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Using Incremental Rehearsal to Teach Letter Sounds to English Language Learners

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Abstract

This study examined the effects of incremental rehearsal (IR) on letter sound expression for one kindergarten and one first grade English learner who were below district benchmark for letter sound fluency. A single-subject multiple-baseline design across sets of unknown letter sounds was used to evaluate the effect of IR on letter-sound expression and fluency. Although visual analysis of the data showed an increase in level and trend for the kindergarten participant, data were variable for the first grade participant who was referred for special education services during the intervention. Mean percentage of non-overlapping data (PND) was 94% for the kindergarten student and 98% for the first grade student. Although both learners made increases in letter sound expression and fluency, the intervention was 17 weeks in duration. Future research should examine both the effectiveness and efficiency of IR, as compared to other interventions, for increasing letter-sound knowledge of English learners.

The importance of acquiring early literacy skills to learn to read in the primary grades is well documented in the research literature (Snow, Burns, & Griffin, 1998; Vellutino, Scanlon, & Zhang, 2007). Students who fail to learn these skills tend to continue to experience difficulties in academic skills throughout school (Stein, Johnson, & Gutlohn, 1999). Results from the National Reading Panel (NRP, 2000)

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specify the importance of systematic and explicit phonics instruction in kindergarten and first grade to improve students' word recognition, spelling, and reading comprehension. Letter-sound correspondence is a particularly important skill in the primary grades. Letter-sound fluency consistently predicts outcomes on high-stakes reading tests later in schooling (Pickart, Sheran, Betts, & Heistad, 2004), as well as other reading-related outcomes across first and second grades (Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004).

Systematic and explicit literacy interventions are particularly beneficial for students at risk for literacy difficulties early in the primary grades (NRP, 2000). For example, Vellutino, Scanlon, Small, and Fanuele (2006) found that kindergarten and first grade students who received targeted literacy interventions performed better on measures of emergent literacy when compared to similar peers who did not receive intervention support. In addition, Al Otaiba and Torgeson (2007) found that providing students with systematic and explicit literacy interventions in combination with a strong and explicit core reading program can reduce the percentage of poor readers by the end of first or second grade.

Although the importance of early literacy interventions in the primary grades is well researched (Stein et al., 1999), early literacy interventions for students from culturally and linguistically diverse backgrounds are underrepresented in the research literature (Klingner & Edwards, 2006). Particularly, far less attention has been given to identifying and implementing research-based interventions for this group of learners (McCray Sorrells, Webb-Johnson, & Townsend, 2004). Upon entering kindergarten, English learners face the combined tasks of learning to understand, speak, and read English. Students may also experience more significant challenges when learning to read because of issues with acculturation, linguistic isolation, and lack of prior literacy experiences in their native language or English (August & Shanahan, 2006). As a result of these confounding variables, researchers often omit English learners from their samples, adding to their underrepresentation in the research literature, and precluding a full understanding of the outcomes of literacy interventions (Gersten & Baker, 2000). If early literacy interventions are to be used with English learners, they must be validated with this population (Klingner & Edwards, 2006).

Preliminary evidence suggests that conclusions drawn by the NRP (2000) about the importance of phonemic awareness and phonics instruction apply to both native English speakers and English learners (Shanahan & Beck, 2006). For example, Linklater, O'Connor, and Palardy (2009) found no significant differences in growth trajectories of native English speakers and English learners on measures of

phonemic awareness in kindergarten. Similarly, Chiappe, Siegel, and Wade-Woolley (2002) found that students learning English who were behind in measures of phonemic awareness in kindergarten made accelerated growth and caught up to their native English speaking peers by first grade. In a study of direct instruction in letter sounds as part of a comprehensive literacy intervention for first and second graders, Kamps et al. (2007) found that all students, regardless of native language, made gains in measures of decoding and oral reading fluency. This collection of evidence, though small compared to that of native English speakers, provides preliminary evidence that early literacy interventions used with native English speakers may also be successfully used with English learners.

One intervention with evidence of effectiveness with native English speakers is Incremental Rehearsal (IR; Burns, Dean, & Foley, 2004; Volpe, Burns, DuBois, & Follen Zaslofsky, 2011). IR is a systematic and explicit intervention that teaches unknown concepts by combining them with known concepts (Burns et al., 2004). In IR, a student knows approximately 90% of the concepts, with the remaining 10% of concepts unknown and interspersed among known concepts. This drill and practice procedure is effective for teaching students in the acquisition phase of learning because it allows for teaching to mastery, introduces unknown concepts in small sets, allows many opportunities to respond, promotes errorless learning, and provides repetition (Burns et al., 2004). IR has been found to be more effective than traditional methods of drill and practice (Burns & Boice, 2009; Burns & Sterling-Turner, 2010; MacQuarrie, Tucker, Burns, & Hartman, 2002).

In addition to the documented success of IR to teach multiplication facts (Burns, 2005; Codding, Archer, & Connell, 2010) and word recognition (Burns & Boice, 2009; Burns et al., 2004; MacQuarrie et al., 2002; Nist & Joseph, 2008; Volpe, Mule, Briesch, Joseph, & Burns, 2011), IR has been used in one study to teach letter sounds. Volpe, Burns, et al. (2011) used IR to teach letter sounds to four kindergarten students, one of whom was identified as an English learner. Participants were identified because they were not making expected progress toward benchmarks on letter sounds given the general reading curriculum and a supplemental intervention. Researchers added more intensive instruction in letter sounds using IR delivered via a computer program. Results showed that students' letter sound fluency increased over the course of 25 intervention sessions. This was the first study to test the effectiveness of using IR to teach letter sounds to kindergarten students, one of whom was identified as an English learner.

This study extends the results of Volpe, Burns, et al. (2011) by testing the effectiveness of IR, delivered one-on-one by an instructor,

to teach letter sounds to two English learners. The following research questions guided the current investigation:

1. What is the effect of IR on overall letter-sound expression of English learners?

2. What is the effect of IR on letter-sound fluency of English learners?

Method

Participants

Participants were two male students, one kindergartener, Jonathan, who was 5 years, 8 months old and one first grader, Omar, who was 6 years, 11 months old at the beginning of the study. Both attended a public elementary school in a Midwestern urban district. Jonathan and Omar were previously identified as English learners and received English Language Learner (ELL) services prior to the start of the study. Jonathan's primary language was Hmong and Omar's primary language was Somali.

This study was conducted within the context of ongoing literacy work between the University and school district. Thus, students were selected for intervention given their need for additional instruction on letter sounds. Specifically, Jonathan was selected for intervention based on a letter-sound fluency score of 14 or below on the Minneapolis Kindergarten Assessment (MKA) administered in January. According to district benchmarks, a score of 14 or below indicated risk for not meeting the proficiency standard on the state high-stakes assessment in third grade. No other kindergarten English learners met this criterion. Therefore, Omar, a first grade student, was included based on similarly low letter-sound fluency scores. Prior to conducting the study, neither participant had been identified as needing special education services. Omar was identified partway through the study as having a learning disability in math and reading.

Jonathan scored at the "entering" level for English language proficiency on a district assessment for ELL services. This level indicates oral language with phonological, syntactic, or semantic errors that often impede meaning when presented with basic oral commands, direct questions, or simple statements with sensory, graphic, or interactive support. Omar scored between the "beginning" and "developing" level on the district assessment, indicating oral or written language with phonological, syntactic, or semantic errors that often impede the meaning of the communication when presented with one- to multiple-step commands, directions, questions, or a series of statements with sensory, graphic, or interactive support. Although both students qualified for ELL services, no additional information

was available regarding their mastery of native languages, formal academic histories, or length of time in the United States.

Measures

We used three measures in this study. As previously noted, the letter-sound fluency subtest of the MKA was used to determine eligibility for the intervention. A dependent measure of letter-sound expression was used at the beginning of each intervention day to establish known and unknown letter sounds. Letter-sound fluency was used to identify the first grade student for inclusion in the study and as a second dependent measure to assess student progress toward meeting district reading benchmarks.

*Minneapolis Kindergarten Assessment (MKA).*The MKA was developed by the Minneapolis Public Schools to measure the literacy and numeracy skills of entering and exiting kindergarten students (Pickart et al., 2007). The literacy portion of the MKA assesses phonemic awareness, the alphabetic principle, oral language, and concepts of print. The same version of the MKA is administered in fall (referred to as the Beginning Kindergarten Assessment or BKA), winter, and spring (referred to as the End of Kindergarten Assessment or EKA) to assess student growth.

To evaluate the psychometric properties of the BKA and EKA, both were administered to 2,180 kindergarten students attending a large urban school district (Pickart et al., 2007). Study authors obtained an internal consistency reliability of .90 for the BKA and .93 for the EKA total composite scores. Test-retest reliability on a randomly selected sample of 88 students was .92 overall and .80 for the letter-sound fluency subtest (Pickart et al., 2007). The EKA correlated with a variety of district and statewide assessments, including first grade oral reading fluency (.80) and the Minnesota Comprehensive Assessment-II (MCA-II) (.602; Pickart et al., 2007), the state accountability assessment in reading and math. Additional research by Betts et al. (2008) examined the predictive validity and predictive bias of the MKA with respect to English learners. Overall, results suggest that fluency-based measures included on the MKA can be used to predict subsequent reading achievement for diverse students.

Letter-sound fluency. The letter-sound fluency measure used in this study consisted of a 1-min task developed by the Minneapolis Public Schools to monitor progress for kindergarten students identified as below benchmark on the BKA. The student is shown a one-page document with seven rows of 10 randomly selected lowercase letters and asked to say the most common sound for each letter. If a student does not respond, the examiner waits 3 s before directing the

student to move on to the next letter. The student's score is the number of letter sounds named correctly in 1 min. Letter-sound fluency was assessed during baseline and once per week to determine the effectiveness of IR. Alternate forms of the measure were available and therefore used to monitor student progress and minimize practice effects. This measure was also used to determine Omar's eligibility for the study. District protocol requires that teachers monitor progress on letter-sound fluency for first grade students who score below 10 words per minute on the district's first grade oral reading fluency benchmark measure. The district letter-sound fluency measure has evidence of reliability coefficients of .90 for test-retest reliability and a validity coefficient of .69 when correlated with first grade oral reading fluency (Marston et al., 2007).

At the beginning of the study, known and unknown letter sounds were established by asking students to say the remaining letter sounds on the letter-sound fluency probe when the timed portion of the measure (i.e., 1 min) was completed. The examiner recorded which sounds were named correctly and incorrectly.

Letter-sound expression. Letter-sound expression was the primary dependent variable in this study. Letter-sound expression was assessed by presenting each set of 5 cards in order (i.e., Set A, Set B, Set C) with the 5 cards within each set shuffled and administered in random order. Cards were 3 inch by 3 inch laminated white cards with one lowercase letter per card. Each card contained one of the 15 unknown letter-sounds from the intervention (e.g., five letter cards per set for a total of 15 cards across three sets). The examiner showed the student each card and asked the student to say the most common sound for each letter. The student was given 3 s to respond before moving on to the next letter. The examiner recorded each sound as correct or incorrect and plotted the total number of sounds expressed correctly in each letter-sound set on the student's graph. A maximum score of 5 was possible on each letter-sound set. Individual letter sounds were considered mastered when the student named the sound correctly in three consecutive sessions with no subsequent errors. A letter-sound set was considered mastered when all sounds were named correctly in three consecutive sessions with no subsequent errors.

Procedure

Six graduate students delivered the intervention. Five were female and one was male. One instructor was Indian, one was Asian, and four were Caucasian. All were proficient English speakers. Intervention sessions were 10–15 min in length and took place outside the classrooms of each student. Initially, sessions were delivered one time per day,

approximately four days per week. Because Jonathan, the kindergarten participant, showed difficulty retaining letter sounds between intervention sessions, the number of sessions was increased to three times per day for the duration of the study to promote more exposure to the target sounds. Omar, the first grade participant, remained on an intervention schedule of one time per day, four days per week. Intervention continued for 17 weeks. Intervention times were predetermined by classroom teachers so as not to interfere with core curriculum.

Pre-baseline assessment. Prior to baseline, the instructor administered the letter-sound fluency and letter-sound expression measures described above to establish known and unknown concepts for each student and thus to determine which sounds to teach during intervention. Known and unknown letter-sounds for each participant were determined via examination of known and unknown sounds on these measures. Knowns were defined as correct letter sounds with no subsequent errors for that particular letter. Unknowns were defined as incorrect letter sounds.

Jonathan had 1 known and 25 unknown letter sounds prior to intervention. Omar had 11 known and 15 unknown letter sounds prior to intervention. Fifteen letter sounds were targeted for each participant. Because Jonathan had more than 15 unknown letter sounds, 15 unknowns were randomly selected as intervention targets from the 25 unknowns. Unknown letter sounds were then randomly divided into three sets of five unknown letter sounds for each participant (table 1). If a student had more than 15 unknown sounds, remaining sounds were excluded from the intervention.

Materials. The instructor created 3 inch by 3 inch laminated cards for the 15 unknown sounds and all known sounds for each student. All known and unknown letter-sound cards were identical in appearance, using black ink and the same font. Because Jonathan knew fewer than five letter sounds prior to intervention, commercially available flash cards with drawings of common objects, shapes, and colors cut to the same size as the letter-sound cards were used as additional knowns in Set A only. We determined knowns by asking Jonathan to name each pictured stimulus. The stimulus was considered known if Jonathan provided the most common response for the item (e.g., labeling a picture of an apple as "apple"). Incorrect or unconventional responses were considered unknown (e.g., labeling a picture of an apple as "circle"). Each set of cards used during intervention consisted of one unknown sound and six known sounds or objects. In previous studies researchers have used ratios of nine knowns to one unknown (Burns, 2005; Burns & Boice, 2009; Burns et al., 2004) and four knowns to one unknown (Volpe, Burns, et al., 2011). Based on

Table 1
Letter-Sound Sets and Total Days of Intervention Per Set

Student	Set	Sounds	Total Days of Intervention
Jonathan	A	a c m t l	25
	B	e x i n u	25[a]
	C	o f h b s	5
Omar	A	p j a g y	17
	B	h q b u c	23
	C	k d i e o	5

[a]Treatment was intensified at the beginning of Set B for Jonathan.

previous research and clinical judgment, we decided to use a ratio of six knowns to one unknown in this study.

Baseline. Three baseline letter-sound expression probes were administered on three separate days prior to beginning intervention on Set A. For Sets B and C, after three consecutive days of baseline data were collected, letter-sound expression probes were administered intermittently until intervention was initiated for each Set. In addition, one letter-sound fluency probe was administered prior to beginning intervention on Set A.

Intervention. At the beginning of each intervention session, the instructor first assessed the participant's knowledge of sounds within the targeted letter-sound set. In addition, participants' knowledge of sounds from the other two letter-sound sets (i.e., sets not being targeted for intervention) was assessed intermittently. For example, during intervention on Set C, the letter sounds from Sets A and B were intermittently measured. When the intervention was intensified for Jonathan, this measure was administered only during the first session of that day. The instructor continued to assess letter-sound fluency once a week during intervention.

During intervention, two unknown sounds were introduced within two IR sequences. In the first sequence, the first unknown sound was modeled by the instructor (e.g., "This is the letter s. It makes the /s/ sound."). The instructor then asked the student to say the sound (e.g., "Say /s/.") and confirmed a correct response (e.g., "Good, /s/.") or corrected an incorrect response (e.g., "This sound is /s/. What sound?"). The instructor then provided a model of a CVC word including the sound (e.g., "/s/ is the first sound in the word sun.") and began the first IR sequence. The instructor again showed the first unknown sound and asked the student to name the sound

(i.e., "What sound?"). After acknowledging a correct response or correcting an incorrect response, the unknown was shown again, followed by one known (e.g., /p/). The unknown (e.g., /s/) was then shown again, followed by the first known and a second known sound (e.g., /p/, /m/). This procedure continued until the unknown sound and all six knowns were presented, thus giving the student seven opportunities to name the unknown sound.

At the beginning of the second IR sequence in each session, one known sound or picture card with a known object was taken out of the card pack and the second unknown was added. The sequence described above was followed for the second unknown, with the first unknown now becoming the first known sound in the second IR sequence. This allowed six additional opportunities for practicing the first unknown (now known), along with seven opportunities to practice the second unknown.

During the session, if a student made an error or did not respond within 3 s, a standard error correction procedure was used (e.g., "That sound is /s/. What sound?"). The intervention session continued until both IR sequences were completed or until the student made three errors. When the second IR sequence was completed or the student made three errors, the instructor then shuffled all cards, with the two unknowns separated by at least one known sound, and presented each card to the student for review. The same error correction procedure was used during the review (e.g., "That sound is /s/. What sound?").

When a participant correctly labeled all five letter sounds on the primary dependent measure (letter-sound expression) administered at the beginning of the session, the next letter-sound set was introduced. The first grade participant, Omar, showed difficulty reaching this criterion in the first letter-sound set. After teaching this set for 9 consecutive sessions, Omar demonstrated knowledge of 3 out of 5 sounds. For this reason, the decision was made to introduce the next letter-sound set for this participant after he knew at least 60% of the sounds across 3 consecutive sessions. This enabled us to move on to the next letter set.

Once the IR intervention was introduced to a new set, learned sounds from previous sets under intervention implementation were used as knowns throughout the remainder of the study. For example, because Jonathan learned all 5 sounds taught in Set A (/a/, /c/, /m/, /t/, /l/), these sounds were used as knowns when Sets B and C were taught.

Research Design

A single-subject multiple-baseline design across sets of letter sounds was used to evaluate the effect of the intervention (IR) on the dependent variables (letter-sound expression and letter-sound

fluency). At the beginning of the study, the instructor tested student knowledge on all three letter-sound sets for three consecutive sessions. When a baseline was established, intervention was implemented with the first set of letter-sounds. Researchers continued to collect baseline data for the remaining letter-sound sets. Intervention on the first set continued until the student learned all sounds within the set. As noted before, the criterion for moving to the next set of letter-sounds was modified to 60% of sounds across 3 consecutive sessions for Omar. Intervention then began for the second set with sounds learned in the first set becoming known sounds in the second and third sets. Thus, participants continued to practice letter sounds learned in previous sets throughout the duration of the intervention. This same procedure was followed when introducing the third letter-sound set.

Interobserver Agreement and Treatment Fidelity

Trained graduate researchers collected interobserver agreement (IOA) and treatment fidelity data throughout intervention sessions. IOA (agreements/agreements + disagreements X 100) was calculated for each sound administered on letter-sound fluency and letter-sound expression measures. IOA was completed across 45% of sessions; agreement ranged from 65% to 97% with a mean of 90%. One IOA score of 65% was anecdotally reported to be due to Jonathan's low volume voice during testing in a busy hallway and appeared to be an outlier. Agreement was 80% or above in all other IOA sessions, so no further training sessions for graduate researchers were deemed necessary.

Researchers calculated treatment fidelity by dividing the number of correctly implemented components by the total number of components. Components of the treatment fidelity checklist consisted of a list of steps for each segment of the intervention, including procedures for the initial set assessment, introducing unknown letter sounds taught in each session and modeling the correct sound, steps for each rehearsal sequence, and error correction. Each of these steps was broken into their component parts and an independent observer circled yes or no next to each part. Treatment fidelity was assessed using this checklist during 30% of intervention sessions. Fidelity ranged from 88% to 100% of intervention components with a mean of 97%.

Results

Intervention letter set assessment (letter-sound expression) data are presented in figures 1 and 2. Visual inspection of Jonathan's graphs (see figure 1) reveals a stable baseline in Sets A and B and a variable baseline in Set C. In Set A, there was an increase in level after the first two intervention sessions, with Jonathan's expression

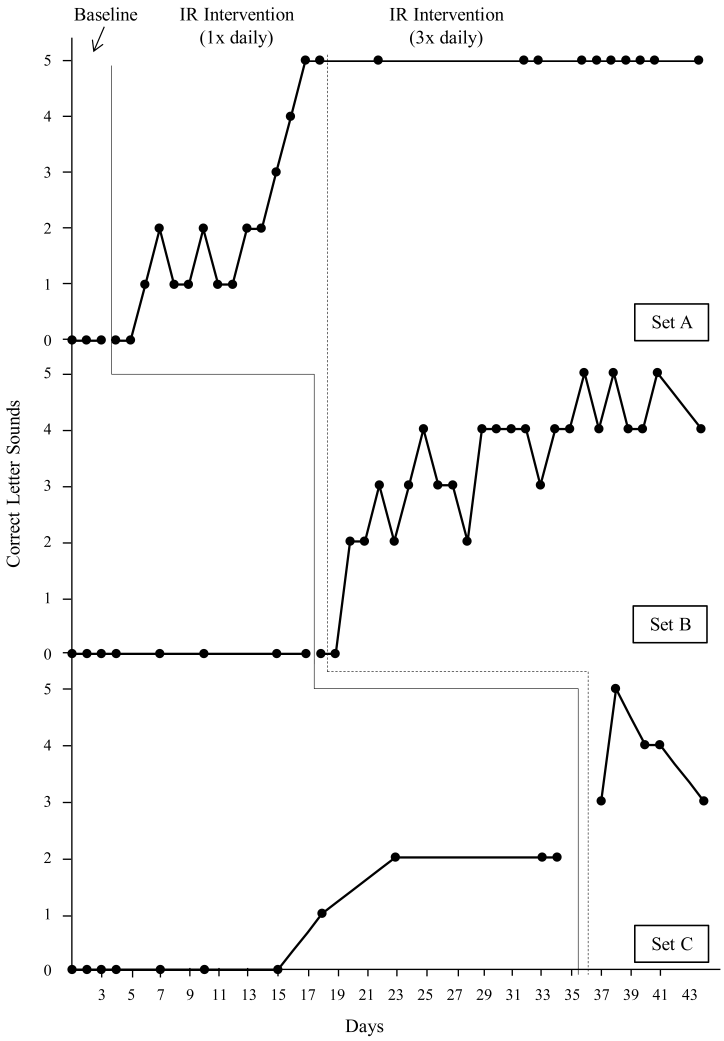

Figure 1. Jonathan's letter-sound expression.

trending upward from zero to five letter sounds. At the beginning of Set B at Session 19, a phase change was implemented, increasing the intensity of the intervention from one time per day to three times per day in an effort to increase exposure. There was an immediate change in level following this phase change and an upward trend in letter-sound expression that increased from zero to a maximum of five letter sounds across Set B. In Set C, there was a change in level following

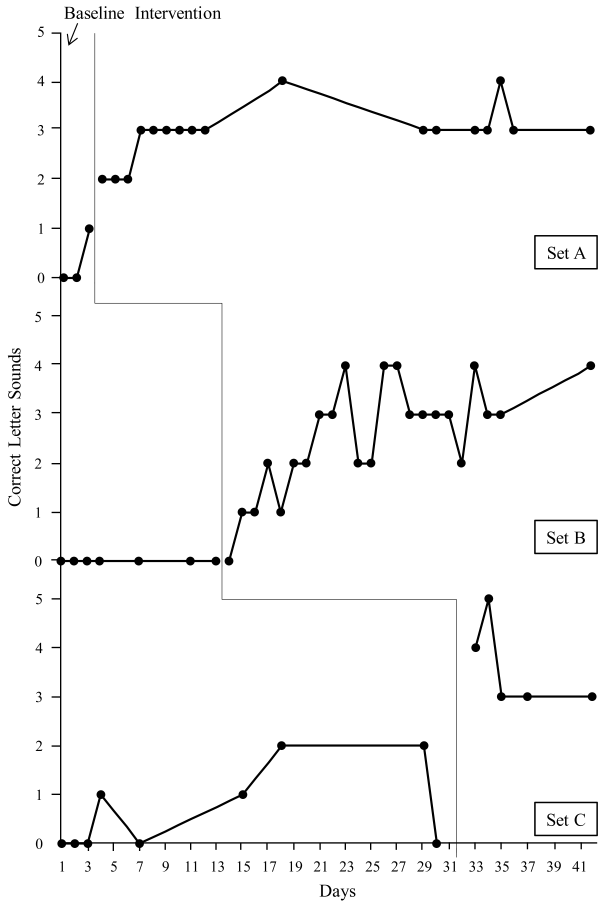

Figure 2. Omar's letter-sound expression.

intervention. Jonathan's letter-sound expression, however, trended downward during Set C, varying from three to five letter sounds. Despite the downward trend in letter-sound expression, intervention was terminated at this point because the school year was ending. In total, Jonathan mastered 12 of the 15 letter sounds targeted during intervention and reached mastery criterion in Set A (i.e., named all sounds correctly in three consecutive sessions with no subsequent errors).

Visual inspection of Omar's graphs (see figure 2) reveals a stable baseline in Set B, with variable baselines in sets A and C. Following intervention implementation, there was an immediate change in level

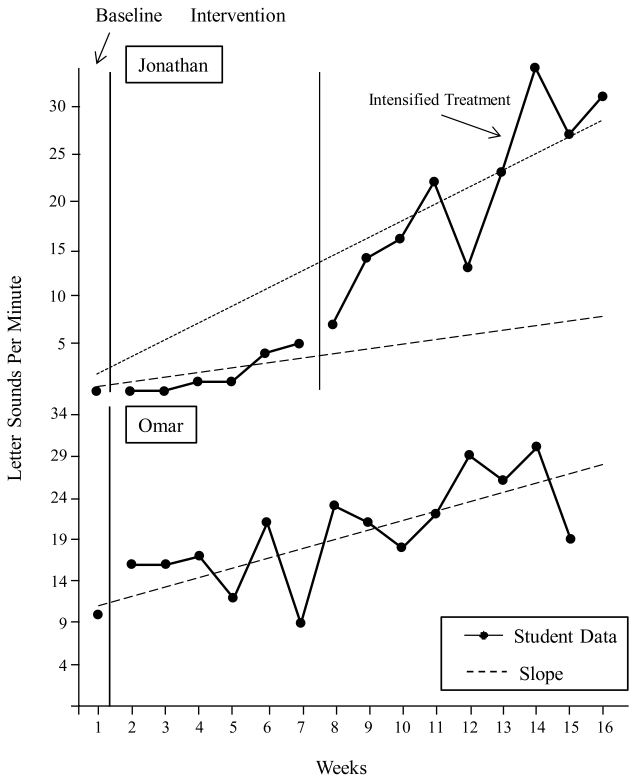

Figure 3. Letter-sound fluency.

in Sets A and C. Omar's trend in letter-sound expression varied across Sets. During Set A, his expression increased immediately but stabilized around three letter sounds. During Set B, a change in level occurred following one intervention session and his expression trended upward from zero letter sounds to a maximum of four letter sounds. In Set C, Omar's expression trended downward, as shown by a maximum of five letter sounds in the second intervention session and a minimum of three letter sounds on the fifth intervention session. In total, Omar mastered 9 of the 15 letter sounds targeted during intervention but did not reach mastery criterion (i.e., name all sounds correctly in three consecutive sessions with no subsequent errors) in any letter-sound Set.

Figure 3 provides a summary of letter-sound fluency data collected at baseline and during intervention for the participants. Visual inspection of Jonathan's graph reveals an upward trend in letter-sound fluency across the intervention period. At baseline, Jonathan expressed

zero letter sounds. As previously noted, the intensity of the intervention was increased to three times per day at session 19. The graph reveals an increased slope following this phase change. Jonathan's maximum score during intervention was 34 correct letter sounds in 1 min. Visual inspection of Omar's graph reveals a notable change in level upon initiation of intervention and a variable upward trend during intervention. Omar expressed 10 letter sounds at baseline, and his maximum score during intervention was 30 correct letter sounds in 1 min.

Slope was calculated for each student using linear least squares estimation, indicating the average number of letter sounds learned each week of the intervention. Each student's baseline point was used as the intercept in this calculation. From a baseline point of zero correct letter sounds, Jonathan's calculated slope was .49 before treatment was intensified and 1.78 after treatment was intensified (see figure 3). From a baseline point of 10 correct letter sounds, Omar's calculated slope was 1.12. According to district data, the expectation for student growth in kindergarten from January to May (15 weeks) is 25 letter sounds, resulting in an expected growth of approximately 1.67 letter sounds per week. No expected growth was formally available for first grade students as the district expectation is that first graders are fluent with all letter sounds at the beginning of the school year.

Percentage of non-overlapping data (PND) was used to analyze the results by computing the number of intervention data points above the highest baseline data point, divided by the total number of intervention points, and multiplied by 100. PND provides an estimate of the effect of the intervention used in single-subject designs (Gast & Spriggs, 2010). PND for Jonathan was 91% in Set A, 91% in Set B, and 100% in Set C. PND for Omar was 100% for Set A, 95% for Set B, and 100% for Set C. Mean PND across letter-sound Sets was 94% for Jonathan and 98% for Omar. Letter-sound fluency PND was 85% for Jonathan and 92% for Omar.

Discussion

This study extends the results of Volpe, Burns, et al. (2011) by testing the effectiveness of IR, delivered one-on-one by an instructor, on the letter-sound fluency and expression of two English learners. Research questions that guided this investigation included whether instruction in letter sounds using IR would increase the overall letter-sound expression and letter-sound fluency of these students.

Effectiveness of the Intervention

Overall, results suggest that both participants made modest improvements in letter-sound expression and fluency measures with the

implementation of the IR intervention. Mean PND across letter-sound Sets ranged from 94% to 98%. PND for letter-sound fluency ranged from 85% to 92%. Scores over 90% have been interpreted as indicating a very effective treatment; scores between 70–90% have been regarded as an indication of an effective treatment (Scruggs & Mastropieri, 1998). Although PND suggests the intervention may have been effective, the duration of the intervention was 17 weeks. There may be other interventions that could produce similar or greater gains in letter-sound knowledge in shorter periods of time.

At the onset of the intervention, Jonathan appeared to have no conceptual understanding of letter sounds. This could have been a contributing factor to the lack of immediate response. In an effort to increase his exposure to the sounds, researchers decided to increase the intensity of the intervention from one to three times per day. Although Jonathan required between 14 and 18 days of intervention on Sets A and B before correctly expressing all 5 letter sounds, he was able to express all 5 letter sounds after only 2 days of intervention on Set C (see table 1). Baseline data for Set C suggest that Jonathan knew 2 of the 5 sounds when intervention began; thus, he had fewer letter sounds to acquire in this Set. However, data suggest that Jonathan was able to express all five letter-sounds only on one out of five intervention days. Based on anecdotal data, Jonathan's on-task behavior during Set C diminished, which could have been a contributing factor to his decline in expression toward the end of the study.

This increase in exposure to the letter sounds resulted in a higher growth rate in letter-sound fluency and expression throughout the remainder of the intervention. Letter-sound fluency results for Jonathan show an increase from zero letter sounds per minute in baseline to a maximum score of 34 letter sounds per minute during intervention. The slope of Jonathan's letter-sound fluency graph was .49 letter sounds per week before treatment was intensified. After intervention was intensified, Jonathan's letter-sound fluency slope increased to 1.78, suggesting that by the end of the intensified intervention phase, he was on track to meet the district end-of-year benchmark of 40 letter-sounds per minute. Overall, on this measure, Jonathan acquired English letter sounds at an acceptable rate according to district expectations.

Omar showed a more variable increase in overall letter-sound expression during intervention and increased his fluency from 10 letter sounds per minute in baseline to a maximum score of 30 letter sounds per minute during intervention. The district expectation of first grade students was fluent expression of all letter sounds at the beginning of the school year. Although Omar did make progress in the intervention, as shown by the positive slope of 1.12 letter sounds

per week in fluency, it was not at the rate or level expected for first grade or kindergarten (1.67 letter sounds per week). Additionally, because Omar demonstrated difficulty acquiring letter sounds, researchers decided to modify the criterion for moving to the next letter set. During the intervention, Omar was referred and qualified for special education services in reading and math, which may help to explain the variability in letter-sound expression and difficulty demonstrating expected growth in first grade.

Limitations

Limitations of this study should be considered in light of the applied nature of this work. This study was initiated based on the needs of students being served within an existing literacy partnership between the University and school district. For example, the heterogeneity of participants, which was the result of providing intervention to those students who demonstrated a need within the participating school, may be considered a limitation of this study. The selected participants represented different grade levels and their responsiveness to IR was also likely moderated by other influential, yet unmeasured, variables. For example, Omar may have presented greater academic need than Jonathan given his older age, limited expression of initial letter sounds, variable intervention improvement trend, and ultimate qualification for special education services. In future studies, it may be helpful to include participants at the same grade level and with similar academic needs to better evaluate the effectiveness of IR with English learners having specific characteristics.

A second limitation is that little background information was available for either student to better interpret respective intervention results. Although both students qualified for ELL services, little additional information about participants' language or academic histories was available. It is possible that such variables may have been observed in association with the participants' response to IR. Measurements of possible English learner-related factors that may affect intervention outcomes on the use of IR with English learners should be considered in future research. For example, the impact of language history and familiarity with English should be measured to better interpret study outcomes. This could be accomplished by gathering additional information from district assessments and from interviews with ELL staff or students' families. In addition, given the varying linguistic backgrounds and different sound systems of the native languages for participants, the order and types of English letter sounds selected for IR may have presented differential challenges as well. For example, the degree of similarity or dissimilarity in selected English

letter-sounds versus Somali and Hmong sounds may have caused greater difficulty in mastering English sounds and thus tempered responsiveness. Although these concerns may have influenced observed results, the extent of their impact remains unknown.

A third limitation is that although we increased treatment intensity for Jonathan because of his difficulty retaining sounds learned from one session to the next, we did not increase treatment intensity for Omar because the nature of his difficulty appeared to lie in his acquisition of sounds within sessions rather than retention of sounds between sessions. It is unknown, therefore, whether a positive response of similar strength would have been observed for Omar had we increased treatment intensity.

A fourth limitation is that although the baseline data in Set A for Omar revealed an accelerating trend, we began intervention with this Set rather than beginning with Set B, which demonstrated a stable trend. In future studies, rather than administering sets in a predetermined order (i.e., Set A first, Set B second, Set C third), researchers should begin intervention on a set with a stable or decelerating trend.

A fifth limitation is that we used commercially available flashcards with common objects, shapes, and colors as known stimuli for Jonathan. This allowed researchers to have enough known stimuli for Jonathan in Set A. However, the use of stimuli other than the letter-sound cards presents a potential confound in this study. In future studies, researchers might modify the ratio of knowns to unknowns, begin with a smaller number of total knowns and unknowns, or present known letter sounds multiple times in an IR session (e.g., include two cards with a known sound) to avoid the use of other stimuli.

A sixth limitation is that several different graduate students delivered the intervention. This was necessary due to scheduling limitations of the graduate students and times available during the school schedule for working individually with students. Although treatment integrity remained sufficiently high, it is possible that responsiveness may have been negatively impacted by the lack of consistency in personnel administering each session.

Implications for Practitioners and Researchers

This paper presented findings from an applied study investigating the effects of IR on letter-sound expression and fluency of two English learners. Results suggest that although IR was effective in improving the overall letter-sound expression and fluency of the participating kindergarten and first grade English learners, the intervention was 17 weeks in duration. Previous research has indicated that IR can be an effective tool in promoting the acquisition of basic

concepts including multiplication facts (Burns, 2005; Codding et al., 2010), word recognition (Burns & Boice, 2009; Burns et al., 2004; MacQuarrie et al., 2002; Nist & Joseph, 2008; Volpe, Mule et al., 2011), and letter sounds (Volpe, Burns, et al., 2011). This extends the results of the Volpe, Burns, et al. (2011) study and adds to the literature by demonstrating the utility of IR for teaching letter sounds to English learners.

Results of this study suggest that IR is a strategy practitioners may want to consider using with kindergarten and first grade English learners who have not responded adequately to whole group and small group instruction on letter sounds. As previously noted, IR introduces a small set of unknown concepts (in this case unknown letter sounds), provides multiple opportunities to practice the unknown concepts, and allows the unknown concepts to be taught to mastery (Burns et al., 2004). Thus, IR provides teachers with an individualized, intensive, and targeted intervention to draw upon when teaching English learners who are struggling to acquire letter sounds.

Future research is needed, however, to guide practitioners in selecting the most effective and efficient strategy to teach letter sounds to English learners with particular characteristics. In future studies, researchers should investigate the use of IR with English learners of varying ages and academic needs. Whether IR is a sufficient intervention tool for English learners upon initial exposure to English letter sounds (such as in kindergarten) versus students who have previously not responded to several interventions also deserves further attention. In addition, researchers should gather more complete information on the language histories of participants to better inform study results. It would be particularly beneficial to compare the effectiveness and efficiency of IR and other letter-sound interventions. Given the importance of acquiring letter sounds for general reading development and the paucity of research on intervention strategies for English learners, future research on both the effectiveness and efficiency of IR and other interventions in increasing letter-sound knowledge of English learners is warranted.

References

Al Otaiba, S., & Torgeson, J. (2007). Effects from intensive standardized kindergarten and first grade interventions for the prevention of reading difficulties. In S.R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of assessment and intervention* (pp. 212–222). New York, NY: Springer.

August, D., & Shanahan, L. (2006). *Developing literacy in second-language learners: Report of The National Literacy Panel on language, minority children and youth.* Washington DC: Lawrence Erlbaum Associates.

Betts, J., Reschly, A., Pickart, M., Heistad, D., Sheran, C., & Marston, D. (2008). An examination of predictive bias for second grade reading outcomes from measures of early literacy skills in kindergarten with respect to English-language learners and ethnic subgroups. *School Psychology Quarterly, 23(*4), 553–570. doi:10.1037/1045-3830.23.4.553

Burns, M. K. (2005). Using incremental rehearsal to increase fluency of single-digit multiplication facts with children identified as learning disabled in mathematics computation. *Education and Treatment of Children, 28*, 237–249. Retrieved from http://www.educationandtreatmentofchildren.net/index.html

Burns, M. K., & Boice, C. H. (2009). Comparison of the relationship between words retained and intelligence for three instructional strategies among students with low IQ. *School Psychology Review, 38*, 284–292. Retrieved from http://www.nasponline.org/publications/spr/index-list.aspx

Burns, M. K., Dean, V. J., & Foley, S. (2004). Preteaching unknown key words with incremental rehearsal to improve reading fluency and comprehension with children identified as reading disabled. *Journal of School Psychology, 42*, 303–314. doi:10.1016/j.jsp.2004.04.003

Burns, M. K., & Sterling-Turner, H. (2010). Comparison of efficiency measures for academic interventions based on acquisition and maintenance. *Psychology in the Schools, 47*(2), 126–134. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=a2h&AN=47589530&site=ehost-live

Chiappe, P., Siegel, L. S., & Wade-Woolley, L. (2002). Linguistic diversity and the development of reading skills: A longitudinal study. *Scientific Studies of Reading, 6*(4), 369–400. Retrieved from http://www.tandfonline.com/loi/hssr20

Codding, R. S., Archer, J., & Connell, J. (2010). A systematic replication and extension of using incremental rehearsal to improve multiplication skills: An investigation of generalization. J*ournal of Behavioral Education, 19*, 93–105. doi:10.1007/s10864-010-9102-9

Gast, D. L., & Spriggs, A. D. (2010). Visual analysis of graphic data. In D. L. Gast (Ed.), *Single subject research methodology in behavioral sciences* (199–233). New York: NY: Routledge.

Gersten, R., & Baker, S. (2000). What we know about effective instructional practices for English-language learners. *Exceptional Children, 66*(4), 454–470. Retrieved from http://www.cec.sped.org/content/NavigationMenu/Publications2/exceptionalchildren/

Kamps, D., Abbott, M., Greenwood, C. R., Arreaga-Mayer, C., Wills, H., Longstaff, J., & Walton, C. (2007). Use of evidence-based, small group reading instruction for English language learners in elementary grades: Secondary-tier intervention. *Learning Disability Quarterly, 30*, 153–169. Retrieved from http://www.jstor.org/stable/30035561

Klingner, J. K., & Edwards, P. A. (2006). Cultural considerations with response to intervention models. *Reading Research Quarterly, 41*(1), 108–117. doi:10.1598/RRQ.41.1.6

Linklater, D. L., O'Connor, R. E., & Palardy, G. J. (2009). Kindergarten literacy assessment of English only and English language learner students: An examination of three phonemic awareness measures. *Journal of School Psychology, 47*(6), 369–394. doi:10.1016/j.jsp.2009.08.001

MacQuarrie, L. L., Tucker, J. A., Burns, M. K., & Hartman, B. (2002). Comparison of retention rates using TD sandwich and incremental rehearsal flash card methods. *School Psychology Review, 31*, 584–595. Retrieved from http://www.nasponline.org/publications/spr/index-list.aspx

Marston, D., Pickart, M., Reschly, A., Muyskens, P., Heistad, D., & Tindal, G. (2007). Early literacy measures for improving student reading achievement: Translating research into practice. *Exceptionality, 15* (2), 97–118. doi: 10.1080/09362830701294177

McCray Sorrells, A., Webb-Johnson, G., & Townsend, B. L. (2004). Multicultural perspectives in special education: A call for responsibility in research, practice, and teacher preparation. In A. McCray Sorrells, H. J. Rieth, & P. T. Sindelar (Eds.), *Critical issues in special education: Access, diversity, and accountability* (pp. 73–91). Boston, MA: Pearson.

National Reading Panel. (2000). *Report of the National Reading Panel-Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction (Report of the Subgroups)*. Washington DC: National Institute of Child Health and Human Development.

Nist, L., & Joseph, L. M. (2008). Effectiveness and efficiency of flashcard drill instructional methods on urban first-graders' word recognition, acquisition, maintenance, and generalization. *School Psychology Review, 37*, 294–208. Retrieved from http://www.nasponline.org/publications/spr/index-list.aspx

Pickart, M., Sheran, C., Betts, J., & Heistad, D. (2007). *Minneapolis kindergarten assessments Technical manual.* Minneapolis, MN: Minneapolis Public Schools.

Schatschneider, C., Fletcher, J. M., Francis, D. J., Carlson, C. D., & Foorman, B. R. (2004). Kindergarten prediction of reading skills: A longitudinal comparative analysis. *Journal of Educational Psychology, 96*(2), 265–282. doi:10.1037/0022-0663.96.2.265

Scruggs, T. E., & Mastropieri, M. A. (1998). Summarizing single-subject research: Issues and applications. *Behavior Modification, 22*(3), 221–242. doi:10.1177/01454455980223001

Shanahan, T., & Beck, I. (2006). Effective literacy teaching for English-language learners. In D. L. August & T. Shanahan (Eds.), *Developing literacy in a second language: Report of the National Literacy Panel* (pp. 415–488). Mahwah, NJ: Lawrence Erlbaum.

Snow, C., Burns, M. S., & Griffin, P. (1998). *Preventing reading difficulties in young children*. Washington, D.C.: National Academy Press.

Stein, M., Johnson, B., & Gutlohn, L. (1999). Analyzing beginning reading programs: The relationship between decoding instruction and text. *Remedial and Special Education, 20*(5), 275–287. doi:10.1177/074193259902000503

Vellutino, F. R., Scanlon, D. M., Small, S., & Fanuele, D. P. (2006). Response to intervention as a vehicle for distinguishing between children with and without reading disabilities: Evidence for the role of kindergarten and first-grade interventions. *Journal of Learning Disabilities, 39*(2), 157–169. doi:10.1177/00222194060390020401

Vellutino, F. R., Scanlon, D. M. & Zhang, H. (2007). Identifying reading disability based on response to intervention: Evidence from early intervention research. In S. R. Jimerson, M. K. Burns, & A. M. VanDerHeyden (Eds.), *Handbook of response to intervention: The science and practice of assessment and intervention* (pp. 185–211). New York, NY: Springer.

Volpe, R. J., Burns, M. K., DuBois, M., & Follen Zaslofsky, A. (2011a). Computer-assisted tutoring: Teaching letter sounds to kindergarten students using incremental rehearsal. *Psychology in the Schools, 48*(4), 332–342. doi:10.1002/pits.20557

Volpe, R. J., Mule, C. M., Briesch, A. M., Joseph, L. M., & Burns, M. K. (2011b). A comparison of two flashcard drill methods targeting word recognition. *Journal of Behavioral Education, 20*, 117–137. doi:10.1007/s10864-011-9124-y