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Support for AAC Use in Preschool, and Growth in Language Skills, for Young Children with Developmental Disabilities

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Abstract

Little is known about how AAC use in preschool may impact language development for children with complex communication needs (e.g., children with autism, cerebral palsy, Down syndrome, and other developmental disabilities). We developed two surveys (a) to describe children's use of AAC in preschool classrooms, as well as the use of prompts and question asking, and augmented input by their communication partners; and (b) to describe teachers' experience, training, and perceived support in providing AAC. We then examined the relationship between children's experience of AAC, including the use of prompts, question asking, and augmented input by their partners, and the growth of receptive and expressive language for 71 children with developmental disabilities over a two-year period. The use of AAC by peers to provide augmented input was associated with stronger language growth; the use of prompting and question asking by teachers was associated with weaker language growth. Teachers reported that they received little training regarding ways to support a child's use of AAC. Results suggest the need for further research on promoting AAC use at the preschool level, including research to promote peer interactions for AAC users.

Keywords

Augmented input; Peer use; Prompting; Receptive language; Expressive language Introduction

Preschool children with significant communication impairments associated with developmental disabilities frequently experience difficulties communicating with family members, teachers, and peers (Beukelman & Mirenda, 2012; Johnston, Reichle, Feeley, & Jones, 2012). For children with severe speech impairments, augmentative and alternative communication (AAC) can substantially improve communication (Cress & Marvin, 2003; Ogletree, Bruce, Finch, Fahey, & McLean, 2011; Reichle, 2010; Romski et al., 2010; van der Meer, Sutherland, O' Reilly, Lancioni, & Sigafoos, 2012). AAC interventions include non-aided approaches such as sign language or other symbolic gesturing, and aided

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approaches such as the Picture Exchange Communication System (PECS; Bondy & Frost, 1994) and speech-generating devices (SGDs). For young children, it is recommended that teachers facilitate language development by providing augmented communication input as well as opportunities to communicate with AAC (Drager et al., 2006; Harris & Reichle, 2004; Jones & Bailey-Orr, 2012; Romski & Sevcik, 1996; Sevcik & Romski, 2002). Implementing these strategies within the classroom, however, may be difficult, due to competing demands on teachers ' time. Furthermore, research on partner instruction in AAC has clearly shown that many communication partners (e.g., educators or paraprofessionals) lack the skills necessary to effectively support successful communicative interactions with those who use AAC (Douglas, Light, & McNaughton, 2012; Kent-Walsh & McNaughton, 2005). Thus, variability in the training and experience of classroom teachers and staff may impact the effectiveness of AAC interventions and children's communication outcomes.

In this study, two surveys, the AAC School Use Survey, and the Teacher and School Characteristics Survey, were developed and implemented across 48 different preschools in 19 different school districts in the United States in order to investigate the relationship between a child's reported experience of AAC, including the use of prompts and question asking, and augmented input by communication partners, and children's receptive and expressive language growth over a two-year period. We also gathered information on the context within which children used AAC in terms of teacher and school district characteristics.

Facilitating Language via AAC

AAC approaches to language intervention are a means to facilitate communication competence for individuals with developmental disabilities and complex communication needs (Beukelman & Mirenda, 2012; Johnston et al., 2012; Romski & Sevcik, 1996). The primary purpose of AAC is to increase opportunities for communication by providing an additional modality through which individuals can communicate with many different people in their lives (e.g., parents, siblings, peers, educators, etc.). While a wide variety of AAC interventions have been demonstrated to have a positive impact for young children (Light & Drager, 2007; Romski & Sevcik, 2005), special attention has been paid in recent years to the evidence base supporting positive effects of two of the most popular AAC intervention strategies: the use of PECS, and the provision of SGDs and appropriate instruction (see reviews by Preston & Carter, 2009; van der Meer & Rispoli, 2010).

PECS

Several studies have documented positive outcomes in speech, language, and social communication following PECS interventions (Cannella-Malone, Fant, & Tullis, 2010; Carr & Felce, 2007; Ganz, Parker, & Benson, 2009; Howlin, Gordon, Pasco, Wade, & Charman, 2007; Yoder & Stone, 2006). Flippin, Reszka, and Watson (2010) conducted a meta-analysis on PECS instruction using studies published between 1994 and 2009. They concluded that PECS was a promising communication intervention strategy for children aged 1 to 11 who had autism spectrum disorders (ASD), although additional research was needed to better establish the evidence base. PECS was originally designed to guide teachers or therapists in teaching functional communication to children with autism who demonstrate

difficulty using speech; however, this symbol exchange system has also been effectively implemented to increase communication of young children with other developmental disabilities (Schwartz, Garfinkle, & Bauer, 1998). For example, Schwartz and colleagues demonstrated that 31 children with developmental disabilities between the ages of 3 and 6 years learned to use PECS in a functional manner to communicate with adults and peers in the classroom after 14 months (range = 3–28 months) of intervention. Schwartz et al., also examined the rate of acquisition and growth in spoken vocabulary for a subset of 18 of the same group of preschool children, and reported that 44% showed marked increases in spoken language after using PECS. Additional studies have since reported similar outcomes in increases in expressive or spoken language following PECS intervention for non-verbal children with autism (Ganz & Simpson, 2004; Yoder & Stone, 2006).

Howlin et al., (2007) noted the lack of expert or high quality training and consultation for school staff implementing PECS, and investigated whether providing expert guidance to teachers would lead to increases in children' s spontaneous communication. The design was a randomized-control trial (RCT) with 18 classrooms from 15 schools assigned to one of three groups: (a) immediate treatment group with PECS training provided immediately after baseline (26 children), (b) delayed treatment group with PECS training provided 5 months after baseline (23 children), and (c) no treatment group who did not receive PECS training and were monitored during baseline and intervention periods (28 children). The results provide evidence that children in the classrooms of staff and teachers who received training in PECS showed significant increases in rates of communication initiations and rate of PECS use in the classroom post-treatment, compared to children in the no treatment group. The authors reported no increases in spoken language on standardized language tests administered pre- and post-PECS intervention. Furthermore, the importance of providing ongoing training and support to teachers or other school staff was further illustrated by Howlin et al.'s finding that the positive effects on initiations and PECS use was not maintained 5 months after the classroom consultations had stopped.

SGDs

Recent research investigating the effectiveness of interventions, including the provision of SGDs (and appropriate communication partner supports) for preschool age children is encouraging (Light & McNaughton, 2012). In an RCT design, Romski et al., (2010) compared language performance as measured by changes in augmented and spoken vocabulary for 62 toddlers (ages 21–40 months) assigned to three different parent-coaching conditions: (a) augmented communication input (i.e., the child was provided with an SGD and the parents used the SGD to provide augmented input to the child), (b) augmented communication output (i.e., the child was provided with an SGD and prompted to make use of it for communication), and (c) spoken communication interventions (i.e., the child was given visual and verbal prompts to produce spoken words for a target set of vocabulary). All of the children in the two SGD groups used augmented words and used more targeted augmented words following intervention. In addition, children in the two SGD groups used more targeted spoken words than children in the speech only group. Romski et al., commented on the clinical implications of these outcomes, suggesting that augmented communication does not impede but may actually aid speech production in preschool

children with developmental disabilities. Contrary to some earlier concerns, then, these findings confirm that AAC does not appear to slow but rather in some cases appears to enhance speech development (Schlosser & Wendt, 2008). Furthermore, SGD instruction may also enhance social communication and interactions with peers without disabilities (Trembath, Balandin, Togher, & Stancliffe, 2009). In short, studies have demonstrated the positive effects of AAC use - including both PECS and SGDs - on speech production, language expression, and social communication of children with developmental disabilities.

Contextual Considerations for Users of AAC

Most studies examining the impact of AAC systems on communication in young children have focused on AAC use in intervention contexts with trained interventionists or in parent dyads rather than in naturalistic school contexts, such as with teachers and/or peers in a classroom. Therefore, additional information is needed on how AAC affects communication in these natural contexts, and how variables within these natural contexts may be related to later language development. Our goals for this research project were to learn more about contextual variables in classrooms that may affect communication outcomes for children learning AAC, specifically the communication partner' s use of prompting and question asking, and augmented input.

Prompting and Question Asking by Communication Partners

Prompting and question asking can be used as part of a hierarchy of prompting, and are widely accepted strategies for encouraging communication (Kent-Walsh & McNaughton, 2005; Van Tatenhove, 2009). Few studies, however, have investigated the role that prompting and question asking, as well as input using AAC by communication partners, has had on the overall language development of young children who use AAC. As noted previously, Romski et al., (2010) compared the augmented vocabulary learning outcomes for toddlers across three parent-coached language intervention conditions: two augmented and one speech-only. The use of prompting and question asking varied across the three conditions. The augmented input condition (described previously) did not include prompting. The augmented communication output and the speech- only condition used explicit prompting to encourage children to communicate using either an AAC device and speech, or speech-only, respectively. Children in the augmented output condition, which combined provision of AAC with prompts for using the system, had the best outcomes in terms of vocabulary growth.

Augmented Input in AAC

Language development for children using AAC systems is also influenced by how adults model the use of augmented language (Romski & Sevcik, 2003). Augmented input consists of all of the communication and/or language that an individual experiences from his or her communicative partner (Romski et al., 2010). This includes speech that is supplemented by picture symbols (e.g., PECS), the synthetic or digitized speech that is generated by an SGD when the symbol is activated, and the environmental context itself (Romski & Sevcik, 2003; Sevcik & Romski, 2002). Augmented input supports the development of language skills for children by providing models of AAC usage, illustrating the system' s usefulness, and

demonstrating that it is an acceptable vehicle for communication (Romski & Sevcik, 2003). Moreover, augmented input illustrates the real-world meaning of symbols, the many functions they can serve, and demonstrates that the AAC system is both accepted and encouraged as a modality for communication (Romski & Sevcik, 2003; Sevcik & Romski, 2002).

Different AAC intervention strategies use variations of augmented input to support language development. For example, during aided language stimulation (Goossens', 1989; Harris & Reichle, 2004) and aided language modeling (Drager et al., 2006) the partner (e.g., parent or clinician) points to AAC symbols while simultaneously speaking the words represented by the symbol. Children engage in interactive play activities while the adult provides models of using the child' s AAC system during play. The System for Augmenting Language (Romski & Sevcik, 1996; Sevcik, 2006) incorporates the use of an SGD in the intervention approach and provides augmented input that includes digitized speech produced by the SGD (which is activated, as appropriate, by the communication partner).

Research has demonstrated that augmented input is successful in improving both comprehension and production across spoken and augmented modalities for individuals who use AAC. Harris and Reichle (2004) reported large increases in comprehension of symbols and spoken words for three preschool children with moderate intellectual disabilities after an aided language stimulation intervention. Similarly, Drager et al., (2006) investigated the effectiveness of aided language modeling for two preschool-aged children with autism using a multiple-baseline design across sets of target symbol vocabulary during a structured play activity. Outcomes revealed increased symbol comprehension and production for both children, with progress in comprehension more apparent than symbol production. The authors suggested the need for future research on the impact of this strategy while interacting in less structured, natural communication contexts. Additional studies examining aided AAC modeling and augmented input have reported positive outcomes in the use of multi-symbol messages for preschool children with developmental disabilities (Binger & Light, 2007), and increased vocabulary comprehension of target vocabulary for children with autism and traumatic brain injury (Brady, 2000). Thus, augmented input is recognized as an important ingredient for children to learn new vocabulary and to increase expressive and receptive language; however, limited information is available describing the impact of augmented input on communication within preschool classroom contexts.

AAC Use by Peers in the Classroom

In classroom settings serving both young children with complex communication needs and typically developing children, teachers often are expected to divide their time between the two groups, all the while contending with increasing limits on resources and/or additional staff assistance. Thus, it is likely that children learning to use AAC may receive 1:1 instruction within structured therapy sessions (for example with a speech-language pathologist), and less augmented input or attention from teachers or other classroom staff. Within classrooms, however, there is another possible source of augmented input for these children - peers. When peers are provided with increased opportunities to direct communication to children using their AAC systems, so too are opportunities for models of

functional use and input that a child receives increases and expectations for communication, which may positively impact language development (Calculator, 2009).

Although limited, a few studies have investigated the effects of AAC interventions that include peers without disabilities as communication partners (Kravits, Kamps, Kemmerer, & Potucek, 2002; Schwartz et al., 1998; Trembath et al., 2009). In the Schwartz et al., study, the 31 preschool children with significant developmental disabilities who learned to use PECS to communicate with adults after 11 months, also learned to communicate with peers without disabilities after an additional 3 months of intervention in integrated, play-based activities. Trembath et al., reported increased communicative acts for three children with ASD following a peer-mediated intervention, and greater increases in communication for two of the three children who received SGD instruction combined with peer-mediated naturalistic teaching during play and meal time. The study did not describe how peers were taught to use the child's SGD, or if changes were observed in augmented input of SGD use by the peer.

Nigam and Wendt (2010) also examined the effects of peer-mediated training with and without an SGD on the communication behaviors of three children with autism spectrum disorders (ASD) and six peers. The six typically developing peers received pre-intervention, naturalistic teaching instruction, and were then asked to play with one child with ASD for 10 min in a routine preschool activity with or without an SGD. The order of peer implementation of naturalistic teaching alone or naturalistic teaching with an SGD was randomly determined. Results showed that, compared to baseline, all three children with ASD showed a greater increase in communicative acts when the SGD was present; however, for two participants this effect was temporary, as their rates of communication decreased as the intervention progressed.

In summary, emerging data supports the suggestion that communication partners (e.g., teacher and peers) can be an important educational resource in the classroom, and can be taught to provide prompts and/or augmented input to communicate with students with disabilities who are learning to use AAC systems in preschool. Much more research is needed to determine how contextual factors (i.e., prompting/question asking and augmented input by peers within natural contexts) may influence the development of communication skills by children with complex communication needs.

Purpose

This preliminary study was comprised of three major activities designed to contribute to a better understanding of the possible relationship between the use of and available supports for AAC in preschool settings and language growth for children with developmental disabilities and complex communication needs. First, we investigated the use of AAC systems by children with significant developmental disabilities in preschool classrooms, with a special focus on prompting and question asking by teachers and augmented input by peers, as reported by teachers in preschool classrooms. Second, we gathered information on the broader contextual environments of children's classrooms in terms of characteristics of both teachers and schools. Third, we investigated the relationships between teachers'

descriptions of the use of AAC in the classroom and the growth of both receptive and expressive language for these children. We predicted that, over the two-year study period, children using AAC who received more prompting and questions from teachers and/or more augmented input from peers in the classroom would demonstrate larger growth in receptive and expressive language scores.

Method

Data for this study were part of a larger longitudinal study evaluating the growth of communication skills in young children with significant developmental disabilities (Brady, Thiemann-Bourque, Fleming, & Matthews, 2013). Data were collected over a two-year period, beginning when children were in preschool and ending when they were in elementary school.

Participants

In all, 83 children were selected to participate in this study (mean CA at the beginning of the study was 4;01 [years;months], range = 36–71 months). Children were recruited by contacting school districts in and near to the Kansas City metropolitan area, and Topeka and Wichita, Kansas. Teachers and SLPs were asked to nominate any children meeting the stated criteria. Once nominated, parents were contacted to gain informed consent and complete the screening and assessment process. At intake, each participant met the following criteria, verified through either teacher report or direct observation: (a) chronological age between 3 and 5 years, (b) enrolled in a preschool program, (c) vision reported as 20/80 or better in at least one eye (with or without correction), (d) hearing reported as 25 dB HL or better in at least one ear (with or without amplification), (e) upper body motor skills sufficient to directly select symbols with fingers, hands, or arms, (f) English as the primary language spoken at home, (g) current teaching plans that included AAC (graphic symbols, sign language, and/or an SGD), and (h) expressive vocabularies of less than 20 different words said, signed, or selected. For this last criterion, parents and teachers were asked to list words produced spontaneously (without prompting), intentionally (directed to another person), and intelligibly. If there were inconsistent reports between teachers and parents for individual children, we moved forward with the first visits and would screen based on further discussions and observations of the child at school and home. Any children whom we observed to produce more than 20 different words during our initial observations at school and home were not included in the study.

A total of 43 children were diagnosed with ASD; the remaining children were diagnosed with other developmental disabilities: Down syndrome = 11, global developmental delay = 3, spina bifida = 1, cerebral palsy = 4, other genetic syndromes = 13, traumatic brain injury = 1, and unknown etiology = 7. There were 17 girls and 66 boys. The mean standard score for the Mullen Early Learning Composite (Mullen, 1995) for the sample was 48.49, SD = 1.80. It should be noted that the Mullen is scaled such that, for standard scores, the M = 100, SD = 15. Furthermore, there were no significant differences between the children with ASD and children with other diagnoses on the Mullen Early Learning Composite, $t(81) = 0.88$, p

= .38, d = 0.20, the MSEL receptive language domain, t(81) = 1.07, p = .32, d = 0.24, or the MSEL expressive language domain, t(81) = 1.04, p = .30, d = 0.23.

Procedure

Research assistants administered a battery of assessments (described next) to participants that assessed communication skills at the beginning and end of the two-year observation period. All assessments were given at the participants' schools at two different times. Time 1 occurred at the beginning of the study, when participants were in preschool (mean = 4;01); Time 2 assessments were administered 2 years later, after children had transitioned to elementary school (Mean CA = 6;01). In addition, we collected information on AAC use during the preschool period via a survey completed by participants' preschool classroom teachers. Finally, we assessed demographic characteristics of the classroom, including those related to teachers, schools, and districts, via a retrospective survey.

Measures

AAC School Use Survey—This survey was developed for the present study to investigate the frequency of AAC use in preschool classrooms, including use of a formal AAC system by the child as well the provision of prompts and question asking, and augmented input by communication partners. Participants' teachers were sent the survey via email every 2 weeks throughout the second-half of the school year for a total of nine surveys per teacher. Teachers received a $15 gift card for every three surveys they returned. Responses were recorded electronically over the Internet to a secure server. The survey consisted of seven questions. The first question asked teachers whether the participant in question was currently using an AAC system (as described in the survey), and if so, what type. The remaining six questions were answered only if the child currently used an AAC system. These questions assessed the frequency of adult prompts (and questions) to the child to use the AAC system in structured and unstructured activities, how often the child used the system, and how often the preschool teacher, other adults, or peers provided augmented input and used the child' s AAC device during the day. Responses for Questions 2 through 7 were on a 5-point Likert scale with possible responses of 0 (0), 1 (1 or 2), 2 (3 or 4), 3 (5 or 6), and 4 (7 or more) times per day. For example, in response to Question 2, the teacher indicated the number of times the teacher prompted the child to use AAC using this scale. The full survey is available upon request.

Teacher and School Characteristics Survey—This survey was developed to assess characteristics related to the teacher and the classroom environment while the participants were in preschool. The survey was sent to the teachers via e-mail at the completion of our study, hence it was retrospective. Teachers received a $10 gift card for returning the survey. Questions were worded so that the teachers were constantly referred to the appropriate time period. For example, Question 3 asks: Which of the following AAC interventions had you received specific training in when the research started? Responses were recorded electronically over the Internet to a secure server. The survey consisted of 11 questions assessing teachers' academic background, teaching experience, professional training, and classroom type. The full survey is available upon request. Receptive Language Measures. Two formal measures of receptive language were administered at Time 1 and Time 2. Time

1 measures were used as covariates; Time 2 measures were used as outcome variables, indicating change from Time 1 to Time 2.

The Mullen Scales of Early Learning (MSEL) Receptive Language Subscale (Mullen, 1995) measures overall receptive language functioning via direct observation and testing in children who are 3–60 months of age. Raw scores were analyzed in the present study. The Peabody Picture Vocabulary Test, 4th Edition (PPVT-4; Dunn & Dunn, 2007) measures receptive vocabulary size. The examiner showed the child an easel page with four pictures and spoke a word. The child then pointed to, or otherwise indicated, the picture that corresponded to the spoken word. We used a modified version of the PPVT-4 with the stimuli reproduced in a larger size, 9.38 in. × 12.75 in. (23.8 × 32.4 cm), so that our participants with motor impairments could easily point to the correct picture. Raw scores were analyzed.

Expressive Language Measures—Two measures of expressive language were collected at Time 1 and Time 2. Again, Time 1 measures were used as covariates; Time 2 measures were used at outcome variables. The MSEL Expressive Language Subscale (Mullen, 1995) measures overall expressive language functioning via direct observation and testing in children who are 3 to 60 months of age. Raw scores were analyzed.

Number of different words (NDW) was calculated for each child using a language sample from a structured interaction with a research assistant. The interaction included initiation, response, and repair activities around a standardized set of objects (e.g., wind-up toys or books) that facilitated communication between the child and the research assistant. Transcripts were produced using the Systematic Analysis of Language Transcripts software (SALT; Miller & Iglesias, 2008). Child utterances were transcribed from a 20-min interaction between a research assistant and the child. The SALT program was then used to calculate the number of different and unique words that the child independently produced during this language sample. Words that were produced with speech, signs, or an SGD were all included in this analysis.

Results

Preparation of AAC School Use Survey Results for Analysis

Preschool teachers returned, on average, five surveys (range = 1–9) for each child participant who made use of AAC in a preschool classroom. The average response rate was approximately one survey per month, M = 52%, SD = 20.17. In order to have a representative score to use in our regression analyses, we summarized the range of scores on each question, for each participant, using the median score. Median scores, instead of means, were chosen because of the ordinal nature of the survey response choices. Analyses indicated that, across all children, the variability around the median scores was small. Average differences between the highest and lowest score were 1.4 (SD = 1.3), 1.5 (SD = 1.2), 1.4 (SD = 1.3), 1.6 (SD = 1.3), 0.9 (SD = 0.9), and 0.6 (SD = 0.9) for Questions 2 through 7, respectively. Consequently, the median score for each question was a good characterization of the overall AAC use reported by preschool teachers.

Descriptive Results

AAC School Use Survey—On Question 1, in response to a list of five options, preschool teachers reported that 22% of participants used object exchange AAC systems, 34% used line drawings and symbol displays, 64% used the Picture Exchange Communication System, 49% used sign language, and 46% used SGDs. Many participants used more than one AAC system. (Based on observations of children in their classroom, most SGDs were low-tech electronic devices consisting of 4–8 vocabulary words.) Means and standard deviations of the median responses for questions 2 through 7 on the AAC School Use Survey are presented in Table I. Question 7 (How many different classmates used the child's AAC system while communicating with the child today?) had the lowest mean of all the questions, M = 0.5, SD = 0.7, indicating that on average children had less than 1 peer use the child' s device to interact with the child on a given day. In fact, according to teachers, 72% of participants had no classmates communicate with them using the child's AAC system.

Teacher and School Characteristics Survey—We sent a survey to each of the 120 preschool and elementary school teachers who participated in the larger study (Brady et al., 2013) Overall, 78 teachers returned responses. For the purposes of this study, we were interested in the experiences of preschool teachers only, so the data from 38 elementary school teachers was not used. Among the 40 remaining preschool teachers in the current study, 35% taught in self-contained, special education classrooms; 52.5% taught in special education classrooms that contained some typical peers; and 12.5% taught in regular education classrooms with some children who had special needs. More than 70% held a master's degree or higher; 70% were 25–45 years old; slightly less than 45% had teaching experience of 1–5 years, 23% had 6–10 years; and 12% had 11–15 years of experience. Nearly 80% and 45% of the teachers, respectively, had received professional training for the PECS and sign language, although only 25% had received SGD training. Nearly 65% responded that their school district provided children with devices within 3 months of requesting a system, but 7% responded that their school district never provided systems to their students. In all, 52% of the teachers reported that three adults consistently interacted with students in the classroom on an average day, while 38% reported that four adults consistently interacted with students in the classroom on an average day.

Factors Associated with Language Growth

Teachers did not return the AAC School Use Survey for 12 of the 83 participants, who were excluded from subsequent analyses. We therefore conducted the additional analyses for the 71 participants for whom AAC School Use Surveys had been returned. Of those 71 participants, at Time 1, one participant was missing data on the PPVT-4; at Time 2, two participants were missing data on the MSEL Receptive, MSEL Expressive, and NDW; and 4 participants were missing data on the PPVT-4. Table II contains means and standard deviations for the receptive and expressive language measures at Time 1 and Time 2. Given the small number of tests conducted and the exploratory nature of this study, a decision was made to set alpha at .05, and not employ a correction factor throughout the study (Bender & Lange, 2001; Nakagawa, 2004). We began our analyses by calculating bivariate correlations between responses on the surveys and the receptive and expressive language outcomes. None of the responses to the Teacher and School Characteristics Survey were related to

language outcomes. Furthermore, correlations between the questions on the AAC School Use Survey indicated a high degree of intercorrelation. To avoid multicollinearity in our regression analyses, we Language subscale; PPVT-4, Peabody Picture Vocabulary Test — 4th edition; MSEL Exp, Mullen Scales of Early Learning Expressive Language subscale; NDW, Number of different words. [a]n = 69. [b]n = 67. *p < .05. **p < .01. examined bivariate correlations between the questions on the AAC School Use Survey and the outcome variables (see Table III) and focused our analyses on the questions that were most consistently correlated with outcomes. Those were Question 3: How many times a day did you prompt the focus child to use their AAC system or ask the child a question when their AAC system was available during informal opportunities (e.g., at meal times, recess, transitioning to activities?); and Question 7: How many different classmates used the child's AAC system while communicating with the child today?.

We conducted four hierarchical regression analyses predicting changes in two measures of receptive language and two measures of expressive language over the two-year period. All analyses had the same structure. In the first step, we entered the Time 1 measurement for the dependent variable. For example, in the analysis for the PPVT-4, we entered the PPVT-4 score at Time 1 into the model in the first step. By entering Time 1 measurements in step 1, results for step 2 of our analyses demonstrated the degree of change in the dependent variable from Time 1 to Time 2.

In step two, we entered the median score for both questions 3 and 7 from the AAC School Use Survey. Significant regression coefficients from this step demonstrate the relationship between the predictor in question and the change in the dependent variable from Time 1 to Time 2. Results for each regression analysis are presented in Table IV. Step one was significant in each regression analysis, indicating that children with higher scores at the beginning of the study had higher scores on the same outcome measures at the end of the study (see Table IV). Following are the results for step two of each of the analyses.

Change in Receptive Measures—Step two accounted for 8.6% of the variance in MSEL receptive language scores after controlling for Time 1 MSEL receptive language scores, $F(2, 65) = 5.37$, $p < .01$. Question 3 from the AAC survey had a significant negative relationship with change in Mullen receptive language scores, $b = -2.06$, $P = -.28$, $t = -2.92$, $p < .01$. This indicated that children with teachers who actively prompted AAC system use and/or asked questions more often demonstrated less growth by the end of the study, relative to children whose teachers prompted and asked questions less often. This may have been due to the association between level of child impairment and prompting or question-asking behavior by the teacher, discussed more completely in the Discussion section. Question 7 from the AAC survey had a significant positive relationship with changes in MSEL receptive language scores, $b = 3.15$, $P = .23$, $t = 2.31$, $p = .03$: According to teacher report, children who had more peers communicate with them using their AAC systems showed greater growth in receptive language scores from Time 1 to Time 2.

Results were similar for the PPVT-4—Step 2 accounted for 13% of the variance after controlling for Time 1 PPVT-4 scores, $F(2, 62) = 6.97$, $p < .01$. Question 3 had a significant negative relationship with PPVT-4 scores, $b = -6.19$, $P = -.32$, $t = -3.24$, $p < .01$, indicating

that children with teachers who prompted the use of AAC systems and/or asked questions more often demonstrated less growth by the end of the study, relative to children whose teachers prompted the use of AAC less often. Question 7 had a significant positive relationship with PPVT-4 scores, b = 9.51, P = .25, t = 2.55, p = .01: According to teacher report, children who had more peers communicate with them using their AAC systems showed greater growth in receptive vocabulary from Time 1 to Time 2, relative to children who had fewer peers interact with their system.

Change in Expressive Measures—Step 2 accounted for 8.5% of the variance in MSEL expressive language scores after controlling for Time 1. MSEL expressive language scores, F(2, 65) = 4.75, p = .01. Question 3 had a significant negative relationship with MSEL expressive language scores, b = − 2.09, P = −.27, t = −2.78, p < .01. This indicated that children with teachers who prompted the use of AAC systems and/or asked questions more often demonstrated weaker growth by the end of the study, compared to children whose teachers prompted less. The results for Question 7 and the relationship with changes in MSEL expressive language scores approached but did not reach conventional levels of statistical significance, b = 2.76, P = .19, t = 1.91, p = .061. Therefore, according to teacher report, there is some preliminary evidence that children who had more peers communicate with them using their AAC systems showed greater growth in expressive language scores from Time 1 to Time 2, relative to children who had fewer peers interact with their system.

Step 2 accounted for 10.0% of the variance in NDW after controlling for Time 1 NDW, F(2, 65) = 4.90, p = .01. As demonstrated with the other variables, Question 3 had a significant negative relationship with NDW, b = − 6.70, P = −.27, t = − 2.60, p = .01. This indicated that children with teachers who prompted the use of AAC systems and/or asked questions more often demonstrated less growth by the end of the study. Question 7 had a significant positive relationship with NDW, b = 11.54, P = .24, t = 2.25, p = 03: According to teacher report, children who had more peers communicate with them using their AAC systems showed greater growth in expressive language scores from Time 1 to Time 2, relative to children who had fewer peers interact with their system.

Discussion

The aims of this study were to describe the use of AAC systems within preschool classroom settings serving children in the beginning stages of learning to use AAC and the demographic characteristics of those classrooms and the broader environment, and to investigate the relationship between a number of factors associated with AAC use and language outcomes for these children. We discuss potential implications of the study and suggest the importance of supports for AAC use in school in order to improve language outcomes of children with disabilities and complex communication needs. Major findings in relation to AAC use in the classroom, the limitations and implications of these findings, as well as future research directions, are discussed.

AAC Use in the Classroom

Responses to the AAC School Use Survey indicated that the use of PECS was the most common form of AAC provided for the preschool children in this study. Signing and SGDs

were the second and third most common forms of AAC used. It is worth noting that, according to the survey results, formal AAC systems were infrequently used by teachers, other adults in the classroom, and peers of children with developmental disabilities. For example, teachers reported that, in a typical school day, children used their formal AAC systems to communicate, on average, only 5 or 6 times. Furthermore, teachers and other adults asked questions or prompted children to use their AAC systems to communicate in structured and unstructured settings, on average, approximately 4 or 5 times a day. It is unclear, therefore, the extent to which (if any) children were typically using their formal AAC systems at times other than the structured opportunities created by educational personnel. The variability around these estimates of reported use was large (see Table II), with some children using their devices and receiving prompting (and being asked questions) more frequently.

It was relatively uncommon for teachers or other school staff to provide augmented input/model AAC system use for the children using their AAC systems: Teachers reported that this occurred only 2 or 3 times per day. Teachers also reported that peers rarely communicated with their classmates with developmental disabilities using the child ’s AAC system(s), although for 28% of the children, at least one peer used his or her system one time in the preschool classroom on a given day. Of this 28%, most teachers reported that only one or two peers interacted with the child using the AAC system; however, two children had as many as five or six peers interact with their AAC system. These findings are congruent with observations that caregivers and teachers rarely provide modeling of AAC use (Calculator, 1997; Light, 1997).

Teacher and School Characteristics

The results from our survey of teacher characteristics showed that more than half of the teachers received professional training on PECS and sign language, while only 25% of the teachers had similar training for the use of SGDs. The lower costs and resulting increased availability of consumer-grade electronic devices, such as tablet computers, appears to be associated with increased availability of SGDs for more students (see McNaughton & Light, 2013, for a discussion). Our results indicated, however, that teachers might not have received the training necessary to successfully implement these types of systems. Lack of professional training also may have contributed to the low system usage reported by teachers. This highlights the importance of providing more information, training, and support to classroom teachers regarding AAC interventions for young children. This is particularly important when considering the fast pace of technological change that will likely impact the types of AAC systems available in the classroom.

Impact of Teacher Prompting and Question Asking on Language Growth

We predicted that there would be a positive relationship between teacher question-asking and prompting using an AAC system and growth in language outcomes based on other research demonstrating that children have significantly larger expressive vocabularies when caregivers explicitly encourage children to use an SGD (Romski et al., 2010). Instead, our results showed a negative relationship between teacher question-asking and prompting of the AAC system and growth in language outcomes, across all measures. In fact, on average,

every one-point increase in our prompting scale was associated with slower growth in a number of areas, including approximately two-points less growth in MSEL scores, six fewer words gained on the PPVT-4, and a smaller number of different words expressed by the children from the beginning to the end of the study. This paradoxical outcome could be erroneously interpreted such that teacher prompting (including question asking) leads to poorer language outcomes for children who use AAC systems. It is more likely, however, that the children in this sample who had the most significant disabilities received the most prompting from their teachers to use their systems. This assertion is partially supported by a follow-up analysis; the correlations between responses on Question 3 and our two Time 1 measures of receptive language approach, but do not reach, the threshold of statistical significance ($r_s = -.21$ and $-.21$, $ps = .08$ and $.09$ for MSEL receptive subscale and PPVT-4, respectively). In other words, children who received more prompting demonstrated slower rates of growth; however, the children who received more prompting may have, from the beginning of the study, been at risk (because of the severity of their disability) for slow rates of growth. They also may have been less likely to initiate recognizable communication behaviors and required multiple questions (and prompts) prior to providing a response (especially in unstructured informal situations such as transitions or recess). What appears to be clear from these findings, however, is that additional prompting alone, and the small number of communication opportunities reported here, will not result in strong rates of growth for these children.

Impact of Peer Use of AAC on Language Growth

Even though teachers reported that only 28% of the children with developmental disabilities had peers that communicated with them using their AAC systems, our results indicated a significant positive relationship between the number of peers that interacted with the child using his or her AAC system and growth in language scores. In other words, children who had more peers communicate with them using their AAC systems demonstrated larger growth over the course of the study, compared to children with whom fewer peers interacted. This was particularly true for measures of comprehension, as growth over the two-year observation in scores on the MSEL receptive subscale and the PPVT-4 was significantly related to the number of peers who interacted using AAC with the child. For production, however, only growth in NDW was significantly related to peer AAC use; results for growth in MSEL expressive did not reach conventional levels of statistical significance.

These findings are congruent with other studies that demonstrated the effectiveness of peer-mediated AAC interventions on increasing communication behaviors of children with (Carter & Maxwell, 1998; Jones & Schwartz, 2004; Nigam & Wendt, 2010; Schwartz et al., 1998; Trottier, Kamp, & Mirenda, 2011). These previous studies, however, demonstrated modest gains within interventions, on targeted communication outcomes. In addition, these studies were conducted with small numbers of children and the peers were trained to interact with the target children using the AAC system. In contrast, the current preliminary study focused on growth in overall language skills over a two-year period in a naturalistic environment that was not constrained by the context of an intervention. Moreover, although we cannot be sure that peers did not receive training from their teachers, we did not provide

peers with any specific instruction on how to interact with children using their AAC system. In spite of these differences, our results demonstrated that the peer's use of the AAC system, when interacting with the child, was associated with gains in overall language skills, particularly comprehension.

Increased peer use of AAC systems may have been related to language outcomes for our participants because of the increased communication input (and models of AAC use) provided. Peers represent an often-untapped resource for augmented communication input. Given that language input and modeling by teachers is often low during classroom interactions (Brady, Herynk, & Fleming, 2010), additional input by peers could bolster the amount of communication input (both speech and AAC) that is likely to improve child language development. Thiemann-Bourque (2012) reported that, following a peer-mediated social intervention training on use of PECS, four children with autism increased their average communication acts to peers using PECS from 0 in baseline to 4.4 per 6-min play session, and peers increased their use of PECS materials directed towards play partners with autism from 0.2–7.4 per session, that is, peer initiations and responses using PECS increased after they were specifically taught how to use the same AAC system as the children with autism, which supports more opportunities for language modeling and social interactions for these children.

In short, the results from our study, although preliminary, as well as previous studies, suggest the importance of having peers interact with users of AAC systems with those systems. During a typical school day, children with disabilities spend most of their time with teachers and peers whom may or may not have disabilities, depending on their particular classroom. Peers who know how to communicate with children with disabilities while modeling the use of their AAC systems can provide increased social communication opportunities for these children, which, in turn, can impact language development in the long run. However, better-controlled studies are needed on the impact that peers have on communication opportunities and child outcomes within preschool classrooms. Specifically, information is needed about how peer- focused interventions and peer characteristics may influence these outcomes.

Limitations

This study has limitations that should be noted. First, this study relied on survey data and all results are correlational in nature; caution, therefore, should be used in interpreting our results. Experimental studies are needed in the future to demonstrate a causal relationship between variables such as peer input and language outcomes for children learning AAC. Furthermore, there are other variables that may have influenced outcomes that were not considered in this study, such as child cognitive levels and parental input. Brady et al., (2013) reported that both child variables and the amount of adult input at home significantly impacted language outcomes for the same participants reported in the current study. Therefore, taken together, these studies show that child variables, adult input at home, and peer interactions appear to be important variables related to child language outcomes.

Other limitations are related to the surveys we used

First, both the AAC School Use Survey and the Teacher and School Characteristics Survey were designed for our research purposes and we did not calculate reliability and validity for these measures. Therefore, it is unclear to what extent the survey responses, which relied on teacher report, accurately characterized AAC use in the classroom. Future research should determine the reliability and validity of these surveys by using an observational paradigm, whereby observers independently record AAC use. For example, it may be possible that some of the behaviors that were "collapsed" for the purposes of this study (i.e., prompting and question asking) should be separated, and that other behaviors (e.g., initiations by the child) should be included. Special attention also should be given to ways to collect information on the wide range of AAC modalities that are typically used by preschool children with complex communication needs, including speech approximations, commonly recognized gestures, and pointing to objects in the environment.

Similarly, responses to our Teacher and School Characteristics Survey were retrospective, as we administered this survey at the end of our longitudinal study. Thus, teachers ' answers were based on their memory of events at the time of child data collection. This may have impacted the accuracy of some items. Ideally, we would have administered this survey when we collected observations of our child participants.

An additional potential limitation has to do with how we administered and collected data using the AAC School Use Survey. Specifically, although we sent surveys to teachers on a consistent schedule, the returns were sporadic based on competing teacher demands. Therefore, unequal numbers of surveys were available for each child and the intervals between the surveys differed for each child. Because of this, we summarized survey responses using the median score for each child. Although our preliminary analyses indicated that the median was a representative score, we lost variability by using a single score for each child.

Conclusion

The current study examined the relationship between AAC use in preschool classrooms (specifically teachers' use of prompts and questions, and augmented input provided by communication partners) and language outcomes of children with developmental disabilities and complex communication needs. Our results provide initial evidence that use of AAC by peers was related to child language outcomes. Based on our results, further research focusing on strategies to facilitate peer interactions for children with developmental disabilities who are learning to communicate via AAC is required. We also noted that while many students used AAC systems such as signing, PECS, and SGDs, many teachers had not received professional training on AAC methods. Therefore, further research examining the effects of providing teachers information and support for AAC use in preschool classrooms on children' s language development and communication outcomes is also indicated.

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Table I

Means and Standard Deviations of Median Scores for AAC School Use Survey.

Item	M	*SD*	Mdn	Range
Question 2. How many times today did you or another adult specifically prompt the focus child to use their AAC system or ask the child a question when their AAC system was available during a structured (teaching) activity?	2.6	1.3	3	0–4
Question 3. How many times today did you prompt the focus child to use their AAC system or ask the child a question when their AAC system was available during informal opportunities (e.g., at meal times, recess, transitioning to activities)?	2.4	1.3	2	0–4
Question 4. How many times did this child communicate at school with his/her AAC system today?	3.0	1.2	3.5	0–4
Question 5. How many times today did you use the AAC system to communicate to the child (either to start talking or to respond to the child's communication attempts)?	1.6	1.3	1.5	0–4
Question 6. How many different school staff used the child's AAC system while communicating with the child today?	1.8	0.7	2	1–4
Question 7. How many different classmates used the child's AAC system while communicating with the child today?	0.5	0.7	0	0–3

Response options for the survey were: 0 (*0*), 1 (*1 or 2*), 2 (*3 or 4*), 3 (*5 or 6*), and 4 (*7 or more*) times per day.

Table II

Means and Standard Deviations of Outcome Variables.

	Time 1			Time 2		
Variable	***n***	***M***	***SD***	***n***	***M***	***SD***
MSEL Receptive	71	17.2	6.2	69	26.0	9.6
PPVT-4	70	8.5	13.2	67	30.7	25.0
MSEL Expressive	71	13.7	4.5	69	22.8	10.0
NDW	71	4.6	7.5	69	21.9	31.4

MSEL, Mullen Scales of Early Learning; PPVT-4, Peabody Picture Vocabulary Test – 4th edition; NDW, Number of different words. Raw scores are reported.

Table III

Preliminary Correlations between the AAC Classroom Survey and Receptive and Expressive Communication Measures at Time 2.

Question	MSEL Rec[a]	PPVT[b]	MSEL Exp[a]	NDW[a]
Q2: Prompting Formal Activities	−.23	−.25*	−.16	−.13
Q3: Prompting Informal Activities	−.33**	−.32**	−.22	−.31*
Q4: AAC Use	−.04	−.07	−.07	−.10
Q5: Teacher AAC Use	−.19	−.12	−.06	−.11
Q6: Staff AAC Use	−.13	−.18	−.09	−.13
Q7: Peer AAC Use	.32**	.33**	.26*	.28*

MSEL Rec, Mullen Scales of Early Learning Receptive Language subscale; PPVT-4, Peabody Picture Vocabulary Test – 4th edition; MSEL Exp, Mullen Scales of Early Learning Expressive Language subscale; NDW, Number of different words.

[a] $n = 69$.

[b] $n = 67$.

* $p < .05$.

** $p < .01$.

Table IV

Results of Hierarchical Regressions for Language Outcomes.

	Dependent variable							
	MSEL Receptive		PPVT-4		MSEL Expressive		NDW	
Predictor	**ΔR^2**	**β**	**ΔR^2**	**β**	**ΔR^2**	**B**	**ΔR^2**	**B**
Step 1	.39***		.32***		.33***		.23***	
Time 1		.63***		.56***		.58***		.48***
Step 2	.09**		.13**		.09*		.10**	
Question 3		−.28**		−.32**		−.27**		−.27*
Question 7		.23*		.25*		.19§		.23*
Total R^2	.48***		.44***		.42***		.33***	
n	69		66		69		69	

MSEL, Mullen Scales of Early Learning; PPVT-4, Peabody Picture Vocabulary Test – 4th edition; NDW, Number of different words.

§ $p = .061$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.