EFFECTS OF A SPEECH GENERATING DEVICE AND PEER TRAINING ON THE DIRECTED COMMUNICATION BETWEEN PRESCHOOLERS WITH DOWN SYNDROME AND THEIR PEERS

By

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Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

In

Special Education

August, 2013

Nashville, Tennessee

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To my amazingly supportive husband and our little baby on the way.

ACKNOWLEDGEMENTS

My work at Vanderbilt would not have been possible without the support of the Early Childhood Special Education Doctoral Leadership Training Grant (H325D070075). Additionally, I would like to thank the Bonsal Family for awarding me with the Bonsal Applied Education Research Award that funded my dissertation research. I am grateful to all of the individuals responsible for providing me with these financial supports.

I feel particularly lucky to have been surrounded by such inspiring researchers and who have provided me with opportunities to grow into the researcher that I am today. I extend my sincerest appreciation to Mark Wolery, Mary Louise Hemmeter, Paul Yoder, and Stephen Camarata. I would particularly like to thank Megan Roberts who has served many roles in my life including mentor, friend, and committee member. Finally, I would like to thank Ann Kaiser, my teacher and advisor, without whom I clearly could not have done any of this. I am eternally grateful for having met you and worked with you.

Last, I would like to thank my family who supported me in this journey before it even began. I am most grateful to my parents Michael and Mary Beth, my first teachers, who instilled within me a great joy of learning and a strong work ethic at a very young age. I would also like to thank my siblings, Shawna and Michael, for their competitive spirits and for modeling persistence, humility, and excellence in their everyday lives. Finally, to my husband, Greg, I would like to extend my deepest love and gratitude for supporting me in every way throughout this adventure. My success in this program is a direct result of your flexibility and sense of humor that encouraged us to continue living our happy, balanced lives despite the pressures of the program.

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CHAPTER ONE

INTRODUCTION

Children with Down syndrome (DS) typically demonstrate expressive language delays that are greater than the delays predicted by their cognitive abilities (Miller, 1999). Further, children with disabilities, including children with DS, have difficulties with peer social interactions (Guralnick & Groom, 1987; Guralnick & Weinhouse, 1984; Lieber, 1993). The current study was designed to address both of these important aspects of social development in children with DS. This study examines the effects of the first by teaching specific activity-based language to children with DS using spoken and speech generated modes, and second, by teaching peers to respond to and communicate with the target children with DS. In this review of literature, language issues specific to children with DS will be addressed first. This will be followed by a discussion of interventions that have been used to target language deficits in children with DS, including the use of speech generating devices (SGDs). Finally, research on peer interventions will be presented.

Language Characteristics of Children with DS

Specific phenotypic differences may exist for children with DS that are not found in other children with intellectual disabilities. These phenotypic differences may explain the disparity between children with DS's expressive language when compared to their cognitive abilities (Chapman & Hesketh, 2000; Fidler, Philofsky, & Hepburn, 2007;

Roberts, Price, & Malkin, 2010). Two key behavioral differences associated with DS may be deficits in verbal short-term memory for auditory information and speech intelligibility. Verbal short-term memory has been shown to predict language abilities in typically developing children (Adams & Gathercole, 1995, 1996, 2000).

Children with DS have weaknesses in verbal short-term memory for auditorily presented information that affects language learning (e.g., Brock & Jarrold, 2005; Jarrold & Baddeley, 1997; Kay-Raining Bird & Chapman, 1994; Laws, 2002). Studies have consistently found deficits in verbal short-term memory of children and adolescents with DS compared to their relative strength in visual short-term memory and compared to the verbal short-term memory of typically developing children (e.g., Brock & Jarrold, 2005; Kay-Raining Bird & Chapman, 1994; Laws, 2002). Jarrold and Baddeley (1997) matched children with DS with children with mild learning disabilities with typically developing children based on receptive vocabulary scores and found significant differences on accuracy for auditorily presented information but no differences for visually presented information across the three diagnostic groups. Additionally, Laws and Gunn (2004) found verbal short-term memory scores predicted expressive language abilities in children with DS five years after the initial assessment of auditory memory. These findings indicate the importance of effective verbal short-term memory skills in early language learning and suggest that strategies for augmenting verbal input with visual representations may be important for helping children with DS process linguistic information.

Speech intelligibility, or comprehensibility, is a second factor in the development of effective communication skills in children with DS (Camarata, Yoder, & Camarata,

2006). Poor speech intelligibility may be the result of relatively poor oral motor skills (Jobling, 1998; Jobling, 1999), speech production errors (Camarata et al., 2006), and maybe compounded by their limited expressive syntax (Chapman, Seung, Schwartz, & Kay-Raining Bird, 2000). Among young children with DS, these constraints on production of spoken language may be a factor in the observed low rate of verbal communication and may disrupt the linguistic input processes that support language development (e.g., parental responsiveness, recasting, and expansions). In typically developing children, it is expected that an unfamiliar partner will be able to understand 100% of a child's speech by the child's fourth birthday (Coplan & Gleason, 1988; Weiss et al., 1987). Although there are limited data describing the specific levels of intelligibility for young children with DS, research indicates that speech intelligibility is a lifelong challenge for this population (Kumin, 2006; Shriberg & Widder, 1990).

Kumin (1994) reported 95% of 937 parents identified their child (birth to 40+ years) as being difficult to understand by unfamiliar partners and identified intelligibility as a continuous concern in their child's development. In one study of children with DS ages 10 to 24, seven of 30 children were removed from analyses due to unintelligible narratives (Laws, 2004). These children did not differ from the remaining group in chronological age; however, they scored lower on every measure including nonverbal cognitive scores, language comprehension, nonword repetition, and number recall. Differences between scores of the two groups on the nonverbal test from the Kaufman Assessment Battery (Kaufman and Kaufman, 1983) and language comprehension from the Test for Reception of Grammar (Bishop, 1983) were statistically significant. Poor speech intelligibility appears to be related to how children are able to understand and use

language. Overall, these findings regarding persistently lower levels of speech intelligibility suggest a need for an alternative mode of expression to support communication.

Augmentative and Alternative Communication Interventions

For children with DS, relative strengths in visual short-term memory and their relative weaknesses in auditory memory and speech intelligibility suggest that using an augmentative and alternative communication (AAC) system with a visual mode in combination with verbal language could promote language learning as well as give children a means for effective productive communication. The oral and fine motor skills required for communication using an augmentative system are different and somewhat less than those required of intelligible speech production are. Introducing AAC systems to support the development of productive language is an understudied area of research in DS.

Most AAC studies including children with DS have evaluated the effects of teaching sign language as an alternative mode of communication. Wright, Kaiser, Reikowsky, and Roberts (2012) taught signed words simultaneously with spoken words using Joint Attention, Symbolic Play, and Emotional Regulation (JASPER) and Enhanced Milieu Teaching (EMT; together J-EMT) strategies to four children with DS between 23 and 29 months of age in a multiple baseline single subject design. Children were taught by a therapist during 20-30 min play based sessions in a clinic setting. The therapist signed more than 85% of modeled spoken words, thus infusing sign models in the interactions. There was a functional relation between the introduction of the

intervention and the rate of total sign use, spontaneous sign use, and number of different signs for three of the four children. Children learned between 10 and 21 new signed words and three and nine new spoken words within the 20 intervention sessions. Results indicated that children learned to use sign as a mode of communication in a naturalistic intervention and generalized use of signs to their untrained parents at home. However, the design of this study did not allow for the conclusion that a simultaneous sign and spoken intervention would be more effective than spoken intervention alone.

Kouri (1988) studied the use of both signed and spoken input with five children, including one 34-month-old with DS. The therapists taught signed and spoken words simultaneously within a naturalistic teaching context. The participant with DS showed an immediate increase in use of signs alone and signs used together with spoken words. After about 25 sessions, the use of signs by the child with DS began to decrease somewhat while spontaneous word productions increased throughout the remainder of the intervention. These results suggest that initial signs may be used as a bridge to spoken language.

In Kay-Raining Bird, Gaskell, Babineau and MacDonald (2000), 10 children with DS (25-62 months) and 10 mental-age matched typically developing children (14-30 months) were taught nonsense words in three different conditions: (a) sign only, (b) spoken only, and (c) sign and spoken. Each session consisted of five exposures of two words in each of the three conditions. This procedure was followed by comprehension and production probes. Children participated in three sessions for a total of 15 exposures to each of the six words. The authors found limited results in the production probes concluding that 15 exposures was not enough to result in learning to the extent of fluent

use. However, the experimental conditions did have differential effects on spontaneous imitation and comprehension of nonsense words. Both groups imitated adult models most often in the sign and spoken word condition; however, children's imitated productions were usually spoken words alone. Additionally, children with DS comprehended more words presented in the sign and spoken condition (37%) than in either the sign alone (25%) or spoken alone (23%) conditions. These results suggest that using simultaneous visual and spoken modes may increase comprehension and production of language. However, because the experiment used nonsense words for the learning task, there were no indications of how children used language taught in the three different conditions for communication. Potentially, words that have a functional use might be learned more quickly than nonsense words.

In addition to using signs as a visual mode accompanying spoken words, another option for a visual AAC system is a speech-generating device (SGD). SGDs may provide additional benefits in ameliorating weaknesses of children with DS that signing alone cannot address. First, an SGD provides a consistent auditory model for speech forms. This could be important for children with variable hearing acuity and difficulty with verbal short-term memory for auditory information. Second, an SGD with visual picture symbols provides a constant visual cue that may assist in increasing rate of communication. Third, although not directly related to phenotypic differences of children with DS, another advantage of an SGD is the voice output that is immediately recognizable to an untrained partner. In comparison, communication partners of children who use sign as a communicative mode would also require training in sign language to recognize and model signed words. Further, interpretation of imprecise sign

representations by children may limit partners' understanding of the communicative message.

Iacono, Mirenda, and Beukelman (1993) studied the differential effects of teaching language through sign and spoken models versus teaching language through sign, spoken, and an SGD in an alternating treatment design with a multiple baseline across word combinations. Two children (one with DS 4.5 years of age) were taught two-word semantic relations in adult-directed sessions using a prompting system with four levels of prompts. One trial was used for each of the three-word combinations in both of the teaching conditions. The participant with DS demonstrated variable performance in the acquisition of the two-word semantic relations. Although some change was observed in each of the three tiers, no functional relation between the intervention and the use of two-word productions can be deduced from the data. In additional to the lack of outcomes, this study only targeted the child's use of the device to label two-word semantic relations in discrete trials. This study did not directly target the use of a device to communicate socially.

In a second study by Iacono and Duncum (1995) enrolling a 2-year-8-month-old child with DS, an alternating treatments design was used to evaluate the effects of sign and spoken models versus sign, spoken, and SGD models on language use in any mode. Upon introduction of the interventions, there was an immediate and consistent difference between the two interventions with an advantage to the sign, speech, and SGD intervention in which the participant had a higher frequency of word use and a higher number of different words. Additionally, in the post-treatment condition in which the adult did not model any language in any mode, the child maintained the rate of language

use in all three sessions. The participant used more than twice as much language generated with the SGD in comparison to sign alone or with both sign and SGD together.

In this study, the device was not available in the baseline sessions as it was considered part of the intervention. Thus, it is difficult to determine if the intervention sessions were targeting specific skills of matching objects and actions taking place in the environment to the pictures on the device or social communication. In turn, it is unclear whether the child's use of the device was in fact to label objects and actions in her environment or to interact with the therapist to communicate socially.

Romski et al. (2010) compared augmented and nonaugmented parent-implemented interventions with 68 toddlers with fewer than 10 spoken words. Children were randomized into an augmented communication input, augmented communication output, and spoken communication intervention conditions. Eighteen sessions occurred within a lab setting followed by six sessions in the home. Results from session 18 and session 24 indicated that children in both augmented conditions used more total language and more spoken language when compared to the spoken communication group, although the results were not statistically significant. Although results favor use of an augmented intervention, this study possesses the same issues as the Iacono and Duncum (1995) study in regards to the social communicativeness of the child's use of the device. It is unclear as to whether the child used the device to communicate or simply to access symbols that matched items and events in their environment.

When teaching children to use SGDs, it is essential that the social communicativeness of the symbol access be considered. None of these studies discusses the social communicative use of the device. In the studies described here, there was little

description of the child's ability to use the device prior to the intervention and whether the intervention was focused on accessing the device or using the device to communicate socially.

Results of these studies indicate that AAC use, either sign or SGD, may improve comprehension (Kay-Raining Bird et al., 2000), and expression (Iacono & Duncum, 1995; Kouri, 1988; Romski et al., 2010; Wright et al., 2012) of language for children with DS. These results may relate to the relative strengths and weaknesses of these children. Using an AAC system that provides a visual model paired with a spoken model of language may support improved processing the auditory information leading to stronger language comprehension and later improved production. Additionally, using AAC provides children with DS an additional repair strategy for expression (e.g., use a sign or indicate a symbol on the SGD) when their speech is not intelligible to a partner. Where AAC systems may give a child a more successful mode of communication, most interventions focus on teaching use of the system with an adult and have no generalization measures of how they use the system with classroom peers or other partners outside of the instructional session. A few studies have directly evaluated the use of AAC systems within a peer-mediated language intervention, and these will be discussed in the next section.

Peer-mediated Interventions to Increase Social Communication

Children with disabilities show reduced frequency of interactions with peers and lower quality of social interactions evidenced by high levels of conflict (Brown, Odom, Li, & Zercher, 1999; Brown, Odom, McConnell, & Rathel, 2008; Kopp, Baker, Brown,

1992). Because children with DS have pervasive deficits in expressive language, it is important that communication interventions are developed to ameliorate both language and social deficits of these children within their natural environments. In a hierarchy for promoting young children's peer interactions, Brown (2001) lists explicit social skills training at the top pyramid, meaning that these skills should be addressed with more intensive interventions for young children, but also successful interventions in this area have the most potential for generalization and maintenance of skills following the intervention.

One social skills training program, the Buddy Skills Training Program has been studied with children with disabilities including Down syndrome and autism (English, Goldstein, Kaczmarek, & Shafer, 1996; English, Goldstein, Shafer, & Kaczmarek, 1997; Goldstein, Kaczmarek, Pennington, & Shafer, 1992). In one study of the Buddy Skills Training Program, four children with disabilities (one with DS) and six peers with typical language aged 43-60 months were studied (English et al., 1997). Peers participated in (a) two 20-min sessions to teach them to identify non-conventional communication of the target children, (b) three direct instruction lessons to teach strategies for interaction including maintaining proximity, saying the target child's name to gain his or her attention and suggesting playing or talking together (stay-play-talk), and (c) two to three practice sessions. Following peer training procedures, practice sessions with the dyad were initiated. In two to four sessions, target children were taught to stay, play, and talk with their peer. Primary outcomes were measured from interactions between children during free play, snack, and large-group activities. Baseline procedures allowed students to participate in everyday routines as usual except for snack when peers and target

children were seated together. When intervention began, peers rotated days assigned as "buddies" and were reminded to stay with their buddy and use the stay-play-talk strategies they had learned. Research assistants and teachers provided verbal praise following classroom activities and the peer received praise and stickers for meeting a goal at the end of the day. Results showed a clear increase in total communicative behaviors (verbal and nonverbal) between all target children and their peers.

Thiemann (2012) extended the work of Goldstein and colleagues by adding both PECS and SGD systems to the stay-play-talk protocol. In this study, seven children with autism and seven peers 36 to 61 months of age were involved in a peer-mediated intervention in which peers were taught how to recognize communication from the target children who used PECS, sign language, and SGDs, and they were taught the specific strategies of stay-play-talk. Specific instruction around PECS and SGDs was also included in the 5-session training. Both interventions focused on the target child requesting items from the peer using either the PECS or SGD system. Results indicated an increase in communication from baseline to intervention across the four children with autism. In the PECS condition, the target children used the system more often that the peers. Peer communication to target children was primarily in the form of responding to the target child's requests (averaged 6 responses to requests, 1 initiation). In the SGD condition, the target children and the peers' communication was zero in baseline sessions and increased to an average of 6.3 for target children and 11 for the peers. There were no measures of generalization.

Trembath, Balandin, Togher, and Stancliffe (2009) also studied peer-mediated intervention comparing naturalistic intervention with and without a SGD with

preschoolers with autism. Six typically developing peers and three children with autism 3 to 5 years old were included in this study. None of the target children had any prior exposure to a SGD. Peers were taught how to interact with the target children using three strategies: (a) show what you are doing or a toy the child can play with, (b) wait to see if child wants to play, and (c) tell the child what you are doing or the name of an item. Additionally, the peers were allowed time to explore the SGD and practice communicating using all the symbols. Results varied across the three children. One child showed overall increases in communicative acts in both the interventions with and without the SGD although there was great variability in the data. The second child showed an immediate change in the frequency of communicative acts in the first five sessions, with the final three sessions decreasing to baseline levels. The final child only participated in three intervention sessions of which the last two overlapped with baseline measures. Generalization was measured only one time during intervention sessions, and was at a level similar to intervention levels for each child. However, based on the visual data provided in this study, we cannot conclude a functional relation between the introduction of the intervention and dependent variable.

Although there has been a recent increase in the number of studies examining peer-mediated interventions including AAC, these studies primarily have focused on individuals with autism or older children with other disabilities. Results indicate that typically developing peers can be taught to use AAC systems with children with disabilities and that both target children and peers have demonstrated changes in communicative behavior following intervention. However, to date, there are no studies

using SGDs with preschoolers with DS in peer-mediated intervention to increase communication between peers and target children.

Purpose of Present Study

Children with DS have a unique set of communication strengths and weaknesses suggesting that including an AAC mode might strengthen language learning and use. Studies have shown that use of SGDs can be taught to young children with DS and other disabilities (Iacono & Duncum, 1995; Romski et al., 2010). More research is needed to determine the effects of specific interventions on the social communicative use of SGDs.

Peer training has long since been recommended and studied particularly in the area of autism; however, research shows that children with many different types of disabilities experience difficulties with peer interaction (Guralnick & Groom, 1987; Guralnick & Weinhouse, 1984; Lieber, 1993). Although some studies have included AAC and peer mediated strategies, there are no studies of AAC peer-mediated intervention for young children with DS.

The purpose of this study was to determine the effects of a multi-component intervention on the unprompted, directed social communication between the target child with DS and peers. The multi-component intervention included: (a) one-on-one training with a therapist using EMT strategies to teach spoken language and language on an SGD, (b) peer training including a short workshop about recognizing communication from the target child with DS and rules for talking to friends, and (c) a facilitated session with the triad in which the therapist prompted interaction between the target child with DS and the

peer. The design of the study was a multiple baseline across participants. Research questions were as follows:

1. Is there a functional relation between the introduction of the multi-component intervention and the unprompted, directed communication between target children with DS and typical peers during play sessions? Are there differences in unprompted, directed communication between the target child with DS and the typically developing peers?

2. Do the target child with DS and peers generalize their use of directed communication to one another when the therapist is not present in the same setting and using the same unstructured tasks used in the intervention?

3. Is there an increase in the use of the SGD as a result of the intervention for target children with DS and peers?

CHAPTER TWO

METHOD

Participants

Three participants, who will be referred to as target children with DS, were recruited from an inclusive, university-based preschool. Inclusion criteria for participants included the following: (a) diagnosis of DS, (b) cognitive age of at least 18 months on *The Mullen Scales of Early Learning* (Mullen; Mullen, 1995), (c) less than 10 peer-directed initiations in a 30-min classroom observation, and (d) demonstration of prerequisite skills necessary for using the SGD in intervention sessions. These prerequisite skills are described in further detail in the procedures section. No exclusions were made based on race or gender. Table 1 provides detailed information about the inclusion criteria.

Target children were between 43 and 56 months of age. Each had previously been included in a model demonstration project in which their parents were trained to model spoken and signed language while using EMT strategies during home routines. All children had established sign vocabularies but did not use signs consistently in the classroom. See Table 2 for more details about each participant.

Table 1

Assessment of Inclusion Criteria

Dimension	Source	Criteria
Diagnosis	Parent Report	Down syndrome
Cognitive Age	Mullen	At least 18 months age equivalent
Initiated Language	Classroom Observation	Less than 10 spontaneous verbalizations in 30 minutes
SGD screener	Direct assessment	4/6 correct on 5 receptive and matching tasks

Note: Mullen= *The Mullen Scales of Early Learning* (Mullen; Mullen, 1995); SGD= speech-generating device.

Xavier was a 56-month-old Caucasian male. He independently walked and was toilet trained. Xavier began using signs around 12 months age and began adding spoken words around 24 months of age per parent report. Throughout his third year, he added words and signs simultaneously. Between the age of 3 and 4, he began to drop signs and by the age of four, primarily used spoken words as his primary mode of communication. His typical communication in the classroom consisted of one to three word utterances, although sometimes he was unintelligible. During baseline sessions, 26 percent of Xavier's utterances were coded as unintelligible. Xavier's target length of utterance for the intervention was two words.

He scored a standard score of 51 on the Mullen Early Learning Composite (Mullen, 1995), with age equivalent scores in the categories of Visual Reception, Fine Motor, Receptive Language, and Expressive Language ranging from 28 to 40 months. His caregiver reported on the *MacArthur-Bates Communicative Development Inventories*

(MCDI; Fenson et al., 2006) that he had a receptive understanding of 390 words and could produce 371 words out of the 396 words included in the inventory.

Table 2

Participant Characteristics

Characteristic	Xavier	Rosco	Leona
Age at start of study	56	51	43
Age at start of intervention	57	53	46
Mullen Early Learning Composite* (SS)	51	49	49
Visual Reception (AE)	40	29	20
Fine Motor (AE)	31	26	22
Receptive Language (AE)	30	27	25
Expressive Language (AE)	28	20	14
MCDI receptive understanding	390/396	197/396	240/396
MCDI words signed	Not reported	39/396	182/396
MCDI words spoken	371/396	64/396	84/396
Peers (age)	Benjamin (52)	Mattias (63)	Callum (41)
	Alice (63)	Cecilia (52)	Elsa (40)
	Ian (61)	Arthur (63)	Pippa (42)

Note. Mullen= *Mullen Scales of Early Learning* (Mullen, 1995). MCDI = *MacArthur Communicative Development Inventories* (Fenson et al., 2006). SS=Standard Score. AE= Age Equivalent

Rosco was a 51-month-old Caucasian male. He independently walked and was not toilet trained. He used vocalizations, word approximations, and signs as his modes of

communication in the classroom. Word approximations were unintelligible as he produced mostly vowel sounds. He had received some support using picture symbol supports in his classroom, although did not have a consistent communication system in place. Rosco's target length of utterance for the intervention was one word. Rosco scored a 49 on the Mullen Early Learning Composite (Mullen, 1995), with age equivalent scores in the categories of Visual Reception, Fine Motor, Receptive Language, and Expressive Language ranging from 20 to 29 months. On the MCDI (Fenson et al., 2006), his caregiver reported he receptively understood 197 of the 396 listed words, said 64 words, and signed 39 words.

Leona was a 43-month-old Caucasian female. At the start of the study, she could walk with one- or two-handed assistance. She learned to walk independently during the course of the study. She was not toilet trained. She had an extensive sign vocabulary that she used at home with several adults who were fluent in sign. In school, her primary modes of communication were gestures and vocalizations. She had a standard score of 49 on the Mullen Early Learning Composite (Mullen, 1995), and age equivalents ranging from 14 to 25 months on the categories of Visual Reception, Fine Motor, Receptive Language, and Expressive Language. On the MCDI (Fenson et al., 2006), her caregivers reported that she understood 240 words and could sign 182 and say 84 of the 396 listed words. Leona's target length of utterance for the intervention was one word.

The nine peers were typically developing children (5 boys and 4 girls) ranging in age from 40 to 63 months of age. Three peers were selected from among the classmates of each target child with DS; thus, three peers came from each of the three classrooms in which the target children were enrolled (see Table 2). The typical peers were selected

based on teacher nominations. Teachers were asked to select students who had good attendance and were generally helpful in the classroom. Parents of the target children and peers signed consent forms for the children, and each child assented to participation each day.

The primary investigator was the interventionist who conducted all baseline and intervention sessions. She was a certified speech language pathologist and doctoral student in Early Childhood Special Education. She had 6 years experience working with young children with disabilities, three years of experience with EMT, and six years of clinical and research experience implementing communication intervention with various types of AAC including SGDs.

Setting and Materials

All assessments, baseline and intervention sessions were conducted in the participants' classrooms during free play. The classrooms measured approximately 10 m by 7 m and were arranged similarly. Each classroom contained areas for centers including home living, blocks, and books and included two tables with six chairs where students ate snacks and meals and completed table activities such as manipulatives and art. Xavier's classroom enrolled 11 children including seven typical children and four with disabilities. Rosco's classroom enrolled 12 children including seven typical children and five with disabilities. Leona's classroom enrolled 11 children including eight typical children and three with disabilities.

Sessions took place in four free play activity centers: table toys, home living, art, and blocks. One to two activities per center were chosen based on availability of

materials and child interest. See Table 3 for a list of activities at each center for each of the target children and Table 4 for a list of furnishings in each center. All sessions including the therapist-target child intervention sessions, the triad (therapist, target child, peer) intervention sessions, and generalization sessions were videotaped by a research assistant using a SONY DCR-SR82 Handycam. The research assistant was positioned to capture the eye contact of the participants, the toys, and the SGD.

Table 3

Participant centers and activities

Center	Xavier	Rosco	Leona
Home Living	Cooking	Tools and blocks	Babies
	Animal picnic	Cooking	Cooking
Blocks	Blocks and animals	Blocks and cars	Blocks and cars
		Weebles and cars	Car ramp
Table Toys	Puzzles	Monkey Tree game	Button picture
		Bingo	Mr. Potato Head
Art	Playdough	Playdough	Playdough
	Color, cut, glue crafts	Color, cut, glue crafts	Color, cut, glue crafts

Note.

Table 4

Participant center furniture and materials

Center	Xavier	Rosco	Leona
Home Living	Table, 2 chairs, and kid sized couch oven, generic cabinets	Table, 4 chairs oven, generic cabinets	Rug oven, refrigerator, sink, generic cabinets
Blocks	Rug Cabinet with blocks	Rug Cabinets with blocks	Rug Cabinets with blocks
Table Toys	Table, 6 chairs	Table, 6 chairs	Table, 4-6 chairs
Art	Table, 6 chairs	Table, 6 chairs	Table, 4-6 chairs

Note.

The SGD used in this study was an iPad2 programmed with a visual symbol based speech-generating program, Proloquo2go™. During the therapist session, the SGD was positioned within the field of vision and reach of the target child, and during the triad and generalization sessions, it was positioned in between the target child and peer. Positioning varied across sessions due to placement of toys. Each page had nine (Leona and Rosco) or 16 words (Xavier) dedicated to the specific activity of the session. One row on the page for each activity contained the same requests and comments (stop, cool, look) for Rosco and Leona. The same three comments plus the word "the" were included for Xavier per the request of Xavier's mother who wanted him to complete longer, grammatically correct sentences. Other words were chosen based on the materials available in the centers for each child and included nouns (e.g., baby, puzzle), verbs (e.g., push, stir), and basic protoverbs (in, out). A complete list of words for each child is contained in Appendix A. Samples of the icon displays for each child are in Appendix B.

Design and Procedures

A multiple baseline across participants design (Gast & Ledford, 2010) was used to determine the effects of the multi-component intervention. Baseline sessions took place simultaneously for all participants. Once stable levels of unprompted, directed communication were established for each of the three groups, intervention was initiated with the first group (one child with DS plus the three peers in rotation for that child) while the other two participants and their peers remained in the baseline condition. The criterion for sequential introduction of the intervention to the second and third groups was a clear shift in level and stable data or an increasing trend in the total directed communication between the target child and his or her peers during intervention sessions. Communication included any communicative gesture (e.g., point, show, give, reach), social communicative use of the SGD requiring a shift in gaze from the SGD to the intended communication partner, or spoken language. Visual inspection was the primary method of analysis. Data on the primary outcome variable (number of directed communication between the target child and peers) were graphed for visual inspection and reviewed daily to assess change and stability.

SGD prerequisite skills. Because the purpose of the study was to determine the effect of the intervention on the social communicative use of the SGD, and not on children's abilities to access symbols, it was imperative that all children demonstrated prerequisite skills for using the device prior to beginning the intervention. These skills included (a) spontaneous manipulation of the device; (b) accessing all icons on the device; (c) identifying an object, picture, and SGD symbol of an object named by an adult (receptive understanding of the word); and (d) identifying a picture and an SGD

symbol to matching an object shown by the adult (matching objects to symbols). First, the access screener addressing the first two skills will be discussed. Then the receptive and matching tasks addressing the second two skills will be discussed.

Each child participated in a screening to determine his or her ability to manipulate and access the SGD. The child was presented with the SGD displaying nine icons on a single page (three rows, three columns) and was allowed to explore the device. First, the child was required to touch buttons on the device spontaneously. To achieve the second skill, accessing all icons on the device, the child was required to demonstrate the motoric ability to touch the individual icons in each row and column without also accessing other buttons with his or her hand. Each time the child accessed a symbol on this page, the therapist contingently imitated activation of the device and repeated the label using spoken language. If the child did not access the icons in a specific row or column, the child was prompted to do so. Each child was required to demonstrate the ability to access at least one icon in each row and column. Once the child had accessed one location in each row and column, the layout of the page was changed to include 16 smaller icons (four rows, four columns). This procedure continued until the child was unable to access icons in each row and column accurately. The purpose of presenting the sequence of increasing larger arrays of icons was to determine the maximum number of icons the child was able to accurately access. Xavier, Rosco, and Leona were able to access 16, 9, and 9 symbols, respectively. Icons on their iPads were arranged in a grid of 3 by 3 for Rosco and Leona and 4 by 4 for Xavier. The materials used for the screening are in Appendix C.

Following the access screening, the children's receptive and matching skills were assessed and taught, if necessary. Six nouns with available matching toys and pictures on the SGD were selected from the list of words on the MCDI (Fenson et al., 2006) for the screening. The words were broom**,** turtle**,** bottle, chair, flower, and brush. Toys were selected to match each of these target words. Additionally, the words were displayed with matching icons from the Proloquo2go application on the SGD on an 8.5 x 11 inch laminated piece of paper. Finally, this same display was programmed on the SGD device using the Proloquo2go application. The materials used in the assessment are in Appendices D and E.

First, the child participated in probes to determine if he or she could identify an object in response to a verbal label. Six objects were displayed in front of the child. Participants were asked to identify each item in random order. The prompt given was, "Show me ___." If the child pointed or gave the correct object, they were praised for their response (Good job!). If the child's response was incorrect, the response was ignored and no feedback was given. If the child did not respond, the prompt was repeated a second time. If the child did not respond after a second prompt, the response was marked incorrect and the probes continued. Criterion for moving to the next step of the screening was spontaneously identifying four of the six items correctly. If the child did not get four of the six items correct, the task was taught to the child in a separate session immediately following the screening session using constant time delay procedures (Handen & Zane, 1987). The session included all six of the items in the probe set. The child participated in another probe session to assess independent identification of the items the following day. If the child got four of the six items correct, the child proceeded to the next tasks of

identifying pictures given a verbal label, identifying SGD symbols to verbal labels, matching objects to pictures, and matching objects to SGD symbols. If the child did not get four of the six items correct, another teaching session took place. This continued for up to three teaching sessions per task. If the child was unable to complete the task with four of six items correct, the child was ineligible to participate in the study. See Appendix F for a flowchart of procedures. Xavier and Rosco passed all levels without instruction. Leona did not demonstrate the ability to match objects to pictures or objects to the SGD, and these tasks were taught to her during three sessions for each task (six teaching sessions).

Baseline. Baseline sessions occurred one to three times per week for all children. Baseline sessions had three components: (a) the therapist and the target child with DS (10 min); (b) the triad of therapist, target child with DS, and one peer (5 min); and (c) the participant with DS and the peer who had just participated in the triad session alone (2-5 minutes).

Therapist session. In baseline sessions, the SGD was present and all words for the specific activity on the iPad pages were available to the child. There was no preview of the words or direct instruction using the SGD. The therapist did not model language on the SGD or use any EMT strategies in the part of the session with the child with DS. The therapist interacted with the child during play routines by talking about what was happening and asking questions related to the play routine. The therapist responded to child initiations, but did not use target language or expand child's communication.

Triad session. During the triad session (target child with DS, peer, therapist) the children were invited to play together but the therapist did not prompt or model language

or use of the SGD. The therapist guided a play routine around the toys and included the target child with DS and the peer but did not prompt language, use of the SGD, or directed communication between the two children.

Generalization session. In these sessions immediately following the triad sessions, the therapist left the target child with DS and the peer alone for a few minutes while she went to another area of the classroom. She reminded them to play and told them that she would be right back. This was done to determine if the children would continue to communicate without the therapist's support. The play materials and the SGD were available to the children, just as they were during the triad session. The generalization session for two children alone was required to last at least 2 min. If either child left the activity area, he or she was redirected to the area. After 2 min, if either the target child with DS or the peer left the activity area or the teacher was transitioning to a new activity in the classroom, the session was terminated. If both children remained in the activity area and the classroom schedule permitted, 5 min of play were videotaped.

Intervention. Intervention sessions took place 3 times per week during free play and the location of the sessions was rotated among the four centers described above. Sessions consisted of the three parts described during the baseline condition: (a) 10 minutes in which the target participant and therapist engaged in the center activity of the day using the SGD during which the therapist used EMT strategies; (b) 5 minutes in which the child with DS, one of the three peers, and therapist; and (c) 2 to 5 minutes in which the target and peer were left to play for 2-5 minutes.

Therapist session. In the one-on-one training sessions, EMT strategies were used to engage the child with DS and teach spoken language and SGD use. The EMT strate-

gies implemented by the therapist included (a) responding to the child's communication; (b) mirroring (i.e., contingently imitating) the child's play actions and mapping (describing shared actions with spoken words and the SGD); (c) modeling target length utterances using words and the SGD; (d) expanding the child's communication attempts by adding spoken words and words on the SGD; (e) using communication temptations to promote child communication (e.g., offering choices, pausing to cue communication), and (f) incorporating milieu prompting episodes to promote child practice of spoken words and the SGD (see Hancock & Kaiser, 2006, for full description of EMT). There was no review of the symbols on the SGD before the session. Words on the device were only modeled once the activity had begun. During the therapist session, on average, the therapist modeled about 60 different words for Xavier (range = 44-84), 37 words for Rosco (range = 24-50), and 47 words for Leona (range = 43-51). At least 50% of all adult utterances included an SGD model. The SGD modeled words were limited by the device and the array designed for the child. Only 16 words were available on the device for Xavier, and nine were available for Rosco and Leona, so additional spoken words were modeled consistent with the child's interest.

Peer training. Prior to the first intervention session for the target child with DS, the three peers assigned to the participant who was starting the intervention phase attended a short training (M = 13 min, range 8.5-16 min) about communicating with the participant. The workshop included videos about how the participant communicated followed by a discussion about noticing and responding to the child with DS's communication. Next, the rules for talking to friends were introduced. These rules included: (a) look at your friend, (b) say his or her name, (c) do what he or she does, (d)

show your toys, and (e) use the iPad (Appendix G). Finally, the children were each given at least two opportunities to practice accessing buttons to say words and phrases. Fidelity of workshop delivery was assessed. The fidelity form for assessing the delivery of the workshop is in Appendix H.

Triad sessions. At the start of each triad session during the intervention condition, the therapist reviewed the rules for talking to friends, modeled the specific words on the SGD for the activity, and gave the peer at least one opportunity to practice using the SGD to communicate with the therapist. The rule sheet for talking to friends that was used before each triad session with the peer is in Appendix G. During the triad sessions, the therapist modeled use of the SGD. She also facilitated target child-peer interactions around the activity by prompting both children to comment on what they were doing and to respond to each other's communicative attempts at least three times each. Generally, the peer and target child were not prompted more than once a minute. Children did not receive any feedback after the session based on their performance.

Generalization sessions. Generalization sessions took place immediately following the triad intervention session and were similar to the baseline generalization sessions. In these sessions, the therapists left the peer and target participant with DS in the center using the materials with which they had been playing. She reminded them to play and talk to each other and told them that she would be right back. The dyad was videotaped for 2 to 5 minutes. If one child left the interaction before 2 min had been completed, they were redirected to the center and activity. If one child left a second time and the session had lasted at least 2 min, the videotaping was ended. Following this session, both the peer and target participant received stickers and were praised for their

participation regardless of the amount of interaction that took place in the session. No specific feedback about spoken language or use of the SGD was given.

Procedural Fidelity

Procedural fidelity was measured for at least 25% of sessions across all phases and participants for each type of session (therapist, peer training, triad, and generalization). The therapist was blind to the sessions selected for assessment of fidelity. Observational and coded data from the session were reviewed in order to complete a checklist of 15 items each for baseline and intervention procedures of therapist, triad, and generalization sessions. Fidelity sheets are in Appendices I and J. Procedural fidelity for baseline procedures for therapist, triad, and generalization sessions averaged 100% (no range), 93% (no range), and 98% (93-100) for Xavier, Rosco, and Leona. Procedural fidelity for intervention procedures for therapist, triad, and generalization sessions averaged 91%, (range = 80-100%), 97% (range = 93-100%), and 91% (range = 80-100%) for Xavier, Rosco, and Leona. Itemized fidelity summaries for baseline, intervention, and workshops are in Appendices K and L. Fidelity was also measured on all workshops for the peers and for generalization sessions. Three of the five workshops (60%) were randomly selected and reviewed for fidelity. Average score was 93% (range 85-100%).

Outcome Measures

Video recordings of the therapist session (10 min), triad session (5 min), and generalization session (2-5 min) were transcribed and each communication act (gesture, spoken, or SGD produced) was coded for form, independence, and social directedness of

the child with DS's and the peer's communication using SALT (Miller & Iglesias, 2008). Two students were trained to transcribe and code child and peer communication to 80% reliability prior to the beginning of the study using practice videos and transcripts. Form included gesture, spoken word, non-social SGD word, socially-communicated SGD word, and combination of spoken and SGD words. Independence included unprompted, imitated, elicited, and prompted. Social directedness included not directed, directed to other child, directed to adult, and directed to both child and adult. Specific definitions of graphed data are provided in the descriptions below.

Child measures during therapist sessions. The total rate of unprompted social communication used by the target participant with DS was graphed as an outcome measure for these sessions. Unprompted was defined as any spontaneous communication used occurring more than 5 s after the therapist's use of a word or SGD, and not directly prompted by the therapist (e.g., during a milieu teaching episode). In order for the language on the SGD to be counted as socially communicated, the child's use of the symbol must have included a shift of eye gaze from the device to the therapist partner following activation. Any other use of the SGD was considered non-social. This convention was not required of spoken words in the therapist session.

Child measures triad sessions. The total rate of unprompted, directed communication between the target child with DS and the peer was graphed as the primary outcome measure. Unprompted was defined as any spontaneous communication occurring more than 5 s after the therapist's use of a word or SGD, and not directly prompted by the therapist (e.g., during a milieu teaching episode). Directed communication was defined as any gesture, word, or socially communicated SGD

utterance that was paired with an indicator of directedness that demonstrated intentional communication *with the other child*. The indicators included eye contact, gesture (e.g., pointing, showing, giving, taking), use of the child's name, or talking about an object the child has or an action the child just completed. Additionally, the mode of each peer-directed communicative act was measured and reported. Mode included gesture, spoken language, SGD language, and the combination of spoken and SGD language. Use of unprompted, directed communication was scored separately for each child.

Child measures during generalization sessions. The total rate of directed communication between the target child with DS and the peer was graphed as the outcome measure for generalization sessions. This measure was defined in the exact way as the measure for the triad session. Additionally, mode, as defined previously, was measured and reported.

Interobserver Agreement (IOA). Interobserver agreement was measured for 30% of data across all phases (baseline, intervention, generalization) and all target child-peer combinations dyads. Sessions were randomly selected prior to the start of the study, and the primary coder was blind to the sessions on which reliability was measured. Reliability data were graphed for the primary outcome variable alongside the primary data to assess the impact of IOA on the measure of outcome (Artman, Wolery, & Yoder, 2010). The IOA data graphed did not affect the interpretation of the functional relation for any outcome measure. Overall reliability for individual code (form, independence, social directedness) for each target child with DS and peer across sessions averaged 92% across participants and sessions (range = 77-100) The lowest average agreement was for Leona's directedness code during triad sessions which was 77%. This was due to the low

levels of communication, especially during baseline. For example, if there were only four acts and coders disagreed on the directedness code for one of these acts, reliability was 75%. However, based on graphed data, the lower IOA for these sessions did not affect the interpretation of the data. Inter-observer agreement by participant, code, and session type can be viewed in Table 5.

In addition, IOA was completed for 30% of data coded for fidelity of each of the intervention components. Reliability for the scoring fidelity checklists was 98% (range= 93-100%) for baseline and intervention conditions across all sessions. Reliability was also assessed on the fidelity of implementation of each of the workshops and was calculated at 99% (range = 96-100%).

Table 5

Interobserver agreement for coded variables across each session for each participant

Code	Xavier	Rosco	Leona
Therapist Session			
Target form	96 (88-100)	96 (78-100)	96 (82-100)
Target independence	89 (83-93)	88 (66-100)	92 (81-100)
Triad Session			
Target form	93 (85-100)	91 (75-100)	95 (80-100)
Target independence	90 (83-100)	94 (75-100)	87 (50-100)
Target directedness	85 (69-96)	87 (67-100)	77 (50-100)
Peer form	93 (81-100)	94 (82-100)	99 (96-100)
Peer independence	82 (60-100)	85 (67-100)	90 (71-100)
Peer directedness	82 (78-86)	87 (81-100)	85 (75-95)
Generalization Session			
Target form	99 (93-100)	100 (--)	94 (80-100)
Target directedness	82 (50-100)	97 (90-100)	95 (89-100)
Peer form	98 (85-100)	98 (89-100)	99 (96-100)
Peer directedness	90 (75-100)	98 (89-100)	91 (71-100)

Note. Ranges presented in parentheses.

CHAPTER THREE

RESULTS

The results of the study are presented in four sections. First data from the therapist sessions are presented to show the effects of the EMT and SGD training on the child with DS communication with the therapist. Then, data addressing the three research questions of the study are presented: (a) the unprompted, directed communication between children with DS and their peers during the triadic intervention sessions with the therapist; b) the unprompted, directed communication between children with DS and peers during the generalization sessions, and (c) the change in average rate of mode across children with DS in all sessions and the peers during triadic training and generalization sessions. Finally, the total communication for each child across conditions and sessions will be presented. In each section, results for the baseline and intervention conditions are described.

Target Children with Therapist

The unprompted communication of the target child with DS while participating in the therapist session was measured to determine the effects of EMT. The rate of communicative acts per minute is graphed in order to compare all session types that varied in length. These data are graphed in Figure 1.

Xavier. Xavier communicated with the therapist at a rate of 2.40 times per minute (range = 1.30-4.20) during baseline sessions. Data were stable with a decreasing trend.

Upon introducing the intervention there was a slight increasing trend with the range overlapping with baseline data (range= 1.30-6.10). There was an overall increase in average rate to 3.46 communication acts per minute. Eleven of the 18 intervention points overlapped with baseline points. The last four points of intervention showed a clear change in level with an increasing trend.

Rosco. Rosco had a very low and stable baseline level of communication in the therapist sessions ranging from 0 to .80 communication acts per minute (*M* = .26). Upon introducing the intervention, there was an immediate change in level with increased variability. Six of the 18 intervention points overlapped with baseline data. Rosco's rate of communication during intervention ranged from .10 to 3.50 acts per minute (*M* = 1.30).

Leona. Leona's communication during baseline was low and stable averaging about .92 communication acts per minute (range = .20-1.60). Upon introducing the intervention, there was a small change in level and a slight upward trend with the average rate increasing to 1.54 acts per minute (range = .40-4.60). Despite the small change in average rate, 10 of 18 intervention points overlapped with baseline data.

Overall, all children demonstrated increases in their overall rate of communication in therapist sessions. Many baseline points overlapped with intervention points; however, the average increase in rate for each target child was 1.06 for Xavier, 1.04 for Rosco, and .62 for Leona. Rosco demonstrated a clear shift in level with variability throughout intervention, whereas Leona and Xavier both had early variability with a slightly increasing trend and late changes in level. Both of their last four data points were above all baseline data points.

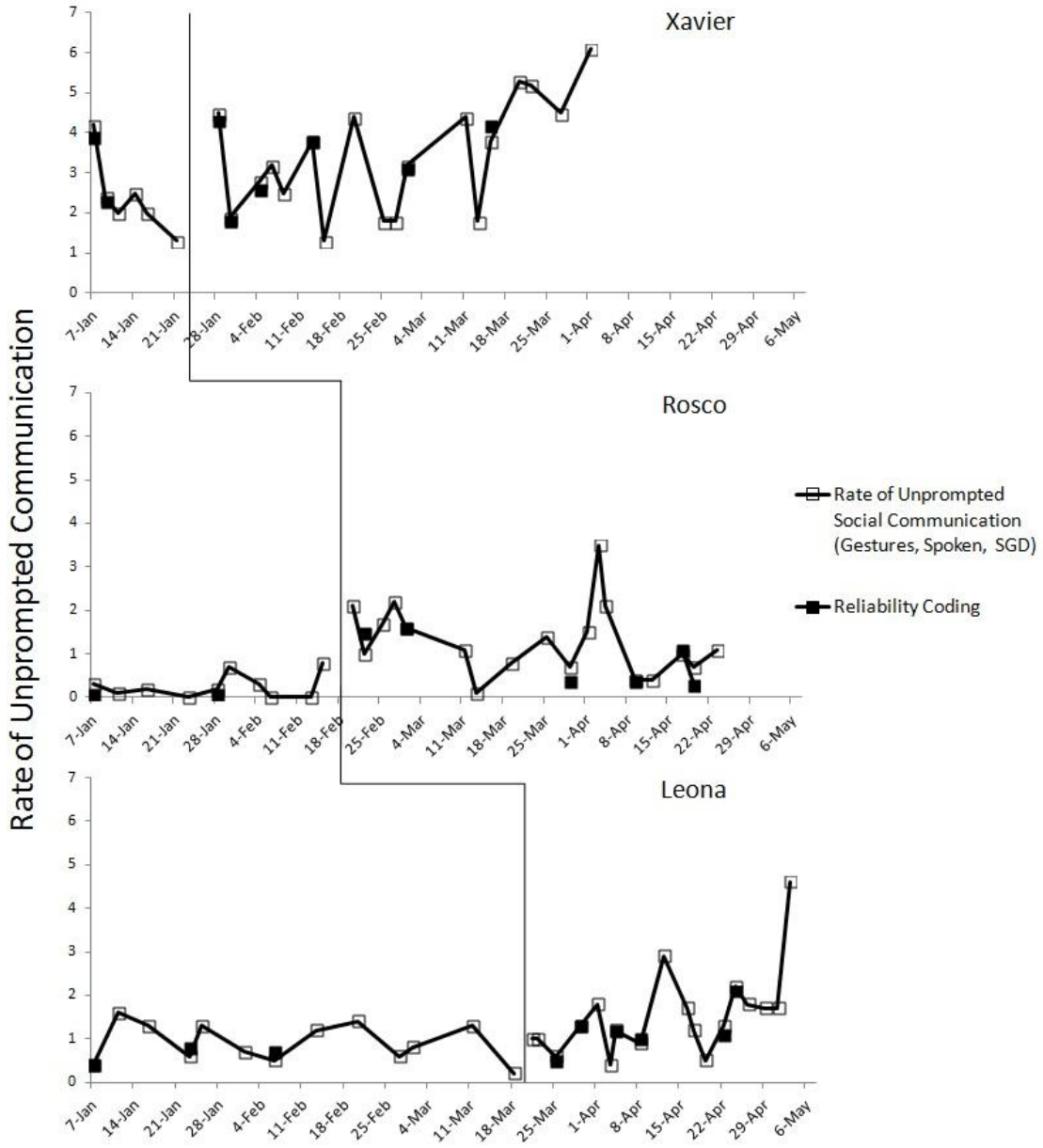


Figure 1. Rate of unprompted communication in 10-min therapist sessions with target children with DS.

Directed Communication Between Target Children and Peers

The primary research question focused on the effect of the multi-component intervention on the unprompted directed communication between children with DS and their peers. Visual inspection of the graphs of primary data and interobserver agreement data for rate of unprompted, directed communication were used to determine the functional relationship between the introduction of the intervention and the primary outcome measure. Graphs of rate of unprompted directed communication in each session for target children with DS and their peers are in Figure 2. Each point represents the target child with DS and one peer; all three peers of each target child are represented across sessions with a different symbol for each peer. Additionally, graphs showing rate of directed communication by the target child to the peers and by the peers to the target child are graphed in Figure 3. Each graphs shows rate of unprompted directed communication for the target child with DS and the peer present in each session during baseline and intervention session. Data for individual peers were graphed with different shaped symbols.

Xavier and his peers. Xavier and his peers spontaneously communicated with each other between .20 and 1.20 times per minute (M = .57) in baseline sessions. Following the introduction of the intervention, there was little change in directed communication between the target child with DS and his peers until each peer participated in his or her first session with the target child. After this point, there was a clear change in level. This change was relatively stable above baseline levels, except for two points (Sessions 11 and 15). Total directed communication ranged from 0 to 2.80

communication acts per minute (M = 1.48) during the intervention condition. Five of the 18 intervention data points overlapped with baseline points.

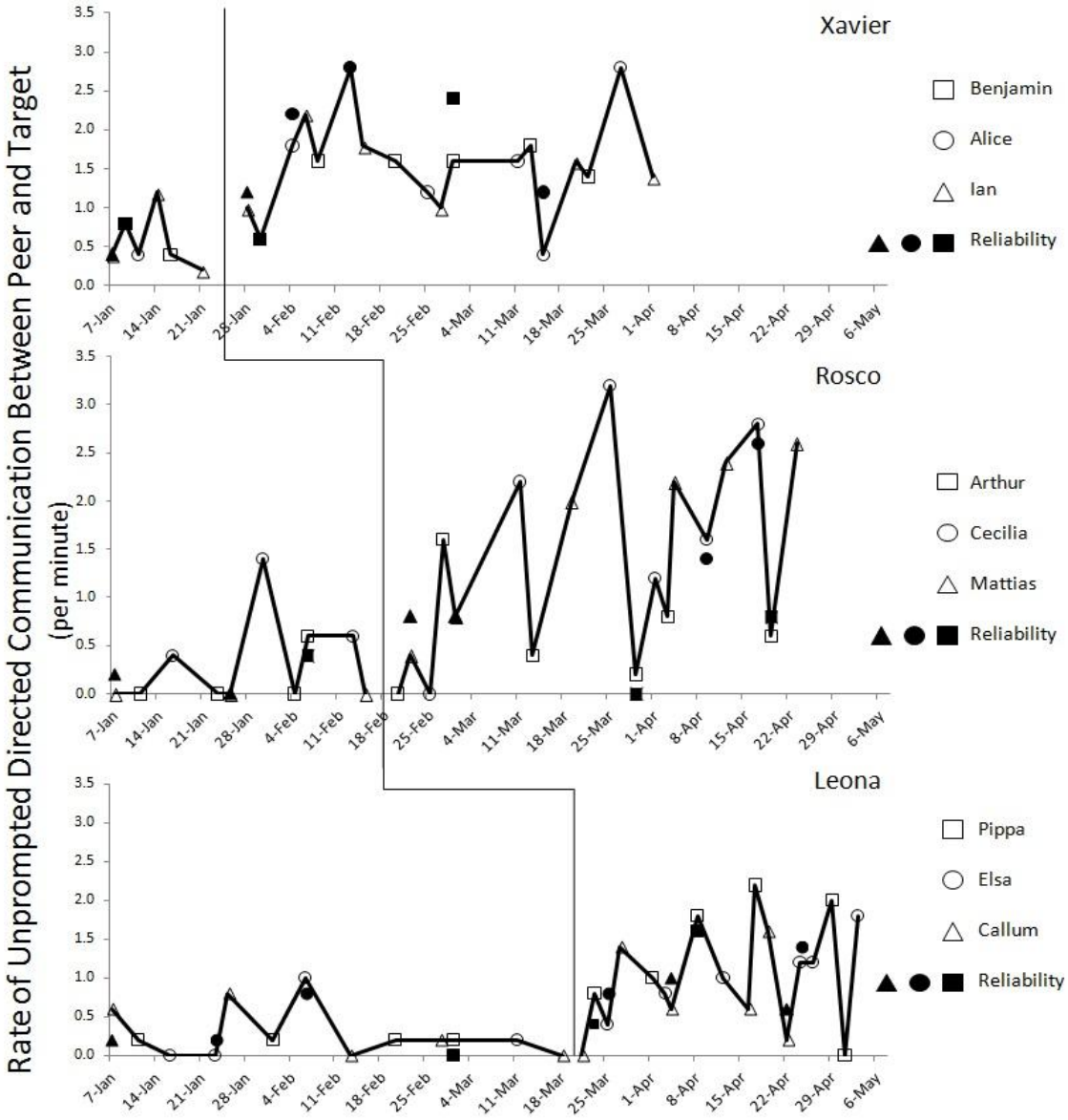


Figure 2. Rate of unprompted, directed communication between target children with DS and peers in triad sessions.

Figure 3 displays the directed communication between Xavier and his peers on separate graphs. Xavier directed communication to his peers between 0 and .80 times per minute (M = .37) in the baseline sessions. In intervention, Xavier's directed communication to peers was variable ranging from 0 to 2.20 times per minute (M = .68). Xavier communicated the least (between 0 and .40 times per minute) with Benjamin. During baseline, Xavier's peers communicated to him between 0 and .40 times per minute (M = .20) Intervention points show a slightly increasing trend across interventions sessions with variability ranging from 0 to 1.80 communication acts per minute (M = .80). There was an inverse pattern with Benjamin's communication. Whereas Xavier had generally lower levels of directed communication to Benjamin, Benjamin directed more communication to Xavier (.20 to 1.80 times per minute; Mn = 1.20) compared to the other two peers.

Rosco and peers. Rosco and his peers typically had directed communication between 0 and .60 times per minute during the baseline sessions. There was one outlier point when seven instances of directed communication occurred between the Rosco and Cecilia (1.40 per minute) during a bingo activity. After introducing the intervention, Rosco's data had a similar pattern to Xavier's data in that the shift in level did not take place until all peers had one session. At this point, there was a shift in level of unprompted, directed communication with some variability and a small increasing trend. Exchanges ranged from 0 to 3.20 per minute during intervention (M = 1.39). Nine of the 18 intervention data points overlapped with baseline points. If the one outlier point of baseline is ignored, only six of 18 intervention points overlapped with baseline data.

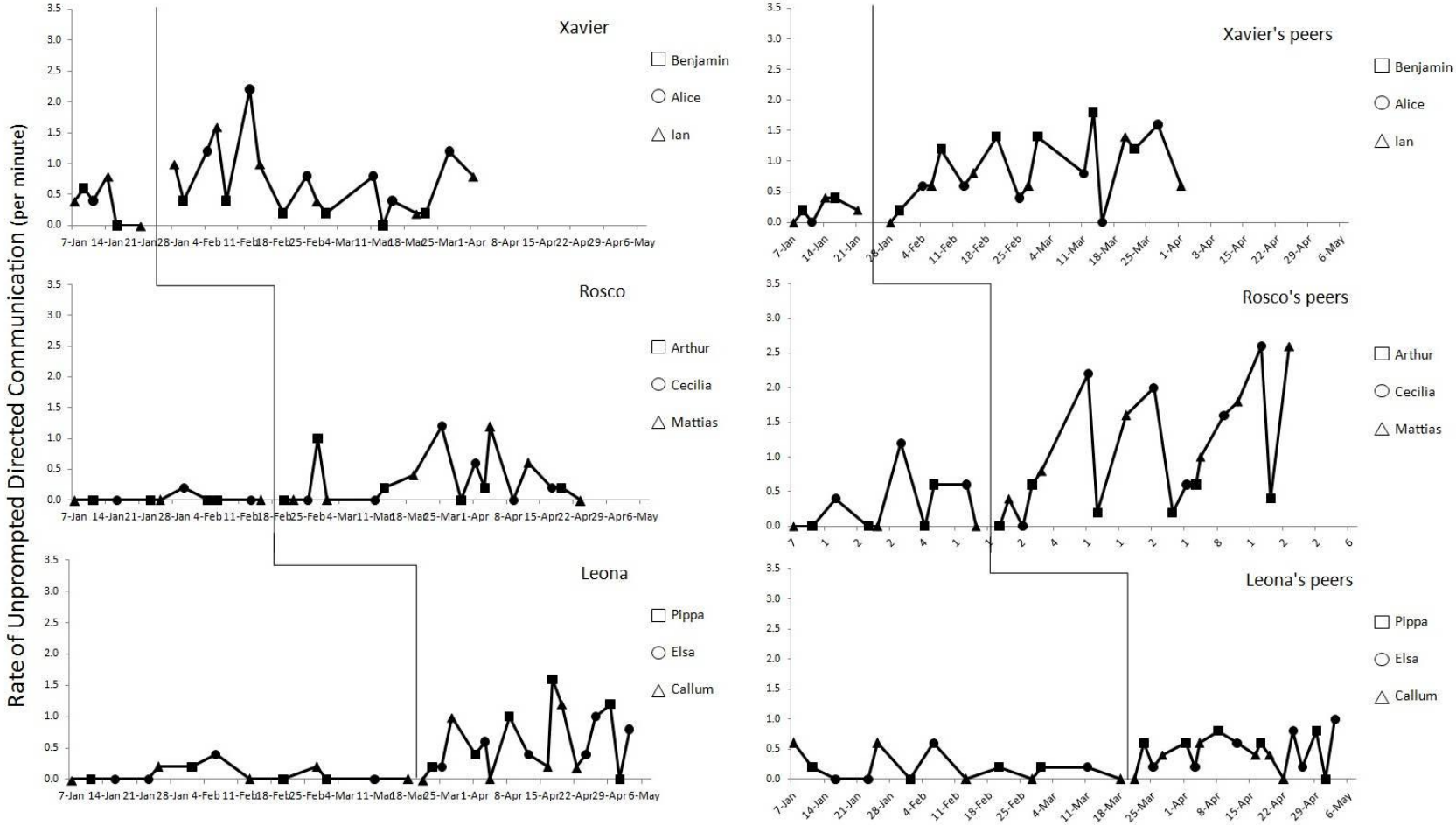


Figure 3. Rate of unprompted directed communication separated by target participants and peers of target participants in triad sessions.

Rosco did not demonstrate any spontaneously directed communication to peers in baseline except for the sixth session in which he directed one utterance (.20 per minute) to his peer, Cecilia. During the intervention condition, there were 12 sessions in which Rosco's unprompted, directed communication was zero or one (less than .20 per minute). Across the condition, however there was increased variability in Rosco's rate of peer-directed utterances (ranging from 0 to 1.20; *M* = .32). Rosco's peers spontaneously directed communication to him at a rate between 0 and 1.20 times per minute (*M* = .28) during the baseline sessions. During the intervention condition, there was a positive trend in peer-directed communication by the typical peers (*M* = 1.07; range = 0-2.60). Arthur consistently communicated the least with Rosco with an average of .33 per minute (range = 0-.60) compared to the other two peers average of 1.43 (range = 0-2.60).

Leona and her peers. Leona and her peers spontaneously communicated with each other between 0 and 1.00 time per minute (*M* = .28) during baseline sessions. The level of directed communication was low and stable. When the intervention was introduced, there was a shift in the level of directed communication (*M* = 1.04) between Leona and her peers, however, the data were variable throughout the intervention ranging from 0 to 2.20 directed communication acts per minute. Ten of the 18 intervention points overlap with baseline points.

Leona directed 0 to .40 communicative acts per minute (*M* = .08) to her peers in baseline sessions. During intervention, there was a slight increase in level with increased variability. During intervention, she directed communication to her peers between 0 and 1.60 times per minute (*M* = .58). Leona's peers communicated spontaneously with her between 0 and .60 times per minute (*M* = .20) during baseline sessions. During

intervention, there was a slight increase in the level and average directed communication to Leona ranging from 0 to 1.00 (*M* = .46). Callum consistently communicated with Leona the least averaging .30 (range = 0-.60) exchanges per minute as compared to the other peers who averaged .53 (range = 0-1.00).

Overall, all children increased unprompted, directed communication. Intervention data were highly variable; however, the change in average rate per minute was .76 for Leona, .91 for Xavier, and 1.09 for Rosco. Of that change, Xavier and Rosco both increased about .30 directed communication acts per minute accounting for about 35% of the overall change for Xavier and 28% of the overall change for Rosco. Leona and her peers had the least change in their directed communication behavior of which Leona was responsible for 66% with an increase of .50 acts per minute increase whereas her peers only increase .26.

Generalization of Directed Communication Between Target and Peers

Generalization of directed communication between the target child with DS and their peers was measured in a session that included the target child with DS and the same peer who had just participated in the intervention session. The session took place immediately after the triadic intervention session in the same setting and using the same materials. The rate of unprompted peer-directed communicative acts per minute is graphed due to the variability of the length of individual sessions. These data are graphed in Figure 4. Additionally, graphs showing rate of directed communication by the target child to the peers and by the peers to the target child are graphed in Figure 5. Data for each of the individual peers were graphed with different shaped symbols.

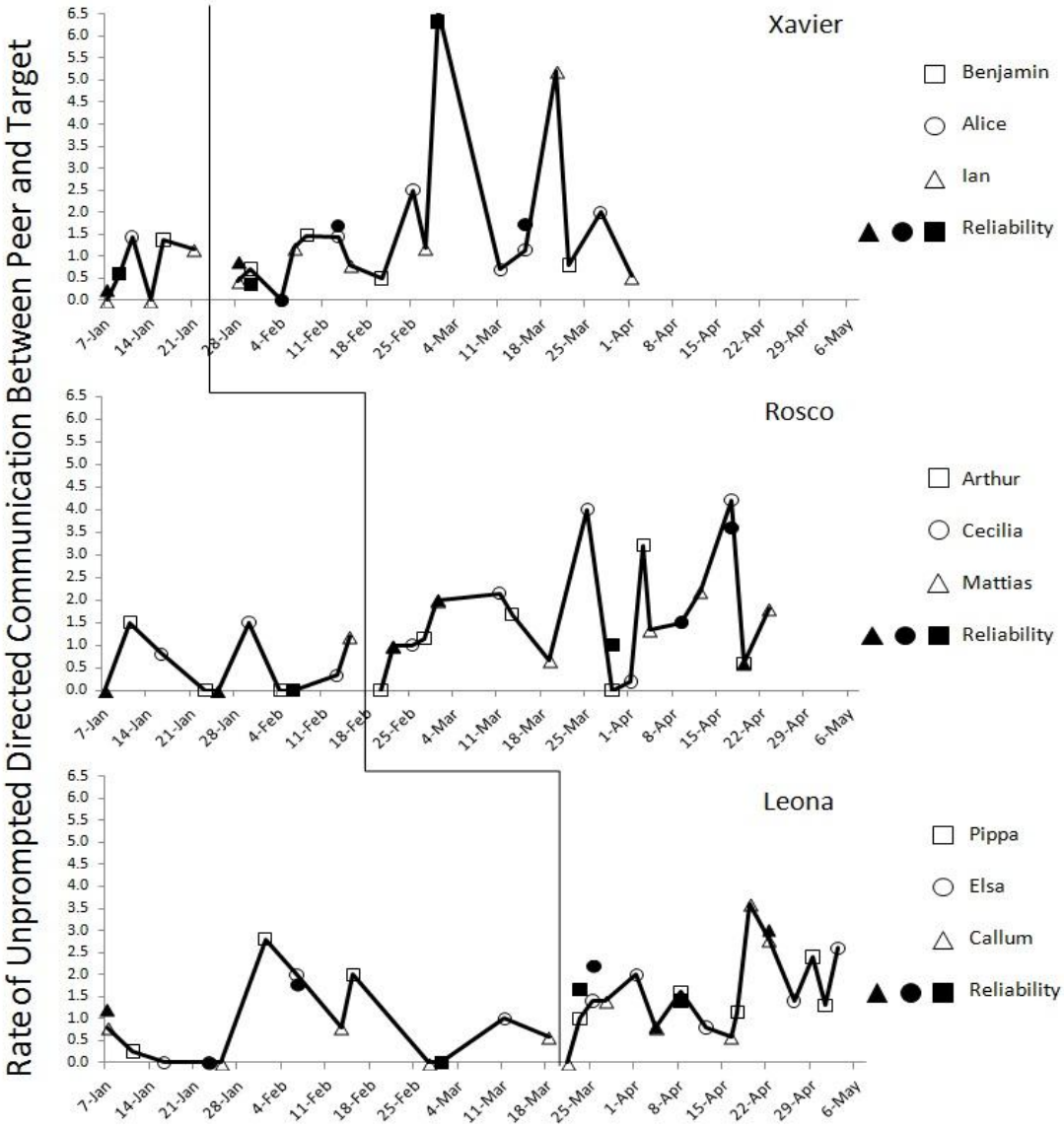


Figure 4. Rate of unprompted, directed communication between target child with DS and peers in generalization sessions.

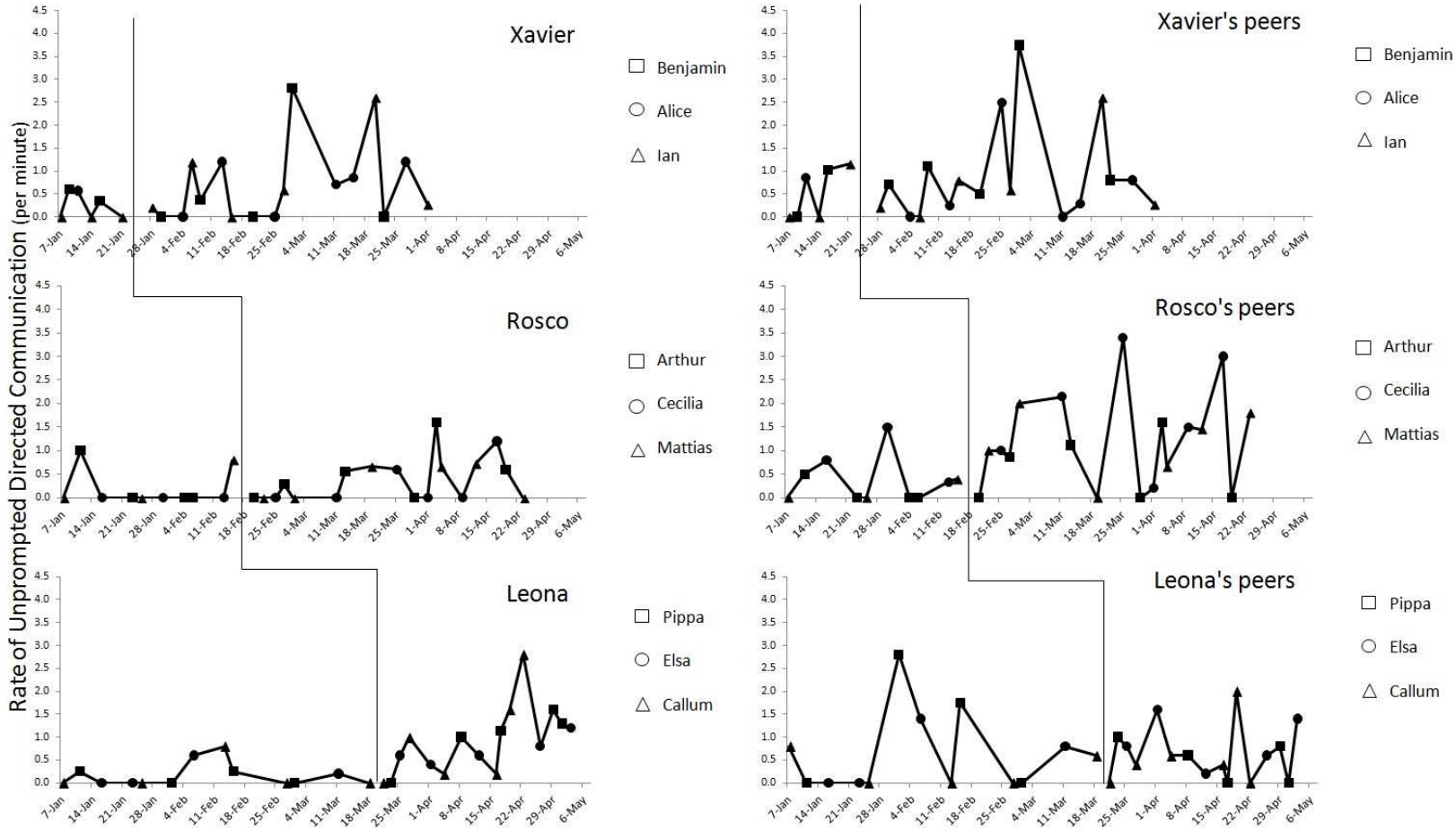


Figure 5. Rate of unprompted directed communication separated by target participants and peers of target participants in generalization sessions.

Xavier and his peers. During generalization sessions conducted concurrent with baseline, Xavier and his peers had between 0 and 1.43 directed communication instances per minute (*M* = .76). There was some variability but overall there was a stable level and no trend. During generalization sessions concurrent with intervention, there were typically 0 to 2.50 exchanges per minute (*M* = 1.03); however, there were two outlier points in which the children communicated with each other 6.56 and 5.20 times per minute. The overall average rate of directed communication during the intervention condition was 1.60. Eleven of the 17 points during the intervention condition overlapped with the highest point of the baseline generalization condition. Generally, there was a slight increase in the level of data between baseline and intervention except for the two outlier points.

Xavier communicated with peers between 0 and .60 times per minute during baseline generalization sessions (*M* = .25). Data were low and stable without any trends. Upon the introduction of the intervention, there was no clear change in trend or level, but increased variability. The range of directed communication to peers increased from 0 to 2.81 instances per minute (*M* = .71). However 10 of the 17 data points overlapped with baseline data.

A similar pattern was apparent with Xavier's peers. The peers communicated between 0 and 1.16 times per minute during baseline generalization sessions (*M* = .51). During intervention there was no change in trend or level, only increased variability that increased the range of directed communication to 0 to 3.75 (*M* = .89). This shift in mean and range is due primarily to three of 17 points in intervention that were above baseline levels.

Based on the means and ranges of data from both triad and generalization sessions, it appears that Xavier and his peers both generalized their directed communication to each other. Averages and ranges are presented in Table 6. However, if the two outlier points that occurred in two of the generalization sessions are removed, there is a smaller effect. Interestingly, Xavier had lower rates of directed communication to his peers in generalization baseline sessions compared to triad baseline sessions whereas his peers had higher rates in the generalization baseline sessions than in triad baseline sessions. Despite the differing starting values, both Xavier and his peers had increased averages of directed communication from baseline to intervention during the generalization sessions (.25 to .71 and .51 to .89). If the two outlier points of generalization are removed from this comparison, there are still some increases, but these are quite small (.25 to .44 and .51 to .59).

Rosco and his peers. Rosco and his peers performed between 0 and 1.50 directed communicative acts per minute (M = .53) in baseline generalization sessions; there was some variability but no trend in the baseline generalization data. After the introduction of the intervention, there was increased variability in the rate of directed communication with a slight increase in level (M = 1.59, range = 0-4.20). Seven of the 18 data points during the intervention generalization sessions were above baseline generalization session levels.

All but two of Rosco's intervention points overlapped with baseline points; however, his average rate of directed communication increased from .18 to .38 with the top end range increasing from 1.00 to 1.60 communication acts per minute. Rosco's peers also had only six non-overlapping intervention points however also had an increase in the

average rate of directed communication from .35 to 1.21 with the top end of the range increasing from 1.50 to 3.40.

Table 6

Rate of directed communication for target children with DS and peers in triad and generalization sessions.

	Triad		Generalization	
Partner	BL	IX	BL	IX
		Xavier		
Target	.37 (0-.80)	.68 (0-2.20)	.25 (0-.60)	.71 (0-2.81)
Peers	.20 (0-.40)	.80 (0-1.80)	.51 (0-1.16)	.89 (0-3.75)
Total	.57 (.20-1.20)	1.48 (0-2.80)	.76 (0-1.43)	1.60 (0-6.56)
		Rosco		
Target	.02 (0-.20)	.32 (0-1.20)	.18 (0-1.00)	.38 (0-1.60)
Peers	.28 (0-1.20)	1.07 (0-2.60)	.35 (0-1.50)	1.21 (0-3.40)
Total	.30 (0-1.40)	1.39 (0-3.20)	.53 (0-1.50)	1.59 (0-4.20)
		Leona		
Target	.08 (0-.40)	.58 (0-1.60)	.16 (0-.80)	.90 (0-2.80)
Peers	.20 (0-.60)	.46 (0-1.00)	.63 (0-2.80)	.65 (0-2.00)
Total	.28 (0-1.00)	1.04 (0-2.20)	.79 (0-2.80)	1.55 (0-3.60)

Note. Ranges presented in parentheses. BL= Baseline. IX= Intervention.

Both Rosco and peers had higher rates of directed communication in generalization in baseline generalization probes as compared to baseline triad probes. Despite starting with higher baseline levels, both Rosco and his peers had similar increased rates of directed communication as were seen in the triad sessions. Rosco increased his average communication from .02 to .32 in triad sessions and .18 to .38 in generalization sessions. His peers increased their average communication from .28 to 1.07 in triad sessions and from .35 to 1.21 in generalization sessions.

Leona and her peers. Leona and her peers directed communication between 0 and 2.80 times per minute (M = .79) during baseline sessions and session data were highly variable with five of the 13 points indicating zero communication. After introducing the intervention, there was less variability in the data, although no change in trend or level occurred until the eleventh generalization sessions at which point there was a shift in level. Although there is substantial overlap in the data between baseline and intervention, the average directed communication increased to 1.55 (range = 0-3.60). Fifteen of the 16 intervention points overlapped with baseline data.

Leona's baseline data were low and stable ranging from 0 to .80 directed communication acts per minute (M = .16). After the introduction of the intervention, there was increased variability; however, only one of the nine first data points was above baseline levels. There was an increase in level in the second half of intervention. Of the last seven data points, six were above baseline points. Overall, her rate of directed communication during intervention ranged between 0 and 2.80 acts per minute (M = .90).

Leona's peers directed communication to her between 0 and 2.80 times per minute (M = .63) in baseline generalization sessions. After the introduction of the

intervention, there was no change in the trend or level of data. The average number of directed communication acts was very similar to baseline (.65) and the range decreased (0-2.00).

Leona and her peers both had higher rates of directed communication in generalization baseline sessions than in the triad baseline sessions. Leona increased her communication in triad sessions from .08 to .58 utterances and demonstrated generalization of her directed communication increasing from .16 to .90 on generalization sessions. Leona's peers did not appear to generalize their skills from triad sessions. Their data during the triad sessions increased minimally from .20 to .46 average directed communicative acts per minute, however, their data in the generalization sessions did not change (.63 to .65).

Overall, all target children and peers had higher levels of directed communication during baseline sessions in the generalization sessions than during baseline in the triad sessions. However, despite the overall increased baseline levels, the pattern of change after the introduction of the intervention was similar across children. All target children and their peers demonstrated small changes in level with increased variability with many intervention points overlapping baseline points. However, the average rate of communication increased to a similar degree in triad and generalization session for each target child. Xavier and his peers increased their average directed communication .91 acts per minute in triad sessions and .84 in generalization sessions. Rosco and his peers increased their average directed communication 1.09 acts per minute in triad sessions and 1.06 in generalization sessions. Finally, Leona and her peers increased to .76 acts in triad

sessions and .76 in generalization sessions. Only Leona's peers did not appear to generalize use of unprompted, directed communication to her.

Table 7

Rate of communication by mode and child with DS across settings and conditions

	Therapist		Triad		Generalization	
Mode	BL	IX	BL	IX	BL	IX
			Xavier			
Gestures	0.25	0.14	0.07	0.10	0.00	0.06
SC SGD	0.12	0.26	0.07	0.07	0.10	0.03
Spoken	2.03	3.06	0.30	0.58	0.16	0.68
			Rosco			
Gestures	0.01	0.20	0.02	0.11	0.04	0.19
SC SGD	0.08	0.38	0.00	0.11	0.11	0.07
Spoken	0.20	0.79	0.00	0.18	0.04	0.23
			Leona			
Gestures	0.54	0.25	0.08	0.30	0.13	0.39
SC SGD	0.02	0.38	0.00	0.01	0.00	0.03
Spoken	0.32	0.69	0.00	0.27	0.02	0.49

Note. BL= Baseline. IX= Intervention. SC SGD= socially communicated SGD.

Mode of Communication

The third research question focused if there was an increase in the use of the SGD for target children with DS and their peers used during sessions from baseline to intervention. We sought to determine if the multi-component intervention resulted in an

increase in the use of the SGD, an increase in spoken language, or both for the target child and the peers. First, the target child with DS's use of mode across settings (therapist, triad, generalization) is summarized. Next, the peers' use of mode within the triad and generalization sessions is described.

Tables 7 through 10 display the average rate of communication in each mode for each type of session for the target children and peers. When a child used spoken language and the SGD simultaneously, it was counted in both modes. Therapist sessions include unprompted communication from the child to the therapist during the 10-min session whereas triad and generalization sessions only include unprompted, directed communication between the target child with DS and the peer during each of the sessions.

Xavier and his peers. During therapist sessions, Xavier demonstrated about a 50% increase in rate of unprompted, directed spoken language (2.03 to 3.06 per minute) and doubled his rate of unprompted, directed social-communicative use of the SGD (.12 to .26 per minute). In triad sessions, Xavier nearly doubled his rate of spoken language (.30 to .58 per minute), but did not demonstrate any change in SGD use (.07 to .07 per minute). Similarly, in generalization sessions, there was an increase in Xavier's rate of spoken language (.16 to .68 per minute), but a decrease in his average rate of SGD use (.10 to .03 per minute).

Xavier's peers had varying results concerning mode within triad and generalization sessions. All peers had increases in their average rate of spoken language; Ian increased from .13 to .60, Alice increased from 0 to .53, and Benjamin increased from .30 to 1.20 per minute. None of the peers used the SGD during baseline triad sessions, but

each increased their use in the same pattern as spoken language; Ian increased his average rate to .03, Alice increased her average rate to .23, and Benjamin increased his average rate to.47 per minute. Results of the generalization sessions differed, though.

Benjamin and Ian both demonstrated increases in rate of spoken language from .51 to 1.26 and .39 to .75 respectively, however Alice decreased in her average spoken language from .86 to .60. As in baseline triad sessions, none of the peers used the SGD in baseline generalization sessions. Similarly to the spoken outcomes, Benjamin and Ian increased their average rate of use of the SGD to .14 and .10 respectively. Alice demonstrated no change in her rate of use of the SGD.

Table 8

Rate of unprompted, directed communication by Xavier's peers across settings and conditions

	Triad		Generalization	
Mode	BL	IX	BL	IX
		Benjamin		
Gestures	0.00	0.00	0.00	0.04
SC SGD	0.00	0.47	0.00	0.14
Spoken	0.30	1.20	0.51	1.26
		Alice		
Gestures	0.00	0.07	0.00	0.03
SC SGD	0.00	0.23	0.00	0.00
Spoken	0.00	0.53	0.86	0.60
		Ian		
Gestures	0.07	0.07	0.00	0.00
SC SGD	0.00	0.03	0.00	0.10
Spoken	0.13	0.60	0.39	0.75

Note. BL= Baseline. IX= Intervention. SC SGD= socially communicated SGD.

Rosco and his peers. Rosco on average had a higher rate of unprompted, directed communication in intervention sessions when compared to baseline sessions across therapist, triad, and generalization sessions. During therapist sessions, his average spoken language increased from .20 to .79 per minute and his average SGD language increased from .08 to .38. In triad sessions, Rosco did not use spoken or SGD language during any baseline sessions. During intervention, there was a slight increase in SGD use to .11 utterances and .18 spoken utterances. In generalization sessions, baseline levels were higher than in triad sessions. Rosco demonstrated a slight decrease in his average rate of the SGD from .11 to .07 and increased his average rate of spoken language from .04 to .23.

Rosco's peers all demonstrated increases in their rate of unprompted, directed spoken and SGD use during triad sessions, however to varying degrees. None of the peers used the SGD during baseline sessions, and the average rate of spoken language varied from 0 to .60 utterances across peers in baseline sessions. Arthur demonstrated the least directed communication in both modes compared to Cecilia and Mattias. After the introduction of the intervention, Mattias averaged a rate of .90 SGD utterances and 1.27 spoken utterances, Cecilia averaged .28 SGD utterances and 1.32 spoken utterances, and Arthur averaged .10 SGD utterances and .30 spoken utterances per minute. All of the peers appeared to generalize their use of the SGD and spoken language in the generalization sessions although to a lesser degree. The average rate of spoken language per minute increased from .13 to .85 per minute for Mattias, from .88 to 1.28 for Cecilia, and from .17 to .64 for Arthur. No peer used the SGD during baseline sessions. During

intervention, the average rate of SGD utterances increased to .62, .49, and .05 for Mattias, Cecilia, and Arthur respectively.

Table 9

Rate of unprompted, directed communication by Rosco's peers across settings and conditions

	Triad		Generalization	
Mode	BL	IX	BL	IX
		Mattias		
Gestures	0.00	0.03	0.00	0.00
SC SGD	0.00	0.90	0.00	0.62
Spoken	0.00	1.27	0.13	0.85
		Cecilia		
Gestures	0.13	0.04	0.00	0.00
SC SGD	0.00	0.28	0.00	0.49
Spoken	0.60	1.32	0.88	1.28
		Arthur		
Gestures	0.00	0.03	0.00	0.00
SC SGD	0.00	0.10	0.00	0.05
Spoken	0.15	0.30	0.17	0.64

Note. BL= Baseline. IX= Intervention. SC SGD= socially communicated SGD.

Leona and her peers. Leona demonstrated increases in her average rate of unprompted, directed language use in all sessions from baseline to intervention. In the therapist sessions, her average rate of spoken language and SGD use increased from .32 to .69 and from .02 to .38, respectively. In triad and generalization sessions she demonstrated a small increase in spoken language (0 to .27 and .02 to .49) and little to no change in SGD use (.0 to .01 in triad sessions and 0 to .03 in generalization sessions).

However, in both triad and generalization sessions, Leona also her use of gestures to communicate with her peers increasing from .08 to .30 in triad sessions and .13 to .39 in generalization sessions.

Table 10

Rate of unprompted, directed communication by Leona's peers across settings and conditions

	Triad		Generalization	
	BL	IX	BL	IX
		Callum		
Gestures	0.00	0.10	0.00	0.23
SC SGD	0.00	0.00	0.00	0.00
Spoken	0.24	0.20	0.28	0.30
		Elsa		
Gestures	0.05	0.07	0.00	0.00
SC SGD	0.00	0.13	0.00	0.10
Spoken	0.20	0.43	0.55	0.75
		Pippa		
Gestures	0.00	0.07	0.00	0.00
SC SGD	0.00	0.13	0.06	0.03
Spoken	0.20	0.47	1.14	0.67

Note. BL= Baseline. IX= Intervention. SC SGD= socially communicated SGD.

Leona's peers had differing patterns in their rate of unprompted, directed language use across mode and session type. Callum, Elsa, and Pippa averaged similar rates of unprompted spoken language use in baseline (.24, .20, and .20 respectively). Elsa and Pippa increased their rate in intervention to .43 and .47, but Callum demonstrated a

decrease in his average rate of unprompted communication to Leona dropping to .20. None of the peers used the SGD in baseline triad sessions. During intervention, Callum did not demonstrate any change in his average rate of use of the SGD whereas Elsa and Pippa both slightly increased their use to .13 average utterances per minute.

During generalization sessions, Pippa demonstrated a decrease in her rate of spoken language, Elsa demonstrated an increase, and Callum demonstrated little change. Pippa's rate changed from 1.14 to .67, Elsa changed from .55 to .75, and Callum remained stable from .28 to .30. The same pattern was seen for average SGD use in generalization sessions, but the changes were very small. Pippa's rate of SGD use decreased .06 to .03, Elsa demonstrated an increase in her average rate of SGD use (0 to .1 per minute), and Callum did not use the SGD in baseline or intervention during the generalization sessions.

Total Communication Across Sessions, Children, and Communication Modes

Because the effects varied across children, settings and types of communication, I summarized these data to provide an overview of the overall effects of the intervention. Figures 6, 7, and 8 contain bar graphs of the average rate of language use and communication within baseline and intervention sessions across therapist, triad, and generalization sessions. These graphs represent all unprompted, prompted, elicited, and imitated language as well as directed and undirected language. Language includes spoken language and socially directed SGD language (required to have a social indicator evinced by a shift in eye gaze to any partner within the session). Communication includes all language and communicative gestures.

Figure 6 displays the average rate of language and communication for all target children with DS within the 10-min therapist session. Both Xavier and Rosco demonstrated significant increases in their average rate communication and language from baseline to intervention. Xavier increased his rate of language use from 2.43 to 4.03 and Rosco increased his average rate from .11 to .99. Leona's language did not significantly change (.57-.66), but her overall communication almost doubled (1.24 to 2.31 per minute).

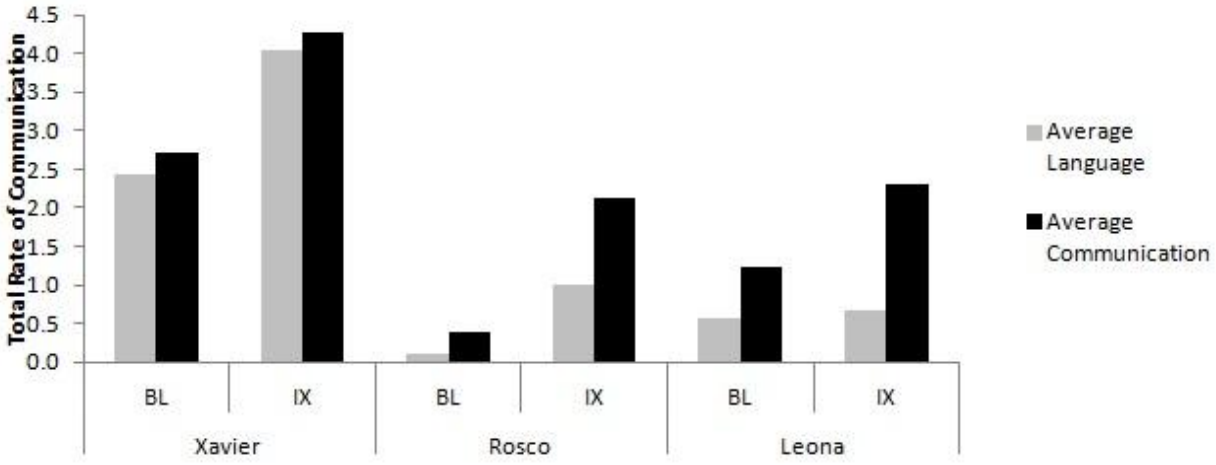


Figure 6. Average total communication and average total language of all target children with DS in therapist sessions.

Figure 7 displays the average communication for all target children with DS within the 5-min triad session. Xavier had very similar rates of total communication and language use in therapist and triad sessions, and while he still demonstrated an increase in rate in the triad sessions, it was not to the same extent as in the therapist sessions (2.63 to 3.64 and 2.50 to 3.42).

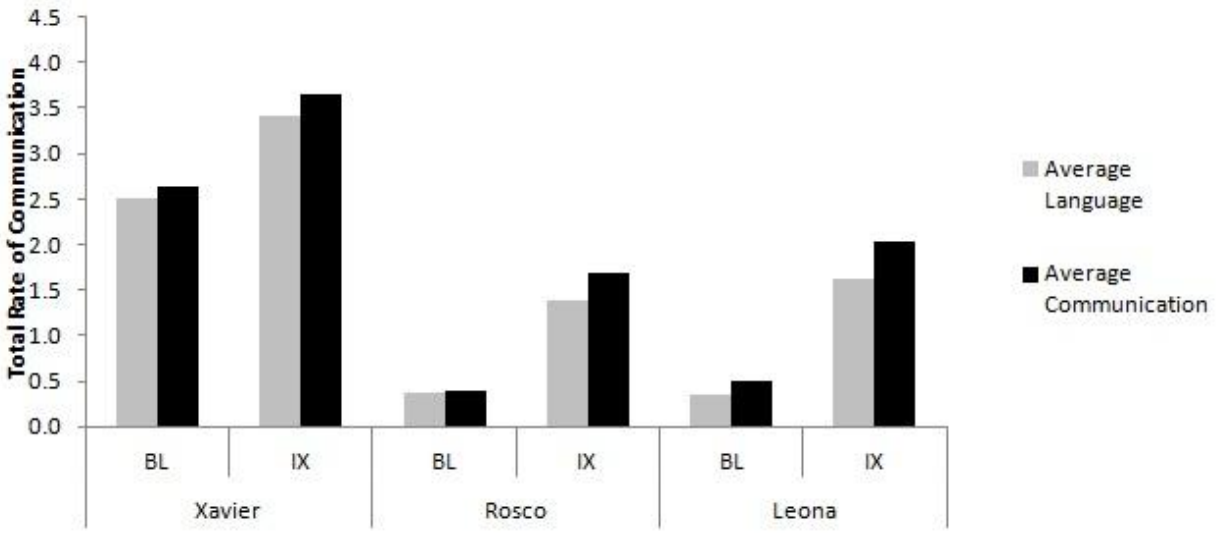


Figure 7. Average total communication and average total language of all target children with DS in triad sessions.

Rosco's overall rate of communication remained stable in therapist and triad baseline sessions, but his language use was higher in triad baseline sessions than in therapist baseline sessions. Similarly, he showed an increase in average rate of communication, although lower than the therapist session (.40 to 1.68), but his language increased a full word per minute in the triad session (.38 to 1.38). Leona's overall rate of communication and language was lower in the triad baseline sessions when compared to the therapist baseline sessions. However, her communication increased to similar rate (.49 to 2.03), and her average rate of language increased substantially (.35 to 1.62).

Figure 8 displays the average communication for all target children with DS within the 2- to 5-min generalization session. All children communicated and use language at significantly lower rates during the generalization sessions than any other session. This is probably due to the lack of adult support, which made all communication

and language use unprompted (unless the peer prompted the child to say something). Despite low baseline levels, all children demonstrated increases in their average rates of communication and language. Xavier's average rate of communication and language during baseline was .82 and increased to 1.49 for language and 1.57 for communication. Rosco communicated an average .21 times per minute and used language .12 per minute and increased to .65 and .46 respectively. Leona's average rate of communication increased from .28 to 1.04 and average rate of language use increased from .15 to .60 words per minute.

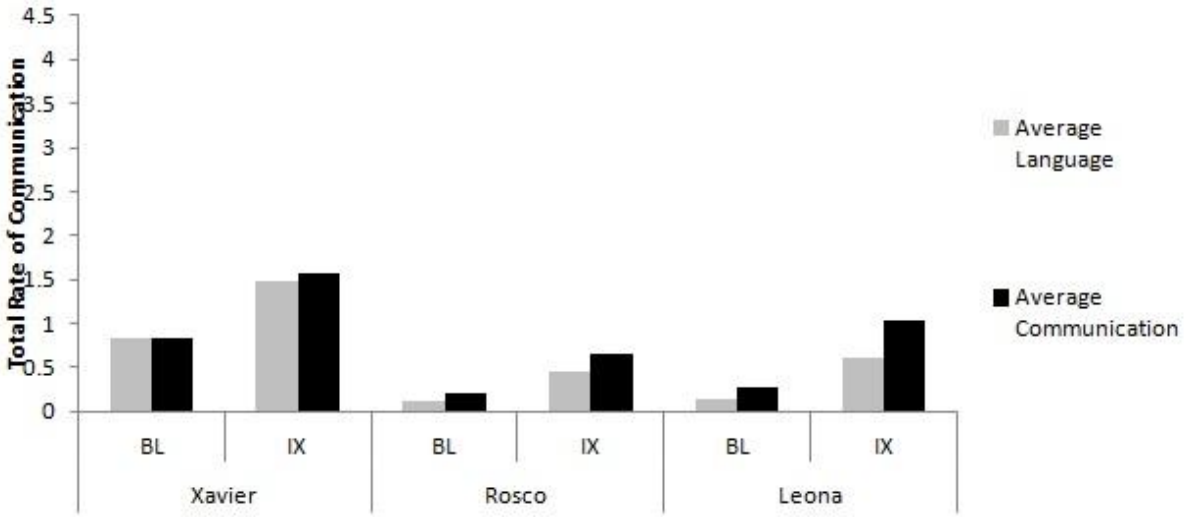


Figure 8. Average total communication and average total language of all target children with DS in generalization sessions.

CHAPTER FOUR

DISCUSSION

This study was completed to determine the effects of a multi-component intervention on the directed communication between target children with DS and their peers. Additionally, the mode of communication used was measured to determine if there was a change in spoken and SGD use during these sessions. The intervention included a therapist using EMT strategies to teach spoken language and language on an SGD to a target child with DS, training peers to recognize communication and communicate with the target children with DS using the SGD and spoken language, and triad sessions in which the therapist facilitated interactions between the target child with DS and a peer during a shared activity. Generalization of communication was measured immediately following the triad sessions in which the target child with DS and peer were left alone with the materials with no therapist support. Overall, there were modest results in unprompted communication within the adult sessions and unprompted, directed communication within the triad sessions. All target children with DS demonstrated some generalization of spoken language, although peers had varying results.

Therapist Session Outcomes

Target children with DS had similar results within the therapist session in which SGD and spoken language was taught using EMT language strategies. All target children with DS demonstrated small increases in level and trend, however many intervention points overlapped with baseline points. These results are similar to past studies of

naturalistic language interventions including children with DS. Children with DS have demonstrated lower levels of response to naturalistic language interventions when compared to other participants with other disabilities, and may require more intensive intervention in order to gains equal to those other participants (Kaiser & Roberts, 2012; Windsor, Kaiser, & Roberts, 2013; Yoder, Woynaroski, Fey, & Warren, 2012). The modest and variable changes during the therapist intervention in the current study also may be explained by the procedures of the study including use of a pre-determined schedule of activities through which the child rotated. Because there were only 18 sessions, and children cycled through six to eight activities, children at most received three sessions with one activity. Specific words were taught for each activity; however, the sessions with the same activity occurred at least 2 weeks apart. Two or three sessions with target language may not have been enough time for children to learn and gain fluency using the new spoken or SGD language associated with the activity.

Triad Session Outcomes

Overall, there was a small change in the rate of unprompted, directed communication between the target children with DS and the peers during the triad sessions for all participants. When the data were analyzed to determine the effects on the target children and peers separately, some patterns emerged.

Xavier consistently communicated less to one peer throughout intervention. Without data points with this peer, his data would more consistently be above baseline levels. Rosco did not have any patterns of communication to his peers. Leona had one peer to whom she also did not direct as much communication to when compared to other

peers. Four of the six points with this child were four of the seven lowest points of intervention. Peers also varied in their communication to the target children. Both Xavier and Rosco had one peer who consistently directed communication to them more than the other peers did. Additionally, Rosco and Leona both had one peer that consistently spoke less to them than their other peers did.

Although there appears to be a functional relation between the introduction of the intervention and the change in directed communication during the triad, the results are modest and variable. There are a few possible explanations for these effects. First, modest changes may be explained by the strict definition of outcome measures that only included (a) formal gestures and language use, (b) unprompted communication, and (c) communication directed to the other child in the triad. Although there are strong conceptual reasons for using this definition since it measures the specific desired spontaneous social communication to peers, it is more restrictive than definitions used in most communication and peer mediated social interaction studies.

Further, only communicative gestures, spoken language, and socially communicated SGD use were counted as communication. Nonverbal acts such as vocalizations, smiling, looking, and laughing were not included as communication in this study. Due to the low levels of language of the participants, particularly Rosco and Leona, nonverbal behaviors were commonly used by these children during the intervention and generalization sessions. These social communication acts could be seen as precursors to using more sophisticated language in either the spoken or SGD mode. This could explain differences in outcomes when compared to English et al. (1997) who counted nonverbal communication as well as verbal acts. Second, only unprompted

communication was counted. Nothing that was elicited, imitated, or prompted from the adult or peer was included in this measure. Third, communication was only counted if it was clearly directed to the other child. Undirected utterances (i.e., the person to whom the utterance was directed could not be determined) and utterances to the adult were not counted.

A second explanation for modest changes could also be attributed to the training and reinforcement procedures of the study. The therapist session only focused on teaching the language related to the activity, and the target child was not given any instruction about communicating with peers aside from the triad practice sessions. Target children with DS only demonstrated small increases in their communication during the therapist sessions. Considering they were not taught to communicate directly with their peers in the following sessions, the triad session could be considered as a moderately supported generalization session. Teaching the target child language and teaching the peers to communicate with the target may not have been enough to teach the target child to direct his or her communication to the peer.

Additionally, the peers had a very short initial workshop to teach them to recognize communication from the target children with DS and communicate back using the iPad. Workshops averaged about 13 min for this intervention. The English et al. (1997) study involved two 20-min training sessions to teach the students about how the child communicates followed by three sessions of direct teaching of strategies. Similarly, the Thiemann-Borque (2012) study included three to five training sessions for a total of 2 to 3 hours. Finally, this intervention did not include procedures for providing performance-based feedback to peers and target children about how they are talking to

each other during sessions. English et al., (1997) set specific goals for the peers to reach and provided feedback in reference to these goals. Thus, the overall impact on social communication may have been greater than indicated by the specific definition of communication used here.

In addition, the procedures of the study did not provide guidance to the children about the level of social communication that was expected and did not give them feedback about their performance during the triad sessions. Setting higher expectations for both the target children with DS and the peers, including the children in the goal setting and monitoring process, and providing performance-based feedback might have resulted in higher rates of directed communication between the children.

Generalization Session Outcomes

Overall results from generalization sessions indicate that all target children and most of the peers generalized their use of unprompted, directed communication. Most children had more directed communication during generalization baseline sessions than in the triad baseline session, which may be attributed to the lack of an adult partner to direct communication. Without an adult present, children seemed to direct more communication to their peers. Despite higher baselines in generalization sessions, all target children with DS and their peers increased their rate of unprompted, directed communication except for Leona's peers whose overall average did not change and range decreased during generalization intervention sessions.

This lack of generalization by Leona's peers may be attributed to her specific communication style and to the age of the children in this group. First, results indicated

that Leona showed very small increases in her spoken and SGD language during triad intervention and generalization sessions, however, she showed an increase in her use of directed gestures to her peers in both types of sessions. It is possible that her peers did not recognize this communication or know how to respond to it as they would more typical spoken language or even SGD use, which they were trained to use. Additionally, Leona and her peers were 16 months younger than the other participants and peers. Peers may have needed more instruction during the peer training phase to understand how Leona communicated before starting the intervention and they may have needed more support during the sessions to recognize her communication attempts.

Mode Outcomes

In regards to mode of communication, all target children with DS increased their use of spoken language across all session types. Less robust results were seen for social-communicative SGD use, which generally only increased in the therapist sessions. Average rates of SGD use for all children were less than .12 per minute indicating that each child averaged less than one social communicative SGD utterance in the triad and generalization sessions. This pattern may suggest that the target children began to learn use of the SGD with the therapist; however, in the triad session, when direct support for use of the AAC was limited and they could not sustain their use of the skill.

Peers generally increased their use of spoken language and SGD use from baseline to intervention in both triad and generalizations sessions. All of Rosco's peers demonstrated increases across all session types. Alice, one peer of Xavier's, did not demonstrate an increase in her average rate of spoken language in generalization sessions

decreasing from .86 to .60 per minute. Callum, Leona's peer, made near zero or zero increases in average rate of spoken and SGD language from baseline to intervention in both triad and generalization sessions. Pippa, another peer of Leona's, demonstrated decreases in her average rate of spoken and SGD language in generalization sessions. Leona's limited generalization mirrors the overall lack of generalization of Leona's peers as discussed previously.

Total Communication Across Children, Sessions, and Communication Modes

Overall, considering all language and communication use regardless of independence and directedness, all children increased their average rate of language and communication from baseline to intervention across all session types. Most importantly, in generalization sessions, where there was no adult present, and thus no opportunities for an adult to elicit or prompt communication, the children still demonstrated significant increases in their language and communication. These data differ from the primary outcomes in that there was no requirement of directedness. When compared to primary data, which required the child to direct communication to a peer, all children communicated at a higher rate in baseline sessions when directedness to the peer was not required. Additionally, all children demonstrated more significant increases in the average rate of total communication during intervention sessions. These results indicate that children may have generalized their overall communication skills, but were not yet always directing this communication to a partner.

Contributions to the Field

Despite modest effects and variable data, there are several contributions of this study to the bodies of literature that include peer interventions, communication, and AAC. First, the study provides evidence that children with DS can generalize their use of directed communication to peers in supported and unsupported settings. These effects are modest and require additional studies to investigate strategies for maximizing the effects on social communication with peers. This study focused on socially directed use of communication forms, including gestures, spoken language and SGD use. Teaching children to use new forms of communication for social interaction is a different skill than simply teaching them to use words or SGD symbols without attention to social use. The findings of the study are impacted by the use of stringent definitions of directed social communication.

Second, the study provides some evidence that children with DS can learn to use SGDs in spontaneous communication with adults, but may not generalize these results to social communication with peers. This is important information in light of increasing access and interest in using SGDs such as the iPads used in this study. SGDs can be highly motivating and interesting, especially for novice learners who are exploring the capabilities of the device. SGDs can be used as tools or toys to match object and actions the child may see in their environment. However, simply using or manipulating an SGD is not the same as social communication using the device. Interventions using SGDs must focus on teaching social communicative use of SGDs and not just the mechanics of accessing a device to label objects and actions.

Third, the results of the study replicate findings from three previous peer mediated interventions (English et al., 1997; Thiemann-Borque, 2012; Trembath et al., 2009) that suggest variability in primary outcomes and limited generalization. Two of the three studies did not measure generalization, and the third had only one data point per participant (Thiemann-Borque, 2012; Trembath et al., 2009). English et al. (1997) reported an increase in total communicative behaviors (verbal and nonverbal) between all target children and their peers. Data were variable among children and peers; however, the overall changes in level were clear enough to demonstrate a functional relation.

The current study differs from this study in the both training procedures and measurement. English et al., used a three tiered training system including training the peers to recognize target child communication, training the peers in stay-play-talk strategies, and training the target children in stay-play-talk strategies. Outcome measures included both verbal and nonverbal communication between children, and there was no requirement of directedness to the peer. There were no measures of generalization in this study.

Thiemann-Borque (2012) reported results that indicated an increase in communication from baseline to intervention across seven children with autism and their peers during adult-supported classroom activities. Average communication increased from .1 to 5.4 for the four children in the PECS condition and 0 to 6.3 for the three children in the SGD condition, however, no graphs for visual analysis were provided and there were no measures of generalization. The current study differs from Thiemann-Borque's study in regards to training procedures and measurement. Thiemann-Borque's study included a longer training period for peers including three to five sessions for a

total of 2 to 3 hours. Additionally, social communicative use of the SGD was not measured.

Trembath et al. (2009) reported varying results for three children autism. One child's data demonstrated a shift in level with great variability, whereas, the others showed an immediate shift in level with data decreasing in trend to baseline levels throughout intervention. Generalization data were only collected once during intervention and two of the three points overlapped with baseline data. Training procedures for this study included two 20-minute sessions that included reading a book to the peers about the strategies for interacting with the target child, role-playing, and exploring the SGD. Additionally, before intervention sessions, the peers were reminded to "show, wait, and tell" to their peers. The training procedures of this study closely matched those of the current study.

The current study extends the literature by examining the effects of a peer-mediated intervention with young children with Down syndrome. Additionally, a therapist session focusing on language acquisition and practice was added to the peer training and peer-mediated sessions of previous studies. Finally, multiple measures of generalization were included to measure the target children's and peer's ability to generalize their unprompted, directed communication to less supported contexts.

Limitations and Future Research

A primary limitation of this study is that the observed effects were the result of package of intervention procedures directed to both the children with DS and their peers. Thus, it is impossible to know the individual contributions of each component of the

intervention. Peer training alone may have been enough to increase directed communication between target children with DS and their peers. Although the children with DS increased their spontaneous communication with the adult, it is not clear the extent to which this training contributed to the effects observed in the triad session. The training with the children with DS was intended to teach new language that could be used in peer activities but also to prime the children to be socially responsive and to use the SGD to communicate. Future studies could focus on analyzing each component of the intervention to study the effects of each.

Second, studies should be completed to determine the amount of communication and interaction that typically takes place in specific center activities presented in preschool settings. For example, it was observed that art activities might not offer as many opportunities for communication without specific adult support (e.g., prompting, arranging the environment) as a turn-taking game, like bingo, does. Sequencing activities from those that offer structural support for interaction (game), to those that offer roles (familiar housekeeping activities like cooking dinner) to those that require child-initiated comments (art) might allow children to be successful across a range of activities.

Third, due to the design of the study, there is no way to determine the contributing effects of the peer and activity on the child's communication. Based on the variability of the data, there is some reason to believe that both of these elements contributed to communication within the session. Some peers (i.e., Benjamin) responded to the intervention with more child-directed communication than others (i.e., Arthur, Callum) did. The younger peers paired with Leona had lower rates of interaction. Given that each peer had limited experience in the intervention (6 opportunities), the choice of peers with

established social communication and a persistent positive style of interaction may be important.

The rotation of activities was chosen to resemble a naturally occurring schedule, to insure that children would not be bored with repeated activities and to promote generalization within classroom settings and activities. This rotation may have made the task of social communication using appropriate words more difficult for the children with DS and for the typical peers. A replication of this study that allows for more practice in activities and a less variable schedule of rotation of centers might produce different results.

Additionally, the specific format of the study may not have been effective for achieving the goals of positive peer interactions. The rotating schedule of peers, activities and settings sometimes resulted in children being asked to participate when they were not interested in either the activity or the particular peer. Motivation for social communication might have been higher if the target children were allowed to choose their activity and peers as they do in a typical free play experience in the classroom. One of the challenges in implementing interventions in natural settings is how to embed the intervention in ongoing activities without removing children from potentially more preferred settings and play partners. The rotation schedule was designed to maximize generalization, but it may have made it more difficult for children to form positive relationships while learning to communicate and respond to each other.

Fourth, the specific measurement of the outcome variable may have resulted in an underestimate of overall effects of the intervention. . Unprompted, directed communication was chosen as an outcome variable in order to show what both the target

children with DS and the peers were intentionally communicating with each other without support. A more broadly defined measure, including all imitated and prompted communication would have increased the apparent magnitude of the outcomes (higher rate per minute). In particular, defining directed communication in a way that excluded communication that was not specifically directed to the other child may have underestimated the total amount of communication intended for the other child. Additionally, it may be important to first increase total communication with the peers, then to seek to increase directed communication from both target children with DS and peers. Future studies should monitor all types of communication (prompted, unprompted, adult directed, non-directed) and include various forms of nonverbal communication (e.g., smiling, laughing, eye contact) that may be precursors to more social and specifically directed language use.

Fifth, the intervention was relatively brief in all of its components. Peer training consisted of one short workshop in which the communication of the target child and strategies for communicating with the child were covered. Target children participated in 18 sessions including a 10-min therapist session and a 5-min triad session. However, each peer only participated in six 5-min triad sessions. This may not have been enough intervention for peers to acquire the skill of directing communication to the target child, learn to respond to the target child's unique forms of communication, and generalize these skills to a setting without adult support.

Finally, there were minimal changes in the target children's and the peer's use of the SGD. This may be in part related to the brief intervention, the rotating schedule of activities, and the limited number of words that could be included on each child's display.

It is possible that in order to get more change in SGD use across session types, the therapist session must focus more on modeling and prompting use of the SGD. It is challenging to model both spoken language and use of the SGD while being highly responsive to child interests and focus of attention. The small set of symbols that were appropriate for the children with DS to use on the SGD significantly restricted the diversity and complexity of language that could be modeled using the device. A focused SGD modeling intervention might require following a much more scripted procedure to ensure a certain number of models and prompts for each SGD word. In the current study, the interventionist followed the child's specific interest in the activity and used language that fit his or her focus of attention. Doing this resulted in using more spoken words because the words on the SGD were limited and not always appropriate to the child's interests.

Future studies should include procedures already found to be effective for training peers such as those found in the Buddy Skills Training Program (English, Goldstein, Kaczmarek, & Shafer, 1996; English, Goldstein, Shafer, & Kaczmarek, 1997). These studies included longer training periods for the peer to recognize communication of the target child, training procedures for teaching the target child to stay-play-talk with his or her peer, and performance-based feedback, which the current study, did not include. Although this program did not focus on teaching the target children language, it could easily be adapted to add specific language training to the target children with or without SGD. Future research that does include teaching language should explore the use of scripts or more discrete training of words selected for each activity. Scripts may allow for

more practice with the specific language chosen for each activity, which may result in more generalized use in less supportive contexts.

Implications for practice

Encouraging positive social interactions between young children with disabilities and typically developing peers should continue to be a priority for researchers and educators alike. High quality, intensive peer training should be used first to teach the peers how to recognize communication from the target child, and second how to respond to this communication. Additionally, strategies for initiating communication with the child should also be addressed. Performance goals and feedback should be used to reward peers for using strategies and communicating with the target child. Additionally, the target child should be trained in a similar way to the peers to teach strategies for initiating communication.

Interventions might be more effective if they are introduced in a sequential manner. The first steps may focus on teaching target children and peers spend more time in near proximity and positive interactions evinced by smiles, looks, and early gestures. After both children have shown a change in these areas, the next level of teaching may include teaching specific language targets to both children to use within they shared activity. The child's language use may start as general and undirected and be shaped to become more directed to the other child over time.

Using a SGD to help facilitate language acquisition and directed peer communication may require intensive training around specific words programmed within the device. Discrete training or scripted interactions may ensure an appropriate number of

models and prompts are provided to the child to facilitate acquisition of the new language. Additionally, it may be beneficial to have other partners should model language on the device in order to show the target child that it is a viable mode with which they can communicate. Allowing others to access the device as a mode of communication also models the social communicative use of the SGD, which is a facet often ignored in SGD instruction.

Finally, it is important for practitioners and researchers to be clear about what outcomes they are measuring when evaluating an intervention. Although changes in total communication may be a necessary step in the intervention, this measure will overestimate the effects by masking what the child is able to do independently. Additionally, by just measuring the unprompted communication of a child, you may still be overestimating the social communicativeness of the utterance. By measuring different levels of independence and communicativeness, the practitioner or researcher can monitor the development of skills from least to most independent and communicative and target intervention where it is most needed.

Conclusions

This study was designed to determine the effect of a multi-component intervention on the directed communication between target children with DS and their typically developing peers. Results indicate that one-on-one SGD practice with a therapist using EMT strategies in addition to a triadic interaction session was functionally related to changes in unprompted, directed communication between target children with DS and peers. Modest results and variability are explained by measurement decisions and

study procedures. This study contributes to the literature on peer, communication, and AAC interventions. Future research should focus on studying the effects of different procedural decisions and adapting existing peer intervention procedures for AAC.

Appendix A

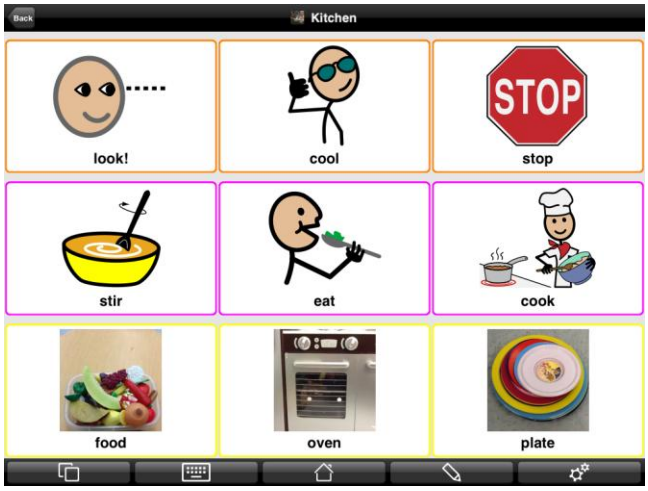
List of Words Programmed on Child Devices per Activity

Xavier		Rosco		Leona	
Animals	Make	Bingo	Monkey	Baby	Look
Block	Marker	Block	On	Blanket	Marker
Bowl	Monkey	Build	Open	Block	Mouth
Boy	Noodles	Color	Pick	Board	Nose
Girl	On	Cookie	Plate	Bottle	Off
Build	Out	cutter	Playdough	Build	On
Building	Oven	Cool	Push	Button	Oven
Car	Paper	Crash	Roll	Car	Picture
Chair	Piece	Crayons	Scissors	Cook	Picture
Color	Pizza	Cut	Screw	Cookie	Plate
Cook	Plate	Drink	Sit	cutter	Playdough
Cookie	Playdough	Eat	Sleep	Cool	Potato head
Cookie	Princess	Fall	Slide	Crash	Push
cutter	Push	Find	Spin	Crayon	Ramp
Cool	Put	Food	Stir	Cut	Road
Courtney	Puzzle	Friend	Stop	Draw	Roll
Cup	Roll	Glue	Tower	Drink	Shoes
Cut	Sit	Goggles	Turn	Eat	Sleep
Dancer	Stamp	Hammer	Tree	Erase	Stir
Dinosaur	Stencil	I	Weeble	Eyes	Stop
Draw	Stir	In	You	Food	Tower
Drink	Stop	Look		Go	
Drive	The			I	
Eat	Track				
Erase	Train				
Fall	Tunnel				
Fix	Turn				
Food	With				
I	You				
In	Zoo				
Look					

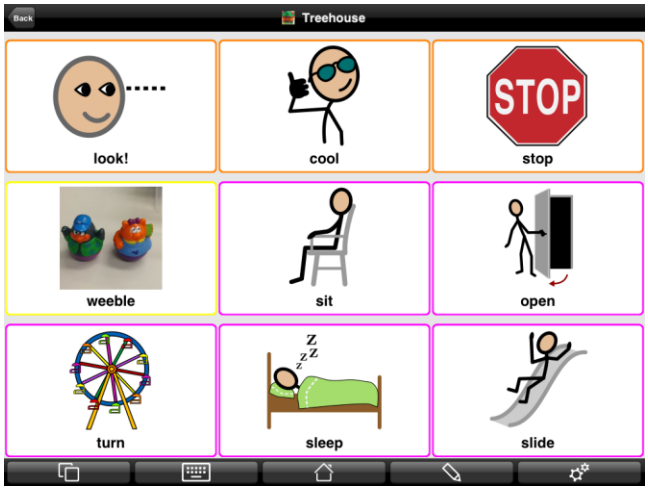
Appendix B

Sample Pages for Activities for Each Target Child with DS

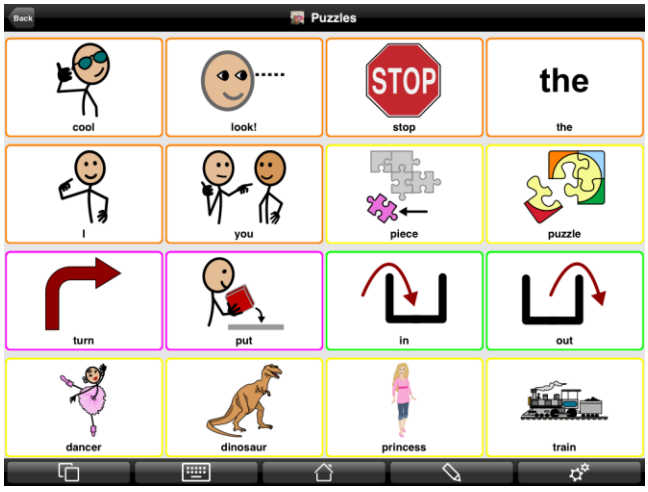
Leona



Rosco



Xavier



Appendix C

Access Data Sheet

Access Test: **Initials:** **Date:**
X= spontaneous access P= prompted access

Appendix D

SGD Prerequisite Testing and Training

Date of Probe:

	Comb	Flower	Broom	Chair	Bottle	Turtle	Training Required OR Task Completed
Verbal to Object							
Verbal to Picture							
Verbal to SGD							
Object to Picture							
Object to SGD							

Date of Probe:

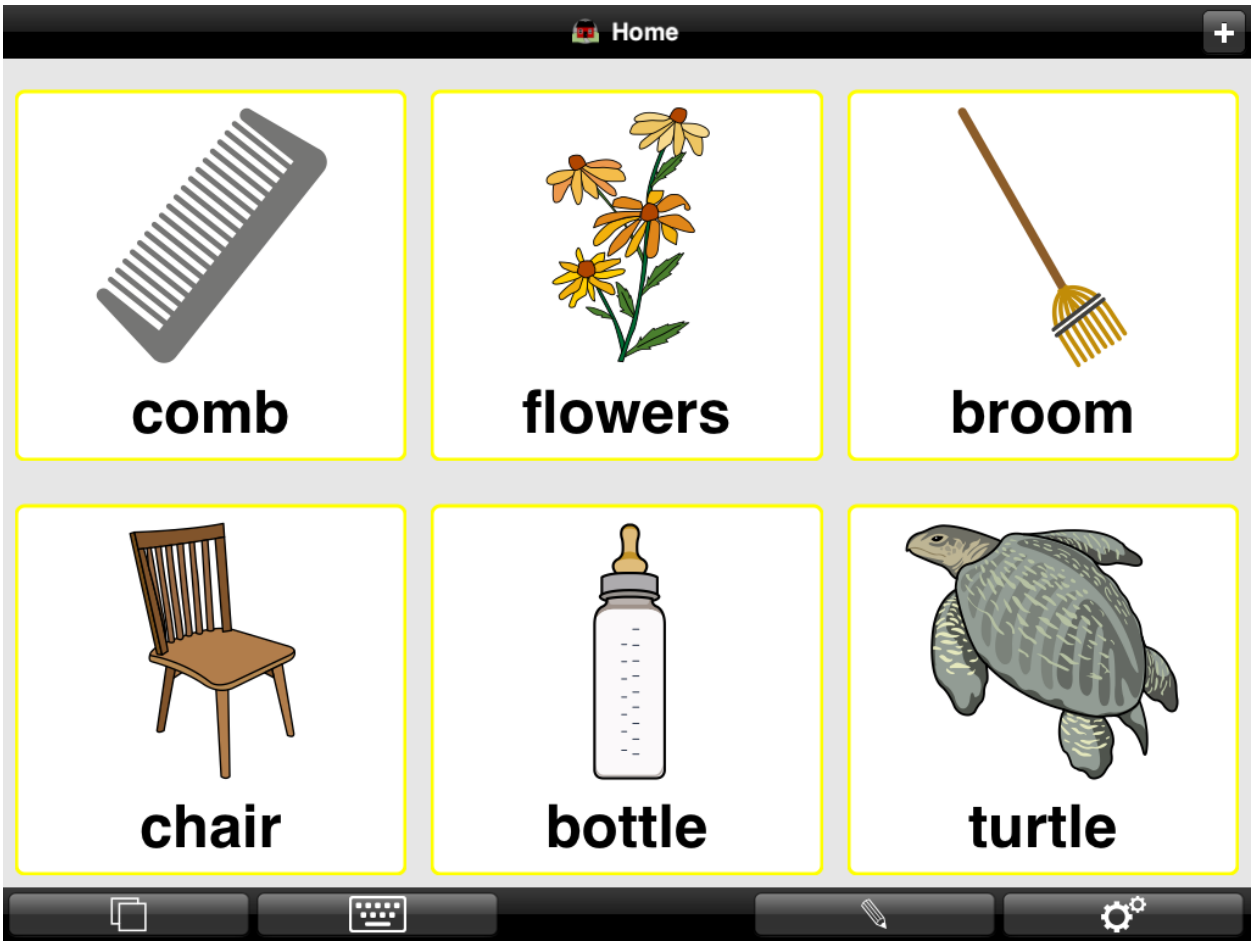
	Comb	Flower	Broom	Chair	Bottle	Turtle	Training Required OR Task Completed
Verbal to Object							
Verbal to Picture							
Verbal to SGD							
Object to Picture							
Object to SGD							

Date of Probe:

	Comb	Flower	Broom	Chair	Bottle	Turtle	Training Required OR Task Completed
Verbal to Object							
Verbal to Picture							
Verbal to SGD							
Object to Picture							
Object to SGD							

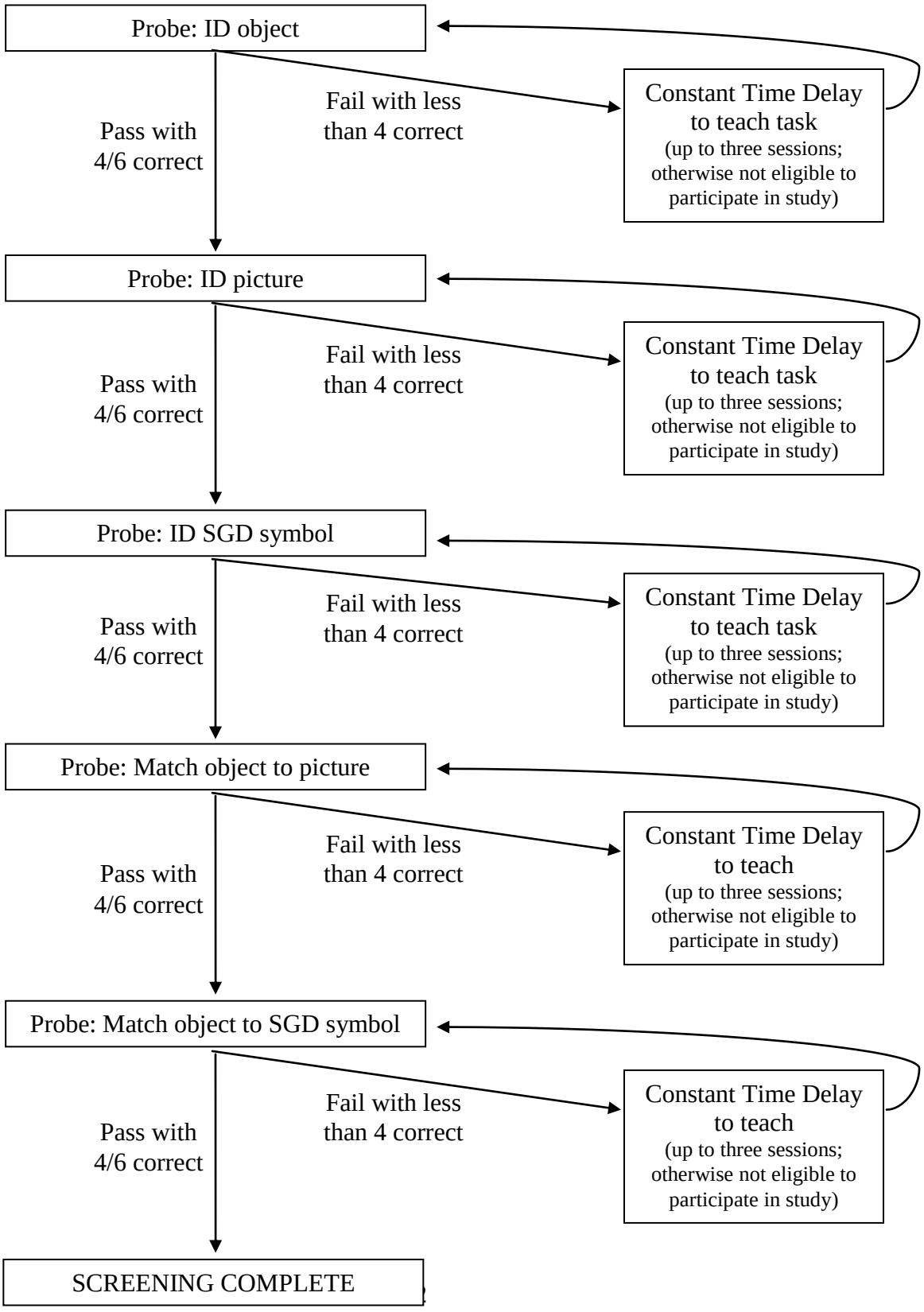
Appendix E

Screener Pictures and SGD Symbols



Appendix F

Flowchart of SGD Screening



Appendix G

Rules for Talking to Peers

Appendix H

Workshop Fidelity

Therapist talks to children about how we "talk" to friends.	/1
Therapist talks about how we "talk" or communicate with voice, gestures, and signs.	/3
Therapist includes at least 3 videos, one of each peer	/3
After watching the video, therapist talks with children about how the target child was communicating in the video	/3
Therapist discusses what we do when our friend talks: - Talk back - Look at friend - Say his/her name	/3
Therapist explains we talk using our voice and the SGD	/1
Therapist asks the children what we do if the friend is not talking.	/1
Therapist explains that we talk to our friend and show him/her our toys	/2
Therapist explains that we do what our friend is doing and talk about it	/1
Therapist reviews 5 rules: - Look at friend - Say his/her name - Do what he/she does - Show him/her toys - Use SGD	/5
Therapist allows each child at least 2 turns using the SGD to communicate	/6
TOTAL	**/29**
PERCENT	**%**

Appendix I

Baseline Fidelity

Date: _____ Session #: _____ Child ID: _____
Observer: _____

Therapist Session: 10 minutes	
Therapist Practice Session	
Responsiveness> 80%	/1
Matched Turns <60%	/1
Target Talk <80%	/1
Modeled on SGD 0%	/1
Expansions <40%	/1
Zero to 5 time delays and prompts	/1
Time delays average <3	/1
Prompting average <8	/1
Model less than 10 JA point, show, gives	/1
Total ***/9=***	
Therapist and Peer Session 5 minutes	
Therapist Practice Session	
Therapist does not review rules with peer	/1
Therapists does not review words on SGD	/1
Therapist and peer do not practice at least one model on SGD	/1
Therapist does not prompt peer to show	/1
Therapist does not prompt target child to show	/1
Total ***/5=***	
Peer alone session 2-5 minutes	
Therapists exits	
Sessions lasts for at least 2 min up to 5 minutes	/1
Subtotal */1=*	
Total ***/15=***	

Appendix J

Intervention Fidelity

Date: _____ Session #: _____ Child ID: _____
Observer: _____

Therapist Session: 10 minutes	
Therapist Practice Session	
Responsiveness> 90%	/1
Matched Turns >80%	/1
Target Talk >80%	/1
Modeled on SGD >50%	/1
Expansions >40%	/1
At least 3 time delays/prompts to use language on SGD	/1
Time delays average >3.5	/1
Prompting average >8	/1
Model at least 15 JA point, show, gives	/1
Total ***/9=***	
Therapist and Peer Session 5 minutes	
Therapist Practice Session	
Therapist reviews rules with peer	/1
Therapists reviews words on SGD	/1
Therapist and peer practice at least one model on SGD	/1
Prompts peer to show/share/comment three times	/1
Prompts target child to show/tell/comment three times	/1
Total ***/5=***	
Peer alone session 2-5 minutes	
Therapists exits	
Sessions lasts for at least 2 min up to 5 minutes	/1
Subtotal */1=*	
Total ***/15=***	

Appendix K

Baseline Fidelity

Therapist Session: 10 minutes	*M*	*SD*	Range
Therapist Practice Session			
Responsiveness> 80%	92%	.07	79-100%
Matched Turns <60%	24%	.10	10-41%
Target Talk <80%	52%	.10	32-60%
Modeled on SGD 0%	0%	0.0	No range
Expansions <40%	5%	.07	0-16%
Zero to 5 time delays and prompts	.13	.35	0-1
Time delays average <3	Na	Na	Na
Prompting average <8	3	Na	No range
Model less than 10 JA point, show, gives	8	2.33	4-11
Therapist and Peer Session 5 minutes			
Therapist Practice Session			
Therapist does not review rules with peer	1	0	No range
Therapists does not review words on SGD	1	0	No range
Therapist and peer do not practice at least one model on SGD	1	0	No range
Therapist does not prompt peer to show	1	0	No range
Therapist does not prompt target child to show	1	0	No range
Peer alone session 2-5 minutes			
Therapists exits			
Sessions lasts for at least 2 min up to 5 minutes	1	0	No range

Appendix L

Intervention Fidelity

Therapist Session: 10 minutes	*M*	*SD*	Range
Therapist Practice Session			
Responsiveness> 90%	98%	.01	96-100%
Matched Turns >80%	90%	.05	80-96%
Target Talk >80%	96%	.05	87-100%
Modeled on SGD >50%	39%	.40	0-89%
Expansions >40%	72%	.16	50-100%
At least 3 time delays/prompts to use language on SGD	3.07	1.75	0-6
Time delays average >3.5	4	0	No range
Prompting average >8	9.7	.39	9-10
Model at least 15 JA point, show, gives	29.27	10.1	18-61
Therapist and Peer Session 5 minutes			
Therapist Practice Session			
Therapist reviews rules with peer	1	0	No range
Therapists reviews words on SGD	.71	.47	0-1
Therapist and peer practice at least one model on SGD	.93	.27	0-1
Prompts peer to show/share/comment three times	.79	.43	0-1
Prompts target child to show/tell/comment three times	93	.27	0-1
Peer alone session 2-5 minutes			
Therapists exits			
Sessions lasts for at least 2 min up to 5 minutes	.86	.36	0-1

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