Preliminary Results on the *Access Code* Reading Intervention

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Internal Studies on the Impact of the *Access Code* Reading Intervention

Introduction

Reading is fundamental for academic success. Yet despite focused instruction and numerous interventions, many children struggle to acquire this fundamental skill. According to the 2009 National Assessment of Educational Progress, 67% of 4th graders score below proficient in reading (US Dept. of Education, 2010). While ultimately instruction must be improved to prevent students from falling behind, there is an immediate need for scientifically sound interventions.

Any such intervention must address two issues. First, it must identify the content of remediation, the skills that are compromised in struggling readers and which give them a boost toward proficiency. Here, a crucial skill is decoding, the ability to understand and use sound, and to map letter strings to phonological patterns (Chall, 1967; Liberman & Liberman, 1990). Decoding is the access point to many other aspects of reading, particularly during the early stages when few words can be directly recognized. By giving children the ability to recover a spoken word from print, effective interventions emphasizing decoding may enable children to benefit from regular classroom instruction and text exposure outside of the intervention. Indeed, a wealth of evidence suggests that interventions based around decoding like phonics and phonemic awareness offer significant gains in word recognition, fluency and comprehension (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998; Santa & Høien, 1999; Savage, Abrami, Hipps & Deault, 2009; Ehri, Dreyer, Flugman, & Gross, 2007; Roberts & Meiring, 2006; Edwards, 2008; Torgesen, Alexander, Wagner, Rashotte, Voeller, Conway, & Rose, 2001), and meta-analyses suggest that phonics approaches are measurably better than other approaches to instruction and remediation (Ehri, Nunes, Stahl, & Willows, 2001).

Second, we must address how those skills are taught and how teaching leads to their retention, generalization and application. Many interventions emphasize content, relying on methods derived from educators' experience and frame the problem as acquiring knowledge (e.g., rules for pronouncing letters). In contrast, a long tradition in psychology and cognitive science emphasizes the mechanisms of learning and the nature of memory (e.g., Cleeremans, 1997; Rayne, Foorman, Perfetti, Pesetsky & Seidenberg, 2001; Reber, 1976; Roher & Pashler, 2010; Shea & Morgan, 1979). In the 1980s and 1990s a number of research groups began bringing together such work into the more formal and concrete theoretical approach known as connectionism and/or statistical learning theory (e.g. Rumelhart, McClelland and the PDP Research Group, 1986; Saffran, Aslin & Newport, 1996; Elman et al, 1996; Seidenberg, 2005). Within this framework a number of formal models of reading were developed, known as the Triangle Model (Figure 1) (Seidenberg & McClelland, 1989; Plaut, McClelland, Seidenberg & Patterson, 1996; Harm & Seidenberg, 1999; Harm, McCandliss & Seidenberg 2003). This offered a new way to think about the nature of decoding sklls, and how they are acquired (Seidenberg, 2005) suggesting that decoding operates over associative mappings between focal representations of phonology, orthography and meaning. Mappings are acquired via implicit or procedural learning and encode statistical regularities between letters and sounds, not abstract rules or knowledge. Thus, acquiring decoding skills is a process of laying down pathways for processing, pathways which reflect the messy statistical relationship between sound and letters, not discrete rules or knowledge. This may harness fundamentally

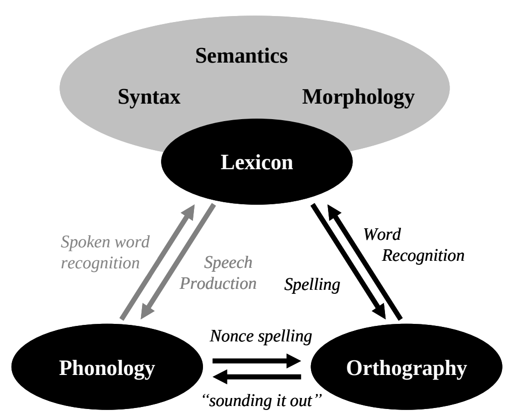

Figure 1: The Triangle Model.

different learning principles.

Perhaps more importantly, this theoretical account of learning and memory, when tied to the rich history of work on basic learning processes in psychology has arrived at a number of findings which can be used to directly improve the efficacy of learning and the retention, generalization and application of skills to new contexts. We loosely describe these findings under the aegis of the "varied practice model" which encompasses findings that (1) interleaving multiple tasks leads to better learning and generalization (a finding known as contextual interference: Shea & Morgan, 1979; Magill & Hall, 1990, for a review), (2) variability in the items to be learned often leads to richer representations (Bourne & Restle, 1959; Bush & Mosteller, 1951; Gomez, 2002; Rost & McMurray, 2009, 2010); and (3) that implicit learning, rather than explicit learning, may better capture regularities like those required for language and reading (Reber, 1976; Howard & Howard, 2001; Berry & Broadbent, 1988; Saffran, Newport, Aslin, Tunick and Barrueco, 1997). *Connectionist models like the Triangle Model and the varied practice approach offer a clear learning theory as the basis for intervention, and suggest that laboratory studies and computational models of learning may inform reading interventions. However, such findings only rarely guide reading interventions (though see McCandliss, Beck, Sandak, & Perfetti, 2003).*

Access Code was developed to bridge this gap. *Access Code* is a supplemental, blended intervention (computer + teacher-facilitated instruction) for struggling readers that provides focused training on decoding and rapid word recognition leading to fluency and comprehension. Its learning model is built on this varied practice approach and on principles from connectionist, statistical and skill-learning theories. NSF-funded basic-science research by the research team (Apfelbaum, McMurray and Hazeltine, 2011) explicitly tested this link. The strength of the VPM is particularly appropriate to this intervention that targets students who have shown persistent barriers to the retention, generalization and application of phonics skills to new contexts.

Access Code has been developed, tested and refined as a theoretically-driven model for reading intervention by Drs. Carolyn Brown and Jerry Zimmermann over the last eight years in an ongoing, iterative process involving researchers, teachers, parents and readers. It is built on a theoretical model of reading and learning that positions reading as a constellation of multiple, flexibly-aligned skills. The purpose of this technical report is to document several internal studies exploring the application of the varied practice model to the retention, generalization and application of phonics skills to connected text and the efficacy of *Access Code* in building decoding and fluency skills with struggling readers. We first start with a brief overview of *Access Code.* We then move on to the studies. Study 1 is a qualitative description of the first interventions with Access Code and their results. Study 2 reports a case study of a school (Lakeview Elementary in Solon, IA) who used *Access Code* with all of its struggling readers and documented their weekly gains in decoding and fluency. Study 3 reports the results of a small randomized control trial conducted at Hillside Elementary in West Des Moines, IA.

Study 4 reports the results of a randomized control trial conducted in Bridgeport, Connecticut. These series of studies--taken together--offer compelling, converging evidence for potential gains from this innovative approach to reading remediation.

Description of Access Code

Individualized Online Component: *Access Code* is a supplemental intervention for 1st -grade and older students reading below grade-level because they lack foundational reading skills. It was designed and developed to help struggling readers acquire, retain, generalize, and automatically apply decoding skills by using a multi-modal computer-based platform of audio, video, graphics and text to keep students engaged. Students interact with a series of multi-media tasks primarily responding with the computer mouse. Each daily session on the computer lasts about 15-20 minutes. The individualized software curriculum is deployed over the internet on computers in the classroom, resource room or at home.

Each unit is organized around a small set of Grapheme-Phoneme-Correspondence rules (for example, the fact that the letter A in a CVC frame, like hat is pronounced as the short A, or /æ/). These are taught using a variety of simple tasks that employ principles from the varied practice model. Students use the same words across 20 tasks that emphasize different pathways within the Triangle Model, such as mapping sound to spelling, spelling to sound and sound to text recognition. This draws children's attention away from singularly and rigidly focusing on the strategies needed to solve any one task, while they sample the statistics implicitly across tasks. This is critical to successful retention, generalization and application of skills. Tasks provide consistent feedback, both as a motivator, and as a necessary condition for long-term learning.

Access Code assumes that students have a working knowledge of basic letter-sound correspondence, but have not yet reached the stage where mappings are automatic or generalizable. The goal of *Access Code* is to use the rapid pace, immediate feedback and, most importantly, the exquisite control over task-structure, relevant contrasts and item statistics offered by a computer platform to quickly build procedural aspects of decoding.

Access Code

Teacher-Facilitated Instruction: Access Code recognizes the essential role that classroom teachers play in the learning process even when skills are effectively taught, learned, and practiced through the online delivery of the curriculum. The Access Code intervention program relies on a blended learning model dependent on both a teacher and a computer. The Varied Practice Model, personalized to each student, is most effectively and efficiently delivered through on-line individualized skill learning that cannot be accomplished effectively for each student by a classroom teacher. Individualized teaching is particularly difficult in a classroom where a number of students are struggling readers. With Access Code, the teacher serves a critical role in engaging, instructing and motivating the student and providing a milieu in which the newly acquired skills can be practiced, applied and well-instantiated. As the daily schedule (Appendix A) illustrates, daily teacher-facilitated instruction extends the principles of the Varied Practice Model to classroom activities. The teacher creates the learning conditions in which students can apply and practice their new skills in the broader context of reading connected text for a purpose. A sample classroom lesson is presented in Appendix B.

Ongoing data are available to the teacher through emails about each student's usage time and performance progress. Email updates are detailed in Appendix C.

Sequence of GPC rules and unit structure. The structure of the *Access Code* curriculum and the software architecture reflect the critical requirements of the Varied Practice Model within a phonics curriculum. *Access Code* is divided into 24 units, each of which stresses a small set of GPC rules (see Appendix E for the units' scope and sequence). Within units, students complete 5 pretest tasks, 20 instructional tasks and 5 posttest tasks, with 8 trials for each task. The unit structure (Appendix F) is organized around 5 instructional levels in which tasks are embedded. The first two levels teach the GPC rules in one syllable words; Level 3 extends these rules to new words and new skills in similar tasks; and Levels 4 and 5 extend the rules to words in phrases and multi-syllabic words (Appendix G).

While *Access Code's* approach to decoding has similarities to systematic phonics, there are theoretical and practical differences. Similar to systematic programs, GPC rules are taught sequentially, advancing from simple rules to more complex ones. Students work in each unit until they perform at criteria for each task and then they advance to the post-test. Unlike other systematic phonic programs, *Access Code* embeds GPC rules in more complex tasks from the beginning. Even initial units about the simplest GPC rules ask students to extend rules to poly-syllabic words and phrases. This ensures generalizability of each rule by offering variation in things like syllable structure, and by asking children to generalize rules to a variety of tasks. In this way, *Access Code* simplifies the relevant statistics (by focusing on a small set of GPC rules) while simultaneously pushing children to use these flexibly. Ultimately this leads to phonics learning that better generalize to new words, new tasks, and most importantly, connected text.

Curriculum. The curricular content of *Access Code* is organized around the phonics rules for vowels (Appendix E). Word lists for each unit include words that are typically known by third graders. Examples of the contrasts embedded in the various tasks for Unit 1 (short vowels A, E, I) are shown in the word lists in Appendix H. The curriculum cycles through 20 tasks (8 trials each) for each set of rules, using the same lexicon (within a set of rules). *Access Code* tasks include multiple activities (e.g., phoneme identification, phoneme manipulation, spelling, syllable and word and phrase identification, oral reading and word construction). See Appendix I for examples of screen displays for two tasks. Through extensive testing and analysis the curriculum has emerged to reflect the considerable difficulties that struggling readers demonstrate with identifying and processing vowels in anything but the simplest contexts (e.g., Post, Swank, Hiscock, Fowler, 1999; Bertucci, Hook, Haynes, Bickley & Macaruso, 2003; Caravolas & Bruck, 2000) and their inability to internalize the structure and function of the syllable.

The use of multiple tasks is for practical and theoretical concerns. At a practical level, frequent task-switching reduces boredom and maintains interest as the dynamic pace and game-like nature of the tasks matches students' attention spans. At the theoretical level, this schedule creates conditions under which contextual interference should emerge. However, switching tasks too frequently can cause problems for children, as they may have difficulty maintaining the instructions for each task. To counter this, *Access Code* uses the same set of tasks for each unit (with different items) so that after a few units children are used to the tasks, and have little trouble with this.

Advantages of computer-based instruction. *Access Code's* computer-based implementation is crucial to its success by allowing it to precisely control the timing and structure of the learning in order to instantiate several principles from learning theory. Statistical learning (e.g., Saffran et al, 1996), for example, suggests that learners learn probabilistic relationships between elements like letters and phonemes. As a result, successful learning requires them to accumulate statistics over many trials. A computer-based implementation can thus deliver more trials more quickly than paper and pencil tasks. Learning theory also suggests that error-driven learning is more effective when feedback is immediate (Maddox, Ashby and Bohil, 2003), particularly when the items to be learned are not easily describable like rules (e.g., the conflicting sound-spelling regularities). This is difficult outside of computer programs. Third, associative (rather than error-driven) learning is most effective when students reach the right answer on their own, and *Access Code* simplifies the tasks when a response is incorrect, scaffolding students to the right answer (e.g., Appendix I). Finally, the computer allows delivery to be standard: auditory stimuli are not confounded by accent or vocal quality, responses are the same, and feedback is consistent. Thus, a computer-based program is ideal for fully implementing a learning theory.

Study 1: Early Case Studies

Work on *Access Code* began in 2006. Its development proceeded empirically as the *Access Code* developers (Drs. Brown and Zimmermann) worked one-on-one or in small groups with struggling readers, and their teachers and parents. The following case studies describe their experiences and the success that eventually led to this full scale intervention.

Case Study 1: Jessica.

The initial model and materials were developed and tested with an otherwise capable third grader, Jessica, who was a struggling reader. Jessica had good receptive and expressive oral language skills and was on or above grade level in all subjects other than reading. She had excellent oral comprehension. She was identified in first grade as a child in need of additional reading instruction and was enrolled in Reading Recovery. Jessica's teachers reported that she would soon "get it". However, she continued to struggle in 2nd grade. She was highly motivated and needed something different from the behaviorist approach that had been used with her and is typically used with struggling students.

The *Access Code* developers worked intensively with Jessica over three months in an attempt to identify learning strategies that were effective. Over the course of this work, they recognized the positive impact of adapting the varied practice approach to phonics and decoding skills. Their initial hypothesis was that this struggling student needed multiple and varied experiences so she could derive and construct the rules governing the decoding skills. As a result of this *Access Code* was implemented, one-on-one, by her teacher for 15 minutes each day for 12 weeks. The tasks and curriculum that would later be incorporated into the technology platform was initially delivered by the teacher. For Jessica , *Access Code* served as an on-ramp to text so, within a year, her reading comprehension scores on the Iowa Test of Basic Skills rose from the 14th to the 74th percentile.

Case Study 2. David and Alex.

David and Alex were identified as struggling readers with similar profiles at the end of 3rd grade. Both boys performed well in subject areas other than reading and each had excellent verbal skills in both the expressive and oral comprehension domains. Each of the boys struggled with word recognition skills, which negatively impacted their fluency and reading comprehension. Teachers and specialists from their respective schools reported that they assumed David and Alex were "late developing boys" who would soon "get it" and catch up in reading. However, neither student made much progress in fluency or reading comprehension.

David and Alex participated in an eight-week summer program organized around *Access Code*. The summer program required that the students use *Access Code* every day. Additionally, they met with the teacher two or three times a week to engage in the extension activities for *Access Code*.

Both boys showed similar gains on the reading comprehension subtest of the Iowa Test of Basic Skills after using *Access Code*. David's reading comprehension scores were at the 32nd percentile in 3rd grade and rose to the 93rd percentile in 4th grade. Similarly, Alex's reading comprehension scores increased from the 44th percentile in the 3rd grade to the 90th percentile in the 4th grade.

Conclusions.

At this point in time, all three students remain on or above grade level in reading comprehension. Crucially, these early successes led to the growing understanding of how to best encapsulate the varied practice approach into phonics remediation, and to the crystallization of *Access Code* into the richly structured 24 week supplement that it is today.

Study 2: Implementation in the Solon Community Schools

In the Spring of 2010, *Access Code* was implemented in the Lakeview Elementary and Solon Middle Schools in Solon, IA with 70 struggling readers. After reviewing the earlier pilot results from using *Access Code* with individual students, the teachers and administration were reluctant to assign targeted children to a control group. As a result, this implementation was designed as *school-wide intervention*, not a research study, and so as a result this constitutes virtually all of the struggling readers (across multiple grades) at Lakeview Elementary

Methods

Participants. Participants were 70 students (24 female / 46 male) enrolled at Lakeview Elementary in Solon, IA. Table 1 reports the number of students by grade and gender. Lakeview is a suburban/rural school in which all participating students were Caucasian except for one African American student. About 40% of the students were classified as having disability of some type. Table 2 presents a breakdown of the numbers for each type.

Table 1: Number of participants by grade and gender.

	Gender	
Grade	**M**	**F**
2nd	6	9
3rd	8	12
4th	4	9
5th	4	7
6th	0	4
7th	2	5

Table 2: Number of participants with disabilities.

Disability Status	**Students**
None	43
Learning disability (general)	19
LD in math	2
LD + behavioral disorder	1
Speech/Language	2
Rule 504	3

All of the students who participated in *Access Code* had been identified by their teachers and the district reading interventionist as struggling readers on the basis of district assessments and results from the Iowa Test of Basic Skills Reading Comprehension Subtest ($ITBS_R$). Inclusion was weighted toward the teacher's or the reading interventionist's impression that the child was specifically struggling with decoding skills (as opposed to comprehension).

As $ITBS_R$ scores were available on all participants they can be used to describe the sample. On the $ITBS_R$ the 24 girls scored in the 29.35th percentile (SD=17.3) and the 46 boys scored in the 32.9th percentile (SD=21.1) putting them below average.

Setting. The Solon Community School District uses both small and large-group reading instruction to emphasize decoding, fluency comprehension and vocabulary. This is used in conjunction with a comprehensive reading program emphasizing phonemic awareness, phonics, fluency, vocabulary and comprehension. Solon employs a reading specialist for 1st and 2nd graders, and in 2009 added an additional specialist for struggling 3rd through 8th graders to provide one-on-one instruction in basic reading skills.

Students participating in *Access Code* used computers in their classroom, computer lab, or special education room to access the training. They were supervised by their teacher, the reading specialist or a special education teacher (for middle schoolers). A handful of children participated in *Access Code* sessions before or after school. After a brief individual or small group session to show students how to log-in and utilize *Access Code*, the role of the person supervising was to assure that students logged in appropriately and focused on the computer tasks. They were also responsible for reading the end-of-unit poems and passages with the students.

Timeline. The intervention was conducted from February 12, 2010 to July 15, 2010 (most students completed the intervention by the end of the school year on June 7, 2010).

Fidelity of Intervention. The computer based component of *Access Code* has a number of features that ensure that it is faithfully executed. The program automatically advances students between tasks and units and offers an engaging platform to keep students motivated. Since *Access Code* is delivered remotely via the internet, this can be monitored on logs maintained by the *Foundations in Learning* servers.

Our analysis of the logs indicated that 52 / 70 students completed an average of 3.5 sessions per week (the "acceptable" recommendations by Foundations in Learning), another 14 completed more than 2 sessions/week, and only 5 completed below two ("unacceptable").

Measures. A number of measures were obtained from each student, before, during and after the intervention. As *Access Code* emphasizes decoding, spelling patterns and word recognition, our proximal measures focused on these abilities, while our distal measures emphasize fluency and reading comprehension.

DIBELs (6^{th} edition) (Good & Kaminski, 2002) served as our proximal measure of decoding and fluency. The Nonword Fluency Subtest (the number of nonwords the student can correctly pronounce in a minute) was conducted in February, before the intervention, and at the end of May, at the conclusion of the intervention, for most students, though there were a handful who were tested just prior to completion. This measure is perhaps the purest measure of decoding as students cannot use any memorized word forms (e.g. direct orthographic-to-lexical mappings) as a proxy for decoding skills. However, to prevent students from memorizing the non-words it cannot be conducted too many times. Finally, the Oral Reading Fluency Subtest was administered to each student each week during the intervention. This provides both the number of words the child can correctly read per minute, and their accuracy in pronouncing them.

The ITBS served as both a baseline measure of reading comprehension, and our distal measure of improvement. The ITBS is conducted in October in the Solon Community School District. We obtained $ITBS_R$ scores from each participant as far back 2007, though these were available on a limited basis for more distal years. In addition, we obtained $ITBS_R$ scores on all participants for the October, 2010, test data *following* the intervention.

Results

We report the results of each of our three measures in turn.

Dibels Non-word Fluency (NWF). Children started the intervention in February with an average score of 64.9 (SD=27.5) and ended at 77.8 (31.75), a fairly sizeable improvement. Figure 2 shows that this improvement was seen in every grade level and in both genders. Results were analyzed with a mixed design ANOVA containing grade and gender as between-participants factors, test-type (pre/post) as a within-participants factor. Dibels NWF scores (non-words / minute) was the dependent measure. We found a main effect of grade ($F(5,57)=9.2$, $p<.0001$) with scores generally increasing for higher

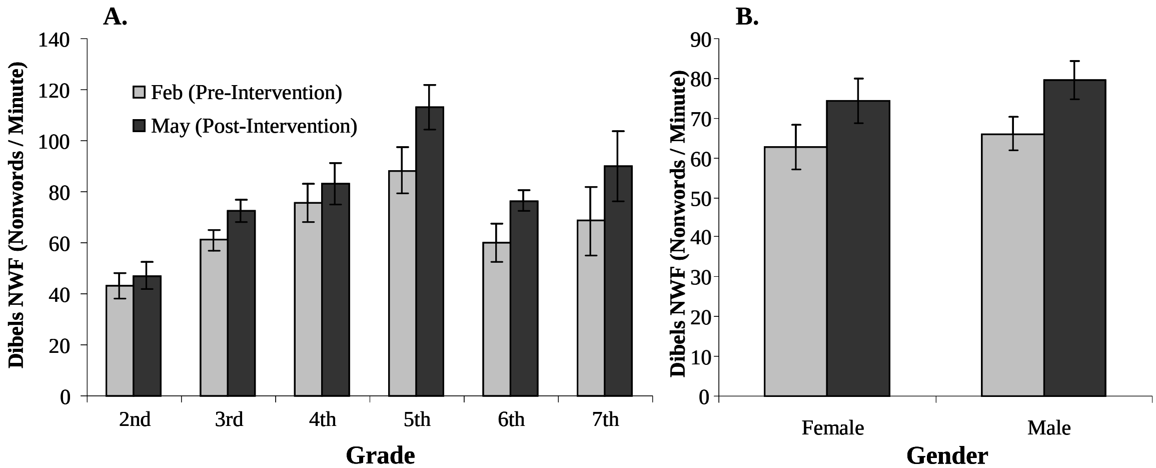

Figure 2: Performance on the Dibels NWF subtest before and after the intervention as a function of Grade (Panel A) and Gender (Panel B). Note that some students had not fully completed the intervention by May when the post-intervention measure was collected.

grades. There was no main effect of gender ($F<1$), but there was a grade × gender interaction ($F(4,57)=2.9$, $p=.027$). This was due to the fact that NWF scores increased at each grade level in the 1st through 5th grades for both boys and girls, however, 6th and 7th grade boys' scores dropped substantially, while girls showed their highest performance in the 7th grade (there were no 6th grade girls in the study). This result should be interpreted with caution, however, due to the small number of 6th and 7th graders in the study as a whole (N=11). Crucially, there was a highly significant main effect of test-type ($F(1,57)=21.3$, $p<.0001$) which did not interact with gender ($F<1$), grade ($F<1$), or with the gender x grade term ($F(4,57)=1.5$, $p=.2$). Thus, we can conclude that NWF scores improved substantially during the short intervention period and this improvement was not different in our different groups. While without a control group we cannot be sure how much these children would have improved without *Access Code*, it is clear that substantial improvement was seen.

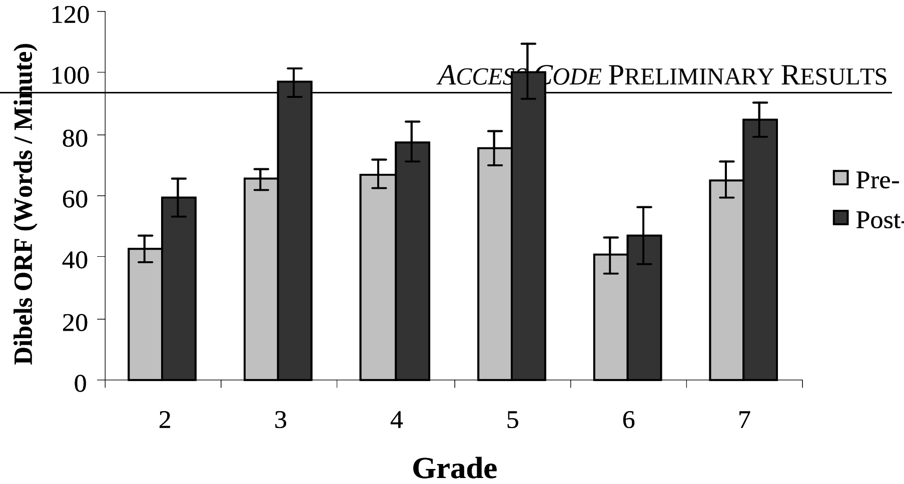

Figure 3: Correct Words / Minute on the Dibels Oral Reading Fluency subtest as a function of grade and treatment.

Dibels Oral Reading Fluency (ORF). The Dibels ORF measure includes both a fluency measure (number of words correctly read per minute) and accuracy. It was collected each week during the intervention on all students. As students varied in the number of weeks it took to complete the *Access Code*, the number of data points differed across participants. This necessitated a multi-pronged analytic approach. We first report a series of analysis on the correct-words-per-minute measure, the primary measure of fluency in the Dibels framework. Next, we report secondary analyses examining accuracy.

To examine ***correct words per minute***, we first took the simplest approach by comparing the first and last ORF data points for each participant as a function of gender and grade. Children started with the ability to produce 61.1 correct words per minute (SD=19.8), and ended at an average of 81.8 (SD=28.2) suggesting a sizeable improvement. This was examined in a mixed ANOVA examining grade and gender as between-participants factors, and test-type (pre/post) as a within-participants factor. There was no significant effect of gender ($F<1$), but there was a significant effect of grade ($F(5,57)=7.6$, $p<.0001$). As Figure 3 shows, this was largely due to the fact that the 6^{th} and 7^{th} graders performed worse than the other grades, likely due to a higher selection threshold on the part of teachers for these older students. Gender and grade did not interact ($F<1$). Most importantly, there was a highly significant main effect of test-type ($F(1,57)=81.7$, $p<.0001$). Test-type did not interact with gender ($F<1$), it did interact with grade ($F(5,57)=3.35$, $p=.01$). However, planned comparisons showed that the test-type effect was significant within each age (all $p<.001$, 6th and 7th graders were collapsed due to small samples in these grades), suggesting that this was a difference merely in the magnitude of the effect. The three-way interaction was not significant ($F(4,57)=1.4$, $p=.26$).

Table 3: Regression slopes and intercepts on the correct-words-per-minute measure broken down by gender and grade.

	Intercept (initial word/min)	**Slope** (words / minute) **Mean**	**SD**	**Sig.**
Boys	67.09	1.00	1.13	T(45)=6.0, p<0.0001
Girls	68.9	0.92	1.14	T(23)=4.0, p=0.001
2nd Grade	47.78	0.79	0.52	T(14)=5.9, p<0.0001
3rd Grade	75.42	1.20	1.43	T(19)=3.7, p=0.001
4th Grade	68.28	0.56	0.79	T(12)=2.6, p=0.024
5th Grade	87.38	0.71	0.77	T(10)=3.1, p=0.012
6th & 7th Grade	60.48	1.54	1.51	T(10)=3.4, p=0.007

This metric tells a compelling story when compared to recommendations by the Dibels research group (Kaminski, Cummings, Powell-Smith & Good, submitted). By their standards, our 2nd graders fell (on average) into the *intensive* category (the cutoff is <52 and they had a mean of 42.5), however by the end of the intervention they were scoring 59.2 which puts them in the *strategic* range (using middle of the year standards). Similarly, the third graders' initial score of 65.3 also puts them in the intensive category (<67) while by their final score of 96.9 puts them at benchmark (normal)! (Unfortunately, there are no published benchmarks for older children).

A second analysis examined the week-by-week data. Since data collection stopped when children stopped the intervention, the varying times-to-completion (M=13.6 weeks; SD=1.8), this could not be accomplished in a standard ANOVA framework. Instead we performed a simple mixed model by fitting regression slopes relating week number to the correct-words-per-minute measure. Here the slope is a measure of improvement, indicating the number of new words that can be produced each minute per week. Here, any value greater than zero indicates improvement; any negative value indicates that children are performing progressively worse.

Table 3 shows the average slopes broken down by gender and grade along with the intercept (the initial value). The average slope across all participants was .97 new words/minute per week (SD=1.12). For 59 of the 70 participants these values were positive suggesting that most children improved on this measure. Slopes were entered into an ANOVA examining the effect of gender and grade. Here, the significance of the intercept serves as sort of an omnibus test that the slope was greater than 0, while individual effects would show that the slope was different between groups.

The intercept of the ANOVA was highly significant (F(1,59)=45.7, p<.0001) showing that overall the slopes were significantly greater than zero. Grade was significant as well (F(5,59)=5.0, p=.001), though there did not appear to be any systematic pattern to which grades showed more improvement. Individual T-tests (reported in Table 3), however, suggest that the test-type effect was highly significant within each gender and within each grade. Gender was not significant (F<1) nor was the gender x grade interaction (F<1). Thus, it appears that at an even finer level, all of the students showed large week-by-week gains in fluency as measured by the Dibels ORF.

The same two analyses were also used to assess ***accuracy*** on the ORF measure. Here, children started out fairly high (M=.92, SD=.053), as they were likely slowing down in order to maintain accuracy. Thus, we expect the magnitude of change (particularly week-by-week) to be somewhat less than observed with words per minute. Nonetheless, we wanted to determine if children's gains in speed were also matched by gains in accuracy.

The first analysis simply examined the accuracy in the first and last session as a function grade, gender and test-type. Here, gender was not significant ($F<1$) as boys and girls performed at about the same level of accuracy. Grade was significant ($F(5,53)=4.5$, $p=.002$) though there was no discernable pattern to this effect and it may simply reflect variation in who was selected for this study by grade. Grade did not interact with gender ($F<1$). Most importantly, the main effect of test-type was highly significant $F(1,53)=10.8$, $p=.002$) with children's accuracies increasing by about 2% after the intervention. Test-type did not interact with any other factor (all $F<1$).

Our second analysis used the same mixed effects model, fitting linear regressions to each participant's accuracy by week. Overall, participants averaged an increase of .0016 / week (SD=.003) and 47 of 22 participants showed a positive slope. These were examined in a gender x grade ANOVA which found a highly significant intercept ($F(1,58)=24.3$, $p<.0001$) meaning that the slopes were significantly greater than zero as a whole. Grade was also significant, this time due to greater slopes in 6^{th} and 7^{th} graders. Gender was not significant ($F<1$), nor was the grade by gender interaction ($F<1$).

Thus, on the ORF, children receiving *Access Code* increased in both the number of words they could read per minute and in their accuracy in doing so. While we cannot uniquely attribute this success to *Access Code* these results offer a compelling glimpse of the performance of a large heterogenous group who are using the intervention.

ITBS Reading Comprehension. Our final analysis examined the distal measure of reading comprehension, the $ITBS_R$. We were able to obtain $ITBS_R$ scores for 59 of the 70 participants for the October, 2009 assessment, *before* the intervention, and scores for 69 of the 70 participants for the October, 2010 assessment, *after* the intervention. Looking only at the 59 children with both measures, we conducted a treatment (pre/post) x gender x grade ANOVA. This unfortunately excluded all of the second graders (the ITBS is not given in the 2^{nd} grade in Solon), but allowed us to examine the older children. As in the prior analyses we found no effect of gender ($F(1,45)=1.2$, $p=.27$) and a main effect of grade ($F(4,45)=4.9$, $p=.002$). As Figure 4 shows, $ITBS_R$ scores tended to decrease at older grades, probably reflecting higher thresholds for study inclusion among these grades. The effect of treatment was not significant overall ($F<1$), but the treatment by grade interaction was highly significant ($F(4,45)=4.0$, $p=.007$). This was driven by the fact that the 3^{rd} graders increased by a whopping 26 percentile points ($T(18)=5.0$, $p<.0001$), while the older children showed no net improvement (though no significant loss either: all $T<1$).

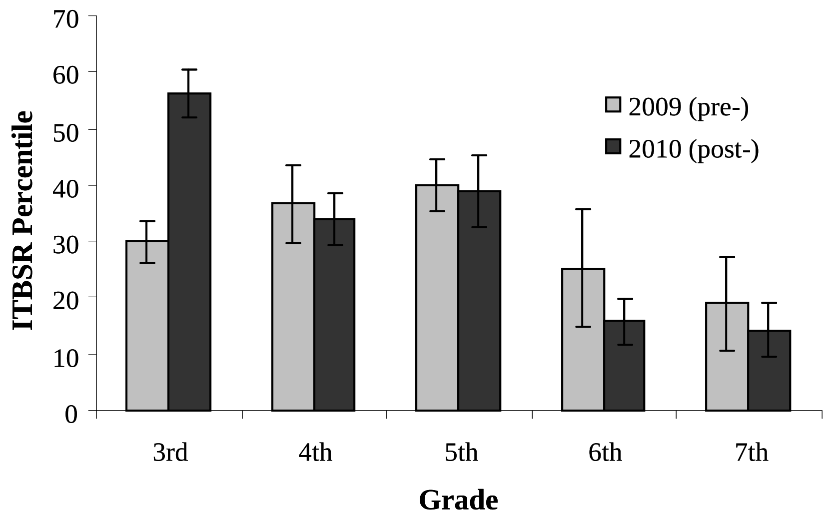

Figure 4: ITBS Reading comprehension scores for 2009 (before the intervention) and 2010 (after) as a function of grade (at the time of intervention). Note 2^{nd} graders are not shown as they do not undergo ITBS testing.

Discussion

The results of this study show a number of promising findings. First, we found significant increases in the Dibels nonword fluency measures before and after testing. Second, we found significant increases in oral reading fluency both before and after the intervention and during weekly testing. Under both measures, gains were equally distributed across grades and genders. Finally, we found large gains in reading comprehension for 3rd graders who received the intervention and no gains for older children. Thus, it seems clear that the children studied improved on multiple decoding measures over the study period and a subset of them made large gains in comprehension. We must be extremely cautious in attributing any of these gains to *Access Code*, as our lack of a control group makes it unclear whether children would have received such gains under business as usual. However, given the lack of systematic reading intervention in older struggling readers in the Solon Community School District, it is likely that *Access Code* made a difference. More importantly, we had a relatively high degree of compliance, and 70 children received the intervention in a 4 month period suggesting that *Access Code* is easily scalable to a large population of struggling readers in a challenging school setting. This is only underscored by the fact that the intervention was distributed across a large number of teachers across two schools. The ease with which *Access Code* was implemented and the gains in reading (that the teachers and administrators attribute to *Access Code*) resulted in its continued use the following year in the Solon Community School District.

The failure of the older students to improve in reading comprehension is worth noting. However, it is important to point out that 1) this constitutes only about half of our sample – the older grades were significantly under-sampled than our higher grades and we had no ITBS data on our 2nd graders; and 2) we had no business as usual group for comparison—it is possible that they would have lost ground in reading without *Access Code*. Thus, while there may be differences in the effect of Access Code on comprehension at older grades, it would be premature to draw any strong conclusions. Importantly, however, *Access Code* was conceived as the on ramp to comprehension – giving students proximal skills in decoding that will enable them to develop comprehension on their own. The Dibels measures show little difference between older and younger children with respect to decoding, and future work should examine whether the route from decoding interventions to comprehension differs in older readers.

Study 3: A Randomized Trial in West Des Moines.

In the Spring of 2010, we completed a small randomized trial of *Access Code* in the West Des Moines School District. This study included 22 children who were matched on grade and randomly assigned to receive *Access Code* or Business as Usual.

Methods.

Participants. Participants were 22 (15 male / 7 female) students enrolled at Hillside Elementary in West Des Moines, IA. Participants ranged from 2nd to 5th grade, and were randomly assigned within grade to either the Treatment or the Control groups to ensure an equal number of participants in each grade (Table 4). The racial and gender makeup of the sample is shown in Table 5 and 6; and the eligibility for free-or-reduced-price-lunch (a proxy for socioeconomic status) is shown in Table 7, and the number of English Language Learners (ELL) in Table 8. None of the students had been diagnosed as having any cognitive, language or behavioral disability at the start of the experiment; however, by the end of the experiment, three of the students in the *Access Code* condition had become eligible for Special Education. Two of the students were 3rd graders and one was in 4th grade. Students were identified as eligible for the study if they

- Were at least one year behind in reading as measured by the benchmark standards used in the WDM school district.
- Had word recognition difficulties documented by their teacher.
- Were not diagnosed with cognitive impairment

Table 4: Number of students in each grade assigned to treatment and control conditions.

Grade	Control	Treatment
2nd	1	1
3rd	4	4
4th	2	2
5th	4	4

Table 5: Number of students by race assigned to treatment and control conditions.

Race / Ethnicity	Control	Treatment
Caucasian	5	5
African American	1	2
Hispanic	5	4

Table 6: Number of male and female participants by condition.

Gender	Control	Treatment
Female	8	7
Male	3	4

Table 7: Number of students eligible for free or reduced price lunch by condition.

Status	Control	Treatment
Not Eligible	6	5
Eligible	5	6

Table 8: Number of students classified as English Language Learner in each group

Status	Control	Treatment
ELL	4	3
Not ELL	7	8

Participants were included on the basis of a comprehensive teacher impression. Students were included if they demonstrated difficulties with reading fluency, if their writing failed to show consistent understanding for letter sound relationships, or if they historically demonstrated difficulty in learning how to read based upon their performance in the Breakthrough to Literacy reading program or other district reading assessment measures.

English Language Learner (ELL) students had to obtain a score of at least 3 on the ELDA (English Language Development Assessment) which indicates that the student can: understand standard speech delivered in school and social settings, communicate orally with some hesitation, understand descriptive material within familiar contexts and some complex narratives and write simple texts and short reports. All 7 ELL students spoke Spanish as a primary language.

Setting. The West Des Moines District used a balanced literacy approach to reading instruction emphasizing comprehending, organizing and evaluating ideas, increasing vocabulary and word recognition skills, applying strategies and reference skills and reading quality literature. It did not employ phonics as a systematic tool. For students at risk of reading failure, reading specialists (Title 1 teachers, ELL teachers, Reading Recovery teachers and Special Education teachers) work directly with students. Reading Recovery, reading resource small group instruction and Title One are used for First Graders who are at risk (not tested here). Small group and individual instruction is provided by the intervention specialists for Grades 2-6.

Students participating in *Access Code* used computers in their classroom, computer lab, or the special education room. They were supervised by their teacher or the reading specialist.

Timeline. The intervention was conducted from February 22, 2009 to June 8, 2009 (the last day of school).

Fidelity of Intervention. Our analysis of the *Access Code* logs indicated that the 11 treatment students averaged 4.6 sessions / week. One student left after 10 weeks and while he did not complete all of the sessions provided data on two of the four outcome measures so was included in the study). Seven of them completed at least 4 sessions per week (“recommended” or “excellent” by Foundations in Learning’s standards), the other 3 were “acceptable”. Hillside set a target of 48 total sessions over the course of the intervention. Treatment students averaged 55 sessions ($SD=12.9$), with 7 of the students meeting this target. The other three averaged between 33 and 40 sessions.

Measures. The DIBELs (6^{th} edition) (Good & Kaminski, 2002) served as our proximal measure of decoding and fluency. These were administered before and after the treatment. The Nonword Fluency Subtest and the Oral Reading Fluency subtest were both administered. Both measures included both a correct words (or nonwords) per minute measure of fluency and an accuracy (percentage correct). As before the $ITBS_R$ was collected as part of district-wide assessments in the October of 2009 (before the intervention) and 2010 (after).

Results.

Given our straightforward design, we used standard ANOVAs on each of the five measures. Our initial analyses did include gender or grade as factors. This was because the number of participants in each treatment group was small ($N=11$)—subdividing further was statistically unwise. Moreover, since grade was perfectly counterbalanced between treatment groups and gender was approximately counterbalanced these factors were not confounded with the primary factors of interest: treatment and test-type. Thus, each ANOVA examined the effect of treatment group as a between-participant factor, and test-type (pre/post) as a within-subjects factor. Crucially, an interaction would indicate that any gains from pre- to post-testing were different depending on the treatment.

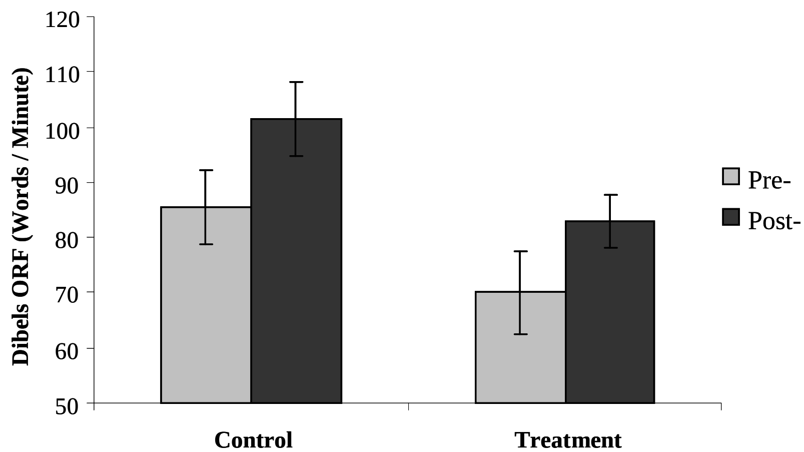

Figure 5: Performance on the Dibels ORF measure (Words Correctly Pronounced / Minute) as a function of treatment group and test-type.

Our first analysis examined the ***Oral Reading Fluency*** measure (correct words per minute). We found a significant effect of test-type ($F(1,20)=17.2$, $p<.0001$). Students correctly pronounced 77.7 words at pre-test ($SD=24.5$) and 92.2 at post-test ($SD=21.0$). The main effect of treatment group was marginally significant ($F(1,20)=4.0$, $p=.06$), with the control group ($M=93.4$, $SD= 22.3$) outperforming the experimental group ($M=76.4$, $SD=20.4$), suggesting that the control group may have been slightly more fluent than the experimental group (this was not significant at pre-test however, $T(20)=1.5$, $p=.14$). The interaction of test-type and treatment was not significant ($F(1,18)=2.1$, $p=.168$). As Figure 5 shows, both groups showed similar gains between pre- and post-testing.

The second analysis examined ***ORF accuracy***. Here we again found a significant effect of test-type ($F(1,18)=5.1$, $p=.037$). Children averaged 94.5% correct at pre-test ($SD=4.8\%$) and 97.2% correct at post-test ($SD=2.1\%$). There was no main effect of group ($F<1$). The group × test-type interaction was not significant ($F(1,18)=2.1$, $p=.168$), but the quantitative pattern of effects is suggestive of a greater effect in the treatment group (Figure 6). Indeed, planned comparisons showed no significant difference as a function of treatment-type in the control group ($T<1$), and a marginally significant difference in the treatment group (T(9)=2.2, p=.058). Thus, while the non-significant interaction does not support a claim of differential learning, the marginally significant planned comparisons are highly suggestive.

The third analysis examined ***Nonword Fluency Subtest*** (nonwords pronounced / minute), the purer measure of decoding skills. It showed a striking pattern of results. The main effect of test-type was highly significant (F(1,18)=44.6, p<.0001). Children averaged 18.2 nonwords / minute at pre-test (SD=9.5) and improved to 27.0 at post-test (SD=11.1). There was no effect of treatment (F<1). However, this time, there was a significant interaction (F(1,19)=4.6, p=.045). Planned comparisons revealed that the improvement was significant in both the control (T(10)=3.7, p=.004) and the Treatment group (T(9)=5.4, p<.0001). Thus, this interaction suggests that gains on the NWF were simply larger in the experimental group (Figure 7). This constitutes clear evidence of an effect of ***Access Code*** on decoding.

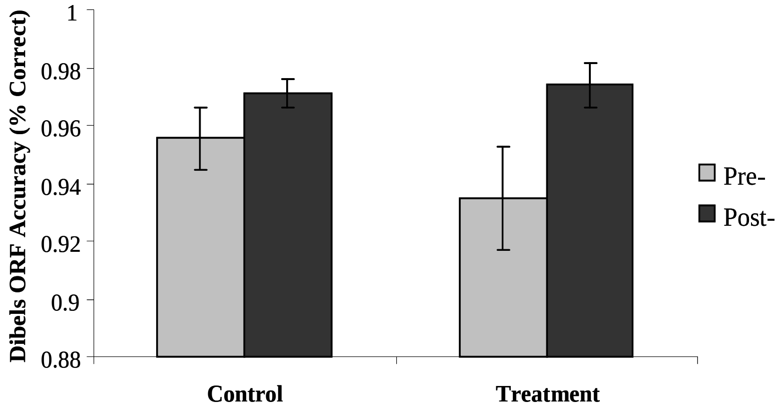

Figure 6: Performance on the Dibels ORF Accuracy (% correct) as a function of treatment group and test-

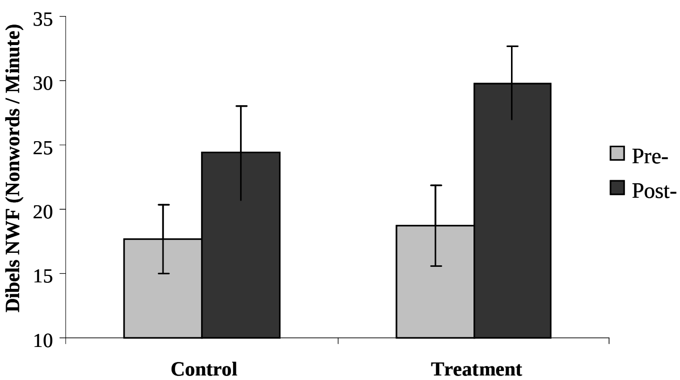

Figure 7: Performance on the Dibels NWF measure (nonwords produced per minute) as a function of treatment group and test-type.

Our final analysis of decoding skills examined the ***accuracy on the Nonword Fluency Test.*** As in all the prior analyses, we found a significant main effect of test-type (F(1,19)=12.1, p=.003). Children averaged 55.1% correct at pre-test (SD=25.3) and 70.1% at post-test (SD=18.4%). There was no main effect of treatment (F<1). The treatment × test-type interaction was not significant (F(1,19)=1.3), p=.27), however as Figure 8 shows, the effects are in the predicted direction with larger gains in the experimental than the control group. Planned comparisons revealed that while the treatment group exhibited significant learning (T(9)=3.3, p=.009), the control group did not (T(10)=1.6, p=.133). Thus, once again, despite the non-significant interaction, we see evidence in the planned comparisons for a statistically significant effect of Access Code on decoding skills.

We next examined examined the first of our two more distal measures: ***reading comprehension***, the $ITBS_R$. We were unable to obtain 2009 $ITBS_R$ scores for 2 students (one in the control and 1 in the treatment

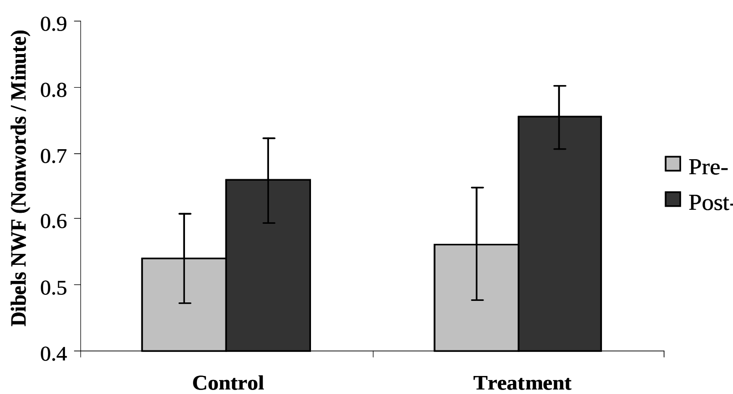

Figure 8: Performance on the Dibels NWF Accuracy (nonwords produced per minute) as a function of treatment group and test-type.

groups) and we were unable to obtain 2010 for scores for three different students. As a result, this left 9 students in the treatment group and 8 in the control group. ITBS_R scores were entered into a similar treatment × test-type ANOVA.

We found a significant main effect of test-type ($F(1,15)=7.5$, $p=.015$) in that scores improved overall from 2009 to 2010: in 2009 students averaged the 47.2th percentile, and this improved to an average of 58 in 2010. There was no main effect of condition ($F<1$). Of most interest, the condition × test-type interaction was not significant ($F(1,15)=1.7$, $p=.2$). However as Figure 9 indicates, the pattern of data qualitatively matches the predicted pattern. This was confirmed by planned comparisons which showed a significant difference between test-years for the treatment group who increased from the 45^{th} percentile to the 58^{th} percentile ($T(8)=3.0$, $p=.017$), while there was no such difference in the control group who increased from the 53^{rd} percentile to the 57^{th} ($T<1$). Thus, despite a fairly limited power/sample size, we see some evidence *Access Code* can lead to longer-term gains in the more distally target skills of reading comprehension in this randomized trial.

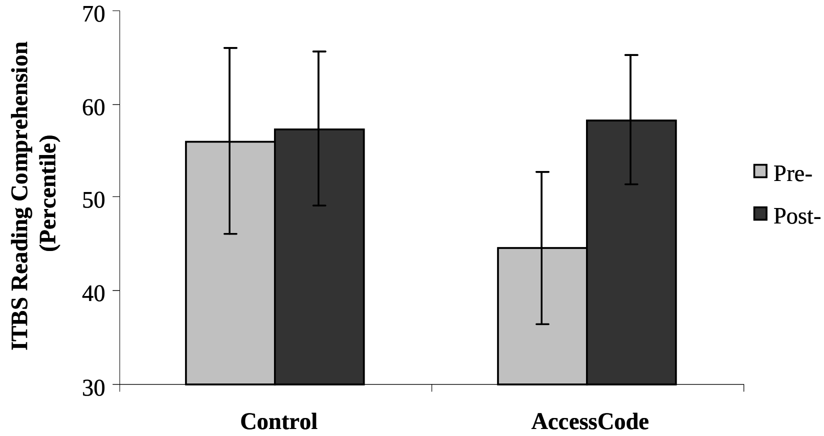

Figure 9: ITBS Reading Comprehension Scores as a function of group and test-date.

Finally, we examined the spelling scores from the ITBS (Figure 10). Here we found no main effect of test-type ($F(1,15)=2.8$, $p=.116$), nor of group ($F<1$). The interaction was also not significant ($F(1,15)=1.4$, $p=.25$). However, Figure 10 indicates that there may have been a substantial reduction in spelling for the control group that was not observed in the *Access Code* group. Planned comparisons confirmed this, suggesting that the effect of test-type was significant in the control group ($T(7)=3.25$, $p=.014$) but not in the *Access Code* group ($T(8)=.28$, $p=.78$).

Discussion

In three of the four measures of decoding ability we saw some evidence for better learning in the treatment group than the control group. In Oral Reading Fluency, while the treatment × test-type interaction was not significant, we found marginal effects of test-type only in the treatment group. For the Nonword Fluency measure, we found a significant interaction on the nonwords / minute measure. For the accuracy component of NWF, the interaction was not significant but we again found significant learning only in the experimental group. Only in the ORF words / minute measure did we find equivalent learning performance in the two groups. Perhaps most compellingly, we

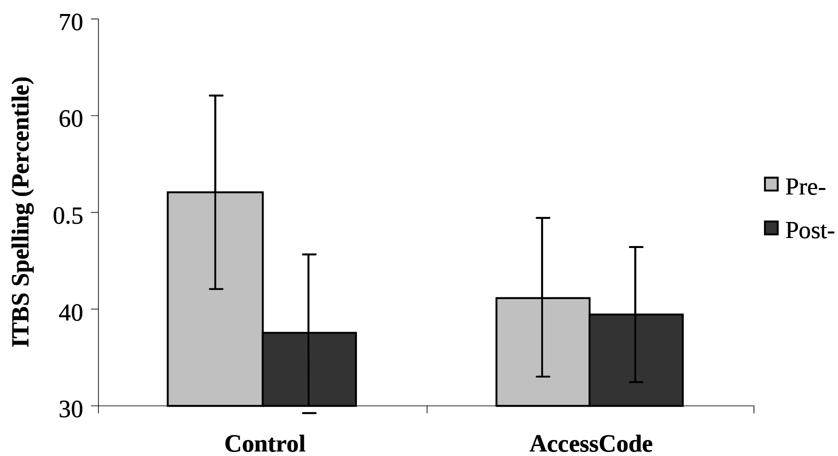

Figure 10: ITBS Spelling scores as a function of group and test-date.

found the same pattern of results in both ITBS measures. In reading comprehension, there was a non-significant interaction, but significant evidence for learning only in the treatment group; in spelling there was a non-significant interaction, but the control group appeared to lose ground, while the experimental group maintained it.

Two factors are crucial to remember in making these points. First, this is a very small sample-size for this study. Power analyses conducted as a component of planning for a larger efficacy study suggest that we need at least 800 students per group for a reasonable power. The fact that we were able to detect effects at all in such a non-homogenous sample (different grades, etc) is impressive, but we should nonetheless interpret these results with caution.

Second, according to our theoretical model the ORF measure is one that students could complete either by mastering the direct orthography-to-phonology mappings, or by mapping orthography to semantics (e.g. sight word recognition), and semantics to phonology (speech production). This dual nature of mappings undoubtedly helps children acquire the necessary mappings, but in this case means that the NWF measure is the purest measure of pure decoding (the target skills of *Access Code*), and also the one in which the clearest evidence for learning was seen here.

Study 4: A Randomized Trial in Bridgeport, CT, with older struggling readers.

In the Spring of 2011, we completed a larger randomized trial of *Access Code* in the Bridgeport Public Schools (Bridgeport, CT). Here our goal was to examine the use of Access Code to help older struggling readers using a larger experimental study. This study included 52 ninth grade students who were randomly assigned to receive *Access Code* or Business as Usual.

Methods.

Participants. Participants were 58 ninth grade students at Central High School in Bridgeport, Ct. Six students (2 in the *Access Code* group and 4 in the control group) were lost due to attrition, leaving 52 students in the final sample (24 *Access Code, 28* control). Participants were randomly assigned by the study team to treatment or control. Gender and racial breakdown are reported in Tables 9 and 10. All of the students were eligible for free-or-reduced-price lunch; none of the students were English Language Learners; and none of the students had any identified learning, cognitive or language disability. Students were identified as eligible for the study if they

- were at least one year behind in reading as measured by the benchmark standards used in the Bridgeport school district.
- had word recognition difficulties documented by their teacher.
- were not diagnosed with cognitive or language impairment.

All of the students at Central High School meeting these criteria were enrolled in the study.

Setting. In order to address the needs of those struggling students (described above) who were not eligible for Special Education or other services, Central High School assigned these students to an

Table 9: Number of male and female participants by condition.

Gender	Control	Treatment
Female	13	17
Male	15	7

Table 10: Number of students by race assigned to treatment and control conditions.

Race / Ethnicity	Control	Treatment
Caucasian	0	2
African American	17	15
Hispanic	10	7

additional language arts class. Classroom teachers provided instruction in comprehension strategies and provided opportunities for reading practice and fluency. Phonics instruction was not provided during this instructional setting.

Students participating in *Access Code* used computers in the computer lab three to four days of the week. They were supervised by either the district reading specialists or one of two graduate assistants and also received small group teacher-facilitated instruction by these same individuals.

Timeline. The intervention was conducted from April, 2011 to June, 2011.

Fidelity of Intervention. Our analysis of the *Access Code* logs indicated that the 24 treatment students averaged 54.9 minutes / week (about 3 sessions), and completed an average of 19 of the 24 units. This somewhat lower than expected completion rate was driven by 8 students who completed fewer than 15 units (the minimum recommended by Foundations in Learning). The other 16 completed an average of 24.25.

Measures. Two AIMSWeb measures were administered by the reading specialist. The AIMSWeb Fluency measure was used as a proximal measure of decoding and fluency. In this task, students read short passages and the examiner scores the number of words correctly read in a minute. The AIMSWeb MAZE was used a distal outcome measure of reading comprehension. In this task, the student reads 150-400 word passages in which words are left blank and must be filled in by the student (selecting from three distractors). The score is based on the number of correct items the student can select in three minutes. Both scores are offered in terms of a grade level of performance.

Results

Our analysis proceeded as before using mixed ANOVAs with test type (pre-/post-) as within-subject effects and treatment as a between subjects effect.

Fluency. Figure 11 shows the results for the fluency measure. On average, the control group appeared to lose about half of a grade level over the course of the study, while the *Access Code* group gained a little less than a quarter. This was confirmed in an ANOVA that showed no main effect of condition (F(1, 50)=2.42, p=.126) or test-type (F(1,50)=1.42, p=.24). However, there was a significant interaction (F(1,50)=6.38, p=.015). Follow-up tests showed that the control group showed a significant decrement (T(27)=2.22, p=.035), while the *Access Code* group showed no significant effect (T(23)=1.45, p=.162). Thus, *Access Code* appeared to arrest a slide in fluency.

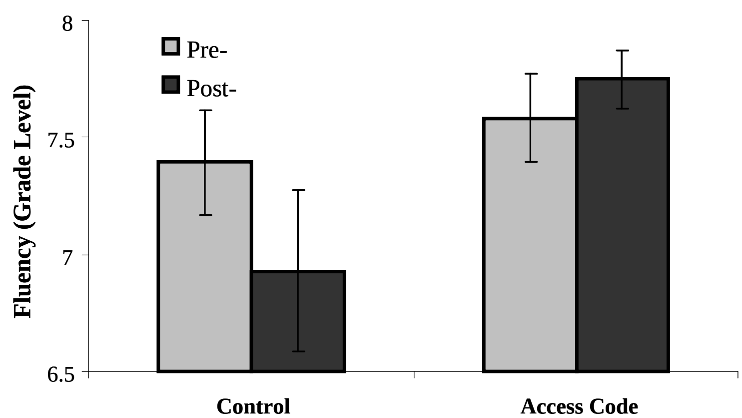

Figure 11: Fluency (grade level) as a function of test-type and condition.

Comprehension. Figure 12 shows the results for comprehension. Here, the control group appeared to show no difference between pre- and post-test, while the *Access Code* group gained half of a grade level. A similar ANOVA showed no main effect of condition (F(1,50)=1.37, p=.25) but a main effect of test-type (F(1,50)=7.63, p=.008). This effect was due to the fact that overall, performance was higher at post-test than at pre-test. However, this main effect was largely due to a significant interaction between test-type and condition (F(1,50)=4.49, p=.039). Here, there were significant gains in the *Access Code* group (T(23)=3.0, p=.006), but no significant gains in the control group (T(27)=.53, p=.6). Thus, *Access Code* appears to facilitate a significant increase in comprehension – despite its targeting more word-level decoding skills in a short term intervention.

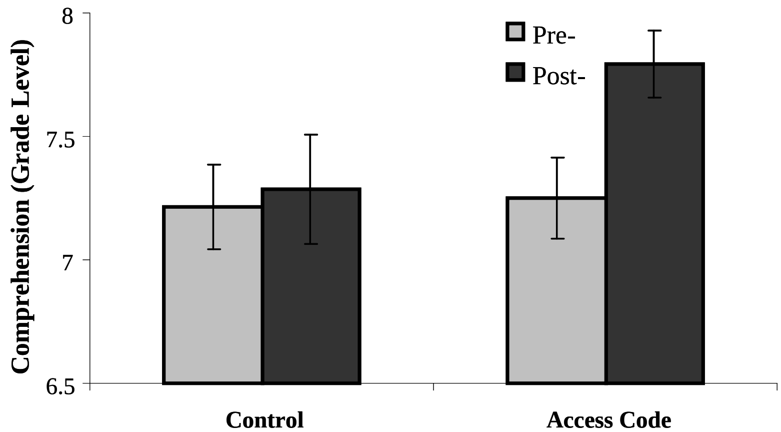

Figure 12: Reading comprehension (grade level) as a function of time-of-test and treatment condition.

External Basic Science Studies Supporting Underlying Learning Principle

Brown and Zimmermann began collaborating with two cognitive scientists, Bob McMurray and Eliot Hazeltine at the University of Iowa to examine the underlying principles of learning in the context of the acquisition and application of word recognition skills. From that collaboration, a series of National Science Foundation (NSF) studies have been funded. The first study assessed the impact of variability within a set of items used for teaching grapheme-phonemic correspondence (GPC) rules. The platform of *Access Code*, was modified to compare two variations of word mappings.

The first study tested 220 first graders in a series of short-term learning studies, to ask if learning principles from cognitive science apply to children's acquisition of GPC mappings. The study showed conclusively that, contrary to standard teaching practice, children form more robust and generalizable mappings for vowels when learning with words containing variable, rather than similar, consonants (Apfelbaum et al., 2013). This supports the model of reading as a skill: flexible skill learning has been consistently shown to benefit from variable practice (Magill & Hall, 1990; Wulf & Shea, 2002). The study verified an important underlying principle of the *Access Code* intervention about the impact of controlled variability which has immediate implications for reading curricula and teaching practice.

Conclusions

We have presented four studies demonstrating the potential of *Access Code* to remediate decoding and fluency deficits in struggling readers. The initial case studies illustrate the power of *Access Code* to help individual students, some of whom had been struggling with reading for some time. Our results from the Solon School District demonstrate the feasibility of deploying *Access Code* and show evidence of improvement in decoding in all of the sub-groups, and some evidence of an increase in reading comprehension. Our small randomized trial in West Des Moines, shows statistically significant evidence of decoding improvements in three of our four measures as well as gains in reading comprehension and retention of spelling in elementary students. Finally, our larger randomized trial in Bridgeport shows statistically robust evidence of gains (or arresting of losses) in both fluency and comprehension for much older (ninth grade) struggling readers.

We should note that our test of reading comprehension was somewhat poorly timed given the philosophy that underlies *Access Code. Access Code* emphasizes the phonics and decoding skills which serve as an entry point to reading. Once struggling readers have mastered these skills, they should then be able to acquire the broader set of abilities that undergird comprehension through regular classroom experience and text exposure more broadly. However, in the context of the Solon intervention and the West Des Moines Study, both cohorts of children completed the *Access Code* intervention just before the summer vacation, and both cohorts were tested on comprehension in the middle of the fall semester. As a result, they are likely to have had very little text exposure or classroom experience between the intervention and comprehension testing that is necessary to develop these skills. Similarly, the students at Bridgeport received their comprehension testing immediately after exposure to *Access Code,* and before they would have had the additional experience necessary to translate gains in word recognition to comprehension. Thus, the fact that we saw gains in comprehension at all is fairly remarkable given this poor testing schedule that was imposed on us by the district testing calendars.

However, individually, these results must be interpreted with a measure of caution. Our data from Solon had no control group, so we cannot uniquely attribute the substantial gains we observed to *Access Code* – it is possible that all children enrolled in their reading remediation program would have shown similar gains (although the teachers report anecdotally that many of these children had shown little qualitative improvement in some time). Our study in West Des Moines was not large enough to examine the effects of different sub-groups (grade, ELL, etc), and the statistical evidence was not consistent (due to this low power). The Bridgeport study had only a relatively coarse (grade level) assessment of reading; finer grained assessments are clearly necessary. However, these studies offer compelling, converging evidence on the efficacy of *Access Code.* By validating the overall efficacy in our small control trial, the gains observed in the larger sample are more likely to derive from *Access Code*. Moreover, the lack of differences between grade and gender observed in Solon, may thus apply to the efficacy of *Access Code* as a whole. Similarly, the gains in comprehension among 3$^{\text{nd}}$ graders in Solon (though it is unclear if this applies to older struggling readers) offer a compelling complement to similar findings (though with less power) in the randomized trial at West Des Moines. While clearly this is still a somewhat circumstantial case, it makes a compelling argument for continued work with *Access Code* and speaks to the promise of this theoretically motivated approach to decoding remediation.

The internal and external studies supporting *Access Code* have yielded 1) published data supporting the unique theoretical basis of the intervention, (2) evidence of improvement in decoding, fluency and comprehension skills, (3) a library of tasks and items that have been verified through basic research studies, (4) a technological platform over the internet for delivering foundational tasks for development of automatic word recognition.

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Appendix A Classroom Schedule

	LESSON 1	LESSON 2	LESSON 3	LESSON 4	LESSON 5
WHOLE GROUP	**DAILY READING** Passage 1 1. Engagement Question 2. Model Reading 3. Oral Discussion	**DAILY READING** Poem 1. Engagement Question 2. Model Reading 3. Shared Reading for Fluency 4. Oral Discussion	**DAILY READING** Passage 1 1. Model Reading 2. Shared Reading for Fluency	**DAILY READING** Poem 1. Partner Reading for Fluency 2. Fluency Progress Monitoring	**DAILY READING** Passage 1 1. Independent Reading for Fluency 2. Fluency Progress Monitoring
	VOCABULARY Introduce Words	**VOCABULARY** Find Categories	**VOCABULARY** Use Your Senses (rotate 3 activities)	**VOCABULARY** Deal with Dimensionality (rotate 5 activities)	**VOCABULARY** Apply Words in Different Contexts (rotate 5 activities)
SMALL GROUP	**DECODING** 1. Level 1 Activity 2. Level 1 Activity	**DECODING** 1. Level 2 Activity 2. Level 3 Activity	**PHRASING** 1. Level 4 Activity	**SYLLABIC WORK** 1. Level 5 Activity	**COMPREHENSION** Passage 1 1. Activity/Question 2. Activity/Question
			DAILY READING Student Selected Paragraph 1. Expressive Partner Reading for Fluency	**COMPREHENSION** Poem 1. Activity/Question 2. Activity/Question	**SPELLING** 1. Performance Activity
SOLO	**COMPUTER WORK**	**COMPUTER WORK**	**COMPUTER WORK**	**COMPUTER WORK**	**COMPUTER WORK**

Appendix B Types of Reports and E-Mails

Reports

Class Summary Report
Shows usage data for each student. It includes the student's name, grade level, educational status, current unit, current cycle, total points earned, average session time, average number of sessions per week, and average time per week.

Objective Assessment Report
Provides a summary of the unit post tests given at the completion of all units within an objective.

Objective Summary Report
Shows side-by-side comparisons of a student's performance on (1) the unit pretests and posttests within the units of an objective and (2) the individual tasks within each instructional level.

Unit Detail Report
Provides a detailed report of the student's performance on the pretest and posttest for each unit, as well as the student's performance on each task within an instructional level.

Unit Assessment Report
Provides the correct percent scores obtained in the easy and challenge levels of the six pretests and posttests of the units.

Unit Certificate
A summary report of the student's performance on each instructional task and the pretests and posttests within a given unit. The certificate can be printed and used in the classroom as a motivator or sent home to reinforce the student's hard work and successful completion of each unit.

Teacher Logs
Helps teachers quickly and easily log the classroom activities for each student and document the student's response.

Screener Results
The Access Code Screener is designed to quickly identify students who have deficiencies with any of the skills required for automatic word recognition.

Appendix B Types of Reports and E-Mails

Emails

Weekly Update Email
A weekly summary providing usage information for each student for the previous week.

Additional Support Email
Identifies those students who may need additional support because they performed between 60-75% on certain tasks the previous week.

Reinstruction Email
Identifies those students who need additional support because they performed below 60% on task(s) the previous day.

Unit review Email
This email alerts the teacher that the student will be transitioning to the next unit very soon.

Appendix C Example of Sample Lesson Plan

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

Unit 1 - Word Lists

Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o

Unit Word Lists (used in activities)

Level 1 Target-Word List		Level 2 Word-Family Words			Level 3 Target Word List		Level 5 Multisyllabic-Word List	
Easy	Challenge	Rime	Easy	Challenge	Easy	Challenge	Easy	Challenge
red	batman	ed			dab	catch	batman	Saturday
lap	laptop	ap	zap	flap	nap	bench	laptop	afternoon
bed	redder	ed	fed	fled	job	lost	redder	forgotten
lob	spotted	ob			jog	rest	spotted	possible
cab	robber	ab	lab	blab	hop	crash	robber	September
fog	popper	og	dog	blog	red	blend	popper	yesterday
men	better	en	hen		wed	frock	better	settlement
pop	penpal	op	top	stop	ten	fleck	penpal	conductor

Weekly Vocabulary

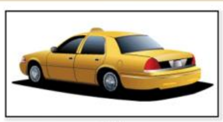
cab	batman	afternoon
bed	robber	forgotten
fog	penpal	September
men	popper	conductor

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

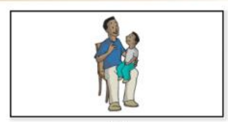
Unit 1 - Pictures

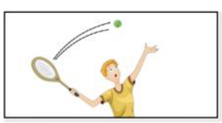
Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o


bed


cab

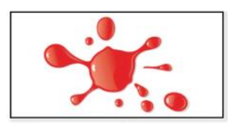

fog


lap

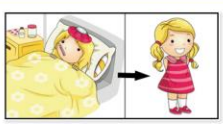

lob


men


pop

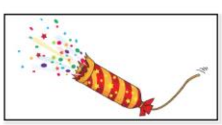

red

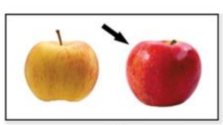

batman


better


laptop


penpal


popper


redder


robber


spotted

Appendix C Example of Sample Lesson Plan

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

Unit 1 - Lesson 1

Access Code™

Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o

Whole Group Instruction

Daily Reading

Unit 1 Passage 1: *The Cab Ride*

Engagement Question:

"Why do people take cabs instead of walking or driving their own car?" Have students share their ideas about using different kinds of transportation (e.g., why are there more cabs in the city, how do you get a cab, how much does it cost?)

Model Reading: *The Cab Ride*

Teacher reads the text and has the students follow along on their own printed passages with their fingers as the words are read.

Oral Discussion:

"If you have taken a cab ride, how was the ride compared to the one in the passage? Where would you like to go in a cab?"

Vocabulary

Introduce Vocabulary Words

1. Write the words from the list below on the board under **Weekly Vocabulary**.
2. For each word, ask students what they know about the word. As they speak, record their answers on chart paper. Try to group together the responses that are similar or in the same category.
3. Correct or clarify any misconceptions by asking a question, or providing a description, explanation, or example of the word. Help the students relate the discussion to their own personal experiences.
4. Have the students write each word in their vocabulary notebooks as the word is discussed.

Small Group Instruction

Introduce the three vowels that will be the focus for the week and explain that you will be studying them inside words in which they make a short vowel sound. Provide examples (can, bed, pop) and identify the vowel between the consonants.

Decoding

Activity 1, Level 1

Word Sort

1. Show the students the pictures of the words from the **Level 1 Target-Word List** and say the words aloud together.
2. On note cards or sticky notes, write the words from the wordlist.
3. Share the cards with the students and as you hand them out, say the word on the card.
4. Have the students underline the vowel on each card and then have them read the word aloud.
5. Have the students sort the cards into groups of words that share common features (e.g., similar vowels, blends).
6. Next have the students quickly read the words aloud.

Decoding

Activity 2, Level 1

The Rule Says...

1. On the board or a large piece of paper and under the heading "The Rule Says...", write the short vowel rule for this unit: when the vowel /a/, /e/, or /o/ is between two consonants, it is usually a short vowel sound.
2. Write the **Level 1 Target-Word List** on the board or chart paper.
3. Have the students write new words that follow this rule on paper, note cards, or small whiteboards.
4. Next, have the students read aloud the words they listed, and then have them trade lists with each other and read each of the student lists out loud.

Independent Computer Work

Students should be on the computer at least 20 minutes per day in Access Code. Class schedules should be arranged to provide daily access for all students. For class scheduling ideas, please see "Suggested Scheduling Ideas."

Foundations in Learning

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

Unit 1 - Lesson 2

Access Code™

Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o

Whole Group Instruction

Daily Reading

Unit 1 Passage 2: *Getting Ready to Cross the Sea*

Engagement Question:

Read the title of the passage. *"What do you think the passage will be about?"* Have students share their ideas with the group. Ask questions such as where they think the story will take place and what the situation and/or characters will be.

Model Reading: *Getting Ready to Cross the Sea*

Teacher reads the text and has the students follow along on their own printed passages with their fingers as the words are read.

Shared Reading: *Getting Ready to Cross the Sea*

All students, led by the teacher, read the entire passage aloud together.

Oral Discussion:

After reading the passage, have students discuss how the story differed from what they originally thought. Discuss how we use our prior knowledge and experience to formulate meaning before we even start reading.

Vocabulary

Find Categories

1. Review the graphic organizers created for the **Weekly Vocabulary** words. As a group, have the students identify common characteristics or descriptions across the words.
2. Help the students identify labels for the common categories (e.g., animals, objects, actions, colors, tools, etc.). Using chart paper, write the words that fit into each of the categories.
3. Have each of the students pick a category and add a word they know that fits into that category. Provide an example.

Small Group Instruction

Decoding

Activity 3, Level 2

Snap It!

1. Using the **Level 2 word family words**, read aloud a word family (rime) and ask the students to add an initial letter sound to the rime to create words as quickly as possible.
2. Direct the students to say aloud each word and then snap. (If they cannot snap, they can clap.) For example, say the rime -op. The students will say aloud pop (snap), hop (snap), and so on.
3. Continue through all the word families listed.

Decoding

Activity 4, Level 3

Head, Shoulders, Knees, and Toes

1. Provide the students with the appropriate magnetic letters to create a word from the **Level 3 word list**.
2. Next, present the students with a target word, and have them sound out the word by first touching a part of their body for each sound and then building the word with magnetic letters *(e.g., cab: c [head], a [shoulders], and b [knees])*.
3. Remove one magnetic letter from the word and ask the students what sound is missing. For example, when spelling cab, what sound do you say when you touch your shoulder?
4. Continue through all target words.

Independent Computer Work

Students should be on the computer at least 20 minutes per day in Access Code. Class schedules should be arranged to provide daily access for all students. For class scheduling ideas, please see "Suggested Scheduling Ideas."

Foundations in Learning

Appendix C Example of Sample Lesson Plan

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

Unit 1 - Lesson 3

Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o

Access Code™

Whole Group Instruction

Daily Reading
Unit 1 Poem: *My Dog*

Engagement Question:
"Picture your favorite dog. What do you see? As we read the poem, keep a mental picture of your favorite dog."

Model Reading: *My Dog*
Teacher reads the text and has the students follow along on their own printed passages with their fingers as the words are read.

Shared Reading: *My Dog*
All students, led by the teacher, read the entire poem aloud together.

Oral Discussion:
"Is the dog you pictured like the dog in the poem?" Ask students why or why not.

Vocabulary
Use Your Senses

Imagine/Visualize

1. Say one of the vocabulary words, then ask students to close their eyes and imagine what the word looks like (a visual picture).
2. What did they see? Have students share what they imagined.
3. Then, have each student draw a picture of the word in their vocabulary notebooks.
4. Repeat for each word.

Small Group Instruction

Phrasing/Fluency
Level 4

Silly Phrases

1. On small note cards or sticky notes, write the words from the **Level 4 "Make the Phrase" list** below:

Easy	Challenge
drives a red cab	pack your bag
likes to lap milk	pack your clothes to go
lob a stick	we'll get on that boat
is there a fog	must move to America
pop its lid	she felt sad all day
nap on the bed	was sorry to leave home
that red bug	fed her cat and left
those ten men	gave her cat a pat

2. Pass out two sentence strips to the students.
3. Next, have the students practice reading the two strips together aloud, creating a silly, longer phrase or sentence.
4. Collect the sentence strips, shuffle, and repeat the activity.

Daily Reading
Student-Selected Paragraph

Expressive Partner Reading

1. Read several sentences aloud and ask the students to identify if you are happy, sad, angry, curious, annoyed, etc. Have the students select several sentences from either the poem or passage and practice by themselves reading that section with expression.
2. Then, in partners, have students read their selected paragraph to each other using expression. Have the students identify what their partner expresses about the text.

Independent Computer Work

Students should be on the computer at least 20 minutes per day in Access Code. Class schedules should be arranged to provide daily access for all students. For class scheduling ideas, please see "Suggested Scheduling Ideas."

Foundations in Learning

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

Unit 1 - Lesson 4

Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o

Access Code™

Whole Group Instruction

Daily Reading
Unit 1 Passage 1: *The Cab Ride*

Partner Reading: *The Cab Ride*

1. Assign partners and have the students read the text to each other.
2. You can have them read alternating sentences or paragraphs or have them read the entire poem and then switch.

Fluency Progress Monitoring
As students read with partners, teacher can meet with individual students for one-on-one reading/fluency assessment.

Vocabulary
Deal with Dimensionality

Compare & Contrast

1. Choose 2–4 vocabulary words that you think are similar and/or different in some way.

   Use the following sentence stems and model how students can think about ways the words are similar and different:

   ________ and ________ are similar (or alike) because they both______________________.

   _______ and _______ are different (or not the same) because _______ is _______, while _______ is _______.

2. Repeat with the same group of words or use 2–4 different words. Repeat the exercise with the entire vocabulary list.

Small Group Instruction

Syllabic Work
Level 5

Three-Syllable Words Have Rules?

1. On note cards or sticky notes, write the **three-syllable words from the Level 5 word list.**
2. Have students quickly underline the syllables that have the vowels /a/, /e/, or /o/ between two consonants.
3. Next, ask students to sort the words from easy-to-read to hard-to-read.
4. Have students read aloud the words as quickly as they can. If they have difficulty reading a word, have them put it in another pile and keep reading.
5. When they are finished reading the words, review the harder words in the other pile.
6. Underline each syllable and read it aloud.
7. Have students read the whole word after you read the syllables separately. Repeat with each word.

Comprehension
Unit 1 Passage 1: *The Cab Ride*

Questions/Activities

1. **Discuss:** *"Why do you think they had to ride in the cab? Look for clues in the text and underline them."* *Next, discuss other reasons to take a cab that are not in the text.* (Make Inferences)
2. **Write:** *"If it was your birthday, what things would you like to do in the city? Share ideas."* (Connect to Life Experiences)

Independent Computer Work

Students should be on the computer at least 20 minutes per day in Access Code. Class schedules should be arranged to provide daily access for all students. For class scheduling ideas, please see "Suggested Scheduling Ideas."

Foundations in Learning

Appendix C Example of Sample Lesson Plan

APPLICATION ACTIVITIES FOR THE CLASSROOM: GRADES 3-4

Unit 1 - Lesson 5

Objective: Short Vowels Easy -- CVC (example: can, bed, pop) - Vowels: a, e, o

Whole Group Instruction

Daily Reading

Unit 1 Passage 2: *Getting Ready to Cross the Sea*

Independent Reading: *Getting Ready to Cross the Sea*

1. Have students read the text to themselves several times and try to focus on remembering the details.
2. They can read a couple of lines, then try to recall the information to themselves, or read the entire text and try to summarize the story in their head.

Fluency Progress Monitoring

As students are reading independently, teacher can meet with individual students for one-on-one reading/fluency assessment.

Vocabulary

Apply Words in Different Contexts

Pick an Object

1. Have the class pick any object in the class (e.g., teacher's desk).
2. Tell the students you will be describing the object using the vocabulary words.
3. Start by creating a sentence with one of the vocabulary words in it (i.e., Mrs. Smith's desk is not a circle.)
4. Have each student add a sentence with a different vocabulary word in it.

Small Group Instruction

Spelling

Performance Activity

1. Choose 4-8 words from the easy word lists that have been used in this unit.
2. Say a word out loud and have students write the word on a separate piece of paper.
3. After the students have written all the words, write the words on the board as you verbally spell them out.
4. Have students check their spelling as you spell the words out loud and then have them rewrite the word correctly, if it was misspelled.
5. Keep the student's spelling sheets for their portfolios.

Comprehension

Unit 1 Passage 2: *Getting Ready to Cross the Sea*

Questions/Activities

1. **Organize:** *"Who are the characters in the passage? What did each character do?"* (Ask & Answer Questions)
2. **Turn & Talk:** Read each paragraph aloud. After each paragraph, have students tell their partners the main idea of the paragraph. Share with the class and discuss differences between main ideas & details. (Summarize)

Independent Computer Work

Students should be on the computer at least 20 minutes per day in Access Code. Class schedules should be arranged to provide daily access for all students. For class scheduling ideas, please see "Suggested Scheduling Ideas."

Appendix D Example of Unit Poem and Passage

Unit 1 - Poem

My Dog

I went to bed to take a little nap
My little dog sat on top of my lap.
When I put him down, he came back with a hop.
I had to sleep, so I called for my pop.
My dad took the dog by his collar of red,
And down the hall my dog was led.
Once I was rid of the pesky dog,
I closed my eyes and slept like a log.

Unit 1 - Passage

The Cab Ride

One day, my mom and I rode in a red cab.

As we drove, I saw ten men.

One man was out for a jog.

Some were going to their jobs.

One man was walking his lab.

We got out of the cab and met my dad.

Appendix E Scope and Sequence of Curriculum

Scope and Sequence

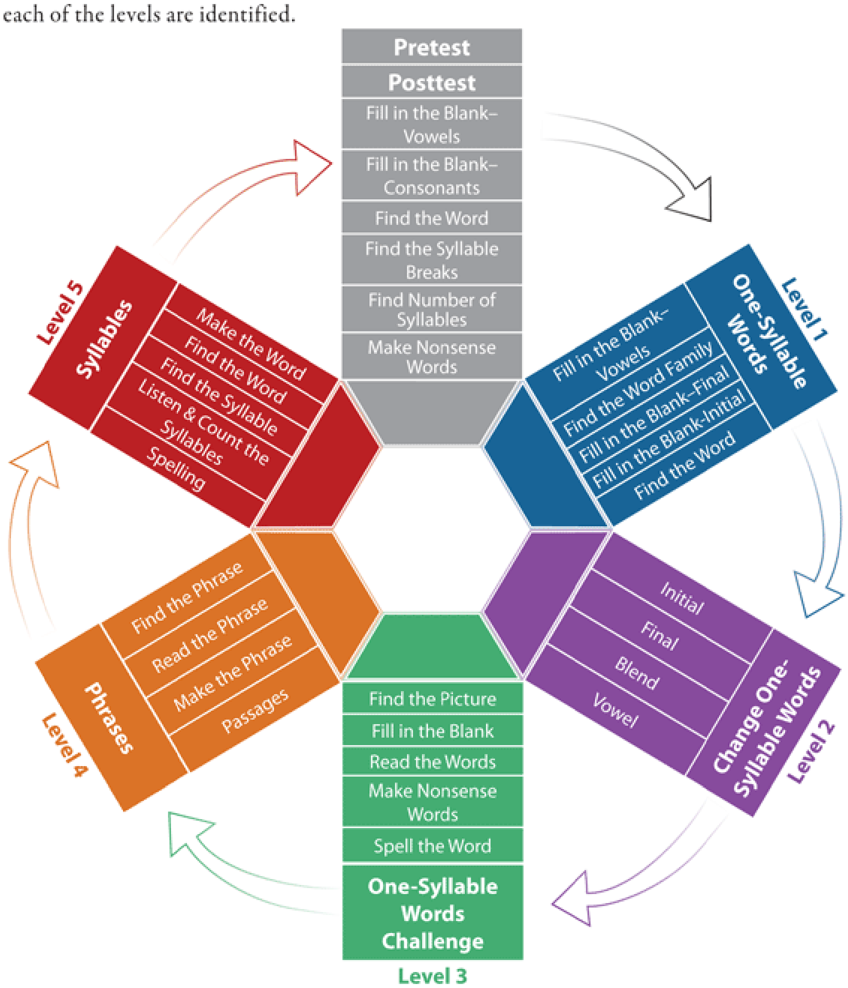
Unit Number	Unit Objective	Vowel or Consonant Focus	Syllable Type	Structure
1	Short Vowels Easy	a, e, o	CVC	1 to 1
2		a, i, u	CVC	1 to 1
3		a, e, i, o, u	CVCC	End Digraph
4*		a, e, i, o, u	CVCC	End Digraph
5	Long Vowels	a, i, o	CVCe	Silent "e"
6		a, i, u	CVCe	Silent "e"
7*		a, i, o	CCVCe	Silent "e", Beginning Blend
8	Short vs Long Vowels	i, u	CVC vs CVCe	1 to 1 vs Silent "e"
9*		a, o	CVC vs CVCe	1 to 1 vs Silent "e"
10	Short Vowels Advanced	a, e, i	CCVC	Beginning Digraph
11		a, i, o	CCVC	Beginning Blend
12		a, e, i	CVCC	Ending Blend
13*		a, o, u	CVCC	Ending Blend
14	Long Vowel Digraphs	ai, ea, oa, ui	CVVC	Vowel Digraph
15		ie, ai, ee	CVVC	Vowel Digraph
16*	Long and Short Vowel Digraphs	oo, ou, ee	CVVC	Vowel Digraph
17	Diphthongs	oi, ou	CVVC, CCVVC, CVVCC	Vowel Digraph (1 to 1), Beginning Blends, and Ending Blends
18	R-Controlled Vowels	ar, ur, er	CVC	1 to 1
19		ir, or, ar	CVCC	Ending "r" + Consonant
20*		ear, oar, air	CVVC	"r" Vowel Digraph
21	Short Vowel Digraphs	au, oo, ea	CVVC, CCVVC, CVVCC	Vowel Digraph (1 to 1), Beginning Blends, and Ending Blends
22*		au, ea, ou	CVVC, CCVVC, CVVCC	Vowel Digraph (1 to 1), Beginning Blends, and Ending Blends
23	Mixed Vowels with Silent Consonants	gh, wr, kn, mb, lk, wh	CVCCC, CCVC, CVCC, CVVCCC CCVCC,	1 to 1, Vowel Digraph, Beginning Blends, Ending Blends, and Consonant Digraph
24*		gh, wr, kn, mb, gn, wh	CVCCC, CCVC, CVCC, CVVCCC CCVCC,	1 to 1, Vowel Digraph, Beginning Blends, Ending Blends, and Consonant Digraph

* Objective assessments follow these units

Appendix F Schematic of Unit Structure

Unit Structure — Task Detail

The following schematic shows the progression from Pretest to Instructional Levels to Posttest for each of the 24 curriculum units. The instructional tasks that are embedded in each of the levels are identified.



Trials per Task = 8

Time per Task = 1–2 minutes

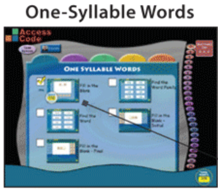
Time per Unit = 30–40 minutes

Appendix G

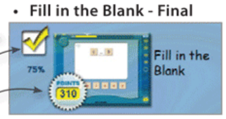
Overview of Instructional Levels
Elementary

The selection screens for each of the five levels of instruction are shown below. The student must click on the task picture or text to begin a task. Depending on the student's performance in the pretest, he/she will be placed in easy or challenging lessons. The program will then adjust the level of lesson difficulty in each task to meet the student's needs. After the task has been completed, the student's percent correct score and the points earned are entered by each task. The tasks for each instructional level are listed below. The grand total of points earned is displayed on the bottom of the selection screens.

Level 1
One-Syllable Words



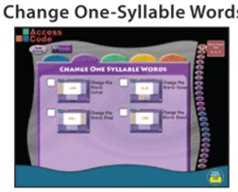
Level 1 – Tasks
- Introduction Video automatically plays at the beginning of Level 1
- Fill in the Blank
- Find the Word Family
- Find the Word
- Fill in the Blank - Initial
- Fill in the Blank - Final



Points Earned

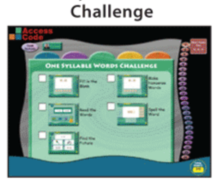
Percent Correct

Level 2
Change One-Syllable Words



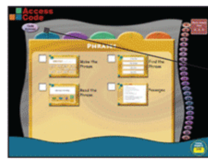
Level 2 - Tasks
- Change the Word — Initial
- Change the Word — Vowel
- Change the Word — Final
- Change the Word — Blend

Level 3
One-Syllable-Words Challenge



Level 3 – Tasks
- Fill in the Blank
- Make Nonsense Words
- Read the Words
- Spell the Word
- Find the Picture

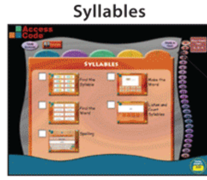
Level 4
Phrases



Level 4 – Tasks
- Make the Phrase
- Find the Phrase
- Read the Phrase
- Passages

Click here to see performance on completed tasks.

Level 5
Syllables



Level 5 – Tasks
Video automatically plays
- Find the Syllable
- Make the Word
- Find the Word
- Listen and Count the Syllables
- Spelling

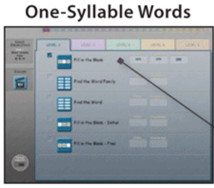
Click here to take the posttest.

Appendix G

Overview of Instructional Levels
Middle School

The selection screens for each of the five levels of instruction are shown below. The student must click on the task picture or text to begin a task. Depending on the student's performance in the pretest, he/she will be placed in easy or challenging lessons. The program will then adjust the level of lesson difficulty in each task to meet the student's needs. After the task has been completed, the student's percent correct score and the points earned are entered by each task. The tasks for each instructional level are listed below. The grand total of points earned is displayed on the bottom of the selection screens.

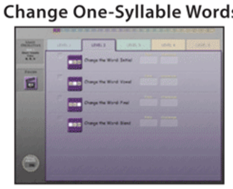
Level 1
One-Syllable Words



Level 1 – Tasks
- Introduction Video automatically plays at the beginning of Level 1
- Fill in the Blank
- Find the Word Family
- Find the Word
- Fill in the Blank - Initial
- Fill in the Blank - Final

Points Earned
Percent Correct

Level 2
Change One-Syllable Words

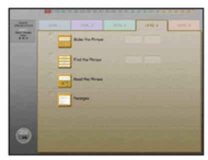


Level 2 - Tasks
- Change the Word — Initial
- Change the Word — Vowel
- Change the Word — Final
- Change the Word — Blend

Level 3
One-Syllable-Words Challenge

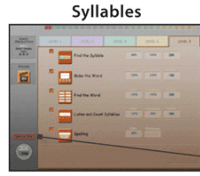
Level 3 – Tasks
- Fill in the Blank
- Make Nonsense Words
- Read the Words
- Spell the Word
- Find the Picture

Level 4
Phrases



Level 4 – Tasks
- Make the Phrase
- Find the Phrase
- Read the Phrase
- Passages

Level 5
Syllables



Level 5 – Tasks
Video automatically plays
- Find the Syllable
- Make the Word
- Find the Word
- Listen and Count the Syllables
- Spelling

Take a Test

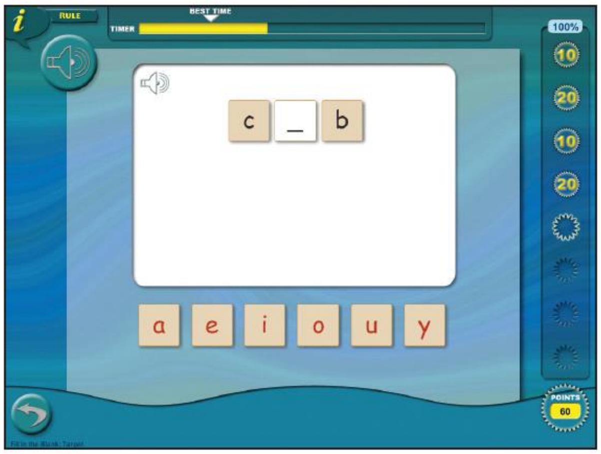
Click here to take the posttest.

Appendix H Example of Screen Display for Two Tasks

Level 1 Fill in the Blank

Task Description

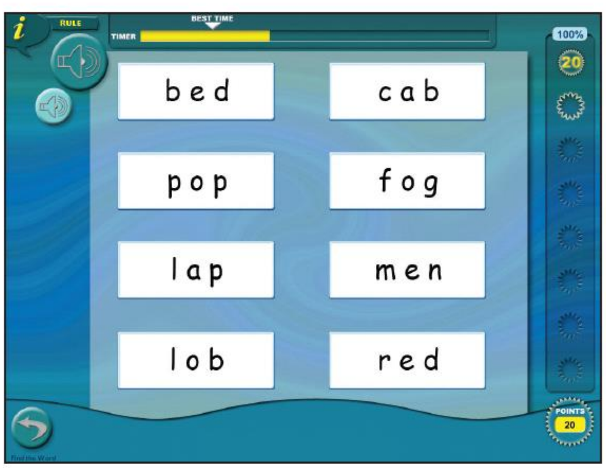
The student is shown a word on the screen that is missing letters. After the student hears the word spoken, he/she must select the letter or letters to fill in the blank in the word.



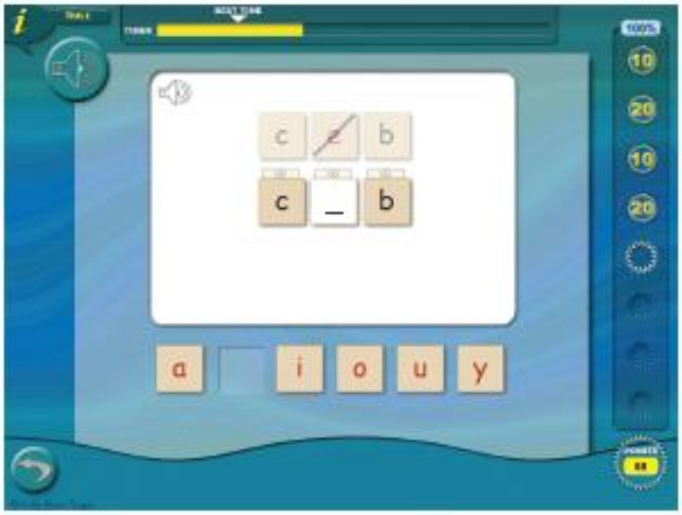
Level 1 Find the Word

Task Description

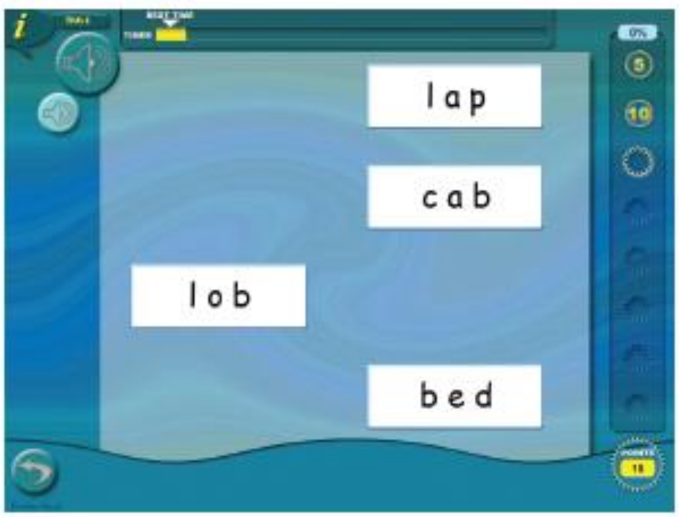
The student is shown a list of words on the screen. The student hears a word and must select that word as quickly as possible.



Appendix I Examples of Two Types of Scaffolding in Access Code



Additional cues are provided if the students miss the answer on the first try. By clicking on the speaker button above the letter, the students can hear the sounds for each letter.



When students have two consecutive errors or a total of three errors, the number of available choices is reduced by half.