Educational Assistants' Use of ImPAACT for Increasing Message Selection and Turn-Taking with Children with Complex Communication Needs

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Abstract: *Context*: Educational assistants (EAs) provide extensive and individualized support for many students who require augmentative and alternative communication (AAC) in school systems. An important factor related to student's success is EA training and skill development for effective communication with children who use AAC.

Case Report: This case series examined ImPAACT: Improving Partner Applications of Augmentative Communication Techniques with three EA and student dyads. The study investigated whether a comparable treatment effect as found in Binger et al. (2010) could be demonstrated. Three phases of intervention (i.e., baseline, instruction, and generalization) were investigated. All phases were completed in the public school setting in which the students were enrolled and the EAs were employed. EA's correct application of instructional strategies, student's multi-symbol selections, and student's turns were calculated. Type and form of student's turn were calculated as well.

Conclusions: All EAs increased correct application of strategies and all students increased use of multi-symbol selections and overall number of turns taken. Students' type of turn (i.e., response, comment, initiation) and form of turn (i.e., vocalization, gesture, symbol selection) increased and diversified. Variable rates of behavior were noted across EAs and students. Potential explanations for these findings are discussed.

Keywords: Augmentative and alternative communication, educational assistant, multi-symbol messages.

Educational assistants (EAs) provide extensive and individualized support for children with complex communication needs (CCN) who require augmentative and alternative communication (AAC). EAs are critical members of school-based AAC teams and skilled EAs contribute to children's success in classroom contexts [1]. An important factor related to children's success is EA training and skill development for effective communication with children who use AAC [2]. To address this factor, instructional programs to train EAs have been developed and empirical support is growing [3]. This study examines an instructional program entitled ImPAACT: Improving Partner Applications of Augmentative Communication Techniques [4]. ImPAACT is an instructional program designed to train communication partners to support children's language and communication during storybook reading. The present study investigated whether a comparable treatment effect as found in Binger *et al*. [5] could be demonstrated with EA and child dyads and whether or not child outcomes would be observed in a non-storybook activity. Further, this study considered turn-taking behavior.

TRAINING COMMUNICATION PARTNERS

Training content, instructional components, and outcome measures vary across instructional programs. Those that utilize best practice and strategy instruction models are beneficial in teaching communication partners appropriate interaction skills and in assisting children with CCN as they acquire language skills [6]. Several studies report pragmatic and semantic gains with children with CCN following communication partner instructional programs. Bingham *et al*. [7] taught three EAs about communicative function and AAC use, instructed EAs on prompt and response strategies, and taught EAs how to self-evaluate their communicative interactions with students using AAC. Results indicated increases in both EA's communicative behavior and children's attempts to use AAC. Hill *et al*. [8] trained three pre-service teachers on Picture Exchange Communication System (PECS) implementation within an educational context and included practice and feedback as key instructional components. Gains in pre-service teacher's correct implementation of PECS were reported. Children increased frequency of requests.

Inclusion of AAC modeling within instructional programs may bolster semantic and pragmatic gains with children with CCN [9]. AAC modeling includes communication partners modeling aided AAC as they speak and engaging in naturalistic communication contexts. Douglas *et al*. [10] trained three EAs using two strategy instructional models (i.e., IPLAN and MORE). IPLAN represents the following steps: identify activities for communication, provide means for communication, locate and provide vocabulary, arrange

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environment, and use interaction strategies. MORE represents the following steps: model AAC, offer opportunities for communication, respond to communication, extend communication). Results indicated that EAs provided an increased number of communication opportunities and children demonstrated pragmatic and semantic gains during play activities after 2 hours of individual EA training.

With regard to ImPAACT, a series of studies indicate gains in communication partners use of communication strategies and children's use of communicative responses across pragmatic, semantic, and syntactic aspects of language. Kent-Walsh and McNaughton [11] described the eight-step instructional strategy model. The first step includes securing commitment to the instructional program. In the second step, instructors describe the target communication strategy to the communication partner. During step three, the communication strategy is demonstrated to the communication partner. In the fourth step, communication partners engage in verbal practice of the communication strategies. The fifth step involves controlled practice and feedback of the strategy by the instructors. In step six, advanced practice and feedback are provided by the instructors. The seventh step involves a post-instruction measure to ensure mastery of the communication strategies. The eighth step consists of strategy generalization.

Rosa-Lugo and Kent-Walsh [5] instructed two Latino parents using the Kent-Walsh and McNaughton [11] protocol (i.e., ImPAACT). Parents were taught to use a communication strategy that incorporated aided AAC modeling, expectant delay, open-ended questions, and responses to their children's communicative attempts. Both parents reached criterion for use of the strategy during storybook reading contexts. Their children with CCN increased communicative turns and novel semantic concepts expressed. Kent-Walsh *et al*. [12] used the ImPAACT protocol to teach 6 parent-child dyads (3 European American parents and 3 African-American parents). The communicative strategy represented the following steps: (1) Read + provide an aided AAC model; (2) Ask a wh-question + provide an aided AAC model; and (3) Answer the wh-questions + provide an aided AAC model. An expectant delay was used after each step. Parents implemented the communication strategy accurately during storybook reading activities. Child gains in semantic and pragmatic skills were noted.

In an effort to facilitate children's syntax, the ImPAACT protocol was used to instruct three Latino parents in supporting their children's productions of multi-symbol messages during storybook reading [13]. The communication strategy (i.e., RAA) represented (1) Read + Model using 2-symbol aided AAC model; (2) Ask + Model using 2-symbol aided AAC model; (3) Answer + Model using 2-symbol aided AAC model. An expectant delay was used after each step. All caregivers successfully learned to use the instructional strategy, and all children increased their use of multi-symbol messages.

Outcomes of ImPAACT with three EA and student dyads were evaluated [5]. The communication strategy included an additional step (i.e., RAAP): (1) Read + Model using 2-symbol aided AAC model; (2) Ask + Model using 2-symbol aided AAC model; (3) Answer + Model using 2-symbol aided AAC model, and (4) Prompt with *show me two* or *your turn*. EAs were trained on the RAAP strategy during storybook interactions. Results indicated that all EAs successfully implemented the RAAP strategy following a brief period of instruction. The three students increased their use of multi-symbol selections.

Study Purpose

Instructional protocols for training communication partners that include instruction strategy models as well as AAC modeling facilitate language and communication in children with CCN. Previous single-subject studies suggest the use of ImPAACT to train EAs leads to meaningful changes across multiple domains of language with children with CNN. However, students with CCN compose a heterogeneous group of individuals with respect to many variables [14]. While single case evaluations provide a meaningful examination of a treatment protocol with a heterogeneous client population, findings from additional case studies afford opportunities to determine if there is a similar positive treatment outcome in students with different communication needs [15]. As such, this study examines outcomes of ImPAACT on EA use of the RAAP strategy and student's multi-symbol selections during post-instruction and generalization storybook sessions. Additionally, this study observes whether or not student's multi-symbol selections will increase during a non-storybook activity (i.e., art) following ImPAACT. We anticipated that all EAs would increase use of the RAAP strategy during post-instruction and generalization storybook sessions. We anticipated that students would increase the number of multi-symbol selections during post-instruction and generalization storybook interaction sessions as well as during an art

activity. While studies indicate gains in pragmatic aspects of language such as number of communicative turns, we examined turn-taking behavior as another variable of interest. We anticipated improvement in turn-taking behavior and further asked whether or not the turn types were characterized as initiations, responses, or comments and whether or not the turn forms were characterized as gestures, vocalizations, or symbol selections.

METHOD

Multiple case examinations were conducted to address the study purposes. Three phases (i.e., baseline, post-instruction, and generalization) were investigated. Three EA and student dyads participated in the study. This study was approved by the university institutional review board (#7341406).

Participants

Three students from rural areas of Southeast Texas participated in the study. These students were enrolled in public school and received special education services from a speech-language pathologist employed with the area school district. The students met the following criteria: All students (1) were enrolled in an elementary school; (2) presented with severe, congenital motor speech impairments (less than 50% comprehensible speech in the "no context" condition; (3) communicated using telegraphic messages (no more than 10% of communicative turns consisted of two or more aided AAC symbols during a 10 minute storybook-reading activity; (4) had hearing and vision within (or corrected to be within) functional limits; (5) had limited exposure to AAC. Informed consent was received from the parents of each participant and the EAs committed to participate in the study.

Students

Kacey, a European American female, age 6;6 (years; months) met eligibility criteria as a student with an intellectual disability and speech impairment under the Individuals with Disability and Education Act (IDEA). She received her education in a self-contained classroom with instruction based on prerequisite skills that were aligned to enrolled grade level curriculum. Kacey had some previous experience using AAC but was not successful. She used picture schedules, low-technology picture communication boards, gestures and vocalizations. She also had previous exposure to an AAC device (ProxTalker) but had not been successful with its use. She had also previously used a PECS notebook with limited success. Kacey effectively utilized gestures and mime to communicate with others. Age equivalency on the Auditory Comprehension of Language, Third Edition (TACL-3) was 3.0 – 3.3. Whole class storybook reading was a scheduled event during the course of the school day. Storybooks were accessible in the classroom and Kacey enjoyed storybooks.

Isaac, a Latino male, age 7;4 (years; months) met eligibility criteria as a student with an intellectual disability, speech impairment, and other health impairment under IDEA. English was a second language for Isaac and Spanish was spoken primarily in the home environment. Isaac used gestures and vocalizations to communicate with others. Isaac had not been exposed to an AAC device and had minimal exposure to picture communication in the classroom. Age equivalency on the TACL-3 was 3.0 – 3.3. Storybook reading was not a scheduled event during the course of the school day and storybook reading did not commonly occur in the classroom context.

Austin, a European American male, age 8;8 (years; months) met eligibility criteria as a student with Autism Spectrum Disorder under IDEA. Austin had some previous experience with an iPad and communication application but was not an effective communicator. Austin displayed echolalic vocalizations in the classroom setting. Austin was unable to complete the TACL-3. Data from the teacher indicated that Austin understood vocabulary categories including animals, food, shapes, colors as well as basic concepts (e.g., in, out, on under). He was able to follow simple 1 step commands and followed a visual schedule in his classroom. Whole class storybook reading was a scheduled event during the course of the school day. Storybooks were accessible in the classroom and Austin enjoyed storybooks.

Educational Assistants and Instructor

The three EAs were employees of the school district in which the students were enrolled. They worked in the special education self-contained elementary classrooms as assistants to the student's classroom teacher and were familiar with the students. The EAs did not have prior AAC training or program implementation. The ImPAACT instructor was the first author of this paper. She holds graduate degrees in special education and speech-language pathology. She is an education specialist at a regional education

Table 1: Overview of Procedures

Phase		Description
Baseline	Step 1	Obtain baseline measures and EA commitment to the program
Instruction	Step 2	RAAP Description
		Read + Model using 2-symbols
		Pause
		Ask + Model using 2-symbols
		Pause
		Answer + Model using 2-symbols
		Pause
		Prompt + Model using 2-symbols
	Step 3	RAAP Demonstration
	Step 4	Verbal Practice of RAAP
	Step 5	Controlled Practice and Feedback
	Step 6	Advanced Practice and Feedback
Post-instruction	Step 7	Collect data following RAAP instruction
Generalization	Step 8	Generalization

service center in the areas of autism, assistive technology, and low incidence disabilities and provides training for 30 school districts.

MATERIALS

Storybooks used for EA instruction and generalization were Clifford the Big Red Dog and Dora the Explorer books respectively [16, 17]. These books were selected since they were used in previous studies of ImPAACT. An iPad with the application Proloquo 2 Go was used as the communication device. One vocabulary display was created for each storybook [5]. Specifically, all displays were created using Fitzgerald keys to organize vocabulary into grammatical categories through a color-coding system [18]. This approach is often used to promote language development for children who are learning to combine words into sentences [19]. Each simple on the display represented one concept in order to form brief sentences. Each page contained 30-35 symbols. Vocabulary boards were designed for the art activity using the same Fitzgerald key and similar vocabulary. Materials used during the art activity consisted of standard classroom items.

The feature of guided access was activated on the iPad. Guided access is an accessibility feature within the operating system that inserts a passcode on the home button preventing individuals from closing out an application. This feature in essence “locks” the student in the application and prevents access of other areas of the device. Guided access was used in this research to simulate a dedicated device.

Procedure

Each phase consisted of instructional steps from ImPAACT. Phases included baseline, post-instruction, and generalization (See Table **1**).

Baseline Phase

Student’s receptive knowledge of the vocabulary was pretested using binary choice. Students were asked to point to a target vocabulary item. All students were able to identify related vocabulary. The EAs received an overview of the research project and signed a commitment form that stated a willingness to learn and accurately implement the strategy. The EAs were assured they would be supported throughout the process.

The baseline phase consisted of three sessions using the Clifford the Big Red Dog storybooks and three sessions with Dora the Explorer books. The EA and student were not familiar with the instructional strategy or communication device and did not receive any instruction prior to the collection of baseline data. The baseline data was gathered to determine how the EA conducted storybook reading and if the student utilized the communication device in a meaningful

manner. The EA was instructed to read the story as she typically would during storybook reading. Baseline data of the student's multi-symbol selections was collected during an art activity as well. Students were given pre-cut items to create an animal (e.g., elephant puppet). The EA was instructed to complete an art activity designed by the first author. All sessions were conducted in a quiet room.

Instruction Phase

Prior to the post-instruction phase, the EAs were individually trained on the RAAP strategy (i.e., steps two through six). The first author served as instructor and Clifford the Big Red Dog books were used for EA training. The instructor described and demonstrated the RAAP strategy to the EAs (step 2 and 3). Then, the instructor provided verbal practice of the strategy steps (step 4). In this investigation the EAs memorized RAAP components during step 4. During step 5, the EAs practiced the RAAP strategy in controlled contexts such as engaging in role-play with the instructor. During step 6, EAs conducted sessions with the student and received feedback from the instructor as needed (i.e., until the EA implemented RAAP with at least 90% accuracy).

Post-Instruction Phase

During step 7, the EA completed three consecutive sessions using the RAAP strategy during three book-reading sessions with Clifford the Big Red Dog storybooks. No feedback was provided from the instructor and data following RAAP instruction was collected (step 7).

Generalization Phase

To measure generalization (step 8), three sessions were conducted using Dora the Explorer books. These books were not used during RAAP training. To observe child behavior during a non-storybook activity following ImPAACT, a second art activity session was conducted. Feedback from the first author was not provided to the student or EA during the generalization phase.

Outcome Measures: Transcription, Coding, and Analysis

EA outcome measures included the percentage of RAAP steps correctly implemented by the EAs on each 2-page spread of the storybook during each phase. Student outcome measures included frequency of multi-symbol messages produced by the students, number of turns, type of turns, and form of turns during each phase.

The baseline, post-instruction, and generalization sessions were videotaped. Sessions were individual and occurred at the same time in the same room each week. Adult verbal and nonverbal behaviors were transcribed. These included utterances, reading text, and actions that help to describe events such as page turning and pointing to pictures in the story. All child verbal and nonverbal behaviors were transcribed. These included use of aided AAC, gestures, vocal approximations, and intelligible productions. The first author trained three undergraduate students majoring in speech language pathology to complete the transcription.

Each transcript was coded using a data sheet in which each step within the RAAP strategy was identified as correctly implemented, incorrectly implemented, or missing. For example, the first step of the strategy is "Read text + provide two symbol aided AAC model," and the second step "Pause" (i.e., provide an expectant delay). Each adult behavior was identified as either an aided AAC symbol or a verbal message.

Student multi-symbol selections were counted when the child selected two symbol combinations with no more than a one second pause between each symbol [20]. During storybook activities a multi-symbol selection was counted only when it occurred once the RAAP strategy was initiated and only if it was contextually relevant. During the art activity, a multi-symbol selection was counted only when the interaction to complete the art task was initiated and only if it was contextually relevant. The first author trained the same three undergraduate students who transcribed the samples to complete the coding.

Frequency and type of student turn was calculated. Turn type included child initiations, comments, or responses. An initiation was defined as a child turn in which the child initiated an exchange. A comment was defined as a child turn that followed an EA statement. A response was defined as a child turn following an EA question or prompt. The following is an example of a child initiation.

- Child: The child selects hug on the Ipad followed by outstretching his arms in imitation of a hug.
- E.A.: Do you want a hug?

The following is an example of a child comment.

- E.A.: "Good job. On weekends Papi and I ride bikes together or sail on a sailboat. Dora and Papi ride bikes together." Selects Dora and bike on the AAC device.
- Child: Vocalizes while pointing to Dora.

The following is an example of a child response.

- E.A.: "Who coaches Dora's baseball team?"
- Child: Points to Dora playing baseball.

Frequency of form of turn was calculated (i.e., gesture, vocalization, message selection). A vocalization was defined as an intentional verbal attempt or word approximation and a gesture was defined as an intentional movement such as pointing, nodding, or moving hands high or low. A turn could include a combination of gesture, vocalization, or message selection.

Transcript and Coding Reliability

For transcription reliability, 20% of the baseline, post-instruction, and generalization, sessions were transcribed by the first and second author. Transcriptions were compared using verbatim agreement in that every adult or child behavior had to be the same. Agreement was calculated using the following formula: (agreements/agreements + disagreements) x 100. Transcript reliability for adult behaviors ranged between 90% and 97% per session. Transcript reliability for child behaviors ranged between 90% and 96% per session.

For coding reliability, 20% of the baseline, post-instruction, and generalization sessions were coded by the first, second, and third author. Coding sheets were compared using verbatim agreement and calculated using the following formula: (agreements/agreements + disagreements) x 100. Reliability measures for outcome measures were: EA use of strategy (92%-94%) and multi-symbol selection (91%-99%). Reliability measures for outcome measures were: turn type (92%-98%) and turn form (95%-98%).

RESULTS

EA Outcomes

All EAs had a baseline of zero steps correctly implemented before instruction (See Figure **1**). Kacey's EA required four hours of advanced practice with a student in which the instructor provided feedback to reach 90% accuracy (step 6). Issac's EA and Austin's EA required two hours of advanced practice. Once instruction was given the percentage of steps correctly implemented by the EAs increased to between 62% and 99% during post-instruction sessions and 56% and 85% during generalization sessions.

Student Outcomes: Multi-Symbol Selections

Kacey produced 0 to 6 multi-symbol selections during the baseline phase (See Figure **2**). During the post-instruction phase, she selected between 34 and 58 multi-symbol selections and between 16 and 33 during the generalization phase. Isaac selected 0 to 6 multi-symbol selections during the baseline phase. During the post-instruction phase, he selected between 9 and 12 multi-symbol selections. Generalization phase data included 5 to 8 multi-symbol selections. Austin

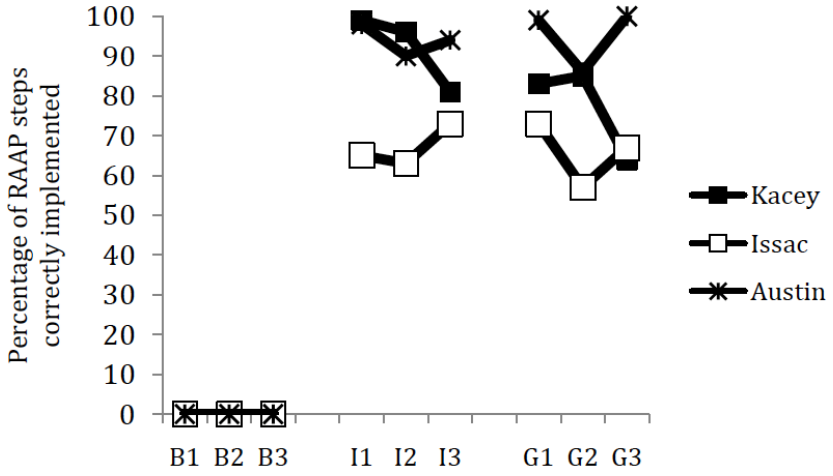

Figure 1: Percentage of RAAP! steps correctly implemented by each EA during baseline, post-instruction with the Clifford book, and generalization sessions with the Dora the Explorer book.

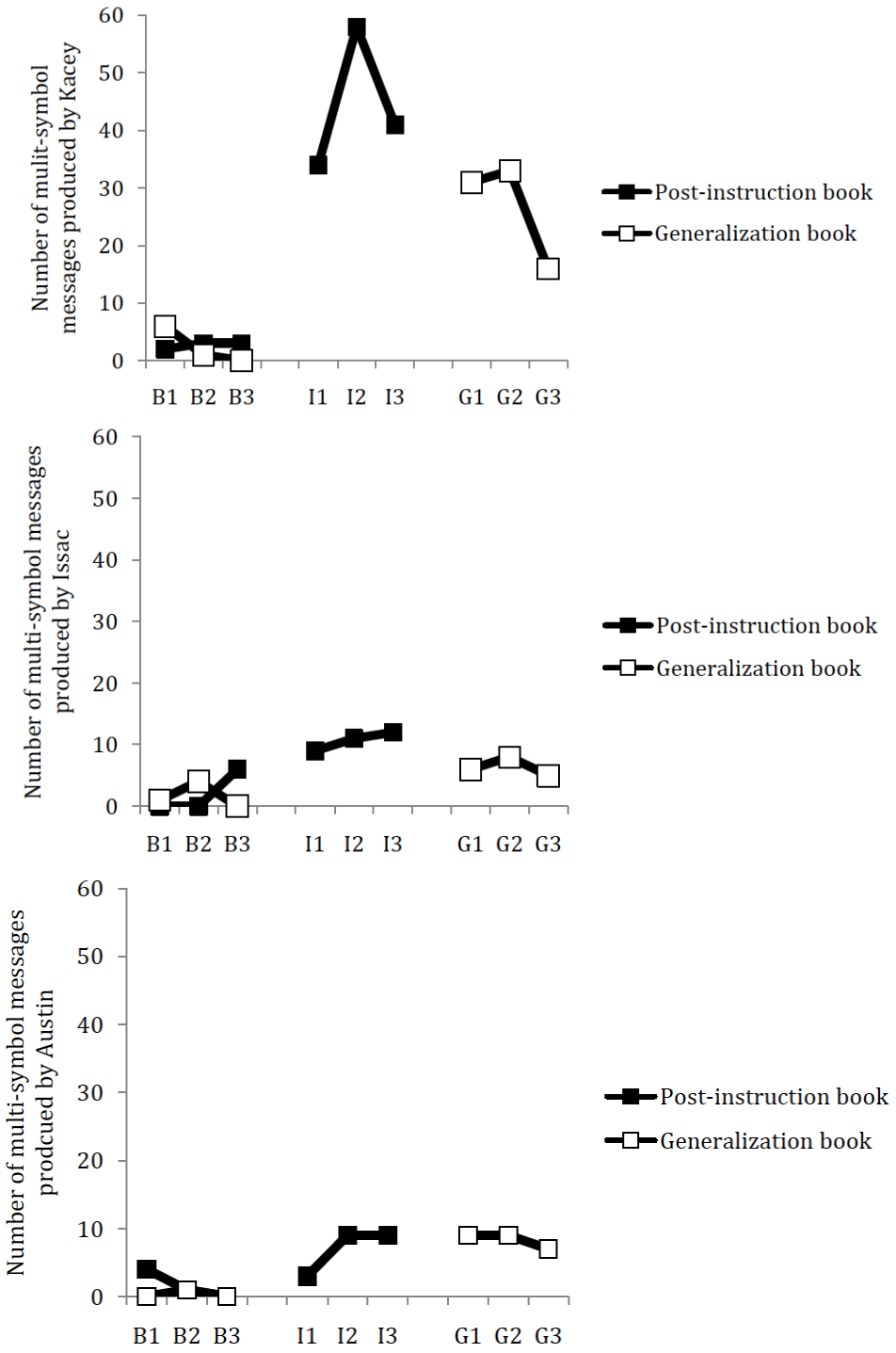

Figure 2: Number of multi-symbol messages produced during baseline, post-instruction with the Clifford book and generalization sessions with the Dora the Explorer book.

selected 0 to 4 during baseline. During post-instruction phase, Austin selected between 3 and 9 multi-symbol selections and 7 to 9 during the generalization phase.

Student Outcomes: Turn-Taking Behavior

Kacey produced 14 to 49 turns during the baseline phase, which increased notably during post-instruction and were maintained during generalization (See Figure **3**). Of the turns taken during baseline, responses and comments comprised the majority of turns. Several initiations occurred during the initial two baseline sessions. During post-instruction and generalization phase, responses and comments increased, while initiations remained low. Turn form during baseline consisted of symbol selections, gestures, and

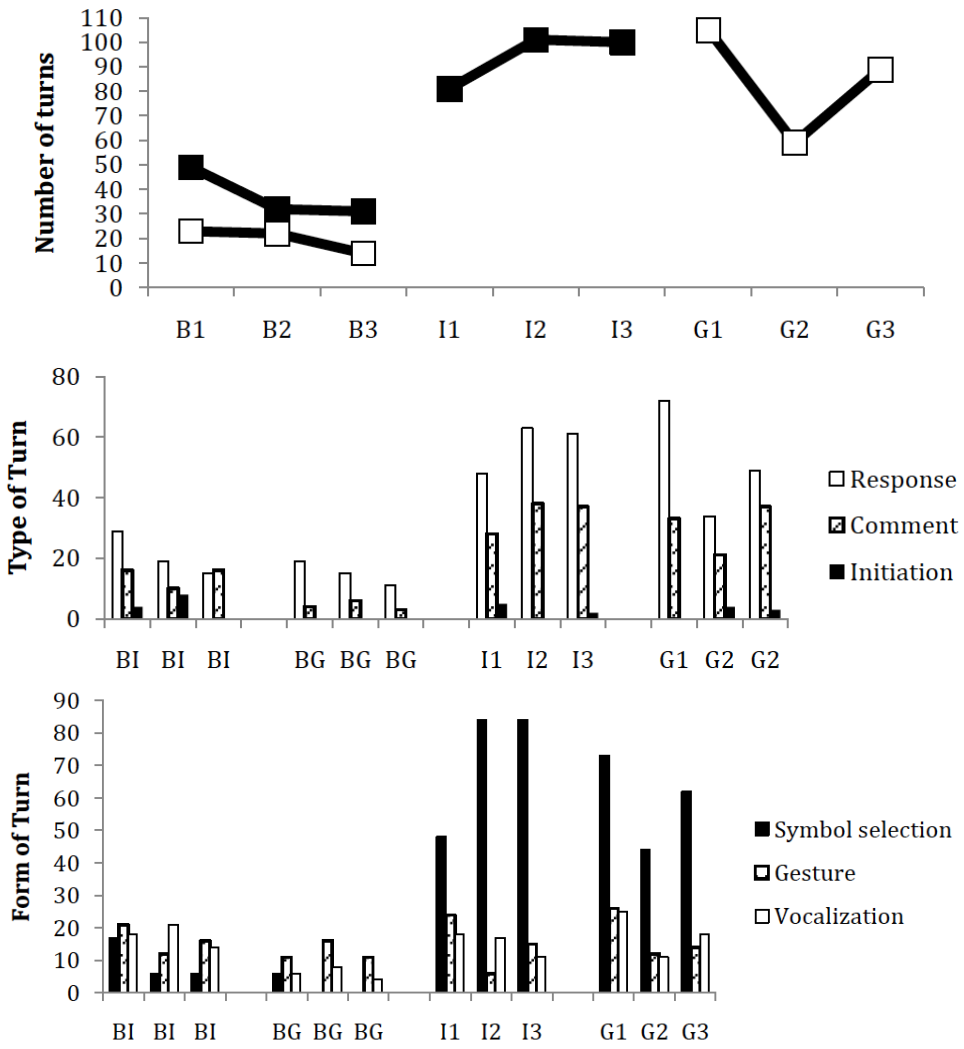

Figure 3: Turn-taking behavior for Kacey.

Note: BI=Baseline with The Clifford book; BG=Baseline with the Dora the Explorer books; I=Post-instruction; G=Generalization.

vocalizations. The most frequent turn form during post-instruction was symbol selections, followed by vocalizations and gestures. Symbol selections were the majority of turn form during the generalization phase, followed by vocalizations and gestures.

Issac produced between 8 and 18 turns during the baseline phase (See Figure **4**). During post-instruction, he took between 29 and 49 turns and between 19 and 44 turns during the generalization phase. Of the turns taken during baseline, responses and comments comprised the majority of turns. One to two initiations occurred during baseline. During post-instruction and generalization phases, responses and comments increased. Initiations remained minimal. Turn form during baseline consisted of symbol selections, gestures, and vocalizations. During post-instruction and generalization phases symbol selections occurred most often, followed by vocalization and gesture.

Austin took between 4 and 12 turns during the baseline phase (See Figure **5**). Number of turns increased during post-instruction. Some decrease was noted during the generalization phase. Of the turns taken during baseline, responses and comments comprised the majority. One to two initiations occurred. During the post-instruction phase, responses and initiations increased, while comments decreased. During the generalization phase, responses decreased slightly and comments remained unchanged. Initiations ranged between 1 and 5 times. Turn form during baseline consisted of symbol selections, gestures, and vocalizations. The majority of turn form during the post-instruction phase was symbol selections and vocalizations. The majority of turn form during the generalization phase were symbol selections, followed by vocalization. Gesture remained minimal during both phases.

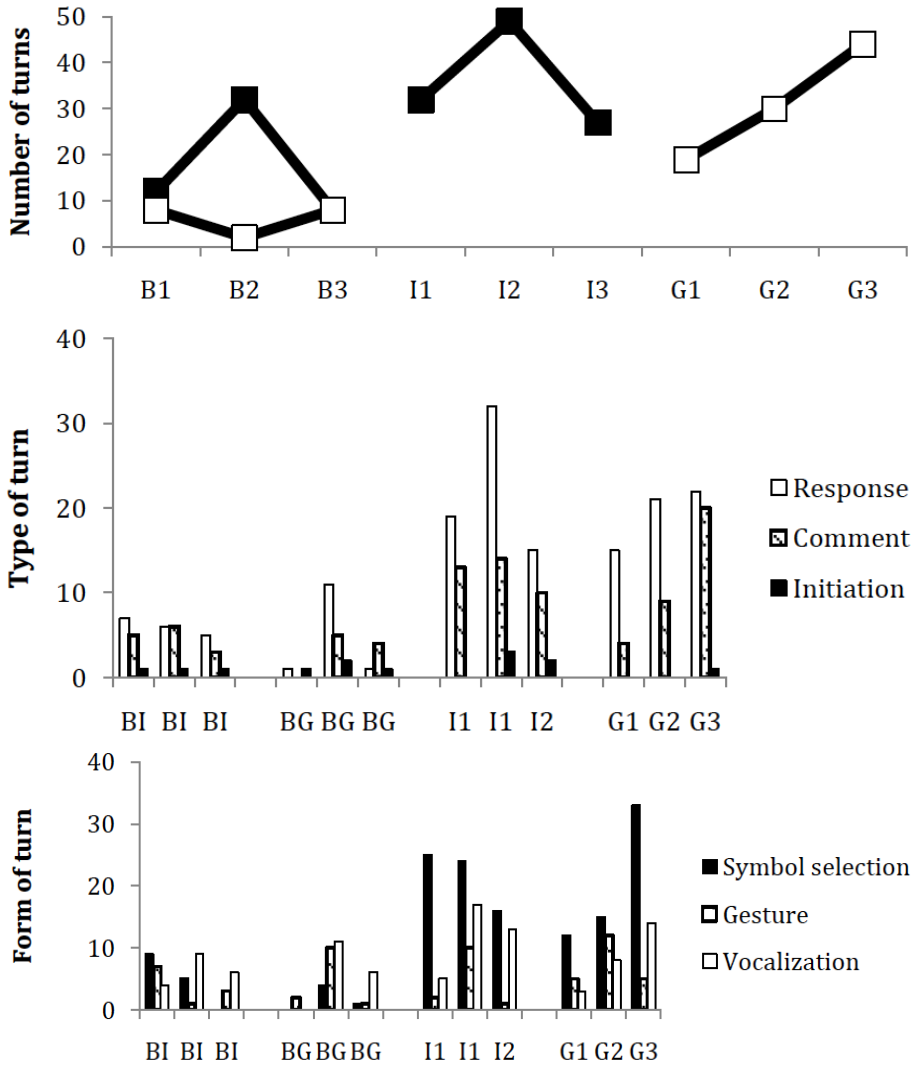

Figure 4: Turn-taking behavior for Issac.

Note: BI=Baseline with The Clifford book; BG=Baseline with the Dora the Explorer books; I=Post-instruction; G=Generalization.

Student Outcomes: Non-Storybook Format

During the baseline art activity, no student produced a multi-symbol message (See Table **2**). Post-instruction data indicated Kacey selected 20 multi-symbol messages. Isaac selected three, and Austin selected one. Turns increased as well. Kacey produced 4 turns at baseline as compared to 89 turns in the post-instruction art activity. Turns were typically symbol selections. Responses were the majority of turn types. During the baseline and post-instruction art activities, Issac produced 22 and 23 turns respectively. Typically, the turns were responses in the form of vocalization and gestures. Austin produced 7 and 8 turns during the baseline and post-instruction art activities respectively. Turns typically consisted of comments and responses. He produced 1 initiation during baseline and 3 during post-instruction. Turn form was either a symbol selection or vocalization during baseline and either a gesture or vocalization during post-instruction.

DISCUSSION

This study examined outcomes of ImPAACT with three EA and student dyads on EA strategy use and student multi-symbol selections during storybook reading activities. This study considered whether or not student outcomes would be observed in a non-storybook activity. Further, this study examined outcomes related to student turn-taking behavior.

EA Outcomes

Based on results from previous studies of ImPAACT, we anticipated that all EAs would increase accurate use of the RAAP strategy post-instruction at levels of 80% accuracy or higher. Results indicated all

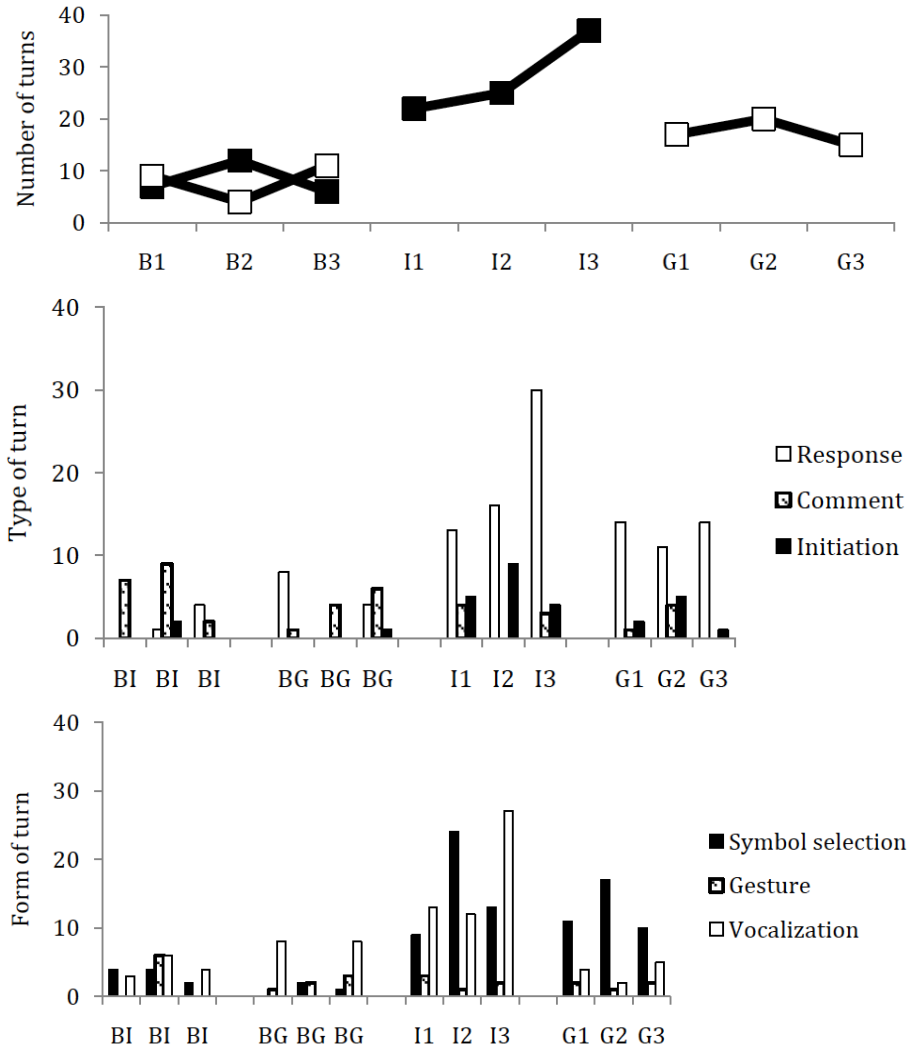

Figure 5: Turn-taking behavior for Austin.

Note: BI=Baseline with The Clifford book; BG=Baseline with the Dora the Explorer books; I=Post-instruction; G=Generalization.

Table 2: Student Outcomes During Non-Storybook Format

Measure	Child					
	Kacey		Issac		Austin	
	BL	PI	BL	PI	BL	PI
Multi-symbol selection	0	20	0	3	0	1
Turn	4	89	22	23	7	8
Turn type						
Response	4	78	16	28	3	3
Comment	0	19	2	3	3	2
Initiation	0	3	4	4	1	3
Turn form						
Symbol selection	0	70	0	6	2	0
Vocalization	2	10	11	11	0	3
Gesture	2	20	15	10	6	8

Note: BL=Baseline; PI=Post-instruction.

EAs increased correct application of RAAP steps from baseline to post-instruction. However, Issac's EA did not use the strategies at the same level as the other EAs, nor did she reach a threshold of 80% or greater accuracy. Overall, the other EAs used RAAP with at least 80% accuracy during post-instruction and generalization. However, during the final generalization probe, Kacey's EA used the steps below the 80% threshold.

Variable success for these EAs may be a function of their familiarity with storybook reading. Reading to students was a common activity in Kacey's and Austin's classroom. The EAs were comfortable adding an AAC device. On the other hand, Isaac's EA exhibited more difficulty implementing the RAAP strategy than the other EAs. She did not have as much exposure to storybook reading and it was not a common activity that occurred in her classroom. Her implementation of the strategy was slow with extended pauses between steps. Regardless of each EA's interaction style and familiarity with interactive storybook activities and AAC devices, baseline comparison of EA accuracy to other phases was notably positive. As noted in Kent-Walsh *et al*. [12] supplemental instruction beyond ImPAACT may have been necessary to augment EAs' skills. Overall, findings are consistent with evidence supporting instructional strategy programs that include AAC modeling for training EA support of students with CCN [9].

Student Outcomes: Multi-Symbol Selection

We anticipated that students would increase the number of multi-symbol selections produced. An immediate response is expected since EAs practice RAAP with students prior to data collection of student performance [5]. Overall, the students responded positively to the EA instruction. However, individual differences were noted. Kacey performed at a higher rate than Issac and Austin and exceeded the criterion of at least 10 multi-symbol selections in three consecutive sessions established in Binger *et al*. [5]. Kacey was interested in using the iPad technology and often sought interaction with her EA during storybook reading. Further, Kacey's performance may be linked to her experience in successful use of picture schedules and low-technology picture communication boards.

Although Issac met the criterion of at least 10 multi-symbol selections for two post-instruction sessions, selections decreased during the generalization storybook sessions. Issac's performance may be linked to limited exposure to AAC prior to the initiation of ImPAACT. Additionally, Issac was bilingual and delivery of the storybook was in English. Although he had been in English speaking classrooms since pre-kindergarten and his comprehension of the vocabulary items were verified, we cannot rule out the impact of English language acquisition on his performance. Austin increased multi-symbol selections; however, he did not meet the criterion. Although he had been exposed to AAC prior to ImPAACT, he did not have success with AAC devices. It may be that atypical social behavior associated with ASD influences the nature of the interaction [3].

It is interesting to consider the required threshold of EA performance to maximize effects with students. Even though the EA working with Issac had limitations (e.g., exposure and experience), increases in Issac's behavior were noted. Kacey's EA met an adequate level of strategy application accuracy, yet Kacey outperformed other students. Austin's EA used RAAP consistently at 90% or greater accuracy, and Austin's performance was comparable to Issac. If an EA performs the strategy at lower levels than other EAs due to internal or external variables, the instructional components generate a positive impact. In other words, the EA can have limitations and the program may still achieve the desired effect.

Student Outcomes: Turn-Taking Behavior

Not only were positive outcomes noted in syntax, but also in communicative competence. Based on results from previous studies [4, 12], we expected that student turn-taking would increase and that type and form of turn-taking would diversify. Results indicated that all students increased number of turns; however, Kacey took a greater number of turns than Issac or Austin.

The majority of turns taken were responses and comments rather than initiations for Kacey and Issac. This is not surprising in light of the structured interaction inherent in RAAP. It may be that the structure of RAAP does not lend itself to child initiations for some students. Once the targeted skill of multi-symbol selections emerges and stabilizes, the EAs can be trained to include less structured interactions in which RAAP strategies in conjunction with recasting and/or expansion. Use of recasting and/or expansion requires the communication partner to respond contingently to the child with greater linguistic

complexity than used by the child [21, 22]. This may increase the reciprocal nature of the interaction and increase types of exchanges as well as facilitate greater semantic and morphosyntactic complexity. On the other hand, Austin increased initiations. It may be that the structure of RAAP has a differential effect for a child with ASD. For all students, frequency and consistency of vocalizations increased concurrent with symbol selections. Use of RAAP facilitated symbol selection and did not impede verbal attempts, which is consistent with previous literature [23, 24].

Results suggest ImPAACT is flexible and portable. Regardless of the EA or student variables, each EA and student increased performance levels. Training EAs to employ RAAP created opportunities for these students with CCN to take communication turns and use multi-symbol selections. The storybook format in which ImPAACT is used may contribute to positive outcomes. Storybook formats narrow the range of possible referents so that the adult can establish, monitor, and maintain joint focus and develop recurring interactive routines. Storybooks provide a context in which a child's actions and vocalizations are interpretable by the adult and therefore pragmatically effective within meaningful interactions. Access to AAC during storybook reading activities provides a naturalistic context to teach symbol selection, turn-taking skills, and vocabulary [25]. Additionally, gains observed in the art activity suggest use of RAAP may promote multi-symbol selections in other curriculum activities.

LIMITATIONS AND FUTURE RESEARCH

Limitations of case studies include the ability to generalize outcomes. Although this study corroborates previous findings, the nature of the design limits interpretation of results and generalization to other EA and student dyads. Additionally, the non-storybook activity consisted of two data points. Increases in some outcome behaviors were observed in the post-instruction probe; however, conclusions are limited. Future research including children with varying diagnoses, in particular ASD, is needed.

Information pertaining to longer outcomes than presented in this study is needed to establish the long-term outcomes of the program. Additionally, the question remains whether or not the progress of the students is a consequence of time with the device and activity rather than the implementation of RAAP. Further, convenience sampling was used to identify the EA-student dyads, which is the least desirable sampling technique.

Evaluation of EA's behavior and familiarity with the storybook reading activities and AAC devices should be considered as a variable of interest. Future research should examine whether or not there is a minimum threshold to maximize effects with students. This study pointed toward positive outcomes in a non-storybook task. ImPAACT should be extended across various contexts to determine the broader uses of the strategy. Finally, additional measures of social validity need to be taken to determine the perceived value of the intervention by the classroom teachers of children in the study [26].

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