Teaching Educational Assistants to Facilitate the Multisymbol Message Productions of Young Students Who Require Augmentative and Alternative Communication

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**Purpose:** Many classroom educational assistants (EAs) have a significant amount of responsibility in carrying out educational plans for children who use augmentative and alternative communication (AAC), but they receive little instruction on how to do so (Kent-Walsh & Light, 2003). This study investigates the impact of using a communication partner instructional program to teach EAs how to teach their students to produce symbol combinations on their speech-generating devices.

**Method:** A single-subject multiple-probe-across-participants design was used to evaluate the effectiveness of the instructional program on (a) the EAs’ implementation of an interaction strategy with their students who used AAC and (b) the rates of multisymbol message productions for the students who used AAC.

**Results:** All 3 participating EAs learned to use the interaction strategy appropriately, and all 3 participating students who used AAC increased their multisymbol message production rates.

**Conclusions:** Results provide further evidence (a) of the viability of using a communication partner instructional program for teaching partners how to facilitate the communication skills of children who use AAC and (b) that the interaction strategy can be an effective tool for increasing expressive multisymbol message rates for children who use AAC.

**Key Words:** augmentative and alternative communication (AAC), intervention, educational assistants, symbol combinations

Many preschool and school-age students who require augmentative and alternative communication (AAC) receive classroom support from educational assistants (EAs; i.e., paraeducators or instructional assistants). In today’s classrooms in the United States, EAs may spend much of their time with students who use AAC, and EAs frequently are given a significant amount of responsibility in carrying out educational plans for these children. In fact, classroom teachers and other AAC team members have indicated that EAs are a crucial part of a child’s AAC team (Kent-Walsh & Light, 2003; Soto, Müller, Hunt, & Goetz, 2001). For example, key stakeholders in one study (Soto et al., 2001) indicated that having knowledgeable and skilled AAC team members, including EAs, was a key indicator of successful classrooms that included children using AAC. One participant noted, “I really think it takes a strong instructional assistant, ‘cause they’re the ones in the trenches all day long” (Soto et al., 2001, p. 65).

Despite the fact that EAs may have more direct contact with children who use AAC than anyone else during any given school day may have, EAs may receive the least amount of guidance in working with these children. In Kent-Walsh and Light’s (2003) study investigating general education teachers’ experiences in working with children who use AAC, the classroom teachers indicated that a lack of EA skills was a common barrier to effective instruction. Soto and colleagues...
(2001) reported similar findings, with one parent noting, “We’ve just had a lot of problems with instructional assistants, and if that’s not in place, and if that’s not working, then everything sort of falls apart” (p. 67).

Such findings clearly indicate a critical need to create effective instructional programs to teach EAs how to work with children who use AAC. Toward this end, Bingham, Spooner, and Browder (2007) implemented an instructional program designed to teach EAs how to increase AAC use and decrease problem behaviors for their students who used AAC. Three EA–student dyads participated in the study. The EAs received a total of 6 hr of instruction, which included foci on the following: (a) an overview of components of behavior, communication, prompting, and self-evaluation (2 hr); (b) role plays to practice prompting student use of AAC (by using a cuing hierarchy) and responding to students’ communication attempts (3 hr); and (c) self-evaluation of their newly acquired skills (1 hr). All data collection for the dependent measures took place in the classroom during typical classroom activities. The EAs all demonstrated increases in prompting student use of AAC (via verbal, gestural, and physical prompts) and in their frequency of responses to the students’ communication attempts. Two of the three students demonstrated modest increases in their AAC use (i.e., use of a speech-generating device, or SGD, up to nine times during a 3-hr classroom period), and all students demonstrated increases in their frequencies of challenging behaviors.

Kent-Walsh and McNaughton (2005) proposed an eight-step model for communication partner instruction and provided a comprehensive discussion of using this approach for AAC communication partner instruction. This model was chosen because of the strong evidence base indicating that this approach can assist learners in acquiring strategies that can be used across a variety of activities and that can be maintained over time (Ellis, Deshler, Lenz, Schumaker, & Clark, 1991). Kent-Walsh, Binger, and colleagues used the guidelines developed by Kent-Walsh and McNaughton to develop the ImP AACT (i.e., Improving Partner Applications of Augmentative Communication Techniques) Program. This program has been used in a series of studies focused on enhancing communication partner instruction by using this instructional model. In the first of these investigations, Kent-Walsh (2003) set out to improve the interaction patterns of EAs and their students who used AAC. All six EAs successfully learned new techniques to improve interactions with their students, and all six students demonstrated increases in their turn-taking skills during storybook-reading activities as a result of the EAs using their new interaction skills. To date, however, EAs have only been instructed to use this program to promote increases in turn-taking rates. Although ensuring that children who use AAC are participating in interactions with others is essential, it is only a first step toward ensuring that children who are symbolic communicators reach their full communicative potential. Individuals who use AAC tend to use a preponderance of single symbol messages, including some preschool and school-age children who have receptive language scores that would indicate the potential to develop expressive syntax and morphology (Binger, Kent-Walsh, Berens, Del Campo, & Rivera, 2008; Binger & Light, 2007, 2008). Unfortunately, many educators may be unwittingly limiting the academic potential of many students who use AAC.

Kent-Walsh and colleagues have published two additional investigations using the ImP AACT Program with parents, one of which addressed the need to expand the findings beyond basic symbolic turn taking. First, Kent-Walsh, Binger, and Hasham (2010) used the program to teach six parents to use an interaction strategy to increase the turn-taking rates of their children who used AAC. Second, Binger, Kent-Walsh, et al. (2008) taught three parents to increase the multisymbol message productions of their children who used AAC. The ImP AACT Program was successful in both studies. Specifically, the communication partners in both investigations successfully learned to implement the strategy, which was a least-to-most cuing hierarchy, and the children in both investigations demonstrated markedly improved communication skills—that is, increases in turn-taking rates in Kent-Walsh et al. (2010) and in multisymbol message production rates in Binger, Kent-Walsh, et al. (2008). It would be useful to replicate and expand the findings regarding multisymbol message productions with EAs to ensure that this approach is also viable for educators. Therefore, the current investigation explored the following research questions:

1. What is the effect of implementing the ImP AACT Program on EAs’ implementation, generalization, and maintenance of the targeted interaction strategy during book-reading activities?
2. What is the impact of the instruction on the multisymbol message productions of their students who used AAC?

Method

Research Design

A single-subject multiple-probe-across-participants design was used to determine the effectiveness of the ImP AACT Program. Three EA–child dyads participated in the study. Multiple-probe designs are well suited for AAC intervention research, as they provide experimental control while allowing for the inclusion of participants from low-incidence and heterogeneous populations (McReynolds & Kearns, 1983).

Participants

Three EAs and three students residing in a metropolitan area of central New Mexico participated in the investigation. Informed consent was obtained from the EAs and from the students’ parents. Participant selection for the EAs included the following criteria: The participants (a) were working in a classroom containing at least one student who used AAC; (b) had at least a high school diploma or equivalent; (c) had no known speech, language, or hearing impairments; and (d) were implementing the targeted interaction strategy in less than 25% of opportunities during book-reading interactions with their students at the onset of the investigation. See Table 1 for EA demographic information.

The children in the investigation met the following criteria, based on Bedrosian’s (1999) selection criteria for AAC
interactive storybook-reading research and Binger and Light’s (2007) selection criteria for teaching multisymbol messages. The participants (a) were enrolled in a preschool or elementary school; (b) presented with severe, congenital motor speech impairments (i.e., less than 50% comprehensible speech in the “no context” condition of Dowden’s, 1997, Index of Augmented Speech Comprehensibility in Children); (c) had an expressive vocabulary of at least 25 words/symbols, as indicated on the MacArthur Communicative Development Inventories (Fenson et al., 1993); (d) communicated using telegraphic messages (i.e., no more than 10% of communicative turns consisting of two or more aided AAC symbols during a 10-min storybook-reading activity); (e) were able to listen to stories and answer simple open-ended questions based on stories (e.g., “Who?” “What?”); (f) comprehended early two-word relations with at least 80% accuracy, based on measures from Miller and Paul (1995); and (g) had hearing and vision within (or corrected to be within) functional limits. In addition, all of the children had prior exposure to AAC; each child had been provided with an SGD prior to the onset of the study, and all used direct selection with their index fingers (and occasionally other fingers) to access their devices. See Table 2 for child participant characteristics.

Oscar Oscar, a Latino male, was age 6;4 (years;months) at the start of the investigation. He had a developmental delay with no additional formal diagnoses. English was his second language; his family primarily spoke Spanish at home. He received the majority of his preschool educational services in English, and bilingual services in his current kindergarten classroom (his classroom teacher was fluent in Spanish and English). Oscar’s mother, teachers, and speech-language pathologist (SLP) reported that his speech and language difficulties were similar in both languages. Although Oscar had an extensive imitative speech sound repertoire, he seldom initiated speech in either language. He attended a kindergarten classroom that contained some students who were

### TABLE 1. Education assistant (EA) participant demographic information.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Sex</th>
<th>Place of employment</th>
<th>Highest education level completed</th>
<th>Years of classroom experience</th>
<th>Racial/ethnic background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscar’s EA</td>
<td>F</td>
<td>Integrated kindergarten classroom (one half with disabilities, one half typically developing)</td>
<td>24 college credits</td>
<td>5</td>
<td>African American</td>
</tr>
<tr>
<td>Adam’s EA</td>
<td>F</td>
<td>Preschool classroom for children with developmental disabilities</td>
<td>9 college credits</td>
<td>4</td>
<td>Latina</td>
</tr>
<tr>
<td>Valerie’s EA</td>
<td>F</td>
<td>Kindergarten classroom for children with developmental disabilities</td>
<td>Bachelor of science in biology, working toward master of arts in education</td>
<td>3</td>
<td>Latina/Anglo</td>
</tr>
</tbody>
</table>

Note. Pseudonyms have been used for child participants.

### TABLE 2. Child participant characteristics including ethnicity, chronological age, sex, primary disability, speech comprehensibility, TACL–3 scores, and communication modes.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Speech comprehensibility and context (I-ASCC)</th>
<th>TACL–3 scores</th>
<th>Communication modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, ethnicity</td>
<td>Age, sex, Disability</td>
<td>No context</td>
<td>Semantic context</td>
</tr>
<tr>
<td>Oscar, Latino</td>
<td>6;4, M</td>
<td>DD</td>
<td>30%</td>
</tr>
<tr>
<td>Adam, Anglo</td>
<td>4;6, M</td>
<td>DD: suspected CAS</td>
<td>0%</td>
</tr>
<tr>
<td>Valerie, Latina</td>
<td>5;8, F</td>
<td>Dysarthria; CP</td>
<td>7%</td>
</tr>
</tbody>
</table>

Note. Ages and age equivalents are in years;months. I-ASCC = Index of Augmented Speech Comprehensibility in Children (Dowden, 1997); TACL–3 = Test for Auditory Comprehension of Language—Third Edition (Carrow-Woolfolk, 1999); V = Vocabulary; GM = Grammatical Morphemes; EPS = Elaborated Phrases and Sentences; SS = standard score; DD = developmental delay; CAS = childhood apraxia of speech; PECS = Picture Exchange Communication System; CP = cerebral palsy.
typically developing learners as well as students with a variety of disabilities. Oscar lived at home with his mother, father, and younger sibling.

Adam. Adam was an Anglo male age 4;6 who had a diagnosis of developmental delay and suspected childhood apraxia of speech, and came from a monolingual English-speaking family. Both of his parents exhibited cognitive impairments. Adam’s speech sound repertoire was extremely limited, consisting mainly of neutral vowels, a few stop sounds, and nasals. He attended a preschool classroom for children with developmental disabilities. Adam lived at home with his parents and older sister.

Valerie. Valerie, a Latina girl who was age 5;8, had profound dysarthria secondary to severe cerebral palsy. She had left hemiplegia with very limited use of her left hand, and her left leg dragged when she walked. Valerie came from a monolingual English-speaking family. Her speech sound repertoire consisted of a variety of vowels, nasals, stops, and a few fricatives. She attended a kindergarten classroom for children with disabilities, but her parents and teachers planned to enroll her in a typical first-grade classroom the following year. She had recently received a Springboard (Pentek Romich), and her team was in the process of learning to use the device. Valerie lived at home with her parents and two younger brothers.

Materials and Instrumentation

The storybooks used for the investigation were the same storybooks used by Binger, Kent-Walsh, and colleagues (2008) and met the same criteria. Namely, the books selected (a) had illustrations; (b) incorporated text and storylines that were appropriate to each child’s receptive language level, cultural background, and interests; and (c) included at least six double-page spreads (i.e., 12 pages). The storybook sets included Mercer Mayer’s Little Critter books and Dora the Explorer books (various authors). To facilitate the students’ productions of multisymbol messages, culturally and developmentally appropriate symbols were added to each student’s SGD. One vocabulary display was created for each storybook used in the investigation and included the main characters, actions, descriptors, and objects in the story. The displays were similar across children, to the extent that programming the different SGDs would allow. All displays were created using Fitzgerald keys (McDonald & Schultz, 1973); that is, symbols were organized from left to right, following typical word order patterns (agents, actions, descriptors, objects, etc.), and each category was color coded. Each symbol on the display represented one concept (e.g., DORA, RIDE, BIKE), so that symbols could be combined to form brief sentences (e.g., DORA + RIDE + BIKE). Each page contained 30–35 symbols (see www.cathybinger.com to view displays).

Dependent Measures

There were two dependent measures for the investigation: (a) the percentage of strategy steps correctly implemented by the EAs on each page of the storybook, and (b) the frequency of multisymbol messages produced by the students, using their SGDs, within a 10-min story-reading session. In addition, collateral measures were taken on the number of different symbol combinations (e.g., DORA + RIDE vs. DORA + PLAY) and the number of spontaneous symbol combinations the children produced in each phase of the study. Additional measures, including the overall number of symbols produced (not just symbol combinations), number of spontaneous aided AAC messages (including single and multisymbol messages), number of syllables vocalized, number of points to the book, and number of other symbolic gestures (e.g., head nod/shakes, manual signs) have been reported previously (Binger, Berens, Kent-Walsh, & Hickman, 2008).

Procedure

Baseline phase. Baseline measures were taken to establish current levels of performance on the dependent measures. A minimum of three baseline sessions were completed for each EA–student dyad and continued until there was little variation in the data, with no indication of an increasing trend (McReynolds & Kearns, 1983). Before baseline probes began, book sets were randomly assigned for each dyad. One set of storybooks was used to instruct the EAs and to take intervention data (Set A books; e.g., Little Critter), and a second set of storybooks was used for generalization measures (Set B books; e.g., Dora the Explorer). Separate baseline measures were taken for Set A and Set B books.

Each baseline session consisted of a 10-min story-reading session with the EA and student. All sessions took place in a quiet room at the student’s school and were videotaped in full. The EAs were instructed to read to their students as they typically would. The students and EAs had access to the students’ SGD, with the relevant communication display on the screen. No feedback regarding performance was provided to the EAs or students during these sessions.

Instruction and intervention phase. This phase was composed of two main components: (a) instructing the EAs to use the interaction strategy and (b) evaluating the impacts of the instruction on the EAs’ use of the interaction strategy and on the students’ multisymbol production rates. Set A storybooks were used for both components of this phase (specifically, Little Critter books for Oscar, and Dora the Explorer for Adam and Valerie).

For the first component of EA instruction, the first author worked individually with each EA. The EAs were taught to use a modified version of the interaction strategy used by Binger, Kent-Walsh, and colleagues (2008) to teach Latino parents how to facilitate their children’s multisymbol aided AAC productions. In Binger, Kent-Walsh, et al., this cuing hierarchy consisted of three main steps: read, ask, and answer (i.e., RAA RAA RAA!). One additional step, a brief verbal prompt, was added for the current investigation (i.e., RAAP RAAP RAAP!). That is, each time the EA turned the page of a story, she was instructed to adhere to the following steps until the student took a multisymbol turn on his or her SGD:

1. Read text + provide two-symbol aided AAC model (i.e., provide a spoken model of a multisymbol message and
also use two symbols on the student’s SGD; Binger & Light, 2007;  
2. Ask a wh-question + provide a two-symbol aided AAC model;  
3. Answer the wh-question + provide a two-symbol aided AAC model;  
4. Provide a brief verbal prompt (e.g., “Your turn” or “Show me two”).

Between each of the above steps, the EAs were taught to provide an expectant delay of at least 5 s to provide students with opportunities to take turns. For the Latino students, EAs were not required to maintain an expectant facial expression during the expectant delay, as delivering the cue in this manner may be interpreted as punitive by some Latino children (Binger, Kent-Walsh, et al., 2008). Finally, the EAs were instructed to respond contingently to each multisymbol message the students produced by using an aided AAC model containing at least two symbols. These responses typically took the form of imitations, expansions, extensions, and corrections. For example, if the student said DIEGO FLY, the EA might respond by saying Diego is flying DIEGO FLY (imitation), Diego and Dora are flying DIEGO DORA FLY (expansion), Yes, Diego is in his plane DIEGO PLANE (extension), or I don’t see Diego flying, but I do see Dora with Boots DORA BOOTS (correction). See Figure 1 for a depiction of the interaction strategy that was provided for and used by each EA. The following is an example of an interaction using RAAP!, in which the student does not use a multisymbol message until the final step of the cuing hierarchy:

**FIGURE 1. Interaction strategy (RAAP, for read, ask, answer, and prompt) used by educational assistants to teach their students to use multisymbol messages with augmentative and alternative communication (AAC) system. Reproduced with permission from Binger, Kent-Walsh, et al. (2008).**

| READ + MODEL 2 SYMBOLS using AAC system |  
| "Pause*" |  
| ASK + MODEL 2 SYMBOLS using AAC system |  
| *Pause* |  
| ANSWER + MODEL 2 SYMBOLS using AAC system |  
| *Pause* |  
| PROMPT (BRIEF verbal prompt) "Show me two" |  
| "Pause*" |  

**RAAP, RAAP, RAAP!**

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Until the child uses 2 symbols, you will **RAAP** on each page of the book:

<table>
<thead>
<tr>
<th>“Elicitation” Component</th>
<th>“Response” Component</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>READ</strong> + <strong>MODEL 2 SYMBOLS using AAC system</strong></td>
<td></td>
</tr>
<tr>
<td><em>Pause</em></td>
<td></td>
</tr>
<tr>
<td><strong>ASK</strong> + <strong>MODEL 2 SYMBOLS using AAC system</strong></td>
<td></td>
</tr>
<tr>
<td><em>Pause</em></td>
<td></td>
</tr>
<tr>
<td><strong>ANSWER</strong> + <strong>MODEL 2 SYMBOLS using AAC system</strong></td>
<td></td>
</tr>
<tr>
<td><em>Pause</em></td>
<td></td>
</tr>
<tr>
<td><strong>PROMPT</strong> (BRIEF verbal prompt) &quot;Show me two&quot;</td>
<td></td>
</tr>
<tr>
<td><em>Pause</em></td>
<td></td>
</tr>
</tbody>
</table>

When the child uses 2 or more symbols: **RESPOND** by using 2 or more symbols

EA: [“read” component] Diego is flying his helicopter DIEGO FLY [expectant delay]  
Student: [does nothing]  
EA: [“ask” component] Who is flying the helicopter WHO FLY [expectant delay]  
Student: DIEGO  
EA: [“answer” component] Yes, Diego is flying the helicopter DIEGO FLY [expectant delay]  
Student: FLY  
EA: [“prompt” component] Show me two  
Student: DIEGO FLY  
EA: [“response” component] Yes, Diego is flying his helicopter DIEGO FLY HELICOPTER

The eight-step communication partner instruction model described by Kent-Walsh and McNaughton (2005), as incorporated into the ImPAACT Program, was used as a framework for instructing the EAs. These eight steps have been used within other ImPAACT Program studies (Binger, Kent-Walsh, et al., 2008; Kent-Walsh, 2003; Kent-Walsh et al., 2010) and were defined as follows:

1. Pretest and solicit the EA’s commitment to learning the targeted strategy.  
2. Describe the strategy.  
3. Demonstrate use of the strategy.  
4. Provide verbal practice of the strategy steps (using the RAAP RAAP RAAP! mnemonic, for the current investigation).  
5. Practice implementing the strategy in controlled contexts (i.e., in role plays with the first author).  
6. Practice implementing the strategy in natural contexts (i.e., book reading with the children).  
7. Complete posttest and solicit the EA’s commitment to long-term implementation of the strategy.  
8. Demonstrate generalized use of the strategy.

This is an errorless learning approach to instruction in which the first author guided each EA through each step, providing feedback for Steps 2–6. During Step 6, the EA practiced using the interaction strategy with the student, while the first author provided the EA with prompting and feedback as needed (i.e., until the EA implemented the strategy steps with at least 90% accuracy for at least 20 double-page spreads of the books).

The second component of this phase, in which outcome measurements were taken, began with Step 7 of the instructional program. That is, during Step 7, the EAs read stories to their students with no further feedback from the first author, and intervention data on the EA and student dependent variables were taken. For each dyad, intervention sessions continued until the student produced at least 10 multisymbol messages per session for three consecutive 10-min sessions.

To provide experimental control, the timing of the phases was staggered across the dyads. Once stable baselines were established with Oscar and his EA, the EA received instruction, followed by intervention for Oscar. Once a treatment effect was noted for Oscar and his EA, Adam’s EA received instruction, followed by intervention for Adam. Similarly,
Valerie’s EA began the instructional phase once Adam demonstrated a treatment effect.

Generalization phase. For Step 8 of the program (i.e., demonstrate generalized use of the strategy), EA and student performance was evaluated with a novel set of storybooks. Set B books were used for this phase—specifically, *Dora the Explorer* books for Oscar and *Little Critter* books for Adam and Valerie. To assess outcomes for this phase, EA and student performance on Set B books in the generalization phase were compared with EA and student performance on Set B books during baseline. Generalization phase measures were taken approximately 2–7 days following the last intervention session. The EAs and students were not provided with any feedback.

Maintenance phase. To ensure that the EAs maintained use of the RAAP RAAP! interaction strategy over time and that the students continued to produce multisymbol messages consistently, maintenance probes were scheduled approximately 2, 4, and 8 weeks following the generalization phase. No feedback or instruction was provided to the EA or student during this phase.

Procedural Reliability

To ensure accurate implementation of the ImPACT Program, the first author followed Kent-Walsh’s (2003) procedural standard for instructing EAs, with slight modifications made to reflect changes in the instructional strategy and child dependent variables (i.e., focus on multisymbol messages instead of turns, and addition of the “prompt” step to the RAAP RAAP! strategy). All instructional sessions were videotaped in full. Trained research assistants (undergraduate and graduate speech-language pathology students) reviewed the instructional sessions to verify the first author’s adherence to the procedural standard. Each assistant used a checklist that contained the steps to be included within each instructional session and checked off the presence or absence of each step. Procedural reliability was taken for 100% of the EA instructional sessions and was calculated as follows: the number of instructional steps correctly implemented divided by the sum of the number of steps correctly implemented, incorrectly implemented, and omitted. For all sessions, procedural reliability was 100%, indicating that the instructional protocol was followed adequately.

Coding

All baseline, intervention, generalization, and maintenance sessions were videotaped and transcribed in full by trained research assistants (undergraduate and graduate speech-language pathology students). The transcripts were created by repeatedly viewing each videotaped session. Both EA and student behaviors were recorded. For EA behaviors, all spoken words were recorded, including reading the text of the storybooks and other speech, in addition to other actions that described events of the session (e.g., turning a page of the book). For the students, all symbolic messages were recorded, including aided AAC messages, intelligible speech, manual signs, and symbolic gestures (e.g., head nod/shake). In addition, unintelligible vocalizations (each syllable marked with an “x”) and other gestures (e.g., pointing to pictures in the story) were recorded. Research assistants recorded the percentage of spontaneous multisymbol messages within each session (i.e., at least one symbol not present in the EA’s prior turn, either via speech or aided AAC) and the number of different multisymbol messages (e.g., *LITTLE CRITTER SHOP* vs. *LITTLE CRITTER MALL*).

Measures for the dependent variables were taken by the research assistants once each transcript was complete. The assistants reviewed the videotapes and transcripts to collect the data. EA and student measures were calculated following the guidelines of Binger, Kent-Walsh, and colleagues (2008). For EA measures, the percentage of steps each EA correctly implemented within each session was calculated. A “step” included each portion of the interaction strategy. For example, the first step of the strategy was “Read text + provide two-symbol aided AAC model,” and the second step was “Pause” (i.e., provide an expectant delay; see Figure 1). Each step was coded as correctly implemented, incorrectly implemented, or omitted on the data collection forms. The percentage of steps correctly implemented was divided by the total number of steps (i.e., implemented correctly, implemented incorrectly, or missing) for each session. For student data, assistants recorded every aided AAC symbol combination, as operationally defined by Binger and Light (2007); that is, any two aided symbols were defined as being part of the same message if there was no more than a 1-s pause between each symbol. All multisymbol messages that the child produced via aided AAC counted toward the dependent variable, with the exception of any symbol combinations produced immediately following a verbal prompt (i.e., at the “P” level of the RAAP RAAP! strategy; e.g., “Show me two”).

Transcript and Data Reliability

Reliability measures were taken separately for the transcripts and for the data. To calculate transcript reliability, a second research assistant transcribed a minimum of 20% of the sessions for each phase (baseline, intervention, generalization, and maintenance) for each dyad, without reference to the original transcripts. A total of 28% of the data were retranscribed and analyzed to calculate transcript reliability. Interrater agreement was calculated separately for EA and student transcript data. For the EA transcript measures, agreement on each aided AAC symbol and spoken word was calculated. For student transcript measures, agreement on all aided AAC symbols was examined. Percentage agreement was calculated by dividing the total number of agreements by the total number of agreements, disagreements, and omissions for each session. The EA transcript reliability averaged 96.4% (range = 92.2%–99.7% per session), and the student transcript reliability averaged 96% (range = 84%–100% per session). When disagreements between the transcripts were noted, the assistants reviewed the videotapes and transcripts together until they mutually agreed on changes to the transcripts.

To calculate data reliability on the dependent variables, a second research assistant independently reviewed 28% of the videos and transcripts (i.e., the same segments that were used for transcript reliability) and rerecorded the dependent variable data for the students, without reference to the data.
that were originally recorded. Cohen’s kappa (Viera & Garrett, 2005) was used to calculate interrater reliability for the EA and student data. Kappa for the EA instructional steps (for the EA data) averaged .82 (range = .70–.92 across EAs). Kappa was calculated on multisymbol versus single-symbol messages for the child data and averaged .75 (range = .70–.78 across students). The results indicated “substantial” to “almost perfect” agreement for both EA and student data, according to Viera and Garrett. That is, the EA’s implementation of the instructional steps and student’s multisymbol message productions were reliably recorded.

**Data Analysis**

Both EA and student data were graphed and inspected for changes in the trend, slope, and level of the data (McReynolds & Kearns, 1983). Also, improvement rate difference (IRD; Parker, Vannest, & Brown, 2009) was calculated to evaluate the effectiveness of the intervention. IRD is analogous to risk reduction effect size measures in medical group design studies. This measure correlates more highly with strong parametric and nonparametric effect sizes and more aptly differentiates among individual data sets (i.e., has better discriminability) than percentage of nonoverlapping data points (Parker et al., 2009).

**Social Validation**

To ensure the social validity of the ImPACT program, two randomly selected, randomly ordered 5-min video clips, one from baseline and one from postinstruction, were viewed by a parent of each child. Parents were asked forced-choice questions about the videos, including “In which tape do you think the EA better supported your child’s language skills?” “In which tape do you think your child used better language skills?” and “In which tape do you think your child communicated more effectively?” In addition, EAs were provided with questionnaires at the close of the study to determine their satisfaction with the program. Questions included items relating to satisfaction with the program (e.g., their willingness to participate in a similar program again and to recommend the program to others), changes that they noticed with their student who used AAC, strengths of the program, and recommended changes to the program.

**Results**

**Instruction and Intervention**

As seen in Figure 2, none of the EAs used the RAAP RAAP RAAP! strategy during the baseline phase, but all three EAs consistently used the strategy after completing the instructional program; that is, during the intervention phase, each EA used the strategy steps with at least 80% accuracy during each session. The IRD for each EA was 100%, indicating that the instruction had a large effect on the EAs’ use of the interaction strategy (Parker et al., 2009). The instruction also proved to be efficient; the EAs spent an average of 2.4 hr receiving instruction during Steps 2 through 6 (Oscar’s EA = 2.7 hr, Adam’s EA = 2.6 hr, and Valerie’s EA = 1.9 hr). Steps 2–6 were completed in a mean of 24 days (range = 10–35).

None of the students produced any multisymbol messages during baseline (see Figure 3). Prior to taking dependent measures for the intervention phase, each child participated in Step 6 with the EA and instructor; this instructional time was approximately 30 min per child (Oscar, Adam, and Valerie = 29, 29, and 34 min, respectively). Following EA instruction (Steps 1–6 of the program), all students rapidly met criterion (i.e., at least 10 multisymbol messages for three consecutive sessions); Oscar, Adam, and Valerie met criterion within 3, 6, and 5 sessions, respectively. The IRD (comparing the baseline phases to the intervention phases) was 100% for Adam and Oscar and 80% for Valerie, which indicates that the intervention had a large effect. All three students used a variety of different multisymbol messages in the postinstruction phases (intervention, generalization, and maintenance), indicating that the students were not repeating the same messages throughout a given session (see Table 3). Additionally, all three students produced numerous spontaneous multisymbol messages; the mean percentages of spontaneous multisymbol messages for Oscar, Adam, and Valerie for the postinstruction phases were 65%, 99%, and 96%, respectively.

**Generalization**

Two generalization probes were taken to see whether the EAs generalized use of the RAAP RAAP RAAP! strategy to a novel set of story books (Set B books; see Figure 2). All three EAs demonstrated no use of the strategy with Set B books during baseline, and all EAs immediately used the strategy appropriately during the generalization phase (90%–100% accuracy). With regard to the student data, Oscar used more multisymbol messages during the generalization phase than any other phase (14 and 15 symbol combinations for each generalization session). Adam and Valerie produced relatively few symbol combinations during their first generalization probe, but performance improved for both during the second generalization session (Adam = 8 and 12, Valerie = 3 and 11, respectively).

**Maintenance**

Maintenance probes were planned for 2, 4, and 8 weeks following the generalization phase. However, scheduling issues and the end of the school year prevented data collection at the 8-week mark for Adam and Valerie. All EAs maintained use of the RAAP RAAP RAAP! strategy during this phase; all achieved at least 90% accuracy with the strategy steps for all maintenance data points. All three students produced at least nine multisymbol messages for each data point.

**Social Validation**

The mothers of the three students viewed pre- and postinstruction video clips. All three mothers indicated that the EAs better supported their children’s language skills in the postinstruction videos. Additionally, they indicated that their children used better language skills and communicated more effectively in the postinstruction video clips. The EA feedback was highly positive, with all three EAs stating that they would participate in the program again and recommend it to other EAs. They provided reasons such as “It’s our job
to help our special needs children as much as possible,” “It gives me the experience to be able to teach this with another student,” and “It helped the student and I have a stronger bond … it was fun.” When asked to indicate changes they have noticed in the students who participated in the study, Adam’s EA stated that she had not noticed many changes in the classroom, because “the teacher usually reads the stories … [and Adam] will just sit there and listen to the story.” However,
Oscar’s EA stated that Oscar “speaks more,” “puts words in sentences,” and “enjoys reading more, because he likes the computer [SGD].” Valérie’s EA noted that Valérie “interacts with the story more now.” She also stated that Valérie “seems to speak less often during story reading, but communicates more effectively. Her speech in everyday classroom activities has stayed the same but she talks to me more often now.”

The EAs indicated that the instructional program was informative, and “the instruction and expectations were very clear.” Only one EA suggested an improvement for the program:
接收更多有关使用学生 SGD 的指导。最终，所有 EA 指出，该程序对他们的学习时间是一种很好的利用。

EA Outcomes

最终结果，所有 EAs 表示，他们将该策略介绍给学生的使用情况相同。进一步，EAs 继续使用该策略的时间以及学习符号组合的准确度。结果表明，该策略在时间过长以及未能准确使用策略的情况下进行测试。此外，EAs 继续使用该策略的时间在小说故事书中。结果表明，EAs 在训练时间短且能准确使用策略的情况下进行测试。因此，可以用 ImPAACT 程序来有效和高效地指导沟通伙伴，使他们能够接收使用 AAC 的学生。例如，将AAC 用于支持儿童的交流和语言技能的儿童（如，来自不同种族/民族背景的儿童），将能够更好地使用此策略来教授沟通伙伴如何支持使用 AAC 的儿童的交流和语言技能。例如，Binger, Kent-Walsh, et al. (2008) 所述的研究表明，使用 RAAP RAAP! 策略与使用 ImPAACT 程序的 EAs 相比，EAs 的语言技能发展可能更好。

Discussion

EA Outcomes

所有三个 EAs 都使用了 RAAP RAAP! 策略。结果表明，该策略在相对较短的时间内有效地教会了学生正确使用符号组合的策略。结果表明，该策略在时间过长且未能准确使用策略的情况下进行测试。因此，可以用 ImPAACT 程序来有效和高效地指导沟通伙伴，使他们能够接收使用 AAC 的学生。例如，将AAC 用于支持儿童的交流和语言技能的儿童（如，来自不同种族/民族背景的儿童），将能够更好地使用此策略来教授沟通伙伴如何支持使用 AAC 的儿童的交流和语言技能。例如，Binger, Kent-Walsh, et al. (2008) 所述的研究表明，使用 RAAP RAAP! 策略与使用 ImPAACT 程序的 EAs 相比，EAs 的语言技能发展可能更好。

Student AAC Outcomes

学生 AAC 成果

学生们在本研究中都学会了在学生 SGD 内生成不同符号组合的策略，并且得出结论，在学生 SGD 内生成不同符号组合的策略可能在一定程度上影响学生的交流。例如，Binger, Kent-Walsh, et al. (2008) 所述的研究表明，使用 RAAP RAAP! 策略与使用 ImPAACT 程序的 EAs 相比，EAs 的语言技能发展可能更好。

### Table 3: Mean number (and percentage) of different multisymbol messages per 10-min session for baseline, intervention, generalization, and maintenance phases.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline</th>
<th>Intervention</th>
<th>Generalization</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oscar</td>
<td>0 (0%)</td>
<td>10.6 (94%)</td>
<td>12.0 (83%)</td>
<td>8.7 (79%)</td>
</tr>
<tr>
<td>Adam</td>
<td>0 (0%)</td>
<td>8.3 (98%)</td>
<td>4.5 (45%)</td>
<td>8.5 (81%)</td>
</tr>
<tr>
<td>Valerie</td>
<td>0 (0%)</td>
<td>7.0 (92%)</td>
<td>6.5 (100%)</td>
<td>12.5 (100%)</td>
</tr>
</tbody>
</table>

### Multiple reasons may have contributed to the rapid success of the children in the current investigation. First, the children received some instruction, albeit a limited amount, during Step 6 of the program—that is, the EAs practiced using the interaction strategy with the student while the first author provided guidance and feedback to each EA. Thus, the children’s first intervention session was not their first exposure to the EAs using the RAAP RAAP! strategy with them. However, the amount of time the EAs and children spent on Step 6 was fairly short (approximately 30 min per student). Another potential reason for student success may be the student’s receptive language skills. Although two of the three participants (Oscar and Adam) had receptive language scores that were below average—well below average in Oscar’s case (see Table 2)—the total age-equivalent score for each child was at least 3.6. It would be expected, then, that each child had the potential to demonstrate expressive language skills at approximately a 3.6 level, which functionally translates into having a mean length of utterance of approximately 3.75, producing various types of sentences (declaratives, negatives, interrogatives), and using a variety of grammatical morphemes (e.g., Brown, 1973). Therefore, learning to create simple two-symbol messages should have been well within their developmental abilities. The results from Binger and Light (2007), in a study investigating the impact of using aided AAC modeling to support children’s expression of multisymbol messages, were similar: Four participants in that study had receptive language scores below the 25th percentile, which might lead a clinician to have relatively low expectations for expressive language. However, three of these four children learned to produce combination symbols fairly rapidly (i.e., four to 15 sessions of 15 min each). These findings may be partly explained by the fact that the receptive language age-equivalent scores for these same three children were between 3.5 and 3.11. In both of these investigations, then, it is important to examine the age-equivalent scores on standardized measures of receptive language to assist with setting appropriate expressive language goals.

One final consideration is the fact that the children in the current investigation, as in other studies focusing on multisymbol message productions (Binger, Kent-Walsh, et al., 2008; Binger & Light, 2007), were provided with communication displays that were specifically designed for each activity (i.e., each storybook, in the current investigation). Similar displays have also been used in studies designed to promote children’s turn-taking skills (Kent-Walsh, 2003; Kent-Walsh et al., 2010; Rosa-Lugo & Kent-Walsh, 2008). The children in each of these studies did not have to navigate through various pages on their SGD to create their messages; instead,
vocabulary relevant to the story the child was reading (or the play activity in which the child was engaged, in Binger & Light, 2007) was located on a single display, which allowed the children to devote more cognitive and motor resources toward creating messages, rather than navigating their SGDs.

Social validation data indicated that the parents of the children who used AAC were able to identify changes in the children’s language and communication skills. Further, EAs noted benefits for their students, including increased enjoyment in and interaction with storybooks and improvements with expressive language skills. One EA also indicated improvements in the child’s speech (Oscar), although another EA indicated that her student (Valerie) did not speak as much. This type of qualitative data, however, must be interpreted with caution. Data pertaining to the speech of these students have been reported elsewhere (Binger, Berens, et al., 2008), with the findings indicating no significant differences from the baseline condition to the postbaseline conditions in the number of syllables that any of these students vocalized. In fact, in opposition to the EAs’ observations, the number of syllables that Oscar vocalized decreased slightly from baseline (M = 59 per session) to postbaseline (M = 53), and Valerie’s increased slightly (76 to 84, respectively).

Limitations

One potential limitation of the current study is that only three EAs and three students who used AAC were included in the study. However, the external validity of the investigation is strengthened by findings from other recent studies, including ones involving EAs (Kent-Walsh, 2003) and other communication partners (Binger, Kent-Walsh, et al., 2008; Kent-Walsh et al., 2010; Rosa-Lugo & Kent-Walsh, 2008). Further, the intervention techniques used to instruct the children have been validated for facilitating both turn taking (Kent-Walsh, 2003; Kent-Walsh et al., 2010; Rosa-Lugo & Kent-Walsh, 2008) and multisymbol message productions (e.g., Binger & Light, 2007; Nigam, Schlosser, & Lloyd, 2006; Wilkinson, Romski, & Sevcik, 1994).

Another limitation pertains to the contexts for intervention. Although the focus on storybook reading as a context for language intervention has much support in the literature (e.g., van Kleeck, Stahl, & Bauer, 2003), there is a need to examine language interventions within other contexts, such as other curricular activities and activities of daily living (e.g., taking a bath and getting dressed). Light (1997) stated that a child’s language learning environment is “a complex network of interrelated contexts” (p. 158), and clinicians, educators, and other communication partners must find ways to support a child’s growing language skills within these contexts. Bingham et al. (2007), for example, designed their instructional program so that EAs could support their students’ use of AAC throughout the classroom day. Although the results of that investigation were somewhat limited, in that students used their SGDs a maximum of only nine times over a 3-hr classroom period, the students’ use of their SGDs did improve. Future research is needed to provide SLPs and educators with further guidance for maximizing the potential of students who use AAC within everyday classroom contexts.

Another limitation was the length of the maintenance phase. For two dyads, maintenance probes were taken 4 weeks after the generalization phase, and 8 weeks later for one dyad. More information pertaining to longer term outcomes is needed to establish the long-term outcomes of programs such as the one in the current investigation.

Directions for Future Research

Recent survey results have indicated that more than half of preschool and school-based SLPs have children who require AAC on their caseloads, with a mean of seven to eight students needing AAC on each clinician’s caseload (Binger & Light, 2006; Fallon & Katz, 2007; Kent-Walsh, Stark, & Binger, 2008). Dowden and colleagues (2006) reported that clinicians’ caseloads have reached unmanageable proportions, which will undoubtedly have a negative impact on children using AAC. One predictable impact is that clinicians with high caseloads have limited time to provide instruction for communication partners, however beneficial such instruction might be. One critical need, then, is to ensure that instructional programs for communication partners are as efficient as possible, in order to maximize use of the SLP’s time. Toward that end, one direction for future research is to modify the ImPAACT Program for delivery within group settings, such as with a child’s AAC team (or perhaps groups of AAC teams), instead of just the EA.

Along similar lines, Oscar’s EA suggested that the current program would have been strengthened by receiving more instruction in how to integrate SGD use into more classroom activities (a sentiment shared by the parents in Kent-Walsh et al., 2010, who expressed a wish for instruction in additional everyday activities). There is a pressing need for research investigating ways to enhance outcomes for students who use AAC, with regard to accessing their entire school curriculum (for reviews of various school-based AAC issues, see Zangari & Soto, 2009). One issue relates to appropriate programming of AAC devices, to ensure that students have access to the vocabulary they need to meet their school-based activities. For the current investigation, the researchers designed and programmed communication displays that were relevant to each storybook. Future research needs to address teaching key members of AAC teams, such as EAs, how to navigate, program, and manage SGDs if the students are to achieve both short-term and long-term success in the classroom. Including such instruction would necessarily lengthen an instructional program such as the program used in the current investigation, and these issues must, of course, be balanced with other SLP and educator time restrictions.

Finally, it is important to note that research investigating viable intervention approaches for teaching turn taking and early symbol combinations represents only the very beginning stages of building full linguistic competence. Although researchers have begun to develop intervention programs to address other aspects of language such as narrative skills (e.g., Soto, Yu, & Henneberry, 2007; Soto, Yu, & Kelso, 2008), surprisingly little research has been conducted to examine various intervention techniques for building syntactic and morphological skills (Binger & Light, 2008; Binger, Maguire-Marshall, & Kent-Walsh, 2009). In addition to examining the
effectiveness of specific intervention techniques (such as aided AAC modeling, recasts, and contrastive targets), a host of other unique and complex issues interact with language acquisition for children who use AAC. For example, research is needed to investigate the relative strengths and weaknesses of current AAC software programs and to clarify the role of early literacy instruction for children who have varied cognitive and linguistic profiles. In summary, research investigating the efficacy of language intervention for individuals who use AAC is in its infancy, and much work is required to begin to fill in the gaps.

Acknowledgments
This research was supported in part by an internal grant from the University of New Mexico. Preliminary results were presented at the Annual Convention of the American Speech-Language-Hearing Association in Miami, FL, in November 2006. The authors would like to thank Jacqueline Berens, Sandy Nettleton, and Annette O’Connor for their assistance with the project. The authors also thank the educational assistants, families, and children who made this study possible.

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Received March 1, 2009
Accepted September 7, 2009
DOI: 10.1044/1058-0360(2009/09-0015)

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