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AAC Modeling With the iPad During Shared Storybook Reading Pilot Study

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Abstract

This pilot study describes an intervention package, MODELER for Read and Talk, designed to provide enriched language interaction for children with complex communication needs who require augmentative and alternative communication (AAC). MODELER (Model, Encourage, Respond) includes (a) modeling AAC as you speak, (b) encouraging communication (through time delay for this study), and (c) responding to child communication (by recasting using AAC as you speak for this study). This pilot A-B design study reports on a method for coaching educational assistants (EAs) to use MODELER for Read and Talk in the context of shared book reading with a pre-school-aged child using an Apple iPad and AAC app. The study provides positive results indicating EA instructional performance gains in MODELER steps and large gains in AAC models performed. The results indicated that the child participant subsequently engaged in higher levels of communication turns. Implications for practice, limitations, and future research directions are discussed.

Keywords

augmentative and alternative communication, AAC modeling, aided language stimulation, iPad

Language input is an important factor in child language acquisition (Gallway & Richards, 1994; Gerken, 2008; Tomasello, 2003). During early childhood, children using speech are exposed to large levels of spoken language input and interaction (Hart & Risley, 1995; Tomasello, 2003). The amount of spoken words that speaking children typically hear in their first 4 years ranges from approximately 8 to 50 million words (Hart & Risley, 1995).

Similar to children who learn to communicate using speech, appropriate language input is important for children who use other expressive communication modalities as well, such as individuals with complex communication needs (CCN) who require augmentative and alternative communication (AAC; Beukelman & Mirenda, 2013; Romski & Sevcik, 1996). Individuals with CCN may communicate expressively using various modalities including *unaided* and *aided* AAC. Aided forms of communication are modalities that require additional external assistance, such as a communication board with visual-graphic symbols, printed words, letters, or a voice output communication device (e.g., an iPad). Unaided forms of communication consist of modalities relying on the individual's body, including gestures, signs, facial expressions, speech, or vocalizations.

The overall AAC language acquisition literature for individuals with CCN who require AAC emphasizes the role of language input that provides models of their expressive language system (Beukelman & Mirenda, 2013; Romski & Sevcik, 1996; Smith & Grove, 2003). For example, regarding unaided communication modalities, research in sign language acquisition stresses the importance language input, demonstrating that given appropriate sign language input, children can develop complex language abilities using sign language (Bavelier, Newport, & Supalla, 2003; Newport & Supalla, 2000).

Individuals with CCN who use aided AAC systems, such as symbolic icons or text based systems that may be either high tech or low tech, also require appropriate language input (Beukelman & Mirenda, 2013; Romski & Sevcik, 1996). However, these individuals rarely observe models of aided AAC use, creating what Smith and Grove (2003) called an asynchrony of language input to output. That is, these individuals experience language input in the form of speech but are expected to communicate expressively using aided AAC.

Consequently, a number of AAC interventions have been developed in an attempt to provide both spoken and aided AAC-based language input to individuals with CCN as a way to stimulate language gains described in a single-subject

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meta-analysis (Sennott, Light, & McNaughton, 2014). For clarity and conciseness, Sennott et al. (2014) used the term *AAC modeling* to consolidate and describe the various types of language input provided through AAC modalities. Various AAC modeling intervention packages have positively affected four different language areas: (a) pragmatics in the form of turn taking (e.g., Kent-Walsh, Binger, & Hasham, 2010), (b) semantics in the form of receptive and expressive vocabulary (e.g., Drager et al., 2006), (c) syntax in the form of increasing multi-symbol utterances (e.g., Binger, Kent-Walsh, Berens, Del Campo, & Rivera, 2008), and (d) morphology in the form of increased use of target structures (Binger, Maguire-Marshall, & Kent-Walsh, 2011). Meta-analysis results also indicated that because of the packaged nature of the interventions, parsing out modeling as the sole independent variable affecting student performance was not possible. In addition to the AAC modeling variable, time delay and responsive language strategies or recasting were included in the majority of the reviewed packaged interventions. Building on that body of work, those three intervention components have been included in a newly designed intervention package called MODELER (Model, Encourage, Respond).

MODELER for Read and Talk

The goal of this line of research is to develop an AAC intervention that successfully and efficiently prepares communication partners to use fundamental language acquisition principles and practices. That goal requires that we (a) develop and refine the use of research-based AAC intervention elements and (b) use an effective communication partner training system.

The MODELER intervention package is built on theory supporting the importance of language input (Gallway & Richards, 1994; Hart & Risley, 1995; Tomasello, 2003) and effective instructional components as highlighted in AAC modeling research (Sennott et al., 2014). The most important goal of MODELER is to help communication partners learn to interactively model AAC as they speak to individuals acquiring expressive language through AAC.

Communication Partner Strategy Instruction

The communication partner training system used in this study is supported by research in strategy instruction and coaching. Strategy instructional models have been successfully used in general and special education, such as use of the Self-Regulated Strategy Development (SRSD) instruction model to teach writing (Harris, Graham, & Mason, 2003). Strategy instruction has also been effectively used in AAC, as evidenced by the Improving Partner AAC Training (ImpAACt) series of studies (e.g., Binger et al., 2008), which adapts the Kansas Strategy Instructional model. The hallmarks of those strategy instructional models are systematic explicit instruction of content combined with models and opportunities for supported practice. For supporting practice, coaching is an important component of the strategy instruction model used in this study.

Coaching

The practice of *coaching* can be defined as a reciprocal and conversational process between a coach and a learner, built upon trust and respect and mutually agreed upon objectives (Flaherty, 1999; Rush, Shelden, & Hanft, 2003). According to Rush et al. (2003), coaching adult learners is exemplified by "(1) nonjudgmental interaction, (2) observation paired with reflective feedback, and (3) acquisition of new knowledge and skills for the adult learner directed towards improving a child's performance" (p. 36). Coaching has been used successfully in many areas of education, including early childhood education and early intervention (Dunst & Trivette, 2009; Rush & Shelden, 2011), early childhood language intervention (Kaiser & Roberts, 2013; Weitzman, 2013), and Positive Behavioral Intervention Supports (PBIS; Horner et al., 2009).

MODELER

The initial ImpAACt series of studies effectively used variants of a specific strategy instructional package (Read, Ask, and Answer [RAA] and related variants) to teach partners to better engage in shared storybook reading with beginning communicators who use AAC (e.g., Binger et al., 2008). These studies demonstrated positive results in the form of increased communication turns (Kent-Walsh et al., 2010; Rosa-Lugo & Kent-Walsh, 2008), increased multi-symbol communication turns (Binger et al., 2008; Binger, Kent-Walsh, Ewing, & Taylor, 2010), and increased use of morphological forms (Binger et al., 2011). MODELER has been designed to build on the findings of the ImpAACt research, but to optimize for generalization beyond the context of shared storybook reading, because of the importance of promoting interventions that can be used across multiple contexts (e.g., play, academics, snack/meal times) for children learning to use AAC.

The major components of MODELER are (a) model—modeling AAC use as you speak (Sennott et al., 2014); (b) encourage—encouraging communication, and for this study, through time delay/expectant delay (e.g., Halle, Baer, & Spradlin, 1981); and (c) respond—responding to child communication attempts, and for this study, through AAC recasting (Camarata & Nelson, 2006; Harwood, Warren, & Yoder, 2002; Nelson, Camarata, Welsh, Butkovsky, & Camarata, 1996). AAC modeling is the foundation of the intervention and is designed primarily to provide a model of

language use (pragmatics), content (semantics), and form (syntax and morphology) for the individual with CCN learning to use AAC. Encouragement to communicate, in the form of a time delay, is designed to provide opportunities for the child to initiate a communication turn, showing them that the adult communication partner is waiting and interested. As a support to the child's communication attempts, the respond component focuses on recasting the child's utterance by repeating their utterance, and expanding it in a meaningful way using both speech and AAC modeling. The respond component is designed as an adaptation of the recasting intervention described in Nelson et al. (1996), which described that the recast maintains the basic meaning of what the child says, focuses on expanding the length of utterance, and keeps the conversation turns flowing. The hope is that the child can better attend to the more advanced structures being modeled, because the utterance is based on what they just previously communicated. Put together, AAC modeling, encouraging by waiting for the child to take a turn and then responding through recasting with both speech and AAC modeling, is designed to create individualized, language-rich multi-turn communication sequences.

Read and Talk

The *Read and Talk* component of the package refers to reading a book and talking about it through (a) making comments or (b) asking questions. The Read and Talk components create a learning environment that would be typical of an early childhood shared reading context. Variants of shared storybook reading, such as dialogic reading, include engaging in conversation with the child, and has extensive empirical support in general education (Dale, Crain-Thoreson, Notari-Syverson, & Cole, 1996; Whitehurst et al., 1988), special education (Ezell & Justice, 2005), and AAC-specific literatures (Bedrosian, 1999; Sennott et al., 2014; Stephenson, 2010).

Dialogic reading interventions (e.g., Dale et al., 1996) are comprised of reading with children and asking targeted questions, which matches the approach the RAA strategy ImpAACt studies took (e.g., Kent-Walsh et al., 2010), which primarily focused on reading and question asking. Through including commenting in addition to question asking, the approach taken in the Read and Talk components of the intervention expands the scope of adapting dialogic reading for children using AAC. The decision to include both commenting and question asking was made because question asking, although important, has the potential to place the child into a passive or question prompt dependent role, which could be detrimental to individuals who require AAC (Light & Kelford Smith, 1993). Instead, this preliminary study is designed to teach the communication partners to model multiple pragmatic functions, both comments and questions, with the objective of promoting the children taking increasingly independent turns, such as making comments or asking questions themselves.

Research Questions

This pilot A-B design study evaluates the effects of the MODELER for Read and Talk package on educational assistant (EA) instructional practice and child communication performance, in an early childhood educational setting, in the context of shared storybook reading. The following research questions are addressed:

Research Question 1: Using a partner-instruction approach, what is the impact of the MODELER for Read and Talk instruction on EA performance of AAC modeling, the encourage step, and the respond step?
Research Question 2: What is the impact of the EA's implementation of MODELER for Read and Talk on the child's communication performance measured by frequency of turns using the iPad and Proloquo2Go software, gesture turns, and speech turns and total communication turns?

Method

Setting

The setting for the present study was a public early childhood center in a university town housing six different early childhood classrooms for approximately 75 children with and without disabilities. The child participant in the study was a member of a classroom specially designed to serve children with autism spectrum disorders and included features such as a low teacher-to-child ratio (one adult to two children), a highly structured sequence of activities, and instruction focused on implementation of the children's individualized education plan (IEP).

Participants

Following university Institutional Review Board approval of the study, local pre-schools were contacted and a potential student was nominated to be included in the study. The student and EA participants were considered based on specific inclusion criteria. The inclusion criteria for selecting children to participate in the study was an adaptation of recommendations described in Bedrosian (1999) and in the ImpAACt studies (Kent-Walsh et al., 2010) for shared storybook reading interventions and included the following qualifications: (a) children aged 3 to 5 years; (b) had severe speech impairment as evidenced by no intelligible speech production or a repertoire of fewer than 50 intelligible spoken words; (c) currently using an aided AAC system (e.g.,

Table 1. Case Study Participant.

Participant, gender, age	Disability	TACL-3 score			Communication	EA, age, experience in schools
		Age equivalent	Percentile	SS		
Bobby, Male, 3 years 1 month	DD, autism assessment in process	2 years 7 months	16%	5	Limited speech (<50 words), vocalizations, gestures, paper-based symbols for visual schedule and choice making, limited access to an iPad with various AAC apps	Beth, 40 years, 4 years

Note. TACL-3 = *Test of Auditory Comprehension of Language*–Third Edition (Carrow-Woolfolk, 1999); SS = standard score; EA = educational assistant; DD = developmental delay; AAC = augmentative and alternative communication.

communication board, speech-generating device); (d) language comprehension no lower than a 2-year developmental level; (e) language production involving one- to three-symbol productions; (f) functional hearing and vision assessed as being within normal limits, with aids; and (g) that the child worked with an EA on a regular basis, at least every day. The inclusion criteria for the EA that worked with the child included the following qualifications: (a) the individual works with the child regularly (typically at least 3 times per week) and (b) has worked with the child for longer than 4 weeks. Parental consent, EA consent, and child assent was acquired prior to commencement of the study.

To describe participant language skills, school report and observation were used to provide a description of their expressive language level and the *Test for Auditory Comprehension of Language–Third Edition* (TACL-3; Carrow-Woolfolk, 1999) was used to provide a measure of their receptive language level (see Table 1).

Bobby. Bobby, a 3-year, 1-month-old boy, was diagnosed with a developmental delay. Bobby was nominated for inclusion in the study because of the low number of intelligible communication turns he was taking during the day and because his team was trying to further incorporate AAC system components to aid in meeting his daily communication needs. At the start of the study, as reported by the school, Bobby successfully used some intelligible words (<50), vocalizations, some signs (<10), and gestures such as pointing to communicate. It was reported that he would frequently try to imitate adult speech, but often the result was unintelligible. The AAC system components that were used in the classroom and at speech class included (a) various eclectic picture communication symbols in a visual schedule system for each student in the class, (b) various therapist created paper-based AAC core and activity display boards, and (c) limited use of Proloquo2Go on the iPad. Yet, at the time the study began, there was no AAC system component that was used regularly with Bobby. As demonstrated by his performance on the TACL-3, his receptive vocabulary scores were below average for his age (see Table 1).

Beth. Beth, a 40-year-old-female, participated in the study as Bobby's EA. At the start of the study, she had approximately 4 years experience working as an EA in an early childhood education setting and had an additional 2 years experience serving as a driver for children with disabilities. Beth had worked with Bobby for at least 3 months during the current school year, and they appeared to have a positive relationship as evidenced during multiple pre-study classroom observations. Notably, Beth had not previously received systematic training in AAC, and she was enthusiastic about learning more about AAC intervention. She appeared excited to be participating throughout the duration of the study and about working to be helping Bobby communicate better. Initially and during the intervention, Beth expressed some apprehension about being able to perform the instructional sequence correctly.

Design

This pilot study used a simple A-B design with the unit of analysis being the child and EA dyad's performance during shared storybook reading in response to EA instruction and coaching in the MODELER for Read and Talk strategy instructional package. A partner-instruction style approach (Kent-Walsh & McNaughton, 2005) was used where the researcher provided training and coaching to Beth, the communication partner with the goal of positively affecting Beth's instructional performance to promote child communication gains in the form of increased communication turns. A pilot study with a simple A-B design was conducted in preparation for single-subject multiple baseline design, because it allowed for rapid testing of the procedures and measures. In preparation for a subsequent single case design study, Institute of Education Sciences (IES) Single Case Design Standards were used for the number of baseline and intervention sessions, five in each phase (Kratochwill et al., 2010).

Dependent Variables

The study's dependent measures included (a) EA instructional performance and (b) student communication performance. EA instructional performance measurement focused on the levels of intervention variables performed during the shared storybook reading sessions at baseline and intervention (see

Table 2. MODELER for Read and Talk Implementation Elements.

Strategy step	Description
Model	EA models one or more AAC symbols during a communication turn using the iPad-based AAC system.
Encourage	EA provides a time delay or wait time, until child takes a communication turn or 5 s.
Respond	EA responds to a child communication turn with an AAC recast by repeating some portion of the child's utterance and attempts to expand the utterance and models one or more AAC symbols during a communication turn using the iPad-based AAC system.
Read	EA reads a page or page spread in the book and uses MODELER.
Talk	EA makes a comment or asks a question using MODELER.

Note. EA = educational assistant; AAC = augmentative and alternative communication.

Table 3. Child Communication Turn Descriptions.

Turn type	Description
Total communication turns	Communication turns are defined as use of the AAC system, vocalization or speech, or a gesture (e.g., pointing). A turn is considered finished by the communication partner taking a turn or a pause of more than 5 s and a change of communication focus. Communication turns can include more than one modality (e.g., a turn with a gesture and an AAC system activation). Only communication turns related to the shared storybook reading were coded (e.g., not turns such as pointing to a new ear ring).
AAC	Child uses the AAC system by activating a vocabulary item. Navigational items were not coded as an iPad AAC turn.
Gesture	Child uses a gesture (e.g., pointing at a picture in the book).
Speech	Child makes a communicative vocalization or speaks words.

Note. AAC = augmentative and alternative communication.

Table 2 for definitions). Using video analysis of the sessions, the following components were measured: (a) the model step, (b) the encourage step, and (c) the respond step.

The model step was defined by the teacher, activating at least one AAC symbol on the iPad combined with speaking an utterance before, during, or after the AAC symbol activation, which is a modification of the definition described in Kent-Walsh et al. (2010). Measurement of the encourage step was adapted from Halle et al. (1981) and consisted of (a) the EA not vocalizing or using AAC until the child took a turn or for at least 5 s and (b) the EA looking in the direction of the child. The respond step was adapted from Nelson and colleagues' (1996) work on conversational recasting and consisted of the EA providing a response that included speech and an AAC model that repeated some part of what the child had just previously communicated and then provided some type of expansion to the child's utterance.

To precisely measure the end of a model or respond step, EA communication turns were demarked by either the child initiating a turn or a 5-s duration without teacher speaking or activating an AAC symbol on the iPad. This allowed the teacher to (a) take a communication turn, (b) perform an encourage step that was followed by 5 s of student and EA silence, and then (c) start a second utterance that would be counted as a new communication turn. Note that, for the purposes of this study, pointing to an item on the AAC system and activation of navigational items such as selecting the book category were not counted as AAC models.

Student target behavior measurements, in the form of student communication turns, were collected to measure student performance (Carter, 2003). Using video analysis, each student communication turn was coded for total number of communication turns (see Table 3). The definition of a communication turn was adapted from Carter (2003) and included the student engaging in a communicative act through one or more of the following communication modalities: (a) AAC device use, (b) gesture use, and (c) speech or vocalization. Note that communication turns often included more than one modality. For instance, a single turn could include both speech and gestural modalities. The communication turns had to include evidence of intentionality, so, for instance, an accidental iPad press with the elbow was not counted as AAC device use. The boundary of the student communication turns were either (a) the teacher initiating a turn or (b) a 5-s duration where the student was not communicating.

Procedures

Baseline. Five baseline sessions were conducted for Bobby. The baseline conditions for the shared storybook reading sessions included three paper storybooks from the Biscuit series of books by Alyssa Satin Capucili, an iPad with an AAC software, and a table and chairs. The EAs were instructed to engage in the shared storybook reading session as they normally would with the child. The iPads included the AAC software Proloquo2Go (Sennott & Niemeijer, 2008) with vocabulary displays for each book that included both core vocabulary that was shared across books and book specific words. For example, see Figure 1 for iPad AAC vocabulary display used in the study.

Intervention. The intervention consisted of a 90-min EA training for Beth that was conducted in one session. Following this training, Beth resumed shared storybook reading

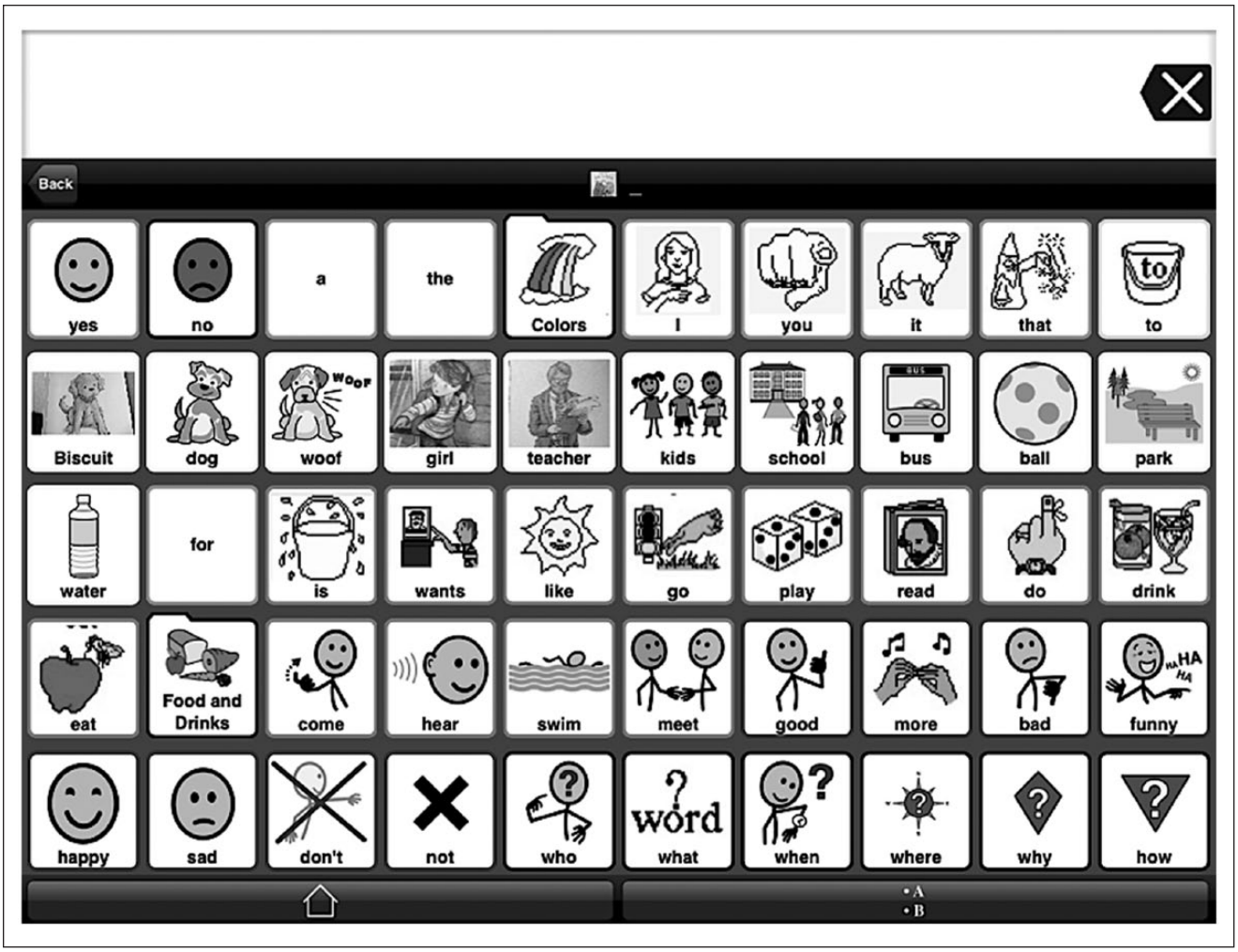

Figure 1. iPad AAC vocabulary display for Biscuit Goes to School.
Note. AAC = augmentative and alternative communication.

sessions with the child, practicing implementing MODELER for Read and Talk using the same books and iPad AAC displays. Each of the sessions lasted approximately 10 min in duration, and exactly 10 min of intervention were coded in the analysis. The principal investigator was present during sessions, serving as a coach.

The MODELER for Read and Talk strategy instructional training was primarily based on six components of explicit instruction for strategy acquisition (Harris et al., 2003) and included the following steps: (1) develop background knowledge, (2) discuss MODELER for Read and Talk, (3) model MODELER for Read and Talk, (4) memorize MODELER for Read and Talk, (5) support MODELER for Read and Talk, and (6) independent performance MODELER for Read and Talk (this step was not conducted because the child participant's family moved).

Following at least five stable baseline points for both EA MODELER steps and student communication turns, training was initialized and EA training Steps 1 through 5 were implemented during an approximately 90-min live training with the principal investigator. The training included developing background knowledge, discussing the strategy, showing models of the strategy in action, memorizing the strategy, and practicing the strategy with support through a simulation experience with the principal investigator. The ultimate goal of the strategy instruction was an increase in each of the MODELER steps performed during reading and talking about the storybooks.

MODELER. The EA was coached that the MODELER steps can be used flexibly as independent steps and that can be used in sequence. For instance, if the child independently communicated an utterance, the EA could launch right into a respond step. They could follow it up with an encourage step, waiting to see if the child will take an additional communication turn. The MODELER strategy could also be

performed in a sequence where the EA could do a model step by speaking and modeling activation of AAC symbols on the iPad and then do an encourage step by pausing. Then the child could take a communication turn and the EA do a respond step adding to what the child said with both speech and activating the AAC symbols on the iPad.

The model step consisted of the teacher activating at least one AAC symbol on the iPad combined with a spoken word performed before, during, or after the AAC symbol activation, which is a modification of the definition described in Kent-Walsh et al. (2010). EA communication utterances in both the model and respond steps could vary in the ratio of the amount of AAC modeled during a spoken utterance. For example, during the study, one particular model step included the spoken language, "Biscuit is good" and only "GOOD" was provided as an AAC model, with other utterances including AAC models for all of the words in the utterance.

The encourage step consisted of (a) the EA not vocalizing or using AAC until the child took a turn or for at least 5 s and (b) the EA looking in the direction of the child. An example of an encourage step is whether Beth took a communication turn and then paused and looked at Bobby and then Bobby then subsequently took a turn. Another example would be whether Beth took a communication turn and then paused and looked a Bobby and waited for at least 5 s for him to respond. This second example would be counted as an encourage step regardless of whether Bobby took a communication turn or not.

The respond step was adapted from Nelson and colleagues' (1996) work on conversational recasting and consisted of the EA providing a response that included speech and an AAC model that repeated some part of what the child had just previously communicated and then provided some type of expansion to the child's utterance. For instance, if Bobby activated the "dog" symbol on the iPad, an example of a respond step would be whether Beth replied to Bobby by speaking with her voice and activating the accompanying AAC symbols, "yes, the dog goes to school."

Intervention sessions. The storybook reading sessions that immediately followed this training were intervention sessions and included the same materials and conditions during baseline. During the intervention sessions, the principal investigator continued to perform Step 5 of the training model (supported practice) by assuming the role of coach. The coach provided supportive and informative feedback during the session. The coach sat at the same table as the child and EA during the intervention sessions and provided in-session feedback in the form of specific praise, prompting, and corrective feedback based on work by Scheeler, Ruhl, and McAfee (2004). The feedback was designed to guide the EA toward successful implementation of MODELER for Read and Talk. The coach tried to keep feedback to a minimum and worked to fade the amount of feedback over the course of each individual session and fade the overall amount of feedback over successive sessions.

Fidelity of implementation. EA training and coaching by the researchers was measured through (a) an implementation fidelity checklist completed by two trained graduate student raters that included the six steps of the strategy instructional approach used for the study and (b) coding intervention sessions for total coaching utterances and type.

To measure researcher implementation, two graduate student scorers observed the video of Beth's training participation and reviewed the intervention sessions. For researcher implementation, the training covered the following steps: (1) develop background knowledge, (2) discuss MODELER for Read and Talk, (3) model MODELER for Read and Talk, (4) memorize MODELER for Read and Talk, and (5) support MODELER for Read and Talk. Step 5 (in-session coaching) was further observed during the intervention session review. Both scorers observed 100% implementation for Steps 1 through 5 using a checklist that had each of the elements and had access to operational definitions of the elements. It was not possible for Bobby to complete Step 6, or fully independent-level sessions with Beth, due to the fact that his family moved at the end of the intervention phase of the study.

The coached intervention sessions were coded for total coaching utterances and type, which included praise, prompting, and corrective feedback. The coaching utterances were defined using the same turn boundary rules as child communication turns and EA models. In addition, 20% of the coached intervention sessions were scored twice for inter-rater reliability by a trained graduate student scorer, obtaining an 85% agreement rate for total utterances and 91% for praise, 82% for prompting, and 100% for correction.

The coaching performance predominantly included a mix of specific praise and prompting. The total number of utterances by the coach had a decreasing trend. The amount of praise and prompting overlapped across the five intervention sessions with both demonstrating a downward trend. There were no documented instances of corrective feedback during this study. Overall, the amount of coaching utterances ranged from 19 to 30 utterances. Examples of praise included, "nice model" and "good encourage step Beth." Examples of prompting included "so you can respond . . . ," "oh you can actually use his system and say . . . ," and "so you responded, he took a turn by nodding, and you can respond again."

Scoring. To code for the study measures, each shared storybook reading session was videotaped with the camera positioned so that the faces of the EA and student and use of the AAC communication system could be seen. Researcher led

training sessions were also videotaped and then later scored for correct implementation. Scorers used the session videos and the video analysis software StudioCode (Sportstec Limited, 2012) to code the videos for target behaviors for the EAs and the students. The scorers were primarily graduate students in special education who had taken coursework in research methods and had completed study-specific training that involved watching sample videos and practicing coding using the coding guides to develop competency with coding the study variables. The principal investigator only participated in scoring the coaching sessions.

Inter-observer agreement. Inter-observer agreement was measured for the researcher implementation of (a) EA instructional performance and (b) student communication performance. Two graduate student research assistants conducted the official scoring and completed a training that included (a) reviewing a coding manual and (b) practice scoring sessions that included a model of how to use the coding manual, data coding software, and supported practice until they reached a high level of proficiency, at least 90% agreement with the researcher model scoring.

For both EA and student target measures, the two research assistants each scored about 50% of the total number of sessions. Then, at least 20% of the sessions across each of baseline, intervention, and post-intervention were scored by a second rater, and total agreements were calculated, and all variables were found to be within acceptable limits. For EA model steps, agreement averaged 89% (range = 67%–100%). EA encourage step agreement averaged 94% (range = 86%–100%). For EA respond steps, agreement averaged 98% (range = 92%–100%). Total child communication turn agreement averaged 99% (range = 96%–100%). For iPad AAC turns, agreement averaged 94% (range = 83%–100%). Gesture turn agreement averaged 83% (range = 55%–100%). Speech turn agreement averaged 83% (range 63%–100%).

Analysis. To analyze the participant performance, the single-subject research analysis procedures used were (a) visual analysis of level, trend, and immediacy of effect (Kratochwill et al., 2010); (b) descriptive statistics in the form of mean differences (calculated as the mean of intervention minus the mean of baseline); and (c) percentage of non-overlapping data (PND; Scruggs, Mastropieri, & Casto, 1987; calculated as the ratio of the number of intervention data points above the highest baseline point; Parker, Vannest, & Davis, 2011).

Results

The results are described in the following order: (a) EA instructional variables will be reported; the number of model steps, encourage steps, and respond steps, and (b) child communication performance will be reported; the number of communication turns and modality (iPad-based AAC, gesture, or speech turns) will be described.

EA Instructional Performance

Beth's instructional performance during intervention was characterized by increases in model, encourage, and respond steps (see Figure 2).

Model steps. From baseline to intervention, Beth made an immediate increase in level for the number of AAC model steps performed and experienced a slight decreasing trend over the five intervention sessions. At baseline, Bobby's EA was performing a very low number of AAC model steps, with a mean of less than one AAC model steps per session (range = 0–1). During intervention, Bobby's EA increased the use of AAC model steps to a mean of 6.8 (range = 5–8) with 100% non-overlapping data.

Encourage steps. Similarly, Bobby's EA also experienced a level increase in the number of encourage steps performed and the trend increased steeply during the course of intervention. At baseline, she was performing a mean of 6 encourage steps (range = 2–9). During intervention, the mean number of encourage steps increased to 18.8 (range = 7–36) with 80% non-overlapping data, with the highs of 23 and 36 encourage steps occurring in the final two intervention sessions.

Respond steps. Beth also demonstrated an immediate level change in her performance of respond steps, which was followed by a steep upward trend. Beth increased responds steps performed from a mean of less than one (range = 0–2) at baseline to a mean of 19.8 (range = 10–29), during intervention, with 100% non-overlapping data.

Child Communication

Bobby increased in level for the total number of communication turns taken from baseline to intervention with an upward trend demonstrated in the data (see Figure 3). Note that communication turns often included more than one modality. For instance, a single turn could include both speech and gestural modalities. In the event that multiple modalities were used, only a single communication turn was counted in the total number of communication turns score. In addition, a count of the modalities used in each turn is reported. In that way, one communication turn could include a count of a speech, gestural, and iPad AAC modalities.

During baseline, Bobby took a mean of 24.3 turns (range = 17–32). The majority of these turns were gestures, as evidenced by the mean of 16.8 gestures (range = 11–27)

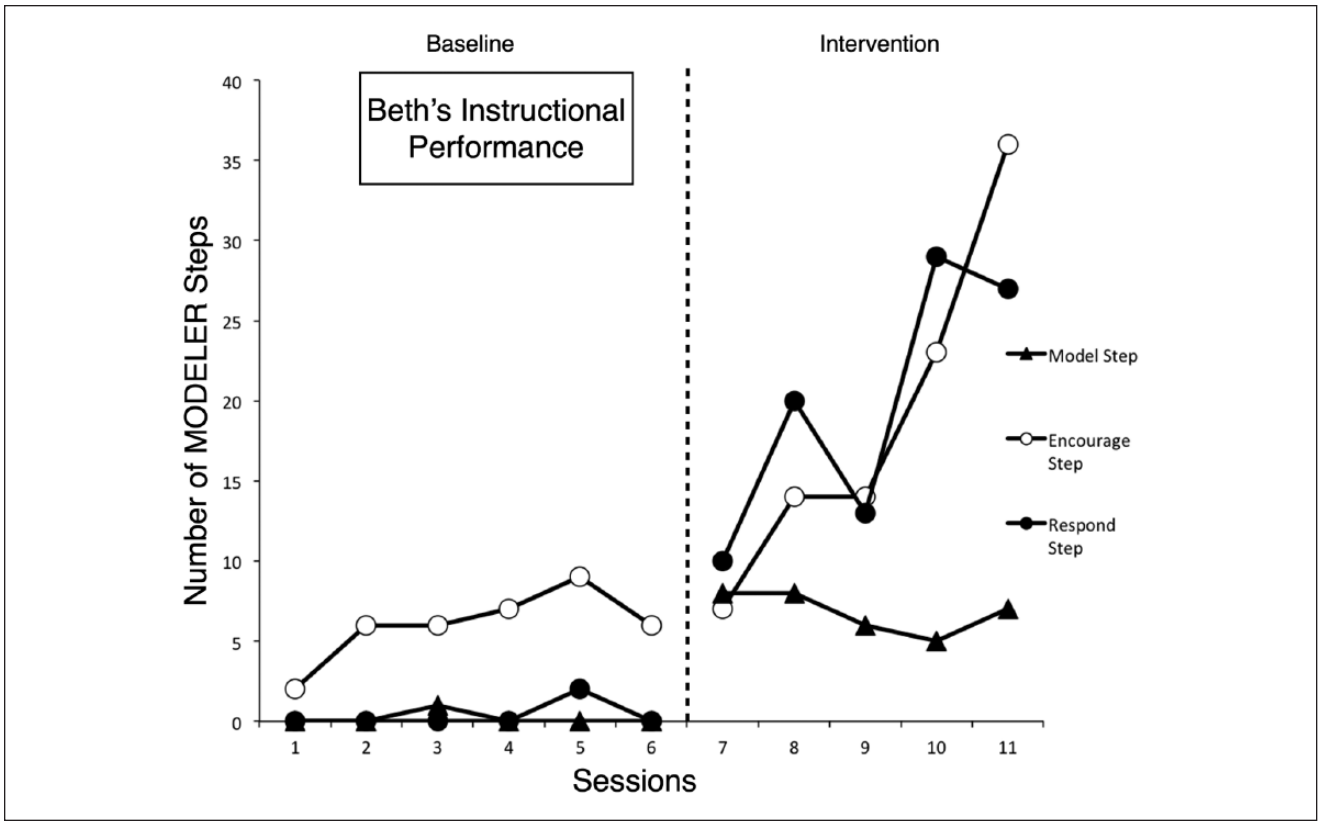

Figure 2. MODELER (Model, Encourage, Respond) steps performed by the EA during shared storybook reading sessions with child during 10-min instructional sessions.
Note. EA = educational assistant.

during baseline. Moreover, nearly all of these gestures were in the form of pointing at pictures in the book. A smaller number of the turns in baseline were iPad AAC turns ($M = 4.7$) and speech turns ($M = 6.7$).

During intervention, the total number of communication turns increased to a mean of 46 turns (range = 34–66) with 100% non-overlapping data from baseline. Bobby's increase in communication turns was accounted for by increases in the AAC and speech modalities and a decrease in turns was represented in the gesture modality. Bobby's AAC turns demonstrated a level change with a sharp upward trend in the data. His AAC turns increased to a mean of 34.6 AAC turns (range = 27–51) with 100% non-overlapping data (see Table 4). The AAC communication turn increase represented a mean difference of 29.9 turns or a 641% gain from baseline. His speech turns also demonstrated a level change with a steep upward trend. His speech turns increased to a mean of 26.8 turns (range = 14–37) with 100% non-overlapping data. These speech turn gains represented a mean difference of 20.1 turns or a 302% gain from baseline. Bobby's gesture turns made a modest decrease in level with a stable trend, shifting from a mean of 16.8 turns at baseline to 5.8 turns during intervention (range = 4–9) with 0% non-overlapping data. This represented a mean difference of 11 turns or a 65.5% decrease. Overall, these results represent a shift from the predominance of gesture turns during baseline to the majority of the turns in the course of intervention being AAC and speech turns, both symbolic modalities.

Discussion

In this study, Beth, an EA, made meaningful gains in the number of model, encourage, and respond steps following an AAC intervention consisting of communication partner strategy instruction and coaching. During baseline, Beth was able to engage with him in shared storybook reading sessions but demonstrated very low levels of the instructional strategy steps. In addition, during the 90-min researcher led training session, Bobby's EA remarked that she had not previously thought of using the AAC device as her own voice. Yet, in response to the training session, she expressed excitement about the new possibilities related to implementing MODELER. Overall, interaction during the intervention sessions was characterized by Beth achieving large gains in the number of total AAC models performed

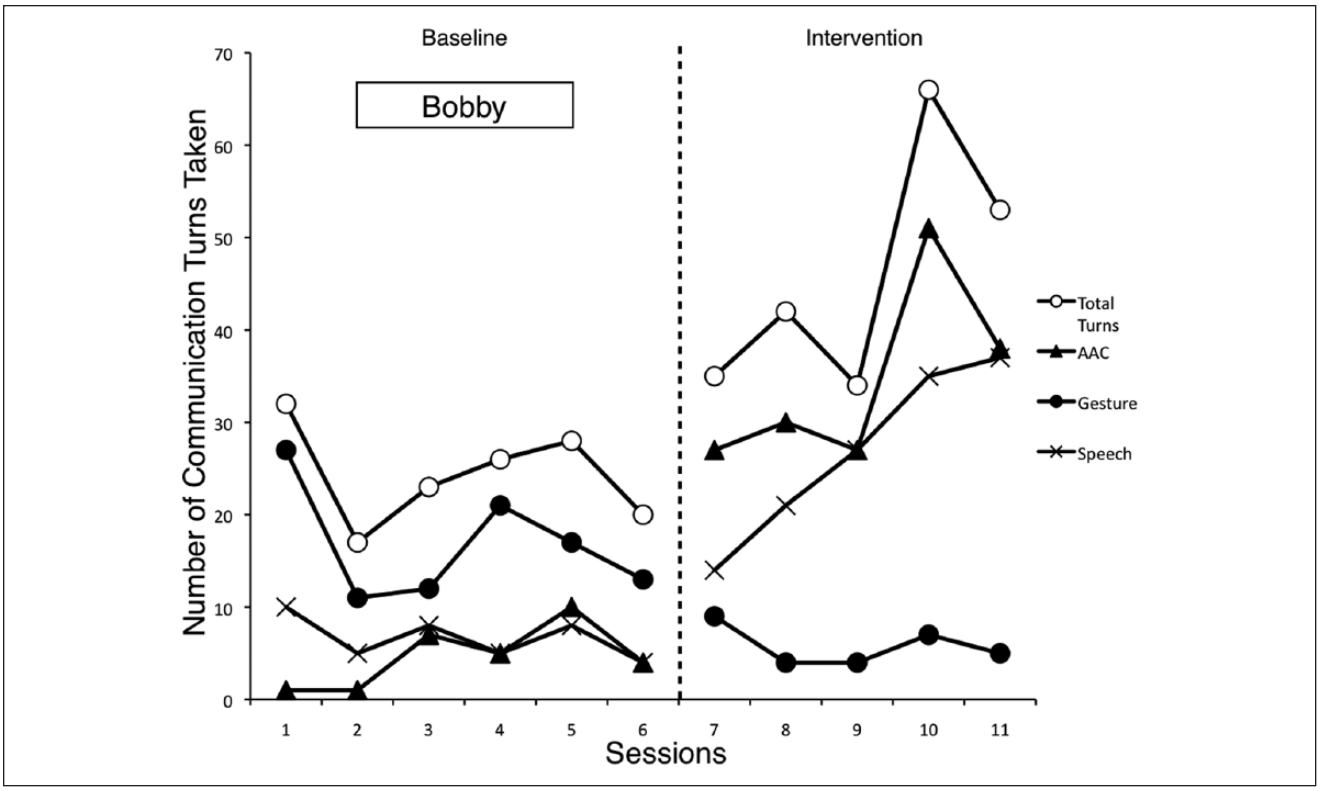

Figure 3. The number of communication turns taken by Bobby during shared storybook reading sessions and modalities used during communication turns.
Note. AAC = augmentative and alternative communication.

Table 4. Student Communication Turns Descriptive Statistics and PND.

Participant	Turn type	Base *M*	Int *M*	MD	MD % change	PND
Bobby	Total turns	24.3	46	21.7	89%	100
	AAC	4.7	34.6	29.9	641%	100
	Gesture	16.8	5.8	−11	−66%	0
	Speech	6.7	26.8	20.1	302%	100

Note. Base = Baseline; Int = Intervention; MD = Mean difference; PND = percentage of non-overlapping data

(across both the model and respond steps) and large gains in encourage steps performed.

Beth's instructional performance shifted from performing nearly no AAC modeling during her communication turns to one session during intervention where she modeled 34 total times (model and respond steps combined). This demonstrated a completely different instructional emphasis where the AAC system had become a frequent tool used by the EA. In addition, for Beth, most of the AAC models came during the respond step, meaning that they came after Bobby had taken a communication turn, putting the AAC models in the context of a multi-turn conversational sequence. Taken together, Beth's instructional performance gains provide evidence to suggest that the strategy instruction was effective at affecting her behavior in a relatively short amount of time, a 90-min training plus five coached shared storybook reading sessions.

Bobby demonstrated communication gains in the form of increased frequency of communication turns. Specifically, increased instructional performance by Beth corresponded with Bobby experiencing large increases in the total number of communication turns, specifically in AAC and speech turns. In Session 4, Bobby made a session high of 66 overall communication turns, with 51 iPad AAC turns, 35 speech turns, and seven gesture turns, which represents a relatively high frequency of communication turns. In addition, the majority of his communication turns during baseline were gestures and primarily were instances of him

pointing to pictures in the storybook. During intervention, they were replaced with AAC and speech turns, as he made a decreased number of these pointing gestures. These gains in AAC and speech turns represent a beneficial shift into symbolic communication modalities that can expand beyond the scope of present contexts and into flexible, generative language.

Implications for Practice

The preliminary evidence reporting increases in communication partner instructional performance in response to the MODELER for Read and Talk intervention package provides an initial demonstration that EAs can change their instructional performance efficiently when provided with training and coaching. The increase in AAC modeling combined with speech turns provides language input to children who require AAC to communicate, which better matches the way they communicate expressively. The presence of these intervention variables, AAC modeling, time delays, and AAC recasts corresponded with the child taking relatively high numbers of communication turns using symbolic forms of communication during the shared storybook reading sessions. This positive student performance is consistent with comparable interventions that include those similar instructional variables (Sennott et al., 2014). Overall, this preliminary evidence underlines the need to provide EAs with training and coaching so that they can successfully support children with CCN and highlights potential positive outcomes obtained with EAs given support in AAC intervention.

Limitations and Future Research

In summary, the EA and student positive results provide promising preliminary evidence of the effectiveness of the MODELER for Read and Talk strategy instructional model. Yet, it is important to note that this preliminary evidence is a pilot study with a historically weak A-B design and therefore should be interpreted with the limitations inherent of that evidence level. In addition, Bobby and Beth were not able to complete Step 6 of the instructional model, which involves fully independent sessions due to Bobby's family moving. This lack of post-intervention sessions is a significant limitation and meant there was not a measure of maintenance.

The positive communication partner and child results, combined with the relative efficiency of the intervention leads to the overall conclusion that the approach should be investigated further with future research, including more participants and increasing levels of experimental control with participants engaging in post-intervention and generalization sessions.

For future research and refinement of the instructional model, it is important to note that Beth demonstrated an increase in trend for instructional performance over the sequence of the five intervention sessions. This can be interpreted that practice had a positive effect on performance. For future research, additional focused practice during the training session should be implemented to determine impact on performance during initial intervention sessions. In addition, for future research, less invasive coaching methodologies could be explored such as bug-in-the-ear technology (Scheeler, McAfee, Ruhl, & Lee, 2006), in contrast to the present coach at the table approach, to control for participant distraction. Another key limitation of this study is the lack of a transcript analysis of the coaching provided in session. Future research should further refine a coding system for the amount and type of coaching provided.

In addition, future research is needed to further evaluate whether the strategy instruction can generalize to increase overall communication turns and AAC communication turns for other children who, similar to Bobby, are taking a low number of communication turns that are primarily simple gestures, vocalizations, and a low number of speech utterances. Systematic replications should investigate people representing various disability groups and having various language skill levels. Future research should also explore the impact MODELER has on communication turn quality outcomes, including pragmatic goals (e.g., turn initiation and multi-turn conversational sequences), semantic goals (e.g., receptive or expressive vocabulary), and grammar goals (e.g., multi-symbol and agent-action utterances, morphology structures).

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