Running Head: Comprehensive Reading Intervention

Teaching Students with Moderate Intellectual Disabilities to Read: An Experimental Examination of a Comprehensive Reading Intervention

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essential components of reading (defined below). Currently, no research has been conducted to determine whether students with ID can learn to read by fully processing the print and meaning of connected text, as is consistent with current theories of reading development (see reviews Browder & Xin, 1998; Browder, Wakeman, Spooner, Ahlgrim-Delzell, & Algozzine, 2006; Conners, 2003; Joseph & Seery, 2004).

In spite of the paucity of research, the research that does exist is promising, suggesting that students with ID are capable of learning various aspects of reading. Sight word recognition has received the greatest attention from researchers and the preponderance of evidence demonstrates that students with even moderate and severe levels of ID can learn to automatically recognize a fairly large corpus of words with systematic instruction (Browder et al., 2006). Even so, these students have little ability to generalize their learning beyond the specific words included in instruction, and thus, are far from achieving even basic literacy (Browder et al., 2006). Research on the effectiveness of phonics instruction is primarily limited to students with mild ID, but that research is also promising. Conners (1992) and Joseph and Seery (2004) found fourteen studies that examined phonics instruction for students with ID and these studies lend preliminary support to the effectiveness of phonics interventions. Unfortunately, these studies were all relatively brief, providing at most a few months of instruction, and they focused on isolated subskills of phonics, rather than a comprehensive, systematic approach that might result in skilled decoding. Further, none of these studies focused specifically on phonemic awareness (PA). In 1996, O’Connor, Notari-Syverson, and Vadasy, described the progress of several progress on sounding out activities than a similar control group (Conners, Rosenquist, Sligh, Atwell, & Kiser, 2006). Studies on vocabulary and comprehension are even more limited, only including demonstrations of very basic skills, such as using a sight word in the context of a functional activity or matching a word to a picture (Browder et al., 2006).

Taken in its totality, the research base on teaching students with ID to read is sparse and inadequate. At the present time, there are no studies that have examined the effectiveness of a comprehensive reading intervention delivered over a sustained period of time. Without this type of research, we cannot determine whether “all” as described in No Child Left Behind should or should not include students with ID. In short, we simply do not know what is possible for students with ID. The mission of the research reported here is to take important steps toward addressing this question. Specifically, we seek to determine what is possible for teaching children with moderate levels of ID to read.

are able to focus attention on the meaning of print because word recognition processes are automatized. The underlying processes of comprehension are arguably more complex, depending on a variety of factors including listening comprehension, linguistic abilities, relevant knowledge, and general intelligence (Perfetti et al., 2005). Specific to written language understanding are factors including sensitivity to story structure, inference making, and comprehension monitoring (Perfetti et al., 2005). We know that students progress through predictable stages as their word recognition and comprehension skills develop (Chall, 1996; Ehri, 2005; Ehri & McCormick, 1998). In early stages, students develop phonological awareness and print awareness, along with expressive and receptive oral language skills. In later stages decoding and morphographic knowledge increases, eventually leading to the quick and effortless retrieval of words from long-term memory, enabling students to read fluently and, most importantly, focus on making sense of the message of text. Good readers make inferences and monitor their own comprehension, ensuring that stories and information are cohesive (Perfetti et al., 2005).

Research on Early Reading Interventions

Over the past 30 years numerous studies focused on the prevention and correction of reading problems with students who struggle to learn to read who do not have ID. A primary finding from this research is that intervention provided to small groups of children in the primary grades can be highly effective in preventing reading problems for most children and greatly reducing the depth of reading problems for those who continue to experience difficulty, (e.g., Foorman & Torgesen, 2001; Mathes, Denton, Fletcher, Anthony, Francis, & Schatschneider, 2005; Mathes & Denton, 2002; Denton & Mathes, 2003; Snow Burns, & Griffin, 1998; National Reading Panel, 2000). Likewise, we now understand the critical content students must acquire if they are to become competent readers. Effective interventions in early reading target multiple components of the reading process in an integrated and comprehensive manner, including concepts of print, oral language, phonological and phonemic awareness (PA), letter knowledge, word recognition, fluency, and comprehension (see Foorman & Torgesen, 2001; National Reading Panel, 2000; Pressley, 1998; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001; Snow et al., 1998). Many experimental studies demonstrate that teaching PA results in improved reading and spelling outcomes (see Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001). Letter knowledge, including letter naming and letter-sound recognition, is also an important predictor of reading achievement (Share, Jorm, Maclean, & Matthews, 1984; Adams, 1990), and these skills influence other key early literacy skills, such as PA and phonemic decoding (Blaiklock, 2004; Evans, Bell, Shaw, Moretti, & Page, 2006; Foy & Mann, 2006;

teach content and model skills, providing systematic review of skills and reinforcement for mastery.

Purpose of the Study

The purpose of this study was to analyze the effectiveness of a carefully crafted, comprehensive reading intervention built on behavioral principles in teaching primary-grade students with moderate ID to read. Students in this study participated in our intervention for one to one and a half years. Specifically, we implemented and expanded an explicit, systematic reading intervention that had been empirically validated with students at-risk for learning disabilities (Mathes et al., 2005) and with students who are both struggling readers and English Language Learners (Vaughn, Mathes et al., 2006). This intervention, now published as *Early Interventions in Reading*

a comprehensive reading program for students with low IQs (ranging from 40-79: Allor, Mathes, Roberts, Jones, & Roid, 2008). Students were randomly assigned to either (a) an intervention group that participated in daily, small group reading instruction delivered by research teachers or (b) a contrast group receiving typical special education.

Participants

Schools

The study took place in 10 elementary schools in a large, southwestern urban school district and one private school for students with special needs. District personnel worked with the researchers to select schools with a relatively large number of students with ID and that would provide a balanced sample, racially and economically. An urban, private school that served students with special needs was added to increase the size of our sample of students with

content was carefully analyzed and organized into a systematic scope and sequence intended to reduce student confusion and target big ideas and key strategies. Errors were reduced through integration of new learning with previous learning, ongoing review, and opportunities for group and individual responding. The goal was to integrate skills and strategies over time, resulting in a set of daily lesson plans with overlapping content strands and extensive cumulative review and application (i.e., concepts of print, phonological and phonemic awareness, letter knowledge, word recognition, connected text fluency, comprehension strategies, vocabulary, and oral language development). Following a behavioral approach, lessons provided for (a) frequent reinforcement on both an interval and intermittent schedule, (b) carefully orchestrated time delay techniques between stimuli presentation and student responses, and (c) multiple opportunities to practice each item of content.

Each lesson plan was highly detailed, providing exact wording to ensure teacher language was clear and kept to a minimum. By following these plans, teachers delivered explicit instruction in integrated instructional strands, responding to individual student learning needs by scaffolding instruction when necessary. Thus, while lesson plans were prescribed, the way in which lessons were actually delivered required teachers to make on the spot decisions and minor adjustments in the plans in order to focus on specific target areas needed by students within a group. Accompanying these lesson plans, teachers were provided storybooks for read-alouds, pictures for vocabulary support, student activity books, magnetic pictures (*Foundation Level* only), daily reading books using decodable stories (*Level One* only), a puppet with a fully articulated mouth, letter-sound picture cards, “automatic” word cards, and lesson mastery tracking forms. Additionally, the *Foundation Level* included a game designed to provide students with opportunities to practice the PA skills of blending, segmenting, and letter-sound

the words was increased (i.e. variant spelling patterns, blends, additional syllable types, and multisyllabic words). Students were also taught to be flexible decoders.

Fluency with connected text. Beginning very early in *Level One*, word recognition strategies were applied as students read decodable stories. As students acquired greater mastery of more elements, as well as the ability to decode more difficult words, this text became more challenging. To promote fluency, repeated reading of these stories was built into daily lessons. Typically students read a story in unison on the first reading, followed by reading a page or two individually on the second reading. The third reading was typically read in pairs, with the teacher timing the reading rate of one student.

Comprehension strategies. A major objective was for children to read strategically to increase understanding. Thus, prior to reading a story, students “browsed the story” looking at the pictures and predicting story content. Students then read to find out if their predictions were true. With expository text, teachers activated prior knowledge by asking students to tell what they already knew about the topic and to read to learn more. After reading the story, students then engaged in a number of activities depending on the students’ competence and text structure. Initially, students were only asked to tell about what they read. Information in any order was accepted. Over time, students sequenced information until they were able to sequence only the most important information. In later lessons, students identified story grammar elements for narrative text and new information learned in expository text.

Vocabulary and oral language development. Language goals were addressed through storybook read-alouds, with direct teaching of spoken vocabulary and key background knowledge, as well as extensive discussion. In the *Foundation Level*, teachers explicitly taught vocabulary and engaged students in conversation using open-ended questions and building on

contrast condition. Statistically significant results were found on the following measures: CTOPP blending nonwords, CTOPP segmenting words, TOWRE phonemic decoding efficiency, and WLPB-R passage comprehension. For all other measures, no statistically significant differences were found. T-test and effect size results are presented in Table 3.

<Table 3 here>

We also applied the Bonferroni correction procedure because we employed multiple, related measures of various reading constructs. This adjustment was made to help control for Type I error (Dunn, 1961). We adjusted our critical *p* value by dividing .05 by the number of measures in a given construct, i.e. phonemic awareness, phonemic decoding, real word recognition, reading comprehension, and oral language measures. After making this correction, differences on CTOPP blending nonwords was no longer statistically significant. Other findings remained the same. Additionally, Analysis of Covariance tests were conducted on the gain scores using pretest measures as covariates. However, results were very similar to the t-test analyses, including significant findings on all of the same measures, as well as significant findings on the PPVT. Therefore, these results were not included.

Growth on Continuous Progress Monitoring Measures

We used a hierarchical linear modeling (HLM) approach to examine student gains on three DIBELS measures: initial sound fluency (ISF), phoneme sound fluency (PSF), and nonsense word fluency (NWF). The advantage of HLM over simple regression, ANOVA, or repeated measures ANOVA is that it allows the researcher to look at hierarchically structured data and interpret results without ignoring these structures. This is accomplished by including a complex random part that can appropriately account for correlations among the data (Roberts, 2004). In the present analysis, a two-level model was examined with measurement occasions at

student in the control group at time=0 (the intervention group receives a “1” for the level-2 grouping variable). This new model is:

$$y_{ti} = g_{00} + g_{10} * time + g_{01} * group + g_{11} * time * group + u_{0i} + u_{1i} * time + e_{ti} \ , \qquad (2)$$

where g_{01} is the effect of a student belonging to the intervention group at time=0 and g_{11} represents the cross-level interaction between time and the intervention effect.

Hox (2002) has noted that it is typical to include both of the main effects in a model in the presence of a statistically significant interaction effect. As can be seen from the results of our three models in Tables 4-6, the model structures are the same across all four analyses. The only change between each analysis was the dependent variable.

<Tables 4-6 here>

The analysis in Table 4 represents the effect of the intervention on ISF across time for students. There was no statistical difference between the intervention and contrast groups at the initial time-point (-1.026, *p*=0.711). The interaction effect tested to see whether or not the amount of difference between the intervention group and contrast group changed over time. For example, a large positive value for g_{11} would mean that students involved in the intervention tended to have larger gains in ISF over the contrast group students the longer they were involved in the intervention. In this analysis, however, the value for this interaction (0.167) was not statistically significant over time (*p*=0.058) indicating that students in the intervention and control groups tended to have the same rate of change over time.

Table 5 shows the effect of the intervention on PSF across time for students. As can be seen from this analysis, there was no statistical difference between the intervention and contrast groups at the initial time-point (-0.199, *p*=0.927), thus indicating that they were statistically equivalent in terms of PSF when the program began. Also in model M1, the value for the

significant differences were found on several measures, including measures of phonemic awareness, phonics, and comprehension.

The clearest, and arguably one of the most important findings in the study were on measures of phonemic awareness (PA). Students participating in the intervention consistently outperformed students in the comparison group on measures of PA. Effect sizes on the four CTOPP subtests (gains from pretest to posttest) ranged from a medium effect of .50 to a strong effect of .99. The differences on both Blending Nonwords and Segmenting Words were statistically significant (See Table 3). After the Bonferroni correction, Blending Nonwords was no longer significant. Results from the HLM analysis also revealed that the students in the intervention group tended to have a higher rate of growth on DIBELS-PSF over time, with this interaction statistically significant over time ($p < .001$; see Table 5 and Figure 1). Unexpectedly, the same pattern of results was not evi009 differences were not statistically significant, *ES*s were strong, .71 on TOWRE-word reading efficiency and .66 on WLPB-R-word identification.

Outcomes for oral language and comprehension were also positive. Effect sizes were moderate for oral language measures, .30 and .47, and strong for passage comprehension, .94 (See Table 3). Although no significant differences were found on the language measures, differences on passage comprehension were statistically significant.

Research Question 2. After receiving comprehensive reading instruction for one to one and a half academic years, what level of reading competence is achieved by students with moderate ID? How does this level of performance compare to similar peers receiving typical special education instruction?

Although the above findings show consistent differences in favor of the students participating in the intervention, we examined the data further to determine the level of performance achieved by these students. We addressed this question by categorizing performance on DIBELS measures as deficit, emerging, or established, and then examining the number of students who improved (i.e. moved to a higher category) by posttest. As can be seen in Table 7, the clearest differences were, once again, in PA, with a significantly higher number of students in the treatment group moving to a higher category by posttest. On LNF and NWF more students improved to a higher category in the treatment group than the contrast group, but the number was not significantly different. Very little progress was seen on the ORF measure, with only 1 student (in the treatment group) moving from emerging to established.

Another way to describe level of performance is to describe student progress in the curriculum. By the end of the study (after one to one and a half years in the intervention), 2 students were in lessons near the middle of the *Foundation Level*; 6 students had completed the

Foundation Level (comparable to kindergarten skills); 6 were near the middle of *Level One* and 2 students had completed *Level One* (comparable to first-grade skills). This means that 8 of the 16 students were approximately halfway through *Level One* or further. At this level, students were able to identify the most common sound for all individual letters and read words made up of those letters. For example, students were able to successfully say the sounds in words such as *last*, *mom*, *slip*, and *step*, as well as blend those sounds together to form the word. Further, students at this level were working on basic comprehension strategies, such as retelling stories, sequencing main events, and story grammar. In the latter half of *Level One*, these strategies gradually increased in complexity and scaffolding was gradually reduced.

Conclusions

This study provides clear support for raising expectations related to reading for students with moderate ID. Students with moderate ID should not be left behind; they should be provided with scientifically-based reading instruction. The findings of this study strongly support the conclusion that students with moderate IDs can make important gains in reading and language skills when provided with intensive and comprehensive instruction over an extended period of time. A broad array of measures was studied, including PA, phonics, word recognition, comprehension, and oral language. *ES*s on all measures were moderate to strong, with means consistently favoring the intervention group. Statistically significant differences were found on several measures, including phonemic awareness, phonics, and comprehension. These findings are consistent with existing research and extend that research in several ways.

First, explicit, systematic instruction in PA and phonics that has proven to be effective for students with IQs in the average range (Ehri et al., 2001; Mathes et al., 2005) is also effective for students with moderate ID. Prior research on teaching PA and phonics to students with ID

discontinuing testing when necessary. We also addressed this issue by including repeated measures across time, when possible. This enabled us to employ data analytic techniques (i.e., HLM) that analyzed trends across time and minimized the impact of variability of the data. Due to this limitation, findings related to measures only administered at pretest and posttest should be interpreted cautiously. Further research is needed to develop reading and language tests that use repeated measures of progress, especially untimed measures as existing repeated measures are usually timed.

Another limitation of the study is the small sample size increases the probability of Type II error. It is possible that significant differences between the groups on some measures were not detected simply because the sample size was small. A competing limitation is that by conducting multiple t-tests on related measures we increased the possibility of Type I error. We addressed this limitation by applying the Bonferroni correction procedure.

Further research is needed to address multiple questions related to teaching students with ID to read. One need is further exploration of the relationship between IQ and response to reading instruction. Currently, we are examining this issue with our larger study in which we are following the progress of students with IQs ranging from 40 to 79 over four academic years. In that study, we are also addressing the question of the level of reading competence that can be achieved by students with low IQs. In this article, language measures were administered only at pretest and posttest. Further analyses of language measures, especially measures across time, are also needed. Given the variability of student performance, language measures that can be administered frequently would be useful for research and for teachers to use in their classrooms for ongoing progress monitoring. Finally, further research is needed to determine progress over a

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Table 1

Student Demographic Data by Group

Variable	Treatment (n=16) n(%)	Contrast (n=12) n(%)	C^2 (df)
Grade			
1	2(13%)	3(23%)	
2	5(31%)	1(8%)	
3	3(19%)	6(46%)	
4	6(38%)	2(15%)	
Gender			47.28 (4)*
M	13(81%)	8(66%)	
F	3(19%)	4(31%)	
R(	21.0094		

Table 6

Model Fit Estimates for Nonsense Word Fluency with Students with IQs in the Moderate Range

	M_0: Null model			M_1 : + group & interaction		
Fixed Effects:	estimate	s.e.	*p*-value	estimate	s. e.	*p*-value
Intercept γ_{00}	2.786	1.794	0.122	4.845	2.668	0.071
Time γ_{10}	0.327	0.065	<0.001	0.140	0.085	0.102
Group γ_{01}				-3.725	3.586	0.309
Time*Group γ_{11}				0.337	0.114	0.003
Random Effects:						
σ^2_e	37.252			37.266		
σ^2_{u0}	73.907			73.004		
σ^2_{u1}	0.088			0.064		
$COV\ (u_0.u_1)$	0.455			0.828		
Fit:						
AIC	1673.274			1666.205		
BIC	1694.057			1693.847		
X^2						

Table 7

Chi Square on Level of DIBELS Performance

	Deficit		Emerging		Established		X^2(df)
Measure	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest	
LNF							
Treatment	11	7	4	3	1	6	0.18
Contrast	8	6	2	3	2	3	
PSF							
Treatment	14	3	2	9	0	4	0.03*
Contrast	10	5	2	7	0	0	
NWF							
Treatment	15	8	0	6	1	2	0.3
Contrast	11	9	1	2	0	1	
ORF							
Treatment	15	14	0	1	1	1	0.378
Contrast	11	11	0	0	1	1	

* Statistically significant at the .05 alpha level

Figure 1 Individual Graphs on Phoneme Segmentation Fluency