VOCABULARY INTERVENTION

Continuing CHAAOS: Vocabulary Intervention for Students with Disabilities in Eighth Grade Who Are Also English Learners

Rollanda E. O'Connor, roconnor@ucr.edu

Victoria M. Sanchez, Victoria.sanchez@ucr.edu

Brian Jones, bjone001@ucr.edu

Luisana Suchilt, lsuch001@ucr.edu

Valencia Youkhana, vyouk001@ucr.edu

University of California-Riverside

Kristen D. Beach, Kristen.beach@uncc.edu

University of North Carolina-Charlotte

Corresponding author:

Rollanda E. O'Connor, Ph.D.

Graduate School of Education

1207 Sproul Hall

Riverside, CA 92521

roconnor@ucr.edu

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Abstract

Few studies have considered academic vocabulary interventions for students who have learning disabilities (LD) and also are English Learners (EL). This research explored the effects of the third year of the CHAAOS (Creating Habits that Accelerate the Academic Language of Students) vocabulary intervention for eighth grade students who received English Language Arts (ELA) in special education classes. Over 70% of student participants had LD and over half were EL. Special education teachers delivered 12 weeks of intervention spaced across seven months to 36 students. Researchers compared outcomes on receptive and expressive measures with 17 students in business-as-usual (BAU) special education ELA. Students receiving CHAAOS intervention learned the 48 taught words better than students in BAU conditions, retained their knowledge of words four weeks following the close of the intervention, and ended the year with higher vocabulary scores on a standardized measure than students in BAU classes. Students who were EL performed similarly on receptive knowledge of words to students who were native English speakers. This study documents the effectiveness of explicit vocabulary routines for students who have LD and are also EL.

Key words: learning disabilities, English Learners, vocabulary, intervention, CHAAOS, middle school

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As students approach their adolescent years, understanding meanings of academic words takes on increasingly large proportions of variance in reading comprehension (Catts et al. 2006; Hjetland et al., 2019; Holahan et al., 2018). Students who struggle with academic language and reading comprehension have difficulty succeeding in content area courses in secondary grades (Foorman et al., 2015). Unfortunately, learning new vocabulary—especially the academic vocabulary of books and content areas—is more difficult than learning to decode words. Unlike decoding skills, which have limited and specific sets of relations and rules, vocabulary words used in texts continue to expand in number and complexity throughout schooling (Paris, 2005).

Learning meanings of new words is especially challenging when reading ability is poor, because most words are learned through repeated exposure in text (Nagy & Townsend, 2012), and poor readers read less text than their average-reader peers (Ahmed et al., 2016; Jenkins et al., 2003). Students with learning disabilities (LD) often have extraordinary difficulty with the vocabulary words in texts because these academic words are not commonly used in conversation and instead appear in texts these students may be unable to read independently. Students who are English Learners (EL) have these challenges also, coupled with lack of exposure to academic language in English at home (Hart & Risley, 1995; Kieffer, 2010), which makes language gaps difficult to fill as the complexity of language used in school increases (Proctor et al., 2005).

For students who have LD and may also be EL, improving understanding of academic language can be arduous due to the sheer volume of word meanings to learn. Differences in language comprehension between students with average and below-grade level vocabulary can be huge by the time students reach middle school regardless of first language (Lesaux & Harris,

2013). Research consistently shows students who struggle with reading acquisition and vocabulary can learn meanings of new words in the short term on researcher-developed measures (Jitendra et al., 2004; Kuder, 2017). A few studies in middle school have also documented retention of taught words over a few weeks or months (Bos & Anders, 1990; O'Connor et al., 2019). Nevertheless, for students with LD, it remains rare to demonstrate generalized improvement in academic vocabulary and comprehension on standardized reading measures (Vaughn et al., 2019). The present study reports findings from the third year of a three-year project in which academic vocabulary was taught to students with LD, including students who were EL, in special education English/Language Arts (ELA) classes in middle school.

The Role of Vocabulary in Reading Comprehension

Teaching vocabulary effectively to poor readers in middle school is no small challenge, because poor readers are hampered by serious delays in reading words, understanding word meanings, and comprehension compared to peers, who mastered the reading basics years before (Swanson & Deshler, 2003). We focus on academic vocabulary because of its strong theoretical role in comprehension and potential instructional accessibility through its emphasis on oral language, as well as on reading. Most theories of comprehension include vocabulary as an essential component. As examples, the much studied Simple View (Gough & Tunmer, 1986) posits reading comprehension as a function of the ability to read words (i.e., decoding and recognizing words) and language comprehension (i.e., vocabulary and language syntax). A recent study by Hjetland et al. (2019) found that these two factors accounted for 99% of reading comprehension among the nine-year-old participants. Kintsch (1988) acknowledges the importance of vocabulary, but complicates the act of comprehending language and text with the process of using words and syntax to generate a mental representation of meanings of phrases,

sentences, and paragraphs as the listener or reader moves through text. His construction-integration model of comprehension emphasizes actions of the reader in constructing meaning. Perfetti and Stafura (2014) accept both of these views of reading comprehension, but focus on depth of word knowledge through lexical representation of words, including ways in which word meanings incorporate their graphical and semantic connotations, as well as linkages to contexts and usage. In all of these theoretical models, understanding word meanings plays a fundamental role in reading comprehension.

The essential nature of word meaning in comprehension for older students is exemplified in studies such as Cromley and Azevedo (2007) and Cromley et al. (2010), who examined the effects of vocabulary on reading comprehension of students in ninth grade and beyond and found vocabulary to be a significant direct and indirect predictor of comprehension. More recently, Ahmed and colleagues (2016) studied multiple predictors of reading comprehension among middle to high school students using a latent variable structural equation model. Both supporting and extending the earlier work of Cromley and Azevedo, results indicated that the effect of the latent construct of vocabulary was related significantly to reading comprehension across grades 7 to 12 ($\beta = .35$-$.51$). Similarly, Holahan et al. (2018) assessed the relation between verbal ability and passage comprehension using multilevel growth models. Their analysis indicated that vocabulary accounted for unique variance in passage comprehension ($\beta = .13$). These findings reinforce treating vocabulary as a relevant instructional target for students in middle school.

Vocabulary Instruction

Several research reviews have identified key practices associated with strong intervention effects for students who have LD (Jitendra et al., 2004; Swanson & Deshler, 2003) and for students who are EL (Hall et al., 2017; Jozwik & Douglas, 2017; Truckenmiller et al., 2019).

Among these practices, explicit instruction is championed extensively (e.g., Hughes et al., 2017; McLeskey, et al., 2017). Hughes et al. characterize explicit instruction as "unambiguous, structured, systematic, and scaffolded" (p. 140). When compared with other approaches to teaching vocabulary, Jenkins et al. (1989) and Bos and Anders (1990) found explicit instruction to be more effective; however, these studies had only a few instructional sessions, so long-term effects were not evaluated.

Explicit vocabulary instruction incorporates a purpose and rationale for learning vocabulary, clear explanations and modeling, guided practice with feedback, ample practice opportunities, and active participation from students (Archer & Hughes, 2011). Academic words and definitions are taught directly to students, examples and nonexamples are incorporated for practice, multiple exposures and practice opportunities are provided, and the academic words are used within exercises that require meaningful interaction with academic words.

Several studies have demonstrated the success of explicit vocabulary instruction in middle school for students in general education classes. For example, Lesaux et al. (2010) developed the Academic Language Instruction for All Students (ALIAS) vocabulary intervention for English/Language Arts (ELA) classrooms that were low-performing and had high numbers of EL students. Results indicated that intervention students improved their knowledge of taught words and the intervention benefited both EL and Native English Speakers (NES). Additionally, McKeown et al. (2018) studied the effects of a 6th and 7th grade vocabulary intervention, Robust Academic Vocabulary Encounters (RAVE), for middle school students. Across both years of the study, RAVE students demonstrated growth on their knowledge of taught words when compared to control students; however, these studies did not include students with disabilities.

Peer interaction and dialogue is another of the practices common to researched

recommendations for both EL and students with LD (Jozwik & Douglas, 2017; Truckenmiller et al., 2019). The early research of Bos and Anders (1990) demonstrated that students with LD placed in interactive vocabulary learning conditions scored significantly higher on comprehension than their peers in a definition-only condition. Lawrence et al. (2015) found that classroom discussion quality predicted vocabulary outcomes in particular for poor readers, and rich discussions have been found useful for students with disabilities (Englert & Dunsmore, 2004) and other poor readers (Kamil et al., 2008, Scammacca et al., 2007). Interestingly, recommendations from research for improving vocabulary of students who are EL and for students with disabilities are remarkably similar (Crosson et al., 2019; Elleman et al., 2019).

The combination of explicit instruction and peer interactions for practice have been used extensively in vocabulary studies in general education environments (e.g., Carlo et al., 2004; Jones et al., 2019; Lawrence et al., 2015; Lesaux et al., 2010; McKeown et al., 2018). Some of these general education studies have included students who have LD (Jones et al.; Lawrence et al.) or who are EL (August et al., 2014; Carlo et al.; Lesaux et al., Truckenmiller et al., 2019). Studies that focus on students with disabilities who may also be EL are rare, and studies that do include them rarely report results for these groups separately (e.g., Jones et al., 2019).

Other studies that included students with LD or who were EL have focused on content area words in social studies (e.g., O'Connor et al., 2017; Swanson et al., 2016) or science (August et al., 2014; Helman et al., 2015; Kennedy et al., 2015; Seifert & Espin, 2012). Because the goal of those studies was to improve content area learning, the interventions included many aspects of reading comprehension in addition to vocabulary, and so vocabulary effects could not be isolated to vocabulary instruction specifically.

Truckenmiller et al. (2019) synthesized outcomes for academic language instruction for

students who were EL; however, if studies included more than 30% of students eligible for special education, they were excluded in the analysis. Nevertheless, Truckenmiller et al. identified similar attributes to effective instructional models as found in studies of special education: a small set of words not used commonly in everyday speech, multiple exposures across relevant contexts, multimodal methods such as graphics displaying word meanings, and discussion with peers and teachers, recommendations echoed by Crosson et al. (2019) and Kuder (2017). Unfortunately, these reviews revealed few impacts of the instruction on standardized measures, replicating findings of Jitendra et al. (2004) and Scammacca et al. (2007).

Context for the Current Study

Few studies of academic vocabulary instruction have been conducted in middle school special education settings that include students who have LD and may also be EL, which is concerning due to increasing numbers of students with LD who are also EL in schools (Roderiguez & Rodriguez, 2017). The current study explores the effects of the third year of the Creating Habits that Accelerate Academic Language of Students (CHAAOS) vocabulary intervention taught by special education teachers to students with disabilities in their intact English/Language Arts (ELA) classes. Special education teachers of ELA were assigned randomly to either CHAAOS or Business as Usual (BAU) conditions in Year 1 of the study and were trained to implement 15 minutes of explicit vocabulary intervention with their sixth grade students. Teachers taught meanings of 48 grade-appropriate academic words (O'Connor et al., 2019). In seventh grade, with a mix of new and returning students and teachers, students were taught an additional 48 academic words (O'Connor et al., in press). In eighth grade, a new set of 48 academic words were taught and these results are reported here. In Years 1 and 2, students in CHAAOS classes learned and maintained the age-appropriate words significantly better than

those in BAU conditions (O'Connor et al., 2019, in press).

Our research questions were: What are the effects of the 8th grade CHAAOS intervention (1) on learning the taught vocabulary? (2) on using the taught vocabulary in contexts? (3) on maintaining knowledge of taught vocabulary? (4) on standardized measures of vocabulary and comprehension? and (5) How does first language affect response to the CHAAOS intervention?

Method

The third year of CHAAOS instruction was designed for eighth graders with disabilities who may also be EL. As in many studies of academic language instruction, we used Coxhead's Academic Word List (2000) as our first resource; however, we also cross-referenced the words we selected with words recommended in Biemiller's *Words Worth Teaching* (2010), sixth through eighth grade academic word lists from the Common Core State Standards (National Governors Association, 2010), and the school district's list of words to teach in 8th grade ELA. From these resources, we selected 48 words for instruction during eighth grade. These 48 academic words were taught across three 4-week cycles during the school year with each cycle of instruction including 16 words.

Participating Teachers and Students

Our study took place in one southern California school district that enrolled approximately 20,000 students. The district had a high proportion of socioeconomically disadvantaged students (81%) and English learners (36%) enrolled. We worked with three 6th through 8th grade middle schools with enrollments that ranged from 973-to-1404 students and these schools participated in all three years.

Teachers

Four eighth grade special education teachers who had taught students with disabilities for

4-to-29 years participated in this study. Their assignment to condition was based on Year 1, in which the sixth grade teacher in each of the three schools was assigned randomly to implement CHAAOS or serve as a BAU class, in essence resulting in random assignment of schools to condition. Personnel in the BAU school were invited to use CHAAOS materials in subsequent years. In Years 2 and 3, schools maintained their assignments to condition with the participating grade.

One of the CHAAOS schools added an additional special education teacher in seventh and eighth grades. Thus three teachers taught in the CHAAOS condition in the current study. The fourth teacher taught in the BAU condition in eighth grade (the current study); however, he taught in the CHAAOS condition with his sixth and seventh grade classes, which were not part of the current study. Because each grade had its own set of materials, we found no crossover between his sixth and seventh grade CHAAOS and eighth grade BAU classes. Two additional teachers had only one or two students who had been in the BAU condition in previous years and maintained their BAU status as eighth graders.

Students

As this was a multi-year project, it is helpful to know the historical participation of the 53 eighth graders who participated in this third year of the project (CHAAOS n = 36; BAU n =17). Of our 36 CHAAOS students, 8 began CHAAOS intervention in sixth grade, 20 started intervention in seventh grade, and 8 began intervention in eighth grade. Of the 17 BAU students in Year 3, 12 were in the BAU class in sixth grade, one joined the BAU in seventh grade, and four joined the BAU in eighth grade. Due to attrition and new students enrolling in the study, we focus on the 8th grade cohort rather than cumulative effects of intervention.

All students received special education services and were eligible based on the following

designations: Specific Learning Disability (76%), Other Health Impairment (9%), Autism Spectrum Disorder (8%), Speech/Language Impairment (4%), and Emotional Disturbance (2%). Most students were EL (72%) with the primary language indicated as Spanish in school records.

CHAAOS Intervention

CHAAOS eighth grade words were clustered into three cycles. Each cycle included 16 lessons that were taught over 4 weeks. Teachers were asked to teach 4 lessons per week for approximately 15 minutes each. The core instructional components of CHAAOS lessons were based on explicit instruction and included:

- Introduction of 4 new academic words per week
- Explicit instruction using student-friendly definitions
- Pairing definitions with a student-friendly context to illustrate meaning
- Follow-up vocabulary activities involving teacher guided, peer practice, and independent practice of words in context using scenarios, photographs, and graphic organizers
- Multiple practice opportunities with immediate feedback

To encourage peer interaction, we used visual depictions of meanings in everyday contexts through drawings, photographs, and graphic organizers discussed with students as teachers displayed PowerPoint slides. Teachers followed whole-group instruction with partner and small group activities that encouraged students' use of the words in discussion and brief writing activities. Although instruction was primarily oral, words were also shown in print on the projected slides, on word cards used in peer practice, and on writing activities in student workbooks developed for the study. In these ways, CHAAOS integrated phonemic and graphemic forms of words with common uses for the words and practice pronouncing and using the words with teachers and peers.

Teachers in each CHAAOS classroom received instructional materials that included a teacher manual, 48 PowerPoint lessons divided into three cycles, student notebooks, and supplemental activities. The teacher manual was a hard copy of all lessons with directions and suggested scripts to use while teaching. The PowerPoint lessons were designed to be used with the entire class while providing instruction. The student notebooks mirrored the PowerPoint lessons to allow students to follow along and write responses. Supplemental activities were prepared for teachers and included individual flashcards sets of the academic words for students to use in class and a class review game of either BINGO or Jeopardy to be used as the culminating activity.

To ease teacher implementation, each week followed a predictable routine for introducing and contextualizing the four new words per week across the 3 cycles. On Mondays teachers introduced the four new words and discussed meanings with students. On Tuesdays and Wednesdays, teachers reviewed all four words and focused instruction and peer activities on two of the four words. Instruction on Thursdays integrated the four words with previously taught words with peer activity for practice and expansion of contexts. A sample instructional week of PowerPoint slides is shown in Appendix A. All of these materials are available to download and print for free at: https://gsoe.education.ucr.edu/CHAAOS/index.php

Teachers and researchers met at the start of the 8th grade school year to review procedures and participants. Cycle 1 instruction was provided in August and September, Cycle 2 instruction in October and November, and Cycle 3 instruction in January and February. During the instructional cycles, the research team completed observations in the classrooms to document fidelity to the CHAAOS activities. During remaining class time in the ELA classes, one of the CHAAOS teachers used the same reading programs used in the BAU class, described below.

The other two CHAAOS teachers focused primarily on writing and editing skills during class time not spent on CHAAOS, teachers in both conditions used Newsela on Fridays.

Instruction in the Business as Usual Class

The BAU teacher used two reading programs in his class. Four days per week he implemented *Corrective Reading, Decoding C* (Englemann et al., 1988). Lessons began with decoding new words in the day's reading, review of previously taught words, and introducing one or two new vocabulary words. The majority of class time was spent reading aloud the day's story individually or chorally, which has controlled text to practice decoding patterns introduced sequentially. The teacher inserted questions at prescribed times and discussed answers when varied responses were appropriate. The last 5 minutes students paired up for fluency practice, starting from the beginning of the day's story.

On Fridays, the teacher reported using Newsela, a web-based program used by all four teachers with adjustable reading levels implemented through Chrome Books. This activity was not observed in the BAU; however, CHAAOS classes also used this program weekly.

Observations in Classes

Our observation tool used a 1–to-3 point rating for the four core activities within the lesson: Discussing words and definitions, Providing multiple contexts, Practice/peer activities, and Providing student support (see Appendix B). Each main activity was subdivided into further components. For example, Discussing words and definitions included how the teacher introduced and reviewed words and whether the teacher provided repetitions of the words and opportunities for students to respond to questions and offer examples. Overall, there were 12 areas where teachers could receive a 1-3 rating. Several of the observation tool features could be common across conditions, including minutes spent on vocabulary instruction, modeling, guided practice,

independent practice, scaffolding student responses, and corrective feedback.

Inter-rater reliability during observations was established in Year 1 at 92% across 8 joint observations (see O'Connor et al., 2019). In Year 2, inter-rater reliability was established between two raters again with 92% percent agreement on eight observations (O'Connor et al., in press). Inter-rater reliability in Year 3 found 91% agreement over three observations. In CHAAOS classes, three observations were conducted in Cycle 1 for each teacher and two in Cycles 2 and 3, for a total of seven observations per teacher. In the BAU class, two observations were conducted per cycle for a total of six observations, which are described in the results.

Measures

A set of experimenter-designed measures of vocabulary were administered pre- and post-instructional cycle on taught words. The first assessed word knowledge through a paper-and-pencil multiple-choice assessment and an individual oral assessment. The second involved how well students were able to use words in context, measured through a paper-and-pencil assessment and an individual oral assessment. Following these cycle specific tests, measures of maintenance of taught words and standardized measures of reading and vocabulary were collected 4-weeks after the conclusion of the intervention.

Word Knowledge

We assessed word knowledge through an experimenter designed 16-item multiple-choice test of taught words that was given pre and post-cycle. Students were asked to circle the correct definition for the taught word among 4 multiple-choice options. Test-retest reliability ranged from .88 to .96 across cycles. Correlation coefficients between the multiple-choice measure and the Comprehensive Receptive and Expressive Vocabulary Test (CREVT) were significant (r = .522, p = .001).

Using Words in Context

We assessed how students used vocabulary words in context with an experimenter designed 8-item paper-and-pencil measure that required students to use the taught vocabulary words at the sentence and passage level, pre- and post-instruction at each cycle. Test-retest reliability ranged from .88 to .96 across cycles. Estimates of validity were obtained for the usage measures with the CREVT (r = .47, p = .003) and Woodcock-Johnson Passage Comprehension (r = .39, p = .014).

Expressive Vocabulary

To assess how well students could express their knowledge of vocabulary words students were administered individually an expressive test where students were asked to generate a definition and sentence for the taught vocabulary words. Similar to others (Cain et al., 2004), we developed a 3 point scale (0 = incorrect, 1 = partially correct, 2 = correct) to describe the quality of student-generated definitions and sentences for taught words. Estimates of validity were obtained for expressive vocabulary scores with the CREVT (r = .52, p = .000) and the WJ passage comprehension (r = .46, p = .000).

Maintenance

The three cycles of instruction were taught between August and February. Similar to the studies of CHAAOS in 6th and 7th grade, we were interested in whether CHAAOS students maintained knowledge of the 8th grade words they had learned four weeks after the conclusion of the intervention. To test maintenance of vocabulary learning, we developed an 18-word vocabulary measure that drew six words from each of the three cycles. We selected the six words on which students scored lowest at pretest and highest on the immediate posttest, thus indicating words on which students showed the strongest growth in word knowledge for that cycle.

Correlation coefficients between the maintenance measure and the three multiple choice measures at each cycle were significant (r = .82, .87, .85; p = .001). Additionally, the maintenance measure correlated significantly with the CREVT (r = .31, p = .020) and WJ Passage Comprehension (r = .362, p = .006).

Comprehensive Receptive and Expressive Vocabulary Test, 3rd ed. (CREVT; Wallace & Hammill, 2013).

The CREVT is an individually administered standardized measure of vocabulary and was administered to participants during the spring of their eighth grade school year. Receptive vocabulary requires students to point to a picture that represents what the examiner says. Expressive vocabulary is measured by asking students to define a word. Internal consistency across subtests is high, with coefficient alphas of .85-.96. The general vocabulary score, which combines results from the receptive and expressive scores, is reported here. None of the words on this measure were taught in CHAAOS lessons. This measure was also used at the beginning and end of sixth grade, and end of seventh grade, and these scores were reported in earlier papers (O'Connor et al., 2019).

Woodcock-Johnson Tests of Achievement III (WJ-III; Woodcock et al., 2001).

The reading comprehension subtest of the WJ-III was administered individually to students during the spring of eighth grade. Passage Comprehension was measured by asking students to independently read short sentences that increase in difficulty that have a missing word; students are asked to supply the missing word. As with the CREVT, the WJ-III was also administered when students were in sixth and seventh grade, reported previously (O'Connor et al., 2020).

Results

Prior to analyzing data to answer our research questions, we determined the fidelity of implementation for the intervention. Next we analyzed the effects of the vocabulary intervention on knowledge of taught words. Then, we compared performance of CHAAOS and BAU students on how well they could use the taught words in context for each cycle. Next we analyzed scores on the maintenance test to determine if there was evidence of maintaining knowledge of words over time. Next, we were interested in whether standardized scores changed for students. Lastly, we compared performance of EL in the intervention with NES who also received intervention.

Fidelity of Implementation

The three CHAAOS teachers were consistent in their implementation and their overall fidelity was 88% (i.e., 2.64 of 3 points possible per item). In at least half of our observations, teachers varied the types of responses from students as directed in the manual, such as whole class, choral, individual, or group practice. Teachers often drew on student experiences to support their understanding of the words and provided additional explanations, examples, and sentences. Teachers were consistent with providing feedback, compliments, and positive reinforcement. When scaffolding was required, teachers provided individual and group support and discussion to make sure students understood the sentences and images that were presented. Additionally, teachers often rephrased a student response to shape the student's words appropriately and prompted students with guided questions. On average, teachers implemented CHAAOS for 19 minutes per observation.

We observed in the BAU class for about 20 minutes each visit, usually in the first part of class in which the teacher provided direct instruction on decoding, guided student practice, introduced one or two new vocabulary words, and began directing reading of the day's story. Across the six observations, vocabulary instruction ranged from 1 to 4.6 minutes, and averaged

2.1 minutes. Some of the elements of explicit vocabulary instruction were present; the teacher provided a user-friendly definition, encouraged students to repeat the definition, and when the word was encountered in text, asked students to provide the definition again. Unlike CHAAOS classes, no additional contexts for word usage were observed, nor did students practice the definitions with peers or generate usage for the taught words.

On the items related to student support, the BAU teacher did not differ from CHAAOS teachers, averaging scores of 90% (2.71 of 3). He praised student effort enthusiastically, pointed out parts of words that were partially correct, scaffolded student responses by asking direct questions to guide students toward inferences, and rephrased students' answers. The CHAAOS word list had been provided to all participating teachers and their administrators, including those in the BAU, and several of the CHAAOS words were included in the eighth grade district vocabulary list; however, we did not observe any of the CHAAOS words being taught in the BAU class.

Analytic Decisions

We were interested in whether group differences would be found in performance on multiple measures of vocabulary during instructional cycles 1-through-3. Multivariate analysis of covariance (MANCOVA) allowed us to examine group differences on several dependent variables simultaneously while also controlling for Type 1 error and taking into account the interrelations among variables (Raykov & Marcoulides, 2008). Considering our pretest measures were administered immediately prior to instruction and correlated significantly with our posttest measures (r = .346-.366, p =.004-.007), we decided to use pretest scores as covariates.

Word Knowledge and Usage Measures

MANCOVA was conducted for the multiple-choice and usage measures using pretest

scores as covariates. Descriptive statistics are shown in Table 2. Treatment had a significant effect on vocabulary word knowledge and usage, $\Lambda = 0.305$, $F(6, 40) = 15.001$, $p = .000$, $\eta_p^2 = 0.692$. Pillai's Trace, Hotelling's and Roy's tests all converged with Wilk's Lambda yielding significant results. Examination of ANCOVA results revealed significant effects for vocabulary word knowledge at all cycles (Cycle 1: $F(1, 45) = 71.550$, $p = .000$, $\eta_p^2 = 0.614$; Cycle 2: $F(1, 45) = 79.628$, $p = .000$, $\eta_p^2 = 0.639$; Cycle 3: $F(1, 45) = 32.195$, $p = .000$, $\eta_p^2 = 0.417$). ANCOVA results for the vocabulary usage measures were mixed. The results were not significant at Cycle 1, $F(1, 45) = 2.854$, $p = .098$, $\eta_p^2 = 0.060$. However, results were significant at Cycles 2 and 3 (Cycle 2: $F(1, 45) = 5.918$, $p = .019$, $\eta_p^2 = 0.116$; Cycle 3: $F(1, 45) = 4.490$, $p = .040$, $\eta_p^2 = 0.091$).

Expressive Measures

MANCOVA was also conducted for the student generated definitions and sentences across cycles using pretest scores as covariates. Descriptive statistics are shown in Table 2. Treatment had a significant effect on expressive vocabulary, $\Lambda = 0.643$, $F(6, 39) = 3.613$, $p = .006$, $\eta_p^2 = 0.357$. For student generated definitions, ANCOVA results were significant at all cycles (Cycle 1: $F(1, 44) = 20.812$, $p = .000$, $\eta_p^2 = 0.321$; Cycle 2: $F(1, 44) = 11.619$, $p = .001$, $\eta_p^2 = 0.209$; Cycle 3: $F(1, 44) = 5.557$, $p = .023$, $\eta_p^2 = 0.112$). For student generated sentences, ANCOVA results were once again mixed. Results were significant at Cycles 1 and 2 (Cycle 1: $F(1, 44) = 8.699$, $p = .005$, $\eta_p^2 = 0.165$; Cycle 2: $F(1, 44) = 5.530$, $p = .023$, $\eta_p^2 = 0.112$). However, results were nonsignificant at Cycle 3 ($p = .098$).

Maintenance

To determine how well CHAAOS and BAU students remembered definitions of taught words four weeks after completion of the intervention, we conducted repeated measures

ANOVA, which compared performance of CHAAOS and BAU at pretest, immediately after instruction, and at maintenance. A significant effect was found for the interaction of treatment and time, $F(2, 90) = 53.67$, $p = .000$, $\eta_p^2 = 0.544$. Although no difference was found between CHAAOS and BAU students at pretest (M =5.81 and 6.68, respectively; $p = .257$), students differed at immediate posttest (M =16.26 and 7.50, $p = .000$) and maintenance (M =13.97 and 7.23, $p = .000$) with CHAAOS students scoring significantly higher than students in BAU.

Standardized Measures of Vocabulary and Reading Comprehension

Of particular interest was whether CHAAOS and BAU students differed on standardized measures of vocabulary and comprehension, which were gathered when students first entered the study and following treatment in Year 3. ANCOVA results indicated that treatment had a significant, positive effect on posttest vocabulary scores on the CREVT, $F(1,41) = 6.45$, $p = .015$, $\eta_p^2 = 0.136$, after controlling for pretests. However, treatment did not have a significant effect on posttest comprehension scores on the WJ-III after controlling for pretest differences, $F(1, 41) = 1.55$, $p = .221$. Table 3 shows means and standard deviations on these measures.

Exploratory EL and NES Performance

Because we were interested in whether students who were EL and NES differed on learning CHAAOS vocabulary words, we analyzed the performance of EL and NES within the treatment group only. ANCOVA results found no significant differences on posttest scores on the multiple-choice test of vocabulary knowledge ($p = .547$) or usage measures (p =.525) after controlling for pretest differences.

The group size was small for this analysis, and so lack of difference should be interpreted cautiously. Examination of total scores across cycles for students who were EL and NES in the CHAAOS condition in Table 4 lend support to the notion that students learned definitions of

words receptively similarly regardless of first language; however, expressive performance may have been more difficult for students who were EL.

Discussion

Despite growing numbers of students with LD who are also EL (Rodriguez & Rodriguez, 2017), few studies of vocabulary intervention have focused on this population. Results of the current study show that students who received 12 weeks of the intervention displayed consistent and substantial improvements on the multiple-choice vocabulary measure, in which effect sizes were large across cycles ($\eta_p^2 = 0.56$). This positive effect was mirrored among our expressive measures, with an average larger effect for generating definitions ($\eta_p^2 = 0.21$) than for generating sentences ($\eta_p^2 = 0.14$). These findings, which replicate the first and second year of the intervention (O'Connor et al., 2019, in press), also align with prior research that has found that teaching academic words directly leads to improved word learning for students with LD (Jitendra et al., 2004) and for students who are EL (Truckenmiller et al., 2019), even though the words we taught were several grade levels above students' independent reading ability.

We share the concern of other researchers that reading instruction in middle school is often eliminated in favor of tutoring support for passing courses (Bulgren et al., 2013). Unlike other studies, our observations in BAU classes revealed strong overall reading instruction; nevertheless, no observed class sessions offered more than four minutes of vocabulary instruction or practice. Although Truckmiller et al. (2019) concluded that more teachers should be trained in academic language instruction, the extent to which special education training programs include this type of instruction is unknown.

Importantly, students in CHAAOS classes maintained knowledge of the taught words four weeks after the conclusion of the intervention. This finding is noteworthy because CHAAOS is

of longer duration with a larger core of vocabulary than most vocabulary studies in special education classes; in the current study students were taught 48 academic words across twelve weeks of instruction spaced across seven months. By contrast, most vocabulary instructional studies in special education have been of short duration (Bos & Anders, 1990) or focused on a content-specific and smaller set of words (Kennedy et al., 2015; Seifert & Espin, 2012; Swanson et al., 2016). For students to learn as many grade appropriate academic words and maintain them over time is a rare finding in the special education literature.

We note that students in BAU special education ELA classes also grew in knowledge of these academic words over time. Words taught during the CHAAOS intervention were drawn from widely available sources, including recommended words on Coxhead's (2000) and Common Core (National Governors Association, 2010) lists, as well as the school district's list for eighth grade general education ELA. The CHAAOS list of words was available in all classes because we had provided the intervention word lists to teachers and administrators in both conditions in all three years of the CHAAOS intervention. Nevertheless, the rate of growth in the BAU condition was slow in relation to students in CHAAOS classes. Taken together, these findings demonstrate the need for systematic vocabulary intervention to improve this key component of reading development for students with LD, regardless of first language.

Generalized Vocabulary and Reading Comprehension Outcomes and Measures

Few studies in general education (e.g., Lawrence et al., 2015; Lesaux et al., 2010, McKeown et al., 2018), special education (e.g., Bos & Anders, 1990; Jitendra et al., 2004), or with EL populations (e.g., Carlo et al., 2004; Lesaux et al., 2010) demonstrate improvement on standardized measures of vocabulary or comprehension as a result of vocabulary intervention. Although theoretically disconcerting given vocabulary's role in reading comprehension (Kintsch,

1988; Perfetti & Stafura, 2014), several factors contribute to the scarcity of measureable generalized gains linked to vocabulary intervention.

First, interventions and standardized measures barely touch the range of vocabulary that supports reading comprehension at any particular grade level. We attempted to improve over earlier studies by including 48 academic words that were recommended for instruction to 8th grade students. Since this study reports the third year of intervention, several participants in CHAAOS classes had instruction on up to 144 words by the close of eighth grade. Second, the standardized measures we used (i.e., the CREVT and WJ-III) were broad range measures with ceiling criteria during test administration that prohibited most students from participating in the range of items intended to sample their grade level. Third, we intentionally excluded from our instructional lists words tested directly on the CREVT to avoid bias toward the treatment.

Thus, we were surprised to find significant differences between conditions on the CREVT favoring students in CHAAOS classes. However, despite evidence that students in the CHAAOS classes made significant gains on this transfer measure of vocabulary knowledge compared to students in BAU, standardized scores on the CREVT do not demonstrate growth against the test norming group of students in general education. Rather, students in BAU conditions fell farther behind on the CREVT and students in CHAAOS showed less slippage in scores over time, a finding also reported by Vaughn et al. (2012).

Despite improving vocabulary, students in CHAAOS classes did not indicate significant growth on the reading comprehension standardized measure (WJ-III) relative to students in BAU. Even so, their scores did not decline significantly over time, which is common for students with disabilities in middle school (Vaughn et al., 2012). The limited range of items for each grade level on the WJ-III may have made it difficult to show growth based on exposure to

just 48 new words, and especially on words that may have contributed to reading comprehension at higher levels than students could reach before exceeding the test ceiling.

We see a related issue in the low-to-moderate validity ratings of our researcher-developed measures of vocabulary with the CREVT and WJ reading comprehension (i.e., validity ranges .30-.68, with most below .5). Students learned the taught words with CHAAOS instruction; however, their overall reading ability remained in the second-to-third grade range. Thus high scores on learning taught words linked poorly with overall reading ability. Interestingly, the highest validity with standardized scores was drawn from the measure of student-generated definitions and sentences, which indicates a higher level of learning than selecting definitions (Krathwohl, 2002). It is possible that students who performed well on these production tasks may also have been able to answer more items correctly on the standardized measures.

Limitations

This study explored the potential of CHAAOS intervention to improve the vocabulary of students with disabilities in middle school who may also be EL. It was conducted in just one school district with the eighth grade students who received special education in three schools; thus we lack evidence for broad generalization of findings. With a larger sample, it may have been possible to analyze the cumulative effects of intervention; however, mobility in this district reduced student numbers, which only allowed analysis of the current year's intervention effects. Thus, it is impossible to determine whether the effects reported here are due to eighth grade intervention alone, or whether intervention in prior years had some influence on student outcomes. Small sample size also inhibited more sophisticated analytic methods.

We were interested in whether students who were EL would learn the words as well as students who were NES. Even though we found no significant differences based on first

language, two concerns limit support for the hypothesis that students who were EL learned as much in CHAAOS classes as did students who were NES. First, the number of NES was smaller in both conditions than students who were EL; thus a non-significant finding could be due to insufficient power in the analysis. Moreover, all of the participants who were EL spoke Spanish as their first language, and so no conclusion can be drawn regarding speakers of other languages.

Implications

In CHAAOS classes, special education teachers devoted fewer than 20 minutes of their ELA allotted time to explicit and interactive vocabulary instruction. Although teaching CHAAOS decreased available time for other important instruction, devoting time to vocabulary did not lead to students falling farther behind in reading comprehension. Moreover, students maintained meanings of words they learned through CHAAOS instruction four weeks after instruction ended, which suggests that teaching vocabulary can be a valuable use of class time.

The current research is important in being one of few studies to focus on academic vocabulary instruction for the growing population of students with LD and other disabilities who are also EL in middle school. This study demonstrates that when effective vocabulary practices that have been validated for students in general education, students with LD, or students who are EL are implemented (e.g., explicit instruction on word meanings, frequent exposure to the words in the classroom, extensive practice, review, and time spent discussing the words), learning is strong for students who have LD and are also EL. Therefore, we suggest that academic vocabulary instruction on grade appropriate words is feasible in special education middle school classes in which most students read below their grade level. Special education teachers implemented CHAAOS with high fidelity and materials are available readily to download by teachers and researchers to evaluate replicability.

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Table 1

Demographic Data

	Business As Usual		Treatment		Total	
Variable	(n = 17)		(n = 36)		(n = 53)	
	%	n	%	n	%	n
Gender						
Male	58.8%	10	77.8%	28	71.7%	38
Female	41.2%	7	22.2%	8	28.3%	15
Special Education Classification						
SLD	70.6%	12	80.6%	29	77.4%	41
Autism	5.9%	1	8.3%	3	7.5%	4
OHI	17.6%	3	5.6%	2	9.4%	5
SLI	5.9%	1	2.8%	1	3.8%	2
ED	0%	0	2.8%	1	1.9%	1
Ethnicity						
Hispanic	100%	17	77.8%	28	84.9%	45
Caucasian	0%	0	16.7%	6	11.3%	6
African American	0%	0	5.6%	2	3.8%	2
Missing	4.0%	1	0%	0	1.9%	1
Language Preference						
Spanish	88.2%	15	63.9%	23	71.7%	38
English	11.8%	2	36.1%	13	28.3%	15

Table 2

Scores on Taught Vocabulary by Treatment Condition

Measure	Business as Usual (n = 17)		Treatment (n = 36)	
	Pretest	Posttest	Pretest	Posttest
Word Knowledge				
Cycle 1 Multiple Choice	6.56 (2.71)	6.87 (2.39)*	8.09 (3.04)	14.37 (2.83)*
Cycle 2 Multiple Choice	6.38 (1.89)	6.44 (1.50)*	7.69 (3.22)	14.18 (2.92)*
Cycle 3 Multiple Choice	6.69 (2.09)	7.31 (2.94)*	7.23 (2.43)*	13.91 (3.17)*
Cycle 1 Student Definitions	2.63 (3.10)	4.00 (4.68)*	5.26 (3.82)	15.50 (8.90)*
Cycle 2 Student Definitions	2.13 (2.73)	3.56 (2.94)*	2.68 (2.59)	11.21 (7.40)*
Cycle 3 Student Definitions	0.56 (1.21)	1.63 (3.14)*	1.21 (1.79)	8.06 (6.87)*
Using Words in Context				
Cycle 1 Usage	3.81 (1.52)	3.93 (1.58)	3.86 (1.77)	5.51 (2.09)
Cycle 2 Usage	2.81 (1.83)	3.38 (1.71)*	3.97 (2.20)	5.09 (2.11)*
Cycle 3 Usage	3.13 (1.41)	3.50 (1.51)*	4.20 (1.49)	5.09 (1.72)*
Cycle 1 Student Sentences	3.69 (3.42)	4.67 (5.19)*	5.47 (3.86)	12.29 (8.23)*
Cycle 2 Student Sentences	2.69 (3.20)	4.81 (4.72)*	3.56 (2.80)	10.12 (6.71)*
Cycle 3 Student Sentences	0.75 (1.13)	2.19 (2.51)	1.44 (1.73)	6.76 (5.55)

Maintenance	Pre	Post	Follow-up	Pre	Post	Follow-up
Mean	6.00	7.50*	7.23*	5.81	16.38*	13.97*
Standard Deviation	(1.89)	(1.64)	(2.45)	(3.16)	(2.97)	(3.61)

Note: Significant differences are marked with asterisks.

Table 3

Scores on Standardized Measures by Treatment Condition

Measure	Business as Usual (n = 17)	CHAAOS Treatment (n = 36)
CREVT General Vocabulary Index		
Time 1	74.89 (7.61)	74.03 (8.93)
Year 3 Spring	69.20 (8.23)*	72.97 (6.30)*
WJ-III Passage Comprehension		
Time 1	55.94 (13.93)	58.37 (12.26)
Year 3 Spring	54.73 (12.85)	61.07 (11.90)

Note: CREVT = Comprehensive receptive and Expressive Vocabulary Test. WJ-III = Woodcock Johnson, 3rd edition. Time 1 = First administration of this measure, which was Fall of Year 1 for most students, or as students entered the study by moving into BAU or CHAAOS classes. Significant differences are marked with asterisks.

Table 4

Treatment Outcomes by Language Status

Measure	Treated English Learners (n = 23)		Treated Native English Speakers (n = 11)	
	Pretest	Posttest	Pretest	Posttest
Word Knowledge				
All Cycles Multiple Choice	21.52 (6.69)	42.35 (8.75)	26.00 (7.39)	42.73 (6.80)
All Cycles Student Definitions	7.78 (6.73)	30.00 (21.16)	11.36 (8.62)	42.36 (20.36)
Using Words in Context				
All Cycles Usage	10.74 (3.68)	14.35 (5.01)	14.36 (3.56)	18.00 (2.86)
All Cycles Student Sentences	8.39 (5.84)	23.87 (17.61)	14.00 (8.14)	38.00 (16.44)