of Autism and Developmental Disorders*, 45, 1809–1824.
- Kasari, C., Gulsrud, A., Freeman, S., Paparella, T., & Hellemann, G. (2012). Longitudinal follow-up of children with autism receiving targeted interventions on joint attention and play. *Journal of the American Academy of Child & Adolescent Psychiatry*, 51(5), 487–495.
- Kasari, C., Kaiser, A., Goods, K., Nietfeld, J., Mathy, P., Landa, R., & Almirall, D. (2014). Communication interventions for minimally verbal children with ASD: A sequential multiple assignment randomized trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, 53(6), 635–646.
- Kent-Walsh, J., & McNaughton, D. (2005). Communication partner instruction in AAC: Present practices and future directions. *Augmentative and Alternative Communication*, 21(3), 195–204.
- Kent-Walsh, J., Murza, K. A., Malani, M. D., & Binger, C. (2015). Effects of communication partner instruction on the communication of individuals using AAC: A meta-analysis. *Augmentative and Alternative Communication*, 31(4), 271–284.
- Koegel, R. L., Shirotova, L., & Koegel, L. K. (2009). Brief report: Using individualized orienting cues to facilitate first-word acquisition in non-responders with autism. *Journal of Autism and Developmental Disorders*, 39(11), 1587–1592.
- Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S., Rindskopf, D., & Shadish, W. (2010). *Single-case designs technical documentation*. Princeton, NJ: What Works Clearinghouse.
- Light, J., & McNaughton, D. (2013). Putting people first: Rethinking the role of technology in augmentative and alternative communication intervention. *Augmentative and Alternative Communication*, 29(4), 299–309.
- Light, J., & McNaughton, D. (2014). Communicative competence for individuals who require augmentative and alternative communication: A new definition for a new era of communication. *Augmentative and Alternative Communication*, 30, 1–18.
- Logan, K., Iacono, T., & Trembath, D. (2017). A systematic review of research into aided AAC to increase social-communication functions in children with autism spectrum disorder. *Augmentative and Alternative Communication*, 33(1), 51–64.
- Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., & Bishop, S. (2012). *Autism Diagnostic Observation Schedule—Second Edition (ADOS-2)*. Torrance, CA: Western Psychological Services.
- Maljaars, J., Noens, I., Jansen, R., Scholte, E., & van Berckelaer-Onnes, I. (2011). Intentional communication in nonverbal and verbal low-functioning children with autism. *Journal of Communication Disorders*, 44(6), 601–614.
- Mullen, E. (1995). *Mullen Scales of Early Learning*. Circle Pines, MN: American Guidance Service.
- National Autism Center. (2015). *Findings and conclusions: National Standards Project, Phase 2*. Randolph, MA: Author.
- Noldus Information Technology. (2009). *The Observer* (Version 9.0) [Computer Software]. Wageningen, the Netherlands: Author.
- Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy*, 42(2), 284–299.
- Schlosser, R. W., & Koul, R. K. (2015). Speech output technologies in interventions for individuals with autism spectrum disorders: A scoping review. *Augmentative and Alternative Communication*, 31(4), 285–309.
- Shumway, S., & Wetherby, A. M. (2009). Communicative acts of children with autism spectrum disorders in the second year of life. *Journal of Speech, Language, and Hearing Research*, 52(5), 1139–1156.
- Sigman, M., Ruskin, E., Arbel, S., Corona, R., Dissanayake, C., Espinosa, M., & Robinson, B. F. (1999). Continuity and change in the social competence of children with autism, Down syndrome, and developmental delays. *Monographs of the Society for Research in Child Development*, 64, 1–139.
- Silver Kite. (2017). *TouchChat HD* [Mobile application software]. Retrieved from <https://itunes.apple.com/us/app/touchchat-hd-aac/id398860728?mt=8>
- Snyder-McLean, L. K., & McLean, J. E. (1978). Verbal information gathering strategies: The child's use of language to acquire language. *Journal of Speech and Hearing Disorders*, 43(3), 306–325.
- Still, K., Rehfeldt, R. A., Whelan, R., May, R., & Dymond, S. (2014). Facilitating requesting skills using high-tech augmentative and alternative communication devices with individuals with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 8(9), 1184–1199.
- Tager-Flusberg, H., & Kasari, C. (2013). Minimally verbal school-aged children with autism spectrum disorder: The neglected end of the spectrum. *Autism Research*, 6(6), 468–478.
- Therrien, M., & Light, J. (2016). Using the iPad to facilitate interaction between preschool children who use AAC and their peers. *Augmentative and Alternative Communication*, 32(3), 163–174.

- Therrien, M., & Light, J.** (2018). Promoting peer interaction for preschool children with complex communication needs and autism spectrum disorder. *American Journal of Speech-Language Pathology*, 27(1), 207–221.
- Therrien, M., Light, J., & Pope, L.** (2016). Systematic review of the effects of interventions to promote peer interactions for children who use aided AAC. *Augmentative and Alternative Communication*, 32, 81–93.
- Thiemann, K., & Goldstein, H.** (2004). Effects of peer training and written-text cueing on social communication of school-age children with pervasive developmental disorder. *Journal of Speech, Language, and Hearing Research*, 47(1), 126–144.
- Thiemann-Bourque, K., Brady, N., McGuff, S., Stump, K., & Naylor, A.** (2016). Picture Exchange Communication System and pals: A peer-mediated augmentative and alternative communication intervention for minimally verbal preschoolers with autism. *Journal of Speech, Language, and Hearing Research*, 59(5), 1133–1145.
- Thiemann-Bourque, K., Feldmiller, S., Hoffman, L., & Johnner, S.** (2018). Incorporating a peer-mediated approach into speech-generating device intervention: Effects on communication of preschoolers with autism spectrum disorder. *Journal of Speech, Language, and Hearing Research*, 61(8), 2045–2061.
- Thiemann-Bourque, K. S., McGuff, S., & Goldstein, H.** (2017). Training peer partners to use a speech-generating device with classmates with autism spectrum disorder: Exploring communication outcomes across preschool contexts. *Journal of Speech, Language, and Hearing Research*, 60(9), 2648–2662.
- Travis, L., Sigman, M., & Ruskin, E.** (2001). Links between social understanding and social behavior in verbally able children with autism. *Journal of Autism and Developmental Disorders*, 31(2), 119–130.
- Watkins, L., O, Reilly, M., Kuhn, M., Gevarter, C., Lancioni, G. E., Sigafoos, J., & Lang, R.** (2015). A review of peer-mediated social interaction interventions for students with autism in inclusive settings. *Journal of Autism and Developmental Disorders*, 45(4), 1070–1083.
- Zagona, A. L., & Mastergeorge, A. M.** (2016). An empirical review of peer-mediated interventions: Implications for young children with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, 33(3), 131–141.
- Zimmerman, I., Steiner, V., & Evatt Pond, R.** (2007). *Preschool Language Scale-Fifth Edition*. San Antonio, TX: The Psychological Corporation.

Appendix

Peer Partner Speech-Generating Device Training Procedure Table

Day/time	Topic	Description of steps
Day 1/20 min	a. Sensitivity training b. Introduce STAY c. Role play/practice STAY	View videos of ways children communicate 1. Sit close 2. If buddy moves, you move
Day 2/30 min	a. Review STAY steps b. Introduce PLAY c. Role play/practice PLAY d. Introduce TALK e. Role play/practice TALK	1. Share toys 2. Take turns 1. Look and listen 2. Push and talk
Day 3/30 min	a. Review STAY-PLAY-TALK steps b. Introduce Get Attention c. Role play/practice Get Attention d. Introduce Hold and Wait e. Role play/practice Hold and Wait f. Give peer award certificate	1. Tap on shoulder 2. Say name out loud 1. Hold toy up 2. Wait, then give toy

Note. All steps written out and placed in a three-ring buddy book with illustrated pictures of children interacting and talking. A book was given to each peer and used if needed during sessions.