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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Abstract

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

In recent years, there has been growing national recognition that literacy is a civil right. The national rhetoric suggests that *all* children have the right to scientifically-based reading instruction and that it is not acceptable for any child to leave school with low literacy skills (No Child Left Behind Act, 2002). However, within the rhetoric about all children, references to students with intellectual disabilities (ID), or mental retardation, are typically vague or absent. One might question how one set of children could be overlooked in discussions about all children. In our experience, the answer appears to be that *all*

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 et al., 2006; Conners, 2003; Joseph & Seery, 2004).

In spite of the paucity of research, the research that does exist is promising, suggestino research ha, c.rat

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.).

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

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 et al., 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; Roberts, 2003; Treiman, Tincoff, & Richmond-Welty, 1996; Treiman, Tincoff, Rodriguez, Mouzaki, & Francis, 1998). Many children who have difficulty learning to read also struggle with the development of good oral language skills (Perfetti et al., 2005). One method demonstrated to be effective for students with language delays is interactive storybook reading (Arnold & Whitehurst, 1994; Dickinson & Smith, 1994; Karweit & Wasik, 1996; Valdez-

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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* (Mathes & Torgesen, 2005a), was (a) rooted in behavioral theory, (b) comprised of all of the content demonstrated to be critical for struggling readers without ID, and (c) supplemented with additional language development support.

This study adds to the literature in several ways. First, the reading intervention is comprehensive in nature, with instruction targeting oral language, phonemic awareness, alphabetic knowledge, phonemic decoding, and basic comprehension strategies. Second, the intervention in this study includes many components that have been previously validated with students at-risk for reading failure who have IQs in the average range, thus extending that research to the population of students with moderate ID. Third, the study extends these techniques with the addition of oral language activities and modified teaching techniques. Fourth, the study employs a longitudinal, randomized trial design. In this article, we report data collected after the students had been in the study for at least one full academic year. Future reports will follow the students for approximately four academic years. Finally, phonemic awareness and phonemic decoding were measured repeatedly allowing for the use of advanced statistical techniques. We addressed the following specific research question: Does a comprehensive reading program taught to primary-grade students who have moderate ID (IQs

ranging from 40-55) result in better reading outcomes than typical special education instruction on measures of (a) phonemic awareness, (b) alphabetic knowledge, (c) word recognition/phonemic decoding, and (d) oral language/comprehension?

Previously Validated Intervention Components

The intervention included components previously validated for students without ID. The first, and most comprehensive, is *Early Interventions in Reading* (Mathes & Torgesen, 2005a; Mathes et al., 2005; Vaughn, Mathes et al., 2006). We also built upon oral language storybook techniques successfully used with English Language Learners (Vaughn, Cirino et al., 2006; Vaughn, Linan-Thompson, Mathes, Duradola, & Cárdenas-Hagan, 2007). Finally, we used a simple game to provide students with extensive modeling, practice, and feedback in phonemic awareness segmentation and blending, as well as the application of those skills to print (Allor, Gansle, & Denny, 2006). (See Method section for further details about the intervention.)

Method

Research Design

This study focused on students with moderate intellectual disabilities (i.e. IQs ranging from 40-55) who were participants in a larger, longitudinal study examining the effectiveness of a comprehensive reading program for students with low IQs (ranging from 40-79: Allor, Roberts, Mathes, Roid, & Cheatham, 2009). Students were randomly assigned within each school to either (a) an intervention group that participated in daily, small group reading instruc

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

Due to the small number of students within each school, students were not matched on other variables. Twenty-four students began the study in the first year and another seven students joined the study at the beginning of the second year (these seven were also randomly assigned to the treatment or contrast group). Of these 31 students, two moved during the study and one was removed from the sample due to misidentification, resulting in a sample of 28 students (treatment, $n = 16$; contrast, $n = 12$). The mean age of the participants was 9.46 ($SD = 1.19$) for the treatment group and 9.25 ($SD = 1.76$) for the contrast group. This difference was not significant ($t = -.106$). Other demographic information is presented in Table 1. Chi-square analyses revealed no significant differences on any demographic variables, including race, gender, socioeconomic status, and educational placement.

Measures

We employed two types of measurement schemes. First, we assessed at pretest and posttest. Second, we collected continuous progress monitoring data every four weeks during the first year of the intervention and every six weeks during the second year.

Pre-post

All students were assessed prior to the intervention and at the end of the Spring semester of the second year. Pretesting during the first year occurred between October and February on a staggered schedule with students in the treatment and contrast groups tested at approximately the same time. The 7 students who entered the study in the second year were pretested in August or September of that year. The following measures comprised the comprehensive battery:

Peabody Picture Vocabulary Test-III (PPVT-III; Dunn & Dunn, 1997). The PPVT-III measures receptive vocabulary. The technical manual reports reliability coefficients ranging from .91 to .98 and adequate content, criterion, and construct validity.

The Expressive Vocabulary Test (EVT; Williams, 1997). The EVT measures expressive vocabulary. The technical manual reports internal reliability alphas ranging from .90 to .98 with a median of .95 and test-retest reliability coefficients range from .77 to .90. Data on content, criterion, clinical and construct validity are reported in the technical manual.

The Woodcock Language Proficiency Battery- Revised. (WLPB-R; Woodcock, 1991). We included memory for sentences and listening comprehension from the language composite. We included the letter-word identification (real word reading), word attack (nonsense word reading), and passage comprehension from the reading composite. The WLPB-R has good reliability (internal consistency ranged from .81-.92; test-retest ranged from.75 to .95). Adequate content, concurrent, predictive, and construct validity data are also reported in its technical manual.

The Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). Five subtests of the CTOPP were used: Blending Words, Blending Non Words, Segmenting Words, Sound Matching (first sound and last sound), and Rapid Letter Naming. The CTOPP has good reliability (internal consistency ranged from .83 to .95; test-retest ranged from .70 to .92). Adequate content, concurrent, predictive, and construct validity data are also reported in its technical manual.

Test of Word Reading Efficiency (TOWRE: Torgesen, Wagner, & Rashotte, 1999). Both subtests were administered: phonemic decoding efficiency and sight word

In order to assess progress continuously across a school year, we used *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS; Good & Kaminski, 2002). DIBELS measures are commonly used for collecting continuous progress monitoring data. We administered 4 subtests: Initial Sound Fluency (ISF), Phoneme Segmentation Fluency (PSF), and Nonsense Word Fluency (NWF). ISF, PSF, and NWF reliability coefficients range from .72 to .92 on single probes and .91 to .98 on the means of multiple probes (3 to 5 probes). Concurrent and predictive validity with a variety of reading tests ranges from .36 to .82. In addition, the Letter Naming Fluency (LNF) test was given at pre and posttest. The alternative form reliability coefficient for LNF was .88. Validity coefficients for this measure ranged from .65 to .71.

Intervention

Overview

Students in the intervention condition received approximately 40 to 50 minutes of instruction daily in small groups of one to four from one of our six highly trained and supported intervention teachers across the duration of the study. The intervention was comprehensive, including systematic and explicit instru

language component was also developed and included in both the *Foundation Level* and *Level One*. In total, 300 lessons have been designed to take students from being nonreaders with very

(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

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 correspondence (See Allor et al., 2006 for details).

Instructional Strands

Concepts of print. During the *Foundation Level*, students developed various concepts of print. These included pointing to the title and author of a book, tracking from left to right, and pointing to individual words while repeating a sentence.

Phonological and phonemic awareness. Activities in this strand span the *Foundation Level* and *Level One* and addressed skills along the continuum of phonological and phonemic awareness, including clapping words in sentences, clapping syllables within a multi-syllabic word, initial sound isolation, phoneme segmentation, phoneme blending, and phoneme discrimination.

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, 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 a

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-

represented. A score of 0 indicated that the behavior was expected but not observed. The measure included a global checklist for readiness of materials, appropriate seating arrangement, and instructor warmth and enthusiasm. Interrater agreement was calculated and exceeded 85%. Averaged across six fidelity observations, teachers scores ranged from 2.29 to 2.96 out of 3 with a mean of 2.75 (*SD* = 0.25). The mean, calculated as a percentage score, was 90.9% (*SD* = 8.63).

Total instructional time for each student varied depending on when they began the intervention and attendance. As a result, instruction for the students varied from 30 to 53 weeks, with a mean of 42.8 weeks (*SD* = 10.34). The average length of an instructional session was 40 minutes (*SD* = 6). Students participated in an average of 119 (*SD* = 11) instructional sessions during the study.

Results

Pretest Equivalence

Pretest data were analyzed using independent *t*-tests. These indicated no statistically significant differences between the treatment and contrast groups on any pretest measure. Pretest equivalency data are presented in Table 2.

Growth from Pretest to Posttest

Independent *t*-tests on difference scores of the pretest and posttest measures were conducted to determine whether students in the treatment condition made greater gains than students in the contrast condition. Because of positive results in previous studies with *Early Interventions in Reading,* we anticipated the directionality of any differences (Mathes et al., 2005) and, therefore, we analyzed the data using a one-tailed test of the null hypothesis (Gall, Gall, & Borg, 2007). *T*-test and effect size results are presented in Table 3. Statistically significant results were found on the following measures: CTOPP Blending Nonwords, CTOPP

Segmenting Words, CTOPP Sound Matching, PPVT, TOWRE Sight Word Efficiency, TOWRE Phonemic Decoding Efficiency, WLPB-R Letter-Word Identification, WLPB-R Passage Comprehension, and WLPB-R Word Attack. No statistically significant differences were found on CTOPP Blending Words, EVT, WLPB-R memory for sentences, and WLPB-R listening comprehension, although all means favored the treatment group and effect sizes were moderate to strong.

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 PPVT, TOWRE Sight Word Efficiency, and WLPB-R Passage Comprehension were 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 CTOPP Blending Words, CTOPP Sound Matching, and WLPB-R Memory for Sentences. 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 the three DIBELS measures: initial sound fluency (ISF), phoneme sound fluency (PSF)

complex random part that can appropriately account for complex covariance structure in the data (Roberts, 2004). In the present analysis, a two-level model was examined with measurement occasions at level-1 and students at level-2. Previously, only *t*-tests were conducted on gain scores to note differences between the treatment and contrast groups. These initial analyses were not performed in a HLM environment because of a lack of power in the HLM design. Therefore,

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 interaction effect (0.417) was statistically significant over time ($p < .001$) thus indicating that students in the intervention group tended to have a larger rate of growth in PSF over time than did the students in the contrast group.

NWF across time. Again, there was no statistical difference between the intervention and contrast groups at the initial time-point (-3.725, $p = 0.309$), thus indicating that they were statistically equivalent in terms of NWF when the program began. Also in model M1, the value for the interaction effect (0.337) was statistically significant over time ($p = .003$) thus indicating that students in the intervention group tended to have a larger rate of growth in NWF over time than did the students in the contrast group. It should be noted that one student in the treatment group was excluded from this analysis because the student began the study above benchmark and maintained scores above benchmark.

Graphs of scores for individual students on PSF and NWF are presented in Figures 1 and 2. The graphs on the left show the scores for the 12 students in the contrast group; the graphs on the right show the scores for the 16 students in the treatment group.

Discussion

Bonferroni correction. Although differences on CTOPP Blending Words and Sound Matching were not statistically significant, effect sizes were strong (.57 and .68, respectively). 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 ($p < .001$; see Table 5 and Figure 1).

on receptive vocabulary (PPVT). Differences on

sight word instruction was one component of the comprehensive reading program implemented. Effect sizes on measures of sight word recognition were high and differences between the treatment and contrast groups were statistically significant.

Third, we found that a comprehensive reading intervention can positively impact oral language and comprehension. With moderate *ES*s on oral language measures and strong, statistically significant differences on reading comprehension and receptive vocabulary, the current study extends previous research that had demonstrated only very basic, isolated comprehension skills (Browder, 2006). As is similar in research with students without ID, it is likely that gains in comprehension are strongly influenced by gains in word recognition. It appeared that the students in the treatment group were able to identify more words than the students in the contrast group, enabling them to answer a few basic comprehension items on the standardized measure.

Fourth, the longitudinal design of this study provides information about the level of reading performance that can be expected after one to one and a half years of consistent instruction in a comprehensive reading program. Eight of the 16 students in the treatment group 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. Generally, students in this study took approximately twice the amount of time to successfully complete lessons than struggling readers in previous studies. Further, a closer look at the graphs in Figures 1 and 2 reveals that gains on DIBELS measures of

PA and phonics (PSF and NWF) were typically not evident until students had been participating in the intervention for approximately 15 to 20 weeks of instruction. The time needed to evidence gain was much longer in duration than is typical of struggling readers without ID. Thus, while the content of instruction for both groups is the same, what differentiates them is the persistence needed on the part of schools

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. This is a common problem when is the

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Table 1
Student Demographic Data by Group

Variable	Treatment (*n*=16) *n*(%)	Contrast (*n*=12) *n*(%)	X^2 (df)[a]
Gender			1.77 (1

Table 2

Table 4

Table 5
Model Fit Estimates for Phoneme Segmentation 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
γ_{00}	0.681	1.032	0.509	0.883	1.608	0.584
γ_{10}	0.369	0.066	< .001	0.124	0.081	0.130
γ_{01}				-0.199	2.139	0.927
γ_{11}				0.417	0.108	< .001

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 Effec		

Figure 1 Individual Graphs on Phoneme Segmentation Fluency

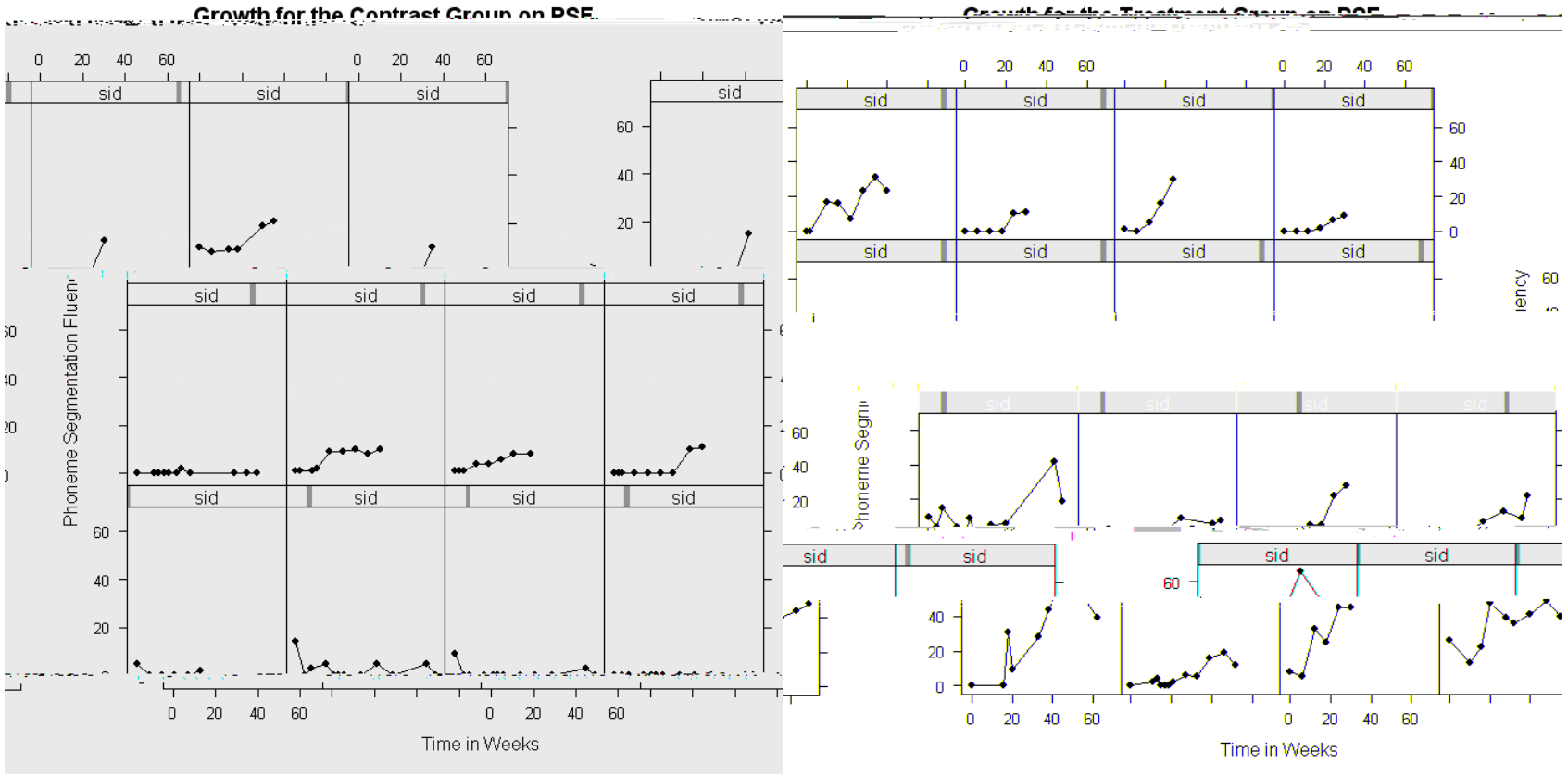
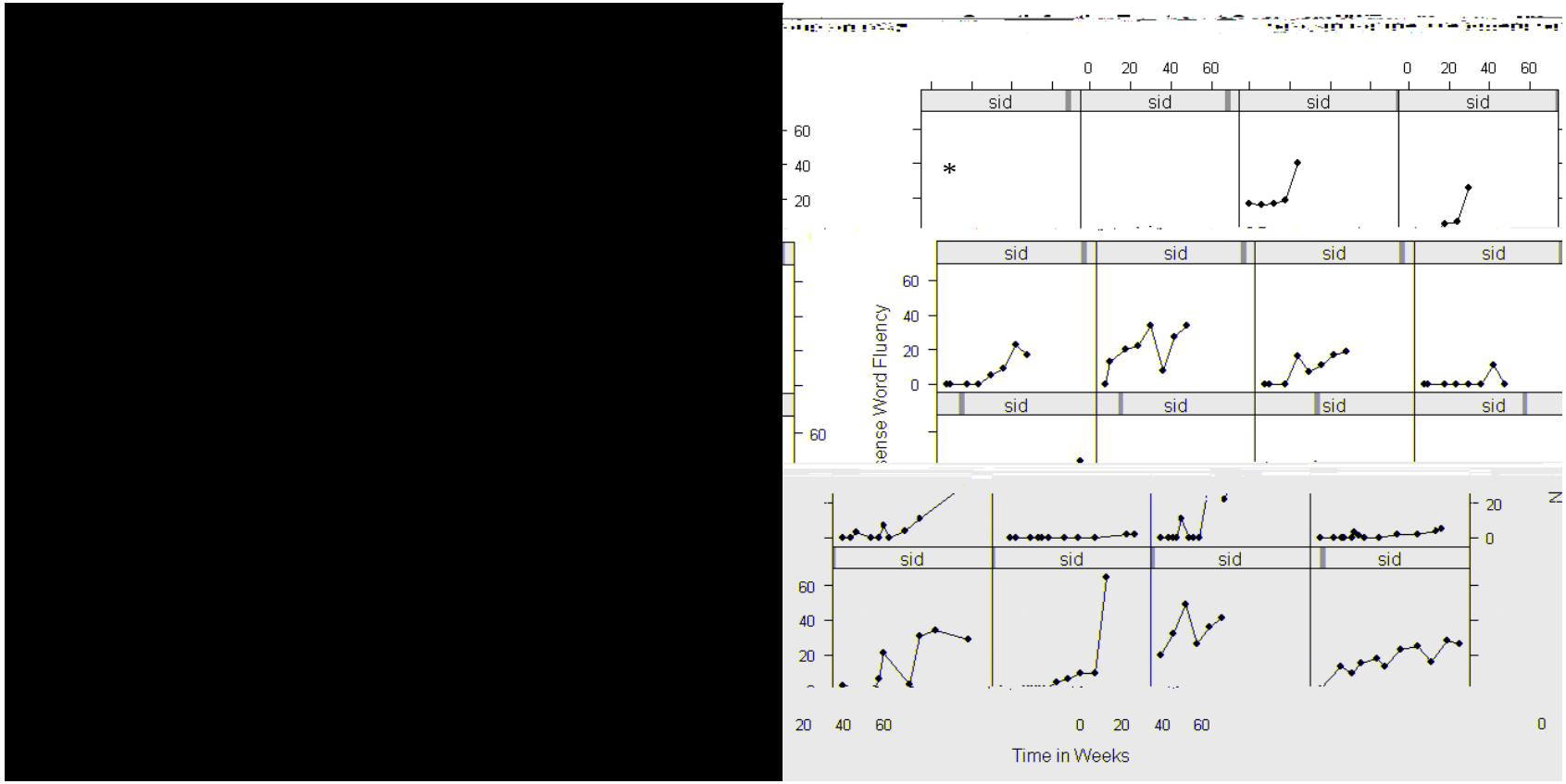

Growth for the Contrast Group on PSF
Growth for the Treatment Group on PSF
sid
Phoneme Segmentation Fluency
Time in Weeks
0
20
40
60

Figure 2 Individual Graphs on Nonsense Word Fluency



*This student began the study above the benchmark of 50 and maintained scores above 50.