Focus on Autism and Other Developmental Disabilities

http://foa.sagepub.com

Integrated Word Identification and Communication Instruction for Students With Complex Communication Needs: Preliminary Results

Gretchen A. Hanser and Karen A. Erickson

Focus Autism Other Dev Disabl 2007; 22; 268
DOI: 10.1177/10883576070220040901

Integrated Word Identification and Communication Instruction for Students With Complex Communication Needs:
Preliminary Results

Gretchen A. Hanser and Karen A. Erickson

The current study investigated the effectiveness of an integrated word identification and communication intervention for children with complex communication needs. Using a nonconcurrent, multiple baseline design, the study involved three participants who completed 75 lessons across 4 to 6 weeks of instruction. All three participants improved their skills of word identification, developmental spelling, icon sequencing, and expressive communication. Generalization was documented through increases in the frequency of communication using icon sequencing and spelling outside of the instructional program. Implications for the development of integrated word study programs that combine systematic, sequential phonics instruction with instruction in the use of augmentative communication are discussed, along with directions for future research.

The importance of literacy for persons with complex communication needs has been addressed in the literature for more than a decade (e.g., Koppenhaver, 2000; Koppenhaver & Yoder, 1992; Mirenda, 1993; Yoder, 2001). Combined with successful augmentative and alternative communication, literacy can have far-reaching effects, affecting access to education, employment, and the community for persons with complex communication needs (Foley, 1993; Light & McNaughton, 1993). In general, higher literacy levels increase the likelihood of successful school-to-work transition and are essential to successful postsecondary education (Giordano, 1996; Lerman & Schmidt, 1999). In contrast, low levels of literacy affect individuals' abilities to manage personal health care and read medical information (National Center for Education Statistics, 2005) and generally have a negative effect on health (Gazmararian et al., 1999; Schillinger et al., 2003). If this is the case for persons who can use speech to meet their face-to-face communication needs, the importance of literacy is surely even more profound for persons who cannot.

Literacy and Complex Communication Needs

While the call to address literacy has been consistent, efforts to identify instructional approaches that address the unique learning needs of students with complex communication needs have been sparse. Few published studies have provided empirical evidence regarding the effectiveness of literacy interventions, and most of those studies have modified instructional programs designed for students without communication difficulties. For example, Fallon, Light, McNaughton, Drager, and Hammer (2004) used a multiple-baseline-across-participants design to study the use of a modified direct instruction approach to teach five students with complex communication needs to match phonemes, blend phonemes, and read single words in isolation. Their findings suggested that the approach helped students learn to read single words in the context of the instruction, and three of the five participants demonstrated at least some ability to generalize the word-reading skills to novel words. In all, the participants learned to read approximately 35 to 45 words over the course of 10 to 34 sessions.

In a pair of studies investigating an approach to word reading instruction called the Nonverbal Reading Approach (NRA), children with complex communication needs were taught to read target words using a decoding method that involves internal speech along with diagnostic distracter arrays and error analysis (Coleman-Martin, Heller, Cihak, & Irvine, 2005). In one multiple-baseline-across-participants investigation, Heller, Fredrick, Tumlin, and Brineman (2002) used NRA to teach participants five words and test their ability to generalize knowledge of the individual sounds in the words to read novel words. The three participants worked individually with an instructor, who employed the following instructional sequence:

1. Show the participant the word.
2. Sound out the word together. To support active participation, encourage the participant with complex communication needs to vocalize the word.
3. Point to and say the first sound in the word while directing the participant to say the sound using internal speech.
4. Repeat Step 3 for each of the individual sounds in the word.
5. Say all of the sounds in the word slowly without stopping between sounds, and direct the participant to say all of the sounds together using internal speech.
6. Say the entire word aloud at a normal rate, and direct the participant to do the same using internal speech.

After a baseline designed to identify a set of words the participants could not read, five pairs of words that shared phonetic elements (e.g., *more* and *core, stick* and *stink, dig* and *fig)* were selected. One word from each pair was used for instruction, and the remaining word was used to test generalization. The three participants all learned to read the five words selected for instruction, with one participant requiring only three sessions to achieve 100% mastery. The other two participants took 6 and 10 sessions, respectively, to achieve 80% mastery. Only the first participant demonstrated generalization to the novel words.

In a second study, Coleman-Martin et al. (2005) employed a multiple conditions design with dropdown baselines to investigate the use of computer-assisted instruction as a mechanism to deliver NRA. The three participants in this study learned equally well in the conditions that employed teacher-directed instruction, computer-assisted instruction, and combined teacher-directed and computer-assisted instruction, although there were differences in rate of mastery across the three conditions for at least one of the participants. The three participants required 10, 12, and 21 instructional sessions to master the 15 words taught. The baseline probe conducted with one of the participants after the teacher-directed instruction suggested that some generalization may have taken place, but the design did not address this possibility directly.

Across these three studies, students with complex communication needs demonstrated success in learning words that are highly decodable using instruction designed to teach a phoneme-by-phoneme synthesis approach, but evidence that this approach leads to the generalized application of the acquired phonics skills outside of the instructional context is minimal. Furthermore, no apparent effort was made in these studies to identify words for instruction that would have high utility in communication. In fact, across the three studies, very few of the words used in the intervention (e.g., *in*, *not*, *up*) were commonly used in communication across situations, activities, and environments. Teaching these common words, or core words, as they are known in augmentative and alternative communication (AAC), should be an important goal of early literacy instruction for students with complex communication needs. Given the value of literacy as a communication support for these individuals, it seems imperative that word-level instruction support not only the isolated skill of decoding individual words but the development of a print-based vocabulary to support face-to-face communication.

Why Integrate Word Identification and AAC Instruction?

There are several models of reading that highlight the importance of spoken and written language in reading with comprehension (e.g., J. W. Cunningham, 1993; Hoover & Gough, 1990; Kamhi & Catts, 1998). Adams (1990) provided a model that focuses exclusively on the processes required to read individual words successfully. This model of word reading offers a detailed framework for understanding how readers draw upon vocabulary and other oral language skills to identify words when reading. In the model, Adams described four processors that work in concert to support readers as they encounter, decode, and understand single words in print.

The four processors in Adams' model are *orthographic, phonological, meaning,* and *context*. The orthographic processor depends on input from print to process a written word visually. At the same time, the phonological processor depends on input from speech, including the internal speech used by the participants in the studies reviewed, to process the sounds when reading words. The meaning processor gets input from both the orthographic and phonological processors to confirm the pronunciation of the word and generate possible meanings. Simultaneously, the context processor considers possible meanings and determines which applies. For example, the meaning processor gets orthographic and phonological input to determine the appropriate pronunciation and multiple meanings of the word *chill.* The context processor then considers all available information to determine whether the word is being used with reference to temperature (e.g., "There is a chill in the air") or to a state of being (e.g., "Let's just chill tonight").

Two of the processors—the orthographic and phonological—are clearly addressed in the word-identification instruction provided by Fallon et al. (2004) and in the NRA studies (Coleman-Martin et al., 2005; Heller et al., 2002). The presentation of print and emphasis on analyzing the individual letters in the words supports the orthographic processor. At the same time, the phonological processor utilizes the input from speech, including the internal speech used by the participants in the two NRA studies, as well as knowledge of phonemes to map the print being processed by the orthographic processor to the sounds required to read the word. Unfortunately, the design of the instruction across the three studies reviewed did not specifically address the development of the meaning and context processors as important supports to the generalized application of the skills being taught.

All four processors must work in concert for fluent reading with comprehension to occur. That persons with complex communication needs often have delays in receptive vocabulary (Berninger & Gans, 1986; Udwin & Yule, 1990) and other language domains (Sturm & Clendon, 2004) suggests that they require instruction that explicitly addresses the integration of the four processors in word reading. Without instruction that is intentionally aimed at developing all four processors as an integral part of word identification instruction, readers with complex communication needs are at risk for acquiring only half of the skills required for successful word reading.

In order to test the hypothesis that integrating word identification and communication intervention would lead to the acquisition of word identification skills that would be generalized across contexts, an integrated word identification and communication instructional program was identified for this study.

Method

Materials

The *Literacy Through Unity: Word Study* program (Erickson & Hanser, 2007) was designed for use with a specific augmentative communication application called Unity® (Prentke Romich, Wooster, Ohio). The program systematically integrates instruction that addresses four of the processors in Adams' (1990) model of word reading. Unity is used in conjunction with a family of augmentative communication devices, including Vanguard, Vantage, and Pathfinder (Prentke Romich, Wooster, Ohio). The most widely known organizational system of Unity involves the use of multimeaning icons that are combined and recombined through a rule-based system of semantic concepts and metaphors, Semantic Compaction™ (Baker, 1982). By combining or sequencing icons, a Unity user can generate individual words (e.g., *his, her, this, see, like*) and word combinations (e.g., *I want, he has, I don't*).

A second organizational system in Unity is a dynamic activity row. Vocabulary in the activity row is arranged by category or topic and changes based on the category the user selects. The primary difference between the words generated using icon sequencing and the words found in the activity row is frequency of use across environments, activities, and purposes. While the activity row vocabulary is environment, activity, and purpose specific, vocabulary produced through icon sequencing is less specific. The final system available across the three devices and versions of Unity is spelling. Users can spell words that are spoken aloud using text-to-speech synthesis.

Instructional Program Description

Literacy Through Unity: Word Study is an integrated word identification, spelling, and communication intervention program designed to meet the specific needs of beginning readers and spellers who are also learning to communicate using Unity on an AAC system. It teaches phonics, letter-by-letter spelling, and icon sequencing.

The program has 75 scripted lessons, which are divided among three types: (a) word wall, (b) making words with letters, and (c) making words with icons. The word wall and making words with letters lessons address word identification and spelling through explicit, structured, and systematically organized phonics and spelling lessons. The underlying principles in the word identification and spelling lessons are reflective of instructional approaches described by P. M. Cunningham (2000a; 2000b) that employ a combination of phoneme-by-phoneme and phonics-by-analogy strategies. The 25 word wall lessons support students in learning to read high-frequency words (e.g., *can, not*) automatically and accurately while learning to use those words to read and spell other words that share a common spelling pattern. The 25 making words lessons support students in learning to hear the individual phonemes in words and manipulate letters to represent the phonemes accurately in spelling.

The final 25 lessons support students in learning the rules and logic that govern the use of the multimeaning icons in Unity to generate words for expressive communication through icon sequencing. During these lessons, the multiple semantic features of the icons are highlighted as students combine and recombine icons in different sequences to make different words. Across all three types of lessons, students are required to read and spell words that they are also learning to communicate using icon sequencing. The words taught in the lessons were selected based on their utility to beginning readers, writers, and communicators.

The program is designed to be used by completing one of each type of lesson in the following order: (a) word wall, (b) making words with icons, (c) making words with letters. Twenty-five of these 3-lesson cycles are completed in sequence across a 75-lesson program that is recursive and provides repetition with variety. In the introduction to the program, the authors state,

> From the beginning, the emphasis is on generalization and the transfer of known skills to the unknown. Learners progress through a carefully sequenced set of 75 lessons that support mastery over time rather than mastery of each element as it is introduced. The structure of the program is designed to help learners begin to think like readers, spellers, and *Unity* users. (Erickson & Hanser, 2007, p. 1)

Participants

The participants were recruited in the southeastern United States through professional contacts, assistive technology organizations, conferences, parent groups, teachers, therapists, and vendors. Recruitment was conducted over a large region due to the anticipated difficulties in locating participants who would meet the study's narrow selection criteria. To be considered as a potential participant, individuals had to be (a) between the ages of 7 and 17 years; (b) unable to use speech to meet their face-to-face communication needs; (c) using a Vanguard, Vantage, or Pathfinder augmentative communication system at home and school; (d) able to communicate two known messages per minute on an AAC system; (e) able to demonstrate a minimum age equivalent of 5 years on the third edition of the *Peabody Picture Vocabulary Test* (PPVT-III; Dunn & Dunn, 1997); and (f) able to have a consistent facilitator to implement the intervention lessons. Additionally, school staff and caregivers needed to be willing to suspend all other forms of word identification, spelling, and AAC device instruction during the intervention period.

A total of eight students were considered for participation. The first three students who met all criteria were selected for participation. Demographic information for the three participants selected is provided in Table 1.

Preintervention Testing

To ensure the appropriateness of a conventional literacy and communication intervention program, a two-stage process was used to assess potential participants. The first author administered all assessment tasks over two to three sessions. Stage 1 tasks targeted foundational literacy skills such as letter identification, which required potential participants to identify a minimum of 37 upper- and lowercase letters from a field of four, and concepts about print (Clay, 1993), which required potential participants to demonstrate 8 of the 11 concepts probed in the researcher-designed assessment. Table 2 describes Stage 1 tasks and includes the final participants' performance, indicating the presence of foundational literacy skills needed to progress to Stage 2 tasks.

A series of Stage 2 conventional literacy and communication assessments was completed to ensure that participants' skills were not too high to benefit from the beginning-level conventional instruction provided in the program. Stage 2 tasks consisted of (a) word identification, (b) icon sequencing, (c) expressive communication, (d) word generation, and (e) developmental spelling. The word identification and icon sequencing tasks probed only items addressed in the intervention. The remaining three tasks were intended to assess generalized knowledge of skills taught in the intervention. During the communication task, instead of being given specific words or phrases to say, participants had to generate their own sequences. Although using letters instead of icons, the word generation task was similar in nature; this task is often used to

TABLE 1
Participant Educational Demographics

Demographic	Participant A	Participant B	Participant C
Gender	Female	Male	Male
Age at pretest	13 yrs 2 mos	13 yrs 1 mo	7 yrs 2 mos
Diagnosis	Cerebral palsy, spastic quadriplegia	Moderate mental retardation, cerebral palsy, spastic quadriplegia	Cerebral palsy, spastic quadriplegia
Grade	5	6	2
Education setting	Self-contained special education classroom	Self-contained special education classroom	Special education support in the general education classroom
PPVT-III age equivalent	6 yrs 6 mos	6 yrs 1 mo	8 yrs 2 mos
AAC device	Vantage	Pathfinder	Vanguard
Unity software version	Unity 84	Unity 128	Unity 45
Access method	Direct selection w/ right index finger	Direct selection w/ right middle or pinky finger	Two-switch scanning via head switches
Lesson facilitator	Mother	Special education teacher	Individual instructional assistant
Intervention setting	Home	Self-contained classroom	Separate room outside of classroom

Note. PPVT-III = *Peabody Picture Vocabulary Test,* third edition (Dunn & Dunn, 1997); AAC = augmentative and alternative communication.

TABLE 2
Description of Stage 1 Assessment Tasks and Participant Performance

Stage 1 tasks	Procedure	Continuation criteria	Participant A	Participant B	Participant C
Icon selection	Asked to communicate known messages using AAC system	2 per min or more	2	2	2
Letter identification	Asked to identify uppercase and lowercase letters when presented with 6 choices at a time	37 or more	52	50	52
Concepts About Print (Clay, 1993)	During book reading of *Stones* (Clay, 1979), student was asked 13 questions targeting concepts about print; multiple choice and yes-or-no questions offered	11 or more	12	11	12
PPVT-III	Followed standard administration guidelines, and presented 4 line drawings from which student selected target word	5.0-year equivalent or more	6 yrs 6 mos	6 yrs 1 mo	8 yrs 2 mos

Note. AAC = augmentative and alternative communication; PPVT-III = *Peabody Picture Vocabulary Test,* third edition (Dunn & Dunn, 1997).

assess beginning readers and writers without disabilities (Clay, 1993). Finally, the developmental spelling inventory (Ferroli & Shanahan, 1987) required participants to spell target words without practice, prompts, or models.

For each Stage 2 task, specific exclusion criteria were established. Potential participants who exceeded criteria in two or more tasks were excluded from the study because their skills were potentially too high to benefit from the intervention lessons. Descriptions of Stage 2 tasks, exclusion criteria, and the final participants' performance are provided in Table 3. Careful inspection of the data shows an interesting, but not entirely surprising, similarity among the three participants on the Stage 2 assessments. All three surpassed the criteria on the word identification task while performing quite poorly on the other four tasks.

Intervention Protocol

Facilitator Training. The first author trained three facilitators in the use of the *Literacy Through Unity: Word Study* program. Each facilitator completed at least three training sessions. During the first session, facilitators were given a copy of the 75 lessons and support materials followed by a brief overview of the study and the Unity application on participants' devices. The second session focused on guided practice for implementing the lessons and incorporating device use.

During training sessions, facilitators were also taught to enter specific information into the AAC devices to identify the beginning and ending of each instructional lesson and to mark their own use of the device to model for the student. The devices used in this study contained a built-in mechanism, the Language Activity Monitor (LAM), which records all use of the devices. LAM files can be transferred to the computer for analysis. A date and time stamp marks each use of the device. To use these LAM files as records of participant communication attempts, facilitators learned to enter "START NOW" and "STOP NOW" at the beginning and ending of each lesson. Facilitators were also instructed to enter their initials whenever they used the device to model icon sequencing or spelling for the student. These conventions were essential in distinguishing participants' use of the device from facilitators' when analyzing data collected by the LAM.

During the third session, practice continued through role-playing while the researcher and facilitator completed all lessons steps and entered lesson information into the AAC device. Session 3 continued or was repeated as necessary until the facilitators completed all of the steps on the fidelity checklist (see Figure 1) for the three different types of lessons.

Participants completed all 75 lessons in the program. Working one-on-one with a facilitator, each participant completed one 3-lesson cycle during a 45- to 60-min session each day, 5 days a week. Participant 1 completed the intervention in the home environment, and Participants 2 and 3 in a school environment. All participants successfully completed the intervention within a 6-week period.

Intervention Fidelity. Fidelity checks occurred throughout the course of the intervention. Each participant was observed a minimum of four times. During visits, the researcher completed lesson fidelity checklists (see Figure 1) and videotaped sessions to allow for further analysis of implementation fidelity as required. Procedural reliability, or treatment implementation fidelity, was calculated for each facilitator using a procedure described by Billingsley, White, and Munson (1980) and recommended as a procedure for use in research in AAC by Schlosser (2003). This process involved multiplying the number of observed lesson steps by 100 and then dividing by the total number of expected steps. The procedural reliabilities for Facilitators A, B, and C were 90%, 96%, and 92% across four, four, and five respective observations.

TABLE 3
Description of Stage 2 Assessment Tasks and Participant Performance

Stage 2 tasks	Procedure	Exclusion criteria	Participant A	Participant B	Participant C
Word identification	Students presented w/ 4 words & asked to identify target word; orthographically & phonologically similar words presented on computer using PowerPoint. Task consisted of 25 words taught in word wall lessons (*can, not, will, on, I, at, mine, is, be, want, it, play, and, she, what, in, make, have, do, like, eat, drink, are, we, more*).	13 or more	14	17	22
Icon sequencing	Using their AAC system, students were to communicate target word(s) using correct icon sequence. Task consisted of 25 words randomly selected from all words taught in making words w/ icons lessons (*eat, it, because, can't, it can, she can't, good, we can, do, have I, game, can, bad, we are, I don't know, are we, she, you like, you don't like, can't she, and, read, in, want, can't it*).	13 or more	2	5	3
Expressive communication	Using their AAC system, students were to communicate as many words as possible, using only icon sequences, in 10 minutes.	120 or more	4	3	3
Word Generation (Clay, 1993)	Using keyboard on their AAC system, students were to spell as many words as possible in 10 minutes; only correctly spelled words counted.	20 or more	8	6	6
Developmental spelling	Using keyboard on their AAC system, students were to encode words from the following developmental spelling list: *back, sink, mail, dress, lake, peeked, light, dragon, stick, side, feet, test* (Ferroli & Shanahan, 1987); spelling attempts were scored using the Developmental Spelling Scoring Rules (Erickson, 2003).	Score of 60 or more	24.0	4.0	53.5

Design

Pretest–Posttest Data. Two distinct designs were utilized to capture participant change across a number of areas. A pretest–posttest format was used to compare participant change over time on communication and conventional literacy measures. Stage 2 screening results served as pretest scores, and the screenings were repeated at the end of the intervention to provide a pretest–posttest comparison for the individual participants.

Nonconcurrent Multiple Baseline. In addition to the pretest–posttest, a nonconcurrent multiple baseline design with a predetermined baseline of 5, 10, and 15 days (Crowe, Norris & Hoffman, 2000; Watson & Workman, 1981) was employed to look at the frequency with which participants used icon sequences and letters. The nonconcurrent design was selected to allow participants to begin the intervention as soon as possible after being identified. Given the low incidence of the proposed population, the narrowly defined participant characteristics, and the labor-intensive nature of the screening procedures, it was not feasible to identify participants and wait to implement simultaneous commencement of baseline (Kennedy, 2005; Winn, Skinner, Allin & Hawkins, 2004). Thus, as each participant was selected, he or she was randomly assigned to the 5-, 10-, and 15-day baseline period, and participation began as soon as possible.

During the nonconcurrent multiple baseline investigation, data recorded by the LAM were used to track changes in participants' spelling and icon sequencing across the baseline, intervention, and two 5-day maintenance phases, which occurred 1 week and 5 weeks postintervention. During the intervention phase, data were collected for analysis only on days when a lesson was completed. To track generalization through spontaneous communication device use, data selected for analysis represented the participant's use of the device outside of instruction time during the intervention. The use of icons and letters during the lessons was not tracked because the *Literacy Through Unity: Word Study* program is not a mastery-based approach to instruction, and LAM data recorded during lessons would only reveal that the participants used their devices as directed in the lessons.

The LAM indicated not only the date and time of the communication but also whether the words were produced through spelling, selecting icons, or using the activity row. Thus, during all phases, LAM data were used to calculate the dependent variables: (a) the number of letters used for spelling and (b) the number of icon sequences used to communicate words or phrases.

Results

Descriptive statistics are used to report the results from the pretest–posttest comparison. Pretest–posttest results in Table 4 revealed that with the exception of a 5% decrease in Participant B's word generation performance, each participant demonstrated gains in all areas. As a group, the participants had an average gain of 20% (5 words) on the word identification task and 56% (14 words) on the icon-sequencing task. In addition, on the 10-min communication and word generation tasks, participants had an average of 19 more words using icon sequences and generated an average of 3 additional words through spelling at posttest than they did at pretest. Finally, their collective developmental spelling scores improved an average of 13 points from pretest to posttest. While the small sample size and the potential for an inflated Type I error precluded the use of tests of significance on these data, the gains made during this short period clearly hold clinical relevance for professionals who have struggled to support literacy and communication development for this population of students.

Descriptive statistics are also used to illustrate the first dependent variable, participant use of icon sequencing to generate words and phrases. As displayed in Figure 2, the icon sequencing dependent variable was measured across all phases. Recall that analyzed data from the intervention phase included only LAM recordings that occurred outside of instructional time. Understanding the significance of these results across phases generally calls for an analysis of the overlap across phases. In the case of icon sequencing use, there is a high level of variability, with considerable overlap (95% or greater) between all phases for all participants, with two exceptions. For Participant A, there is a 58% overlap between baseline and intervention, and for Participant C, a 60% overlap between 1 week post and 5 weeks post. Traditional measures of overlap do not capture the impact of the intervention.

The high overlap rate coupled with day-to-day fluctuations in icon sequencing use warrants the examination of phase levels. This analysis, indicated by horizontal lines on Figure 2, reflects the average of icon sequences produced per day and

Lesson components	**No. observations & comments**	**%**
Records lesson start time	# of observations: # of possible opportunities:	
Types "START NOW"	# of observations: # of possible opportunities:	
Records lesson stop time	# of observations: # of possible opportunities:	
Types "STOP NOW"	# of observations: # of possible opportunities:	
Uses educator code on device before modeling	# of observations: # of possible opportunities:	
Refers to sentences provided in the lesson	# of observations: # of possible opportunities:	
Models on device as indicated in lesson	# of observations: # of possible opportunities:	
Points to icon/letter/word cards as indicated in lesson	# of observations: # of possible opportunities:	
Provides instructional feedback for all student attempts	# of observations: # of possible opportunities:	
Includes steps in lesson observed (see attached photocopy of lesson)	# of observations: # of possible opportunities:	
	Average Lesson Fidelity:	

FIGURE 1. Lesson fidelity observation checklist.

TABLE 4
Pretest and Posttest Scores

	Participant A		Participant B		Participant C		Group	
Task	**Pretest**	**Posttest**	**Pretest**	**Posttest**	**Pretest**	**Posttest**	**Pretest**	**Posttest**
Word identification[a]	56%	76%	68%	96%	88%	100%	71%	91%
Icon sequencing[a]	8%	56%	20%	80%	12%	72%	13%	69%
Expressive communication[b]	4	36	3	22	3	10	3.33	22.67
Word generation[c]	8	15	6	5	6	10	6.67	10.00
Developmental spelling[d]	24.00	26.00	4.00	22.00	53.50	73.50	27.17	40.50

[a]Score represents percentage correct out of 25 items. [b]Score represents total number of icon sequences generated by the participant. [c]Score represents total number of correctly spelled words generated by the participant. [d]Score represents total number of points, with 127 as the highest possible score.

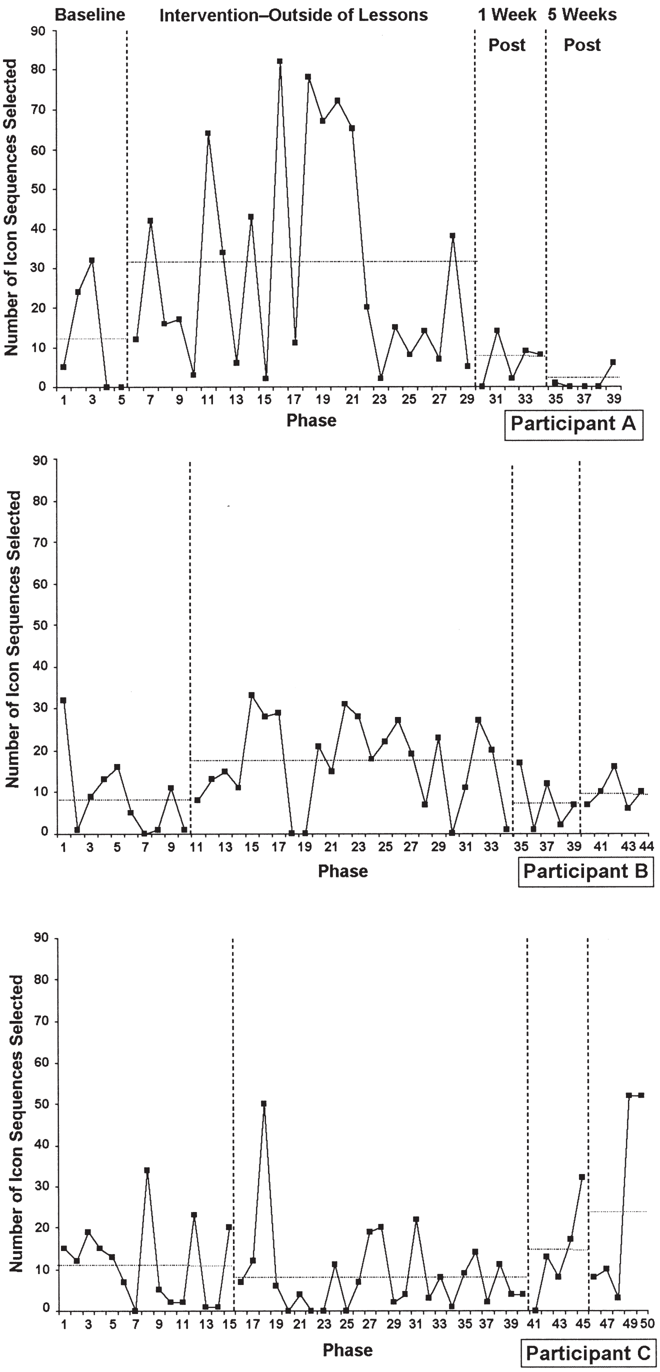

FIGURE 2. Frequency of icon sequence selections across all phases. *Note.* Horizontal lines indicate mean icon sequence use.

suggests participant change from one phase to another. Participant A had a mean use of icon sequences of 12.2 (range = 0–32) at baseline, 30.1 (range = 0–82) during intervention, and 6.6 (range = 0–14) and 1.4 (range = 0–6) during the two generalization phrases. Participant B had a mean icon use of 8.9 (range = 0–32) at baseline, 17.0 (range = 0–33) during the intervention, and 7.8 (range = 1–17) and 9.8 (range = 6–16) during the two generalization phases. Participant C had a mean icon use of 11.3 (range = 0–34) at baseline, 8.8 (range = 0–50) during the intervention, and 14.0 (range = 0–32) and 25.0 (range = 3–52) during the two generalization phrases.

Further analysis was done on participants' daily use of the icon sequences specifically taught in the intervention. Per day, the average number of intervention-specific icon sequences used by Participant A was 7.3 during baseline, 14.5 during intervention, and 3.3 and 2.5 during the two generalization phases. Per day, the average number of intervention-specific icon sequences used by Participant B was 1.4 during baseline, 9.9 during intervention, and 1.2 and 4.0 during the two generalization phases. Per day, the average number of intervention-specific icon sequences used by Participant C was 4.4 during baseline, 6.0 during intervention, and 10.5 and 12.0 during the two generalization phases.

Figure 3 illustrates the second dependent variable, participant use of the communication device to select individual letters for spelling, measured across all phases. Similar to the calculation of the first dependent variable, data on the days of the intervention do not include the selection of letters during instruction; rather, they include only data from outside instructional time.

Overall inspection of the data demonstrates variability and overlap between phases that mirrors the icon-sequencing variable. All phases have an overlap of greater than 75% for all participants, with the exception of a 60% overlap between 1 week postintervention and 5 weeks postintervention for Participant B. Once again, the day-to-day variability with high overlap warrants the inspection of mean levels across phases. Per-day average use of letters for spelling was calculated for each phase. This analysis reveals an increase in letter use from baseline to intervention for all participants. For Participant A, the average number of letters selected per day was 46.8 (range = 0–106) during baseline, 71.6 (range = 0–594) during intervention, 156.8 (range = 2–315) during the 1-week postphase, and 73.8 (range = 1–203) at the 5-week post. For Participant B, the average number of letters selected per day was 42.5 (range = 0–212) during baseline, 72.7 (range = 0–213) during the intervention, 24.2 (range = 0–85) during the 1-week postphase, and 110.0 (range = 9–230) during the 5-week postphase. Participant C showed a consistent increase over time in the number of letters selected, with means per day of 20.4 (range = 0–62) during baseline, 31.3 (range = 0–111) during intervention, 39.4 (range = 6–118) during the 1-week postphase, and 52.8 (range = 23–94) during the 5-week postphase.

Discussion

The results of this 4- to 6-week intervention suggests that systematic, integrated word identification, spelling, and AAC vocabulary instruction was effective in increasing literacy and communication skills for the three participants in the study. The pretest and posttest measures of the preliminary data suggest that participants made measurable gains across word identification, spelling, and communication tasks. Results from the multiple baseline component displayed considerable variability and overlap but support general improvement across the phases for the three participants.

All of the participants made progress on the word identification and icon sequencing tasks, showing that they had learned the items taught directly in the intervention. During the unprompted expressive communication task, participants demonstrated generalization of their icon-sequencing skills by generating sequences taught in the program as well as sequences that were not addressed. At pretest, participants generated a mean of 1.67 icon sequences directly taught in the program and 1.67 that were not. At posttest, participants generated a mean of 8.67 program-specific sequences. More important, at posttest participants generated a mean of 14.00 icon sequences that had not been taught in the program, suggesting that they were using their knowledge of the icon rules taught in the intervention to generate new icon sequences.

During the 10-min word generation task, Participant A and Participant C almost doubled the number of correctly spelled words they could generate. At pretest, Participant A generated only 8 words, including 2 names and 4 words that would be taught in the intervention. Participant A generated 15 words at posttest. The posttest list included 11 words from the intervention: 5 word wall words, 1 word from making words with icons, and 5 words from making words with letters. Participant C's results are similar. Participant C generated 6 words at pretest, including 2 from the intervention. At posttest, Participant C generated 10 words, including 5 word wall words, 1 word from making words with icons and 1 word from making words with letters. The posttest increase in intervention words for Participants A and C suggests that the integrated nature of the lessons was effective. The only decrease in all of the test areas was for Participant B, who demonstrated a slight 1-word decrease in the number of words generated. The fact that Participant B had almost no spelling skills at pretest may have influenced his ability to generate words and improve on this task.

The developmental spelling measure required participants to spell words that were not included in the instructional program. Participants' spelling attempts on these items were scored according to the number of phonemes that were accurately reflected and the order in which the phonemes were represented. While all participants made gains, Participants B and C showed the most evidence of improvement in their spelling. Participant B was only able to represent 4 phonemes on the pretest. However, at posttest, his score increased to 22, and he was able to represent most initial and final consonants correctly in his spelling attempts. While he still had substantial progress to make to use spelling as an effective means of communication, he acquired enough initial and final phoneme knowledge to begin to take advantage of the word prediction feature available in his device. Participant C also demonstrated evidence of

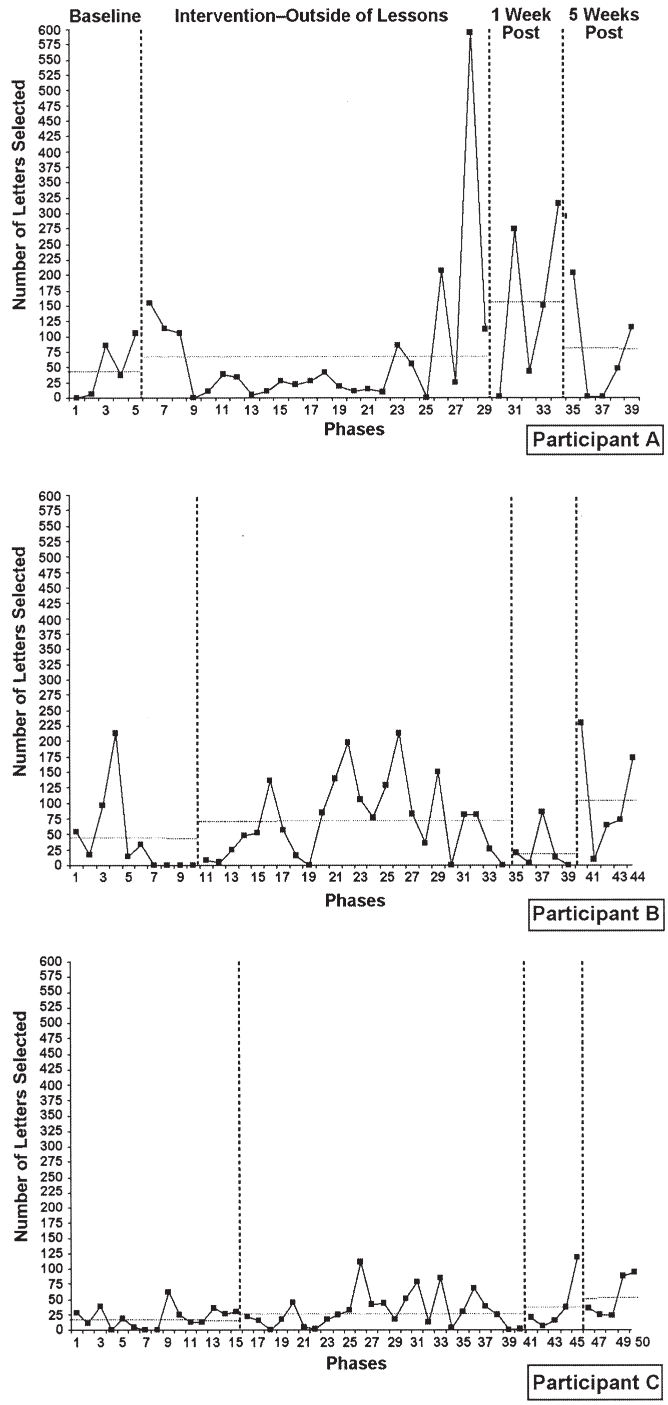

FIGURE 3. Frequency of letter selections across all phases. *Note.* Horizontal lines indicate mean levels.

generalization on the developmental spelling measure. He received a fairly high score on the pretest yet improved his score by an additional 20 points, correctly spelling most phonemes in the 12 words and putting them in the correct order on the posttest.

Visual inspection of Figures 2 and 3 suggests that there was a great deal of fluctuation from one day to the next in the number of icon sequences the participants generated and the number of letters they selected to spell words. With the exception of Participant C's use of icon sequences, all participants increased their use of icon sequences and letter selections from baseline to intervention. When examining icon sequences taught only in the intervention, similar trends are seen, with an increase in their use from baseline to intervention.

Future research investigating the *Literacy Through Unity: Word Study* program should consider comparing the effects of instruction that utilizes only two components at a time. In other words, the hypothesis that integrating word identification and communication intervention will lead to more significant progress than a single-pronged approach can only be tested if a comparison is made. One alternative would be to use only the word wall and making words with letters intervention with one group of students and use the entire integrated set of lessons with a carefully matched or randomly assigned second group.

Other research to test the hypothesis might integrate explicit instruction of communication into existing word identification programs, such as the nonverbal reading approach. Incorporating the careful selection of items for instruction that have high utility in face-to-face communication and adding instruction that supports the use of those words for communication would further contribute to our understanding of the importance of integrated instruction.

Students with complex communication needs face many challenges in learning to read, write, and communicate (Sturm & Clendon, 2004). The current investigation suggests that instruction that integrates these three areas may address many of these challenges. The research reported here provides one form of evidence to suggest that the *Literacy Through Unity: Word Study* program may be an effective instructional program. Although findings are based on a small sample, participants showed gains on pretest–posttest measures that reflect the generalization of the decoding, encoding, and icon sequencing skills taught in the intervention. Even more compelling is the impact the instruction had on participants' lives. A speech and language pathologist who works with one of the participants at school recently called the second author to report that the student has been teaching the pathologist new icon sequences every time they work together. She also reported that the student is using the augmentative communication device to spell and participate more fully in the classroom. Another participant has acquired enough initial and final phoneme knowledge to take advantage of the word prediction feature in his communication device to support his beginning spelling attempts. Such growth in spelling skills suggests that the intervention's approach to phonics instruction was effective and merits further investigation.

All three of the participants now behave in ways that suggest that they see themselves as readers and writers. Outcomes of this research for teachers include the development not only of new resources but, more important, of methods that will allow teachers to support their students in moving toward more sophisticated levels of literacy and communication.

ABOUT THE AUTHORS

Gretchen A. Hanser, *MS, OTR, is the associate director of school-age services at the Center for Literacy & Disability Studies at the University of North Carolina. This study was completed in fulfillment of the first author's dissertation through the Education Department at the University of New Hampshire at Durham. Her current interests include literacy instruction for students with significant disabilities, augmentative and alternative communication, and accessibility.* ***Karen A. Erickson,*** *PhD, is the director of the Center for Literacy & Disability Studies at the University of North Carolina. Her research interests are in the areas of literacy assessment and instruction for students with disabilities, including those with the most significant disabilities. Address: Gretchen A. Hanser, The Center for Literacy & Disability Studies, Department of Allied Health Sciences, The University of North Carolina, Bondurant Hall, CB #7335, 321 S. Columbia St., Chapel Hill, NC 27599; e-mail: gretchen_hanser@med.unc.edu*

REFERENCES

Adams, M. A. (1990). *Beginning to read: Thinking and learning about print.* Cambridge, MA: MIT Press.

Baker, B. (1982). Minspeak. *Byte, 9,* 186–202.

Berninger, V., & Gans, B. (1986). Assessing word processing capability of the nonvocal, nonwriting. *Augmentative and Alternative Communication, 2,* 56–63.

Billingsley, F. F., White, O. R., & Munson, R. (1980). Procedural reliability: A rationale and an example. *Behavioral Assessment, 2,* 229–241.

Clay, M. M. (1979). *Stones-the concept about print test.* Portsmouth, NH: Heinemann.

Clay, M. M. (1993). *An observation survey of early literacy achievement.* Portsmouth, NH: Heinemann.

Coleman-Martin, M. B., Heller, K. W., Cihak, D. F., & Irvine, K. L. (2005). Using computer assisted instruction and the nonverbal reading approach to teach word identification. *Focus on Autism and Other Developmental Disabilities, 20,* 80–90.

Crowe, L. K., Norris, J. A., & Hoffman, P. R. (2000). Facilitating storybook interactions between mothers and their preschoolers with language impairment. *Communication Disorders Quarterly, 21,* 131–150.

Cunningham, J. W. (1993). Whole-to-part reading diagnosis. *Reading and Writing Quarterly, 9,* 31–49.

Cunningham, P. M. (2000a). *Phonics they use: Words for reading and writing* (3rd ed.). New York: Longman

Cunningham, P. M. (2000b). *Systematic sequential phonics they use.* New York: Longman.

Dunn, L. M., & Dunn, L. M. (1997). *Peabody picture vocabulary test* (3rd ed.). Circle Pines, MN: American Guidance Service.

Erickson, K. A., & Hanser, G. (2007). *Literacy through unity: Word study.* Wooster, OH: Prentke Romich.

Fallon, K. A., Light, J., McNaughton, D., Drager, K., & Hammer, C. (2004). The effects of direct instruction on the single-word reading skills of children who require augmentative and alternative communication. *Journal of Speech, Language, and Hearing Research, 47,* 1424–1439.

Ferroli, L., & Shanahan, T. (1987). Kindergarten spelling: Explaining its relationship to first-grade reading. In J. B. Readance, & R. S. Baldwin (Eds.), *Research in literacy: Merging perspectives* (Thirty-sixth yearbook of the National Reading Conference, pp. 93–99). Rochester, NY: National Reading Conference.

Foley, B. E. (1993). The development of literacy in individuals with severe congenital speech and motor impairments. *Topics in Language Disorders, 13*(2), 16–32.

Gazmararian, J. A., Baker, D. W., Williams, M. V., Parker, R. M., Scott, T. L., Green, D. C., et al. (1999). Health literacy among Medicare enrollees in a managed care organization. *Journal of the American Medical Association, 281,* 545–551.

Giordano, G. (1996). *Literacy programs for adults with developmental disabilities.* San Diego, CA: Singular.

Heller, K. W., Fredrick, L. D., Tumlin, J., & Brineman, D. G. (2002). Teaching decoding for generalization using the nonverbal reading approach. *Journal of Developmental and Physical Disabilities, 14,* 19–35.

Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing, 2,* 127–160.

Kamhi, A. G., & Catts, H. W. (1998). Language and reading: Convergences and divergences. In H. W. Catts & A. G. Kamhi (Eds.), *Reading disabilities: A developmental language perspective* (pp. 1–24). Boston: Allyn & Bacon.

Kennedy, C. H. (2005). *Single-case designs for educational research.* Boston: Allyn & Bacon.

Koppenhaver, D., & Yoder, D. (1992). Literacy issues in persons with severe physical and speech impairments. In R. Gaylord-Ross (Ed.), *Issues and research in special education* (Vol. 2, pp. 156–201). New York: Teachers College Press.

Koppenhaver, D. A. (2000). Literacy in AAC: What should be written on the envelope we push? *Augmentative and Alternative Communication, 16,* 267–277.

Lerman, R. I., & Schmidt, S. R. (1999, May). Functional literacy and labor market outcomes. Paper presented at the conference *Helping low-wage workers: Policies for the future*, held at the Urban Institute, Washington, DC.

Light, J., & McNaughton, D. (1993). Literacy and augmentative and alternative communication (AAC): The expectations and priorities of parents and teachers. *Topics in Language Disorders, 13*(2), 33–46.

Mirenda, P. (1993). Bonding the uncertain mosaic. *Augmentative and Alternative. Communication, 9,* 3–9.

National Center for Education Statistics. (2005). *A first look at the literacy of America's adults in the 21st century.* Retrieved January 8, 2006 from http://nces.ed.gov/naal/Prentke Romich Inc., Unity®, Wooster, OH.

Schillinger, D., Piette, J., Grumbach, K., Wang, F., Wilson, C., Daher, C., et al. (2003). Closing the loop: Physician communication with diabetic patients who have low health literacy. *Archives of Internal Medicine, 163,* 83–90.

Schlosser, R. W. (2003). *The efficacy of augmentative and alternative communication.* Boston: Academic Press.

Sturm, J. M., & Clendon, S. A. (2004). Augmentative and alternative communication, language and literacy: Fostering the relationship. *Topics in Language Disorders, 24,* 76–91.

Udwin, O., & Yule, W. (1990). Expressive language of children with Williams syndrome. *American Journal of Medical Genetics, 6,* 108–114.

Watson, P. J., & Workman, E. A. (1981). The non-concurrent multiple baseline across-individual design: An extension of the traditional multiple baseline design. *Journal of Behavior Therapy and Experimental Psychiatry, 12,* 257–259.

Winn, B. D., Skinner, C. H., Allin, J. D., & Hawkins, J. A. (2004). Practicing school consultants can empirically validate interventions: A description and demonstration of the non-concurrent multiple-baseline design. *Journal of Applied School Psychology, 20,* 109–128.

Yoder, D. (2001). Having my say. *Augmentative & Alternative Communication, 17,* 2–10.