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First Grade Outcomes From a Phonological Awareness Intervention

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ABSTRACT OF THE DISSERTATION

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by

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Researchers report that early intervention can reduce and eliminate reading difficulties for early readers. What Works Clearinghouse evaluated several phonological awareness interventions, but only one had positive effects on alphabetics and one had potentially positive effects on phonological processing and alphabetics. Additionally, the most recent National Assessment of Educational Progress reported that only 36 percent of fourth grade students performed at or above the proficiency level of reading in 2015. Researchers must continue rigorous evaluations to identify effective interventions for students in primary grades. Researchers and educators have implemented Phonological Awareness and Vocabulary Intensive Intervention (PAVII), an early literacy intervention, but no study has tested its efficacy on a native English speaking population using a rigorous causal research design, and no study assessed treatment acceptability. The purpose of this study was to evaluate this intervention's effects on first grade students' phonemic awareness and phonics skills and to evaluate treatment integrity and treatment acceptability. The participants were selected from a suburban elementary school in Southern California. The efficacy of the intervention was tested using a regression

discontinuity design. The treatment integrity and acceptability outcomes were high, although the treatment acceptability results were not as high as anticipated. The RDD results indicated that PAVII did not have a casual main effect on students' phonemic awareness or phonics skills. However, the effect of the intervention on phonemic awareness skills was moderated by students' initial phonemic awareness: The intervention had significantly greater effects on students with initially higher phonemic awareness skills. This suggests that the effect of PAVII on phonemic awareness skills depends on students' initial phonemic awareness skill level. Future research is needed to examine whether PAVII combined with direct phonics instruction improves the intervention's efficacy.

Table of Contents

List of Tables

List of Figures

CHAPTER 1: INTRODUCTION

Introduction

This section will introduce the purpose of this study and explore the research currently available on early reading intervention. In particular, the first part will discuss the importance of reading intervention, response to intervention, and its essential components. The next subsection will present the research questions of this project.

The Problem

According to the most current National Assessment of Educational Progress (NAEP, 2015) report, only 36 percent of fourth grade students in public schools performed at or above the proficient level of reading in 2015. These results are similar to those from the 2013 assessment period, indicating that at least over the past two years many students have continued to struggle with reading even after five years of instruction in school. This also emphasizes the need for high-quality reading intervention in the years preceding fourth grade for students who are at-risk for reading failure. Intervention is especially important during the early grades because for children who are poor readers at the end of first grade, there is an 88 percent probability that they will remain poor readers at the end of fourth grade (Juel, 1988). In addition, 34 percent of eighth grade students in public schools performed at or above the proficient reading level in 2015 (NAEP, 2015), and another study reported that approximately 75 percent of struggling readers in third grade remained poor readers in ninth grade (Lyon, 1995). Furthermore, in one study, 70 percent of third grade children with a reading disability were still identified as reading disabled in twelfth grade (Shaywitz et al., 1999). The results of these studies indicate that

early intervention is necessary in the prevention of further reading problems throughout the elementary and high school years.

In addition, when students do not learn to read in the early years of school, this affects their attitudes and motivation to read (Oka & Paris, 1986). For example, public school students who frequently read for enjoyment tend to have higher average reading scores (National Center for Education Statistics, 2013). Unfortunately, children who remain poor readers during the first three years of elementary school have fewer opportunities to practice reading, which limits their likelihood of ever acquiring average reading fluency levels (Torgesen, Rashotte, & Alexander, 2001). These findings indicate that reading disabilities can be chronic and lifelong, extending from kindergarten into adulthood. Because early intervention for students who struggle with early literacy skills is critical to the prevention of more serious reading difficulties (Torgesen, 2002), researchers must identify the most effective ways in which to provide intervention for students at-risk for reading failure.

Early Reading Intervention

Because many students struggle to read from kindergarten through adolescence and into adulthood (Shaywitz et al., 1999), there is a clear need for research on early intervention. A strong body of research supports the provision of early intervention to prevent and remediate reading difficulties (Adams, 1990; Snow, Burns, & Griffin, 1998). Lyon and colleagues (2001) estimated that early intervention can reduce the number of children who are typically identified as poor readers by up to 70 percent. Based on the results of these and other studies, researchers encourage educators to identify students at-

risk for reading difficulties in kindergarten and first grade and to provide skills-based intervention (Simmons et al., 2008). Based on a review of the literature, the Institute of Education Sciences recommended that schools provide early screening and intervention in these grades to detect reading problems and prevent struggling readers from further reading failure (Gersten et al., 2008).

Consistent with these guidelines is the finding from a meta-analysis that early literacy interventions provided before second grade produce the largest effect sizes (Wanzek & Vaughn, 2007). Fortunately, intervention support during first grade can prevent short- and long-term reading difficulties for most at-risk children (Vellutino, Scanlon, Small, & Fanuele, 2006). Also, when compared to struggling readers who are not identified until later grades, struggling readers who receive early intervention can avoid later reading problems (Lyon, et al., 2001; Torgesen, 2000). Finally, Torgesen (2000) summarized the results of five studies and found that early intervention in kindergarten and first grade can substantially reduce the number of children who might otherwise have received services for a reading disability. All five studies reviewed resulted in a reduction in the number of children potentially eligible for special education services from 12 to 18 percent to 1.4 to 5.4 percent. These studies emphasize the importance of early intervention in the remediation of reading difficulties.

Early literacy intervention can also have lasting effects as well. Research has supported the notion that kindergarten students who respond well to early intervention can benefit from an "inoculation effect" (Coyne et al., 2004, p. 90). This means that intervention support provided in kindergarten can prevent future reading difficulties. For

example, Coyne and colleagues (2004) discovered that when kindergarten students struggling with literacy skills received intervention, 75 to 100 percent of these students performed in the average range by the middle of first grade and no longer required intervention. Similarly, Blachman and colleagues (1999) found that students who received a phonemic awareness intervention in kindergarten followed by explicit, systematic instruction in the alphabetic code in first grade significantly outperformed students in a control group on all four measures of word recognition a year later at the end of second grade. Although few studies have examined intervention effects more than an average of about 15.52 months (Suggate, 2010), Blachman and colleagues (2014) compared long-term outcomes for students who received intervention in second or third grade to those of students who did not receive intervention. As a result, over ten years later, those who received intervention demonstrated a small to moderate effect size advantage on reading and spelling measures when compared to those who did not receive intervention.

Response to Intervention

Monitoring students' response to intervention (RtI) through multiple tiers of support is one way in which educators can provide a structured instructional support system. As part of the multi-tiered support framework of RtI, students receive instructional support through a three-tiered system in which students at-risk for reading failure receive more intensive support when they do not respond to instruction at a particular level. For example, students who do not respond adequately to core instruction at tier 1 receive intensified support in a smaller group format (Gersten et al., 2008) at tier

2. Educators progress monitor intervention students' academic skills, and students who still do not respond to intervention at this tier receive intensified intervention support in an even smaller group or individualized setting within tier 3. Researchers have recommended the use of small group formats when providing intervention targeting phonological awareness (Foorman & Torgesen, 2001).

Studies have evaluated the effects of phonological awareness interventions that were provided in small group formats. Healy, Vanderwood, and Edelston (2005) reported growth on reading skills after they provided a phonological awareness intervention in small groups of no more than five students. Similarly, Vanderwood, Tung, and Arellano (2013) found that a phonological awareness intervention provided in small groups of up to five or six students each with paraeducators effectively increased students' phonemic awareness and phonics skills and eliminated the gap in phonemic awareness skills between intervention students and typically performing peers. In a third study, kindergarten students received explicit, systematic phonemic awareness intervention support in groups of six students (Schuele et al., 2008). In this study, compared to a control group, students who received the phonemic awareness intervention demonstrated higher phonemic awareness skills. Finally, following a phonemic awareness intervention, first grade students in small groups of four or five significantly outperformed students in a control group on phoneme segmentation (Weiner, 1994). These results support the notion that phonemic awareness interventions in small group formats can effectively improve students' reading skills.

The NRP (2000) concluded that smaller group sizes targeting phonemic awareness produced larger effect sizes as compared to larger groups. This synthesis reported larger effect sizes when children received instruction in small groups (d=1.38) rather than individually (d=0.60) or in whole classrooms (d=0.67). However, the NRP (2000) reported large effects from phonemic awareness instruction in various group sizes. While the panel found that phonemic awareness is an important foundational reading skill and that educators can teach it effectively, researchers need to study additional aspects of this type of intervention such as treatment integrity and acceptability.

Purpose of the Study

The purpose of this study is to determine the extent to which there is a significant difference between the intervention and comparison students. Many researchers have evaluated the effects of phonological awareness interventions, but few have evaluated Phonological Awareness and Vocabulary Intensive Intervention (PAVII), and only one study has evaluated PAVII using a quasi-experimental design. The evaluation of PAVII using this type of design is important because most of the previous studies of PAVII's effectiveness did not utilize an experimental or quasi-experimental design. Arellano (2013) used a quasi-experimental design to evaluate outcomes from PAVII, but instruction was in Spanish and it was implemented less frequently and with only 12 sessions. Additionally, this is the first study to provide treatment acceptability data for PAVII. The results will provide information regarding not only the efficacy of this intervention but also whether interventionists perceive it as an appropriate and useful

tool, which will provide information schools can consider when searching for an appropriate intervention for first grade students struggling with phonemic awareness.

Research Questions

This study addressed the following research questions:

1a. To what extent is there a statistically significant difference between the intervention group and its comparison group on phonemic awareness outcomes?

1b. To what extent is there a statistically significant difference between the intervention group and its comparison group on phonics outcomes?

2. To what extent can interventionists deliver PAVII with treatment integrity?

3. To what extent do interventionists rate PAVII regarding treatment acceptability?

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter will review the research findings regarding the development of phonemic awareness and its relationship to phonics and more advanced reading skills. It will also introduce PAVII and present research regarding its instructional components as well as its efficacy. The next subsection will discuss the need for stronger evaluation methods for PAVII based on the limited studies currently available.

Phonological Awareness and Phonemic Awareness

Gersten and colleagues (2008) recommended that educators remediate reading difficulties through early intervention by targeting a small set of the critical foundational reading skills. The National Reading Panel (NRP; 2000) has identified the five critical areas of reading as phonemic awareness, phonics, fluency, comprehension, and vocabulary. The first skill area, phonemic awareness, is a specific type of phonological awareness (PA). PA involves understanding the sounds of language as distinct from their meaning, including onset-rime patterns such as "/b/ /at/" and syllable sounds such as "/en/ /ter/ /ing/." Phonemic awareness is a type of PA involving the understanding of phonemes, or the smallest sound units that make a difference to meaning (Snow, Burns, & Griffin, 1998). For example, the ability to identify words that rhyme with each other represents one's phonological awareness. The ability to identify the first sound in "ball" as "/b/," blending together the sounds "/m/…/a/…/t/" to create the word "mat," and segmenting "lip" into the sounds "/l/…/i/…/p/" are all indicators of phonemic awareness.

A child's level of phonemic awareness upon entering school may be the single most helpful determinant of the success he or she will experience in learning to read and of the likelihood of failing in reading (Adams, 1990). Juel, Griffith, and Gough (1986) found that the rate at which first grade children progressed through the books they were reading was related to their growth in phonemic awareness. Additionally, Al Otaiba and Fuchs (2002) reviewed studies that described children who were unresponsive to early literacy interventions and found that most unresponsive students had PA deficits. Similarly, in a large study of 199 children aged seven to nine who had significant difficulties in decoding and word recognition, more than 85 percent of the children demonstrated deficits on measures of PA (Fletcher et al., 1994). These researchers concluded that PA skills were robust indicators of differences between children with impaired reading and children without a reading disability (Fletcher et al., 1994). Also, children who become poor readers tend to enter first grade with little phonemic awareness (Juel, 1988). The strong relationship between phonemic awareness and reading achievement these studies have found suggests that students' performance on phonemic awareness tasks can be useful in identifying students who would benefit from intervention.

An extensive amount of research supports the effectiveness of explicit intervention targeting PA skills, particularly phonemic awareness (Snow, Burns, & Griffin, 1998). To be able to learn letter-sound correspondence and eventually read fluently, children must become aware of phonemes, and only pre-readers who acquire phonemic awareness learn to read successfully (Adams, 1990). Without phonemic

awareness skills, exposure to printed letters does little to facilitate spelling-sound knowledge (Juel, Griffith, & Gough, 1986). Finally, Iversen and Tunmer (1993) found that the first grade children selected for intervention in their study tended to be particularly deficient in phonological processing skills (i.e., phonological awareness and phonological recoding, the ability to translate letters and letter patterns into phonological components). These researchers also found that students who struggled with these skills demonstrated progress in reading as they developed phonological awareness and phonological recoding. In sum, these results emphasize the importance of developing an understanding of the phonemes in words.

More recent research findings further support the efficacy of phonological awareness interventions. One meta-analysis reported that, when compared to other skill-based interventions, phonemic awareness and comprehension interventions yielded the largest effect sizes after an average follow-up period of 11.17 months (Sugatte, 2016). Similarly, Melby-Lervag, Solveig-Alma Halaas, and Hulme (2012) conducted a meta-analysis of the relationships among three phonological skills (phonemic awareness, rime awareness, and verbal short-term memory) and word reading skills. The analyses revealed that phonemic awareness was the strongest correlate of individual differences in word reading skills, a relationship that remained after controlling for variations in verbal short-term memory and rime awareness. Research groups have reported positive effects for phonological awareness interventions with preschool (Kruse, Spencer, Olszewski, & Goldstein, 2015) and kindergarten students (Kjeldsen et al., 2003). These findings

demonstrate the important role of phonological awareness as a predictor of individual differences in early reading development.

Given that phonemic awareness is a critical foundational reading skill, it is important to identify when to provide intervention targeting this skill. Many studies have consistently demonstrated that phonemic awareness interventions can effectively improve the reading skills of students. The NRP (2000) reported that the effects of phonemic awareness interventions were significantly larger for kindergarten students than for students in first grade or higher, although this could be because younger students tend to begin intervention with lower phonemic awareness skills than do first grade students. However, the overall effect size of phonemic awareness interventions on phonemic awareness outcomes was large (r=.86), and the overall effect size on reading outcomes was moderate (r=.53). Consistent with this is the finding that, based on a synthesis of 27 kindergarten intervention studies, reading interventions effective for improving reading outcomes for kindergarten students with and without disabilities that included a phonemic awareness component produced the largest effect sizes (Cavanaugh, Kim, Wanzek, & Vaughn, 2004). These findings suggest that phonemic awareness, in addition to PA in general, is an important skill for early elementary school students to learn through intervention. However, many of the studies reviewed at this point have been correlational.

The Causal Link between Phonemic Awareness and Reading

Phonemic awareness not only predicts reading achievement; it also has a causal effect on reading and is a foundational reading skill (NRP, 2000). Bradley and Bryant

(1983) were the first researchers to provide empirical evidence of a causal link between PA and reading and spelling skills. They conducted a study to determine whether a causal relationship exists between PA and reading skills and addressed both longitudinal relationships direct as well as long-term effects of PA training. First, they found high correlations between four- and five-year-olds' initial PA levels and reading and spelling skills over three years later. Second, these researchers provided direct PA training and found that students who received the training performed higher on reading and spelling tasks than did students in the control group. This causal link between phonological awareness and reading skills implies that schools should focus on improving these skills at an early age.

More researchers have supported a causal link between phonemic awareness and more advanced reading skills. Cunningham (1990) compared reading outcomes for a control group and two experimental groups. One of the experimental groups focused on phoneme segmentation and blending, while the other group explicitly discussed the application, value, and utility of phonemic awareness in addition to the segmentation and blending activities. The results produced a significant improvement in reading achievement for kindergarten and first grade students from both experimental groups, and the group that addressed the application, value, and utility of phonemic awareness significantly outperformed the group that focused only on segmenting and blending. In another study, Hulme, Bowyer-Crane, Carroll, Duff, and Snowling (2012) found that a phonology and reading intervention that focused on letter-sound correspondence and phonemic awareness resulted in significant improvements in these skills and in later

word-level reading and spelling skills. The authors provided evidence that phonemic awareness, in addition to letter-sound knowledge, is a causal influence on the development of reading skills. These studies offer consistent evidence that phonemic awareness is a foundational reading skill.

Furthermore, Perfetti, Beck, Bell, and Hughes (1987) found that phonemic knowledge and learning to read have a reciprocal relationship in that each supports the development of the other. In their longitudinal study, researchers assessed first grade students throughout the year on phonemic awareness skills. The study identified correlations between phonemic knowledge and reading tasks, and time-lag correlations suggested that phonemic synthesis enabled later reading (Perfetti, Beck, Bell, & Hughes, 1987). This indicates that phonemic knowledge facilitates reading and that reading also facilitates phonemic knowledge. Unfortunately, while most children acquire PA skills easily by age seven, about 17 percent of children do not learn these skills well and will continue to struggle with learning to read unless these skills are acquired (Lyon, 1996). This suggests that educators must provide intervention in phonemic awareness skills for students who struggle in this area.

Additionally, Ball and Blachman (1991) provided intervention support to kindergarten students and presented more evidence that phonemic awareness is a necessary component in reading skill development. In their study, three groups were formed: The first group received training in phoneme segmentation and letter-sound correspondence, the second group received training in letter-sound correspondence, and the third group did not receive intervention and was the control group. Data analysis

revealed that while training in phoneme segmentation and letter-sound correspondence significantly improved the reading and spelling skills of students, training in letter names and letter sounds without phonemic awareness instruction did not significantly improve the students' segmentation, early reading, or spelling skills. This indicates that children must learn phonemic awareness before being able to learn alphabetic principle.

Given that phonemic awareness is a precursor to the ability to decode, it is important to evaluate the outcomes of phonemic awareness interventions in controlled studies. Griffith (1991) found that phonemic awareness training facilitates spelling in first grade. Also, Hurford and colleagues (1994) found that training in phonological processing, a group of skills related to phonemic awareness, effectively increased the phonological processing and reading skills of first grade students at-risk for a reading disability or poor reading skills. Additionally, Weiner (1994) provided a phonemic awareness intervention to low- and middle-achieving first grade students. When she compared the phonemic awareness and reading skills of students in a control group to those of a phonemic awareness and decoding training group, both experimental groups performed significantly higher on a phoneme segmentation test than did the control group. These studies, in addition to meta-analyses such as the NRP's (2000) report that found medium to large overall effect sizes for phonemic awareness, reading, and spelling outcomes, suggest that phonemic awareness intervention can improve the reading skills of early elementary students.

Phonemic awareness interventions have a short-term effect on reading skills but also long-term effects as well. Cartledge, Yurick, Singh, Keyes, and Kourea (2011)

demonstrated that a phonemic awareness intervention provided to kindergarten students produced positive effects that extended one to two years after the intervention. This suggests that a one-time intervention in kindergarten can produce reading effects that persist for at least two years. Elbro and Petersen (2004) also reported positive long-term effects as the result of a phoneme awareness intervention implemented with 35 children. In this study, the researchers evaluated student outcomes in second, third, and seventh grades. The students who received phonemic awareness training outperformed untrained control students in both word reading and pseudoword reading at each time period. They also found that the children who were not responsive to the intervention tended to have relatively poor phonological representations of the words they recognized. Additionally, after receiving systematic PA intervention support, kindergarten students demonstrated a significant gain in word reading that maintained through the end of second grade (Kjeldsen, Niemi, & Olofsson, 2003). These findings highlight the short- and long-term benefits of phonemic awareness intervention.

Phonemic Awareness and Phonics

Phonemic awareness interventions can improve skills in addition to phonemic awareness. Because children must understand the phonemes in words before they develop alphabetic principle (Ball & Blachman, 1991; NRP, 2000), interventions that target this skill can result in improvements in phonics skills as well. For example, Kruse and colleagues (2015) reported that, following a phonological awareness intervention, preschool students struggling with early reading skills demonstrated improvements on both phonemic awareness and alphabetic knowledge skills. As Al Otaiba, Kosanovich,

and Togesen (2012) summarized, phonemic awareness facilitates children's ability to read in the following ways:

> "1. It helps children understand the alphabetic principle and develop alphabetic knowledge.
>
> 2. It helps children notice the regular ways that letters represent sounds in words.
>
> 3. It helps children become flexible decoders to decode even irregular words, and it makes it possible to generate possibilities for words in context that are partially 'sounded out.'" (p. 114-115).

These findings suggest that phonemic awareness impacts a child's ability to use sound-letter correspondence when decoding words. One example of a transfer between phonemic awareness and phonics skills is a study in which first grade English language learner students completed an intensive phonological awareness intervention (Healy, Vanderwood, & Edelston, 2005). Twelve of the 15 students met exit criteria for both phonemic awareness and phonics tests. In another study, PA intervention resulted in significant improvements in both phonemic awareness and phonics (Vanderwood, Tung, and Arellano, 2013). In a third study, PA intervention in Spanish resulted in a significant improvement in Spanish phonics (Arellano, 2013). In these three studies, the PA interventions focused solely on phonemes without incorporating any printed letters or phonics instruction. These studies support the idea that students must first become aware of phonemes before being able to learn letter-sound correspondence and eventually read fluently (Adams, 1990). Furthermore, meta-analyses reveal that phonemic awareness interventions can be effective with or without phonics components (Cavanaugh, Kim,

Wanzek, & Vaughn, 2004; Sugatte, 2016). These findings also indicate that PA interventions can directly improve phonemic awareness skills while indirectly improving phonics skills as well.

Characteristics of Effective Phonological Awareness Interventions

Various studies have identified the characteristics of effective PA interventions. For example, educators should provide intervention on PA that is explicit rather than implicit (Adams, 1990; Allor, Gansle, & Kenton Denny, 2006; Cunningham, 1990). For example, merely presenting phonological awareness examples such as identifying phonemes without explicitly teaching children how to identify the sounds themselves does not ensure that they will learn phonological awareness; mere exposure is not sufficient for learning this skill (Adams, 1990). PA training must also be strictly systematic in that the instructor clearly plans the order of the PA components and monitors the students' learning rate (Kjeldsen, Niemi, & Olofsson, 2003). Classroom teachers can be very effective in teaching phonemic awareness, and instruction on this skill can benefit students in various group sizes, from small to whole-class group settings. (NRP, 2000). Researchers have also found that phonemic awareness intervention leads to improvements on this skill when individuals who are not researchers, such as paraeducators, lead the intervention (Allor, Gansle, & Kenton Denny, 2006; Vanderwood et al., 2013). These findings highlight the effective components of PA training and also demonstrate the practical utility of this type of instruction.

Although some studies support the use of both phoneme awareness and letter-sound training, other studies have reported that phonemic awareness intervention alone

produces similar effects when compared to interventions that include phonemic awareness and print. Cavanaugh and colleagues (2004) found that the intervention components that produced the largest effect sizes included phonemic awareness instruction with or without print. While interventions that included PA and print instruction produced moderate to high effect sizes for most of the studies reviewed, interventions that provided PA awareness instruction alone produced large mean effect sizes. These findings further highlight the beneficial impact of PA intervention in preventing reading problems for kindergarten students, whether or not they also include letter-sound correspondence training. Furthermore, Ball and Blachman (1991) compared training consisting of phonemic awareness combined with instruction in letter names and letter sounds to training with the use of letter names and letter sounds alone. These researchers found that instruction in letter names and letter sounds alone did not significantly improve segmentation, early reading, or spelling skills. That is, direct instruction in PA was necessary to improve students' reading and spelling skills. Finally, Weiner (1994) found that intervention that combined phonemic training and decoding training was ineffective for low readers but effective for middle-achieving readers, suggesting that phonemic awareness training may affect low- and middle-achieving beginning readers differently. It could be, as the author stated, that combining both phonemic awareness and decoding training is too confusing or difficult for lower-skilled first grade readers.

Existing Phonological Awareness Interventions

Several phonological awareness interventions are available, but few meet stringent research standards. According to What Works Clearinghouse (WWC), a resource that reviews existing research for programs, policies, practices, and products in education, few phonological awareness studies meet WWC's stringent evaluation criteria. WWC evaluates interventions based on the quality of the research study's design, the statistical significance of the results, the difference between participants in the intervention and comparison conditions, and the consistency in results across studies. WWC reviewers then rate each intervention with one of the following ratings: positive, potentially positive, mixed, no discernible effects, potentially negative, or negative. According to WWC, general phonological awareness training has positive effects on phonological processing, while phonological awareness combined with letter knowledge instruction has positive effects on print knowledge but potentially negative effects on phonological processing and early reading and writing.

WWC has only evaluated two interventions that target phonological awareness without print knowledge. Sound Foundations, a preschool intervention that consists of phoneme identity activities that include worksheets and card games, has potentially positive effects on phonological processing and early reading and writing (What Works Clearinghouse, 2007), but it was only evaluated for preschool students and only consists of phoneme identity activities. Based on research emphasizing the importance of combining phonemic segmentation and blending activities (Torgesen, Morgan, & Davis, 1992) and addressing more than one phonemic awareness activity (Slocum, O'Connor, &

Jenkins, 1993), it is important to evaluate and use interventions that have these evidence-based components. Additionally, WWC (2006) reported that Daisy Quest, a computer-based program for ages three through seven that incudes rhyming, phoneme counting, and phoneme identification, has positive effects on alphabetics. The disadvantages of Daisy Quest are that it is about 20 to 25 minutes per session and requires the use of a computer for each child, which can be a challenge for schools with limited resources. Researchers and educators in the Southern California area have implemented PAVII for several years, but few studies have evaluated it. Unlike the phonological awareness interventions WWC describes, PAVII involves multiple phonological awareness activities and does not include any visual materials such as printed letters or words. Due to the limited research regarding small group phonological awareness interventions for first grade students, it is important to evaluate additional interventions such as PAVII to identify appropriate options for schools.

In summary, phonological awareness is an important early literacy skill and that interventions that target this skill lead to improvements in phonemic awareness and reading skills. Since the presentation of the NRP's (2000) report, researchers have sought, as the NRP suggested, to identify the specific factors that intensify intervention support and effectively improve students' literacy outcomes. Although several phonological awareness interventions exist, few have sufficient research support, and among the interventions that are available, few include only phonological awareness activities without print instruction. It is critical to identify effective PA interventions for beginning readers and determine the ways in which to produce the greatest impact.

PAVII

History

Several districts in California have implemented PAVII in urban and suburban areas for about 10 years with both kindergarten and first grade students. PAVII has been used to increase kindergarten and first grade students' phonemic awareness and phonics skills as a way to assist students at risk for reading failure and those who are struggling with reading. This manualized and scripted intervention is called Phonological Awareness and Vocabulary Intensive Intervention (PAVII; Vanderwood, n.d.) and was intended to provide intensive tier two support to kindergarten and first grade students who are identified as at-risk for reading problems in phonemic awareness. The authors created this intervention as an adaptation from an existing intervention (i.e., Sounds and Letters for Readers and Spellers; Greene, 1997) and is intended to be implemented with a small group of three to five students who are struggling with phonemic awareness skills. In general, most students who have received support from this original 12-session version of PAVII made significant gains in phonemic awareness and phonics skills.

Components of PAVII

Direct Instruction

PAVII's creators followed a direct instruction model throughout the intervention development stages. Direct instruction typically involves highly structured and explicit support in a small group setting with multiple opportunities to respond individually and in unison and immediate corrective feedback (Carnine, Silbert, & Kame'enui, 1997; Engelmann & Carnine, 1982). Direct instruction features a model, lead, test procedure in

which the academic content is explicitly taught (Carnine, Silbert, & Kame'enui, 1997). For example, in the Phoneme Blending section of PAVII, the interventionist provides a verbal and visual demonstration of how to blend phonemes by tapping different parts of the arm and then smoothly moving the arm across all areas to represent blending. The interventionist then repeats the activity with the students, and then he or she tests their understanding by asking them to complete this task individually and in unison.

Overall, studies using direct instruction techniques for reading instruction have found that it is effective for at-risk students, including students with disabilities (Carnine, Silbert, Kame'enui, & Tarver, 2004). For example, a recent study found that the direct instruction model effectively improved reading comprehension and language skills in students with autism spectrum disorders and developmental disabilities (Flores et al., 2013). A meta-analysis listed direct instruction within the top three models of the 29 it reviewed for its effectiveness in urban and low-performing schools (Borman, Hewes, Overman, & Brown, 2003). Direct instruction's highly structured methods also help students who are at-risk for reading failure accelerate their academic achievement as early as kindergarten (Engelmann, 1999). In contrast, minimal guidance during instruction is less effective than explicit direct instruction (Kirschner, Sweller, & Clark, 2006). Therefore, the notion that students will learn through discovery, personal experience, and other similar methods rather than through direct, structured instruction is false despite the popularity of such learning models.

Small Group Format

PAVII also follows a small group format, which researchers have recommended for intervention targeting phonological awareness (e.g., Foorman & Torgesen, 2001). Based on a meta-analysis, the NRP (2000) concluded that smaller group sizes targeting phonemic awareness produced larger effect sizes when compared to larger groups and whole class instruction. Gersten et al. (2008) recommended using small group intervention and reported a strong level of evidence to support it: "Recommendation 3. Provide intensive, systematic instruction on up to three foundational reading skills in *small groups* [emphasis added] to students who score below the benchmark in universal screening" (p. 20). Ganske, Monroe, and Strickland (2003) claimed that small groups are critical for students who struggle with reading. They explained that in small groups, students can receive direct support for the skills on which they struggle in a format that enables teachers to more easily engage students who might otherwise disengage from academic content. In a list of key aspects to developing and maintaining an effective intervention system for students in kindergarten through third grade, Torgesen (2005) included the provision of interventions in small groups of three to five. He also noted that the benefits of small groups are that teachers can match instruction directly to the needs of individual students, there are more opportunities for the students to respond and for the teachers to receive feedback, and it is also the most efficient way to increase the intensity of instruction for students struggling with reading.

Furthermore, when comparing engagement in small and large group sizes, engagement tends to improve in the smaller group setting (Homan et al., 2001).

O'Connor (2000) compared students' academic engagement and performance in small group and whole class settings. In her study, increasing the intensity of a kindergarten intervention by forming small groups of two or three students resulted in increased participation, response accuracy, and appropriate application to reading and writing task demands as compared to their behavior in whole-class groupings for most students. Another study found that first grade students who received a phonemic awareness intervention in small groups of four or five significantly outperformed students in a control group on phoneme segmentation (Weiner, 1994). With its small group format, PAVII offers many opportunities to respond through a highly interactive, intensive, and engaging script.

Intensity and Engagement

The PAVII creators designed it so that it is highly engaging and interactive. This is important because phonemic awareness activities should be interactive, positive, fun, informal, enthusiastic, and playful (Yopp, 1992). Following the three brief introductory sessions A through C, the sessions are 30 minutes in length and include one vocabulary activity and five phonological awareness activities. These features are consistent with recommendations from the literature. For example, Gersten et al. (2008) recommended that tier 2 intervention sessions are 20 to 40 minutes in length. Gersten and colleagues (2008) also recommended that interventions should target up to three literacy skills, which is consistent with the inclusion of two literacy skills in PAVII. Torgesen (2002) emphasized the importance of providing at-risk students with literacy instruction that is more intensive, explicit, and supportive than is typically provided to the whole class.

PAVII aims to address these critical factors with its intensive skill-based activities and frequent positive reinforcement, respectively. Finally, PAVII provides multiple opportunities for students to respond both individually and in unison. A high rate of opportunities to respond elicits active engagement in observable ways (Simonsen et al., 2008). Choral responses encourage on-task behaviors (Godfrey, Grisham-Brown, & Halle, 1986) and modeling of correct responses for students who are learning the skill. Individual responses also encourage participation and attention and allow the interventionist to determine whether each student understands the skill, allowing for opportunities to provide immediate error correction. These features ensure that students receive the intensive literacy intervention they need in a positive, engaging, and supportive environment.

Segmenting and Blending

PAVII includes two separate phoneme segmenting and blending activities. Ball and Blachman (1988) demonstrated that a group of kindergarten students receiving phoneme segmentation instruction outperformed two control groups on both segmentation and reading measures. Furthermore, Muter, Hulme, Snowling, and Taylor (1997) reported that phoneme segmentation predicts early reading progress. However, Tunmer and Nesdale (1985) emphasized that while phoneme segmentation is necessary when learning to read, this skill alone is not sufficient. In particular, existing research suggests that teaching phoneme segmentation and blending skills is more effective in improving reading skills than are other phonemic skills (Cunningham, 1990; O'Connor, Jenkins, & Slocom, 1995; Yeh & Connell, 2008) and skills such as vocabulary (Yen &

Connell, 2008). It is also important to combine both segmenting and blending because together they improve phonemic segmenting and blending skills as well as word learning skills (Torgesen, Morgan, & Davis, 1992). Additionally, Slocum, O'Connor, and Jenkins (1993) found evidence that a high level of performance in one type of phonological skill does not indicate transfer to another phonological skill. These two phonemic awareness skills are important to the development of phoneme knowledge and are two of the phonemic awareness activities in PAVII.

Error Correction

In addition to being fast-paced and highly engaging, PAVII also includes immediate error correction procedures so that students learn correct responses. The immediacy of the error correction procedure was based on findings that immediate error correction is more effective than delayed error correction during reading instruction (e.g., Barbetta, Heward, Bradley, & Miller, 1994; Simonsen et al., 2008). As an example, if a student makes an error, the manual instructs the interventionist to say, "Stop. My turn. The correct answer is [answer]. Now your turn. Get ready." This explicit approach with frequent corrective feedback in a model-lead-test format is also a component of the direct instruction model (Carnine, Silbert, & Kame'enui, 1997; Engelmann & Carnine, 1982).

Revisions of PAVII

After the previous three studies' evaluations of PAVII, graduate students adjusted PAVII in a number of ways. First, based on requests from teachers who implemented PAVII, the intervention now has three brief introductory sessions (A, B, and C) designed to more easily and gradually teach the students about the structure of the intervention, the

behavior expectations, and how to participate in the intervention before the start of the full 30-minute sessions. According to the teachers who requested this change, these introductory sessions simplified the transition for both students and interventionists from whole-class instruction to the highly intensive intervention sessions.

Second, researchers adjusted the treatment integrity checklist at the end of the intervention manual to include a Likert scale rating system. The original treatment integrity checklist consisted of 68 total rating items with the option of rating the interventionist based on whether the interventionist did or did not demonstrate the step without the option of indicating whether the interventionist demonstrated a behavior such as encouraging students to respond with a signal sometimes or never. The updated treatment integrity list now includes "Never," "Sometimes," and "Always" options for each component to allow for more flexibility and precision in ratings and now has 76 total rating items with a section including items from the corrective procedures such as "Interventionist corrects student errors by modeling the correct answer and then asks the student(s) for the correct response." The treatment integrity checklist also includes a more explicit scoring section with an example calculation of overall treatment integrity. Please see the Appendix to view the current treatment integrity checklist.

Third, the intervention manual now includes a phoneme pronunciation guide and a complete vocabulary list at the end of the manual. These lists provide interventionists with explicit guidance for pronouncing the phonemes when treatment integrity checks prior to the present study revealed that interventionists occasionally mispronounced

phonemes, particularly during the Phoneme Repetition activity when each phoneme is verbalized individually.

The final change to the structure of PAVII was that the interventionists implemented a structured behavior management system to increase student engagement. While the original manual included brief corrective procedures, for this study the interventionists received more detailed directions with a script to follow not only for correcting students' responses but also for preventing and addressing behavior difficulties. The intervention's behavior management component now requires interventionists to implement behavior management strategies as well. Behavior management consists of the following five empirically supported components: (a) maximized structure; (b) posting, teaching, reviewing, monitoring, and reinforcing expectations; (c) actively engaging students in observable ways; (d) the use of strategies for responding to appropriate behaviors; and (e) the use of a strategies to respond to inappropriate behaviors (Simonsen et al, 2008). The interventionists were required to use these behavior management components during every intervention session, excluding teaching the behavior expectations, which they only did on the first day of intervention. The interventionists explicitly taught three behavior expectations with a cartoon picture corresponding to each. The expectations were the following: 1. Keep your bottom in your seat, 2. Keep your hands and feet to yourself, and 3. Eyes on the teacher. The interventionist explained the first expectation while referring to a computer-generated image of a child sitting at his desk. The second expectation corresponded to a cartoon of a group of seven students sitting on the floor in a half circle and looking up at a teacher.

The cartoon associated with the third expectation was an image of three children sitting on the floor with their legs crossed and their arms behind their backs on the floor while facing an adult. The interventionists then explained that the students would earn a score for following the rules and those who earned a score of 75 percent or higher based on the interventionist's judgment would be able to pick a prize from the treasure box. After this first session, to address inappropriate behaviors, they referred to the posted expectation cards and reviewed appropriate behaviors. The interventionists also used behavior-specific praise and redirections such as "Great job keeping your bottom in your seat, Jason!" and "Marina, remember to keep your hands to yourself." The rationale for the behavior-specific feedback was based on research supporting the use of specific praise suggesting that students' on-task behaviors increase when the teacher's behavior-specific praise increases (Sutherland, Wehby, & Copeland, 2000). To address behavior difficulties during intervention, interventionists were directed to calmly redirect the student with brief directives and to try to avoid sending students back to class for off-task behaviors. The purpose of adding this behavior management component was to prevent and address students' inattentive and disruptive behavior problems. When students are off task or demonstrate poor engagement in academic settings, this adversely affects achievement, and, conversely, significant academic engagement has a strong positive effect on achievement (Nystrand & Gamoran, 1989). The rationale for adding behavior management steps was that they would encourage and maintain intervention students' engagement and contribute to their learning of phonemic awareness and phonics skills.

The procedures for administering rewards to the students who earned them were standardized. When a student met the goal of following the three behavior expectations at an estimated 75 percent of the time, at the end of the intervention session, the student would pick one item from the prize box, which included prizes such as stickers, erasers, and pencils. The interventionists explained the following rules to the students: 1. Each student must pick one prize within a few seconds, 2. The student could not return or exchange a prize once he or she has selected one, and 3. The student could not tell the interventionist to keep a prize in the box for him or her to earn another day. The rules the interventionists followed were that the student would pick a prize immediately following the group, students could not lose points the earned, and if a student did not want to pick a prize that was acceptable and the interventionist would verbally praise the student. Additional reinforcement ideas included allowing the student to be a line leader, lunch time with a designated adult, or another teacher-approved reward.

Research on PAVII

PAVII has produced positive outcomes in two published studies with first grade students. Healy et al. (2005) implemented a 12-session version of PAVII with small groups of low socioeconomic status English learner first grade students. To participate in the study, 259 students were administered a reading mastery test, and those who scored below mastery level were administered phonemic awareness and phonics measures. The students whose scores fell within the 25th percentile on both measures were eligible to receive PAVII support in a small group setting. Graduate students implemented the intervention two times per week for 30 minute sessions. The analysis included three

groups of five students and one group of four students. To address behavior, students could each earn stars for engaging in appropriate behaviors. When they earned 10 stars, they were able to pick a prize from the treasure box. After 25 sessions, 80 percent of the 15 intervention students met their phonemic awareness and phonics goals. The exit criteria were that a student needed to reach a score of 45 correct phonemes on a phonemic awareness measure and 50 Correct Letter Sounds on a phonics measure.

Vanderwood and colleagues (2013) used a 12-session version of PAVII, and after 11 weeks of implementing PAVII for 30 minutes each session, there were significant differences between pre-intervention scores and post-intervention scores on phonemic awareness performance. The researchers found a significant interaction and differences in growth rates. In other words, the intervention closed the PA performance gap between themselves and typically performing peers. There was a significant interaction between group membership and time. They did not, however, find significant group differences in phonics outcomes as measured by a nonsense word fluency measure when they examined growth rate differences between intervention and non-intervention students. Additionally, treatment integrity results revealed that the four interventionists yielded an average treatment integrity score of 98 percent, suggesting that paraprofessionals can implement this intervention with high adherence to the manual's intended procedures.

For her dissertation project, Arellano (2013) conducted a study to evaluate the effects of a Spanish translated version of PAVII with Spanish-speaking kindergarten English language learners who struggled in both English and Spanish phonological awareness skills. Following nine weeks of this Spanish intervention, a regression

discontinuity design analysis was used and revealed a significant main effect for the intervention students' phonemic awareness skills in both English and Spanish. Another finding was a significant main effect for students' phonics skills in Spanish but not in English, and there was not a significant difference between students' growth in English as compared to Spanish measures of PA and phonics. Finally, measured treatment integrity was high, with average ratings of 98 percent and 97 percent. This suggests that graduate students were able to implement the Spanish translation of PAVII with strong treatment integrity. Because the structure and words were identical or highly similar to those of the English version of PAVII, it was expected that interventionists would also be able to implement the English PAVII curriculum well.

Contributions of this Study

This study offers a number of contributions to the current research literature base. First, compared to Arellano's (2013) project, the present study evaluates PAVII in English. Although Arellano (2013) used a regression discontinuity design, which is a powerful way to evaluate causal effects (Trochim, 1984), she evaluated a Spanish translation of the intervention that included Spanish phonemes. For example, rather than blending phonemes such as "/b/ /a/ /t/" to produce the English word, "bat," the students blended phonemes to produce Spanish words such as "/g/ /au/ /t/ /o/" for "gato" or "/p/ /a/ /n/" for "pan." Arellano (2013) translated PAVII into Spanish based on the concept that phonemic awareness skills transfer from Spanish to English (e.g., Quiroga, Lenos-Britton, Mostafapour, Abbott, & Berninger, 2002). One would expect, therefore, that children whose Spanish phonemic awareness skills improved with the Spanish PAVII

intervention would demonstrate improvements in English phonemic awareness skills as well. Arellano (2013) did find that Spanish phonemic awareness training led to improved English and Spanish phonemic awareness and Spanish phonics skills. However, these results cannot be applied to the English version of PAVII because this language difference between interventions means that the English version is a different intervention.

Because this study's version of PAVII is implemented in a different language, it is important to determine whether it is effective. There are external validity concerns regarding applying results from a Spanish intervention to the evaluation of an English intervention even if it is a close translation between languages. Specifically, one cannot assume English PAVII will be effective for any group of students if only the Spanish version has been evaluated because it is a different intervention. It is possible that while the Spanish PAVII effectively increases Spanish-speaking students' Spanish and English phonemic awareness and Spanish phonics, the English version might have different effects. For instance, the Spanish PAVII did not have a significant effect on English phonics (Arellano, 2013).

Because it is in English and does not require cross-linguistic transfer, English PAVII might have a larger effect on English phonics skills and also on phonemic awareness skills. Although Spanish phonemic awareness transfers to both English and Spanish phonemic awareness and phonics skills (Quiroga et al. 2002), intuitively, one would expect an English intervention would have a larger effect on an English reading skill. A study by Vaughn and colleagues (2006) found that an English intervention

provided to first grade English language learners resulted in stronger outcomes on English measures when compared to those on Spanish measures. Another possible outcome is that it might not be effective in English. For example, including both blending and segmentation is an evidence-based phonemic awareness activities (Torgesen, Morgan, & Davis, 1992). It is possible that PAVII, which features three phonological awareness activities in addition to segmenting and blending, features too many phonological awareness activities. The Spanish PAVII might be effective, but it is possible that one or more components of the English translation is not sufficient to improving English literacy skills.

The present project's research is also important to determine the benefits of this intervention on English-only speaking students and English language learner students who receive instruction at school only in English. Arellano's (2013) participants were all Spanish speakers who received core reading instruction solely in Spanish. This suggests that the current study's participants have different demographic backgrounds than those from Arellano's (2013) study and further highlights the need to evaluate PAVII in English with students receiving core reading instruction in English. The impact of PAVII on students receiving instruction in English is important to determine because students who need reading intervention should receive this support in the language of their instruction (Brown & Sanford, 2011). If effective, it would be appropriate to provide PAVII in English for students receiving instruction in English and PAVII in Spanish for students receiving instruction in Spanish. It might even be appropriate to provide PAVII in both Spanish and English for students, based on recommendations from The National

Center on Response to Intervention (2011), which emphasized the importance of considering a student's language proficiency in English and in his or her native language. Specifically, a school might provide intervention in a student's first language and second language or in both (Gersten et al., 2007).

Additionally, Arellano (2013) focused on outcomes for kindergarten students and used a 12-session version of PAVII that was administered three times per week for nine weeks. In contrast, interventionists provided the updated version of PAVII in English and was implemented with first grade students with 20 full sessions and three additional introductory sessions that helped train the students on the intervention's components. The students in the present study also received intervention support four days per week rather than three days, and the intervention was 10 weeks in total. Increasing the frequency of an intervention is one way in which to increase the intensity of intervention support (Batsche et al., 2005). The increased intensity of the present intervention was intended to provide students with more frequent support. The present study also evaluates outcomes for first grade students, whereas Arellano (2013) evaluated outcomes for kindergarten students. It is important to evaluate intervention outcomes for first grade because research has shown larger intervention effects for interventions provided before second grade (Wanzek & Vaughn, 2007). While reviewing results for kindergarten students is beneficial, it is important to address outcomes for first grade students because they might require a different level of support than younger students. Similarly, while first grade students benefit from phonemic awareness instruction, students in second grade and

higher might not benefit from phonemic awareness instruction as much as younger students (Ehri et al., 2001).

The Lack of Rigorous Evaluations of PAVII

While Arellano (2013) conducted a rigorous evaluation of a Spanish translation of PAVII using a regression discontinuity design, prior to the present study, researchers had not evaluated the English PAVII with an experimental or quasi-experimental design. Although other researchers have evaluated PAVII in English, they used descriptive data (Healy et al., 2005) and t-test analyses (Vanderwood et al., 2013). A review of the current research evaluating PAVII reveals that these studies are limited and have not yet sufficiently evaluated this intervention with rigorous statistical methods or analysis. Furthermore, in general, the experimental methodology of studies evaluating phonological awareness interventions has been poor (Troia, 1999). This study intends to contribute to the research literature not only regarding PAVII's efficacy but also regarding phonological awareness interventions more generally.

Treatment Acceptability

In addition, no studies have assessed treatment acceptability for this intervention. Wolf (1978) introduced the concept of social validity, a comprehensive term involving the social significance of a treatment's goals, procedures, and outcomes. Rather than focusing solely on an intervention or treatment's direct results, social validity addresses how acceptable it is within a social context. Treatment acceptability, a component of social validity, is the perception of how reasonable, justified, fair, and conventionally appropriate a treatment is for those who administer it (Kazdin, 1980). It specifically

addresses consumers' perceptions of a treatment's overall procedures. For example, applied to an academic intervention, a treatment acceptability scale could include a question about whether the interventionist believes the intervention appropriately targets the academic concern.

The analysis of treatment acceptability for PAVII is important because it affects how likely people are to implement an intervention. For example, Forman, Olin, Hoagwood, Crowe, and Saka (2009) found that the extent to which educators favor an evidence-based school intervention can be either a facilitator or barrier to implementation. For instance, 58 percent of participants identified teacher support as a significant factor that contributed to successful intervention implementation. Similarly, when teachers favored System 44®, a phonics-based reading intervention implemented on a computer, they expressed a strong desire to continue its implementation (Leko, 2014). Furthermore, when teachers rated a small group phonological awareness intervention positively, they expressed that they wanted to continue using the intervention in their classrooms (Kruse et al., 2015). Together, these findings reflect the powerful influence positive perceptions have on intervention implementation.

In addition to being more likely to implement interventions they find favorable, educators are more likely to implement these well. Efficacy data alone are not sufficient to influence educators to continue an intervention; the educators could dislike the materials and methods or the logistical challenges with creating groups (McDuffie & Scruggs, 2008). In a specific example, Mautone et al. (2009) reported that higher acceptability for a reading intervention is related to higher treatment integrity. When

individuals have a positive perception of an intervention, they are more likely to adhere to the intended intervention components than would individuals who have a less positive perception of it. Furthermore, researchers found that support from teachers is critical to the sustainability of a program (Nunnery, 1998; Witt & Elliott, 1985). This is important factor in intervention development because overall social validity increases when interventionists continue to use the intervention even after the support or expectation for its use is removed (Horner et al., 2005). Therefore, it is essential that educators find an intervention acceptable so that they are more likely to implement the intervention well and continue to do so.

Additionally, feedback directly from interventionists can help intervention developers and those who are searching for an appropriate intervention. If educators are aware of the acceptability ratings of effective interventions, they can either select among them an intervention with higher acceptability or attempt to increase the acceptability of an effective intervention (Miltenberger et al., 1990). For example, one study evaluated the treatment acceptability of a phonological awareness intervention for first grade students and found that teachers perceived it as beneficial academically but not helpful when there was a need to address significant behavior problems (Lane et al., 2007). This feedback from interventionists could have helped determine that a behavior management component was needed or suggested that the intervention was not appropriate for children with serious behavior challenges. These studies emphasize the importance of high treatment acceptability and the value of measuring it when evaluating an intervention. It also suggests the importance of collaboration between intervention developers and

individuals who are implementing the intervention (Mautone et al., 2009). If PAVII is both effective and highly acceptable, it would be a powerful tool that educators would likely implement well and continue using.

Conceptual Framework

Figure 1 presents a visual representation of difficulties students have with phonological awareness, the PAVII components that address these areas, and the theory regarding how research supports these components. Based on the preceding literature review, one would expect PAVII to significantly improve students' difficulties with phonological awareness. PAVII uses evidence-based phonological awareness strategies to explicitly teach students these skills with a direct instruction format with a model, lead, test approach. The conceptual framework illustrates the three types of phonological awareness problems PAVII addresses: (1) general phonological awareness, (2) difficulty identifying and producing phonemes, and (3) difficulty understanding how to apply it to verbalize words. PAVII addresses these difficulties in each of the 23 intervention sessions with specific activities. The students who receive PAVII support receive intensive intervention through a direct instruction model that explicitly teaches them how to recognize, produce, and manipulate phonemes.

First, PAVII addresses students' difficulty with general phonological awareness instruction through a rhyming activity. Such activities can be difficult for students because spoken words do not have easily identifiable segments that correspond to phonemes (Stahl & Murray, 1994). Rhyming is one activity that helps students develop phonological awareness (Adams, 1990; NRP, 2000). The PAVII script explicitly defines

rhyming with examples and helps students produce words that rhyme with specific words. Phonological awareness interventions, which can include rhyming activities, play an important role in learning to read (Cavanaugh et al., 2004; Melby-Lervag, Lyster, & Hulme, 2012; Snow, Burns, & Griffin, 1998). Therefore, one would expect this rhyming activity to improve first grade students' phonological awareness.

Second, children struggle to identify and produce discrete phonemes. Yopp (1988) described two types of phonemic awareness abilities: simple phonemic awareness, which includes phoneme segmentation, counting, blending, and isolation, and compound phonemic awareness, which consists of phoneme deletion. PAVII includes phoneme production, isolation, segmentation, counting, and blending activities. During phoneme production, the interventionist produces individual phonemes and the students repeat them in unison. The interventionist models how to pronounce the different phonemes students will identify and use throughout the session. The rationale for using both segmentation and blending activities originates from research recommending the combination of these two approaches (Slocum, O'Connor, & Jenkins, 1993; O'Connor, Jenkins, & Slocum, 1995) rather than only including either of the two alone. The interactive phoneme segmentation, counting, blending, and isolation activities explicitly teach the students how to engage in these tasks independently through its highly interactive and intensive design.

Third, students struggle to understand the purpose of phonemic awareness and how to apply it. According to Uhry (2013), phonemic awareness can be difficult to learn because children must be able to listen to a word and then segment it into separate

phonemes. They must also conceptualize phonemes by recognizing them, distinguishing between different phonemes, and manipulating them. PAVII teaches students the definition of phonemes and how to combine them to create words. In the phoneme segmentation activity, the interventionist provides a word and the students produce the individual phonemes. In the phoneme blending activity, students hear individual phonemes and produce the whole words. Overall, this conceptual framework can help improve the relationship between research and practice by guiding educators toward how to design or select an effective PA intervention. Because PAVII follows evidence-based phonological awareness and overall intervention strategies, one would expect it to effectively resolve students' difficulties with phonological awareness.

CHAPTER 3: METHODOLOGY

Introduction

This chapter will describe the methods used for participant recruitment, intervention implementation, and data collection. The first subsection will describe the process of identifying school participants based on the study's purposes and district-related restrictions. The next subsection addresses the intervention materials and steps followed. The final subsection presents the data analysis process and lists the hypotheses for each research question.

Participants

The primary researcher emailed all principals in one district at schools that were not already implementing a systematic intervention for first grade students to request voluntary participation in a phonological awareness intervention study. The participants were first grade students selected from a convenience sample from a suburban Southern California elementary school during the 2014-2015 school year. Although demographic data were not available from the 2014-2015 school year, during the 2013-2014 school year, 7 percent of the students in this school were English learners and 38.8 percent received free/reduced price meals (CDE, 2014). The student ethnic distribution included the following 43.1 percent Hispanic or Latino, 32.8 percent White, 9.4 percent Black or African American, 5.4 percent Asian, 4.1 percent Filipino, 0.2 percent Native Hawaiian or Pacific Islander, 0.6 percent American Indian or Alaska Native, 3.1 percent two or more races, and 1.5 percent of students' data were not reported. The participating school's students' demographic background characteristics are summarized in Table 1.

All intervention and comparison group participants in this study received instruction in their general education classrooms using kindergarten Macmillan/McGraw-Hill Treasures Reading curriculum.

Procedure

In the current study, participants were recruited from one elementary school in Southern California. First, the school district's research review board approved the study. The site principal and first grade team at the participating school assisted the principal investigator (PI) with identifying interventionists and determining times and locations for the intervention groups. Parent consent forms were sent to the parents of all first grade students' parents to obtain permission to administer beginning-of-year and middle-of-year DIBELS Next and easyCBM probes. The first grade teachers collected consent forms and submitted them to the PI. Before students began intervention, parental consent was obtained from the parents of students selected for intervention based on their beginning-of-year PSF scores. The intervention groups began and the two research assistants collected treatment integrity data to measure the extent to which the teachers delivered the intervention. These research assistants also collected all beginning-of-year and middle-of-year data for all participating intervention and comparison group students. At the end of the intervention, the PI met with the interventionists to distribute and collect anonymous treatment acceptability ratings.

Student Selection Process

Students were selected for participation in PAVII based on their beginning-of-year phonemic awareness skills, as measured by their Dynamic Indicators of Basic Early

Literacy Skills (DIBELS) Next scores on Phoneme Segmentation Fluency (PSF), a measure discussed below. Students who scored 0 through 26 on PSF received intervention. The cutoff score was based on the first grade beginning-of-year PSF risk categories and the number of students who scored in each score range. All students who received intervention scored in either the Below Benchmark or Well Below Benchmark range based on the DIBELS Next score ranges. All students who scored in the Well Below Benchmark range participated in the intervention. However, not all students who scored in the Below Benchmark range participated due to group size restrictions. The groups would have been too large if students who scored 27 or higher received intervention.

PAVII Implementation

This study used a 23-session version of PAVII, including three 15-minute introductory sessions (Session A, Session B, and Session C), which gradually introduce the students to the intervention's structure and activities. As shown in Table 2, each full session of PAVII following the three introductory lessons consists of approximately 30 minutes of instruction targeting vocabulary and PA. The sections are titled Vocabulary, Phoneme Production/Replication, Phoneme Segmenting and Counting, Phoneme Blending, Phoneme Isolation, and Rhyming. The vocabulary activity explicitly introduces words that are used during the session's PA activities with definitions, example sentences, and practice questions with the students. In the Phoneme Production/Replication activity, students chorally repeat phonemes the interventionist says. In the Phoneme Segmentation and Counting activity, students segment the sounds

in words and count the number of phonemes in each word. For the Phoneme Blending activity, students listen to the interventionist produce individual phonemes and then blend the sounds to produce a word. For Phoneme Isolation, the students identify the first, middle, or last sound in a word. Finally, the Rhyming activity involves producing words that rhyme with a given target word or word ending. Compared to the original PAVII manual, the current manual now includes eight additional sessions and three additional introductory sessions, a phoneme pronunciation guide for interventionists, and an updated treatment integrity checklist. Further analysis with this possibly improved version of PAVII is needed.

The interventionists delivered one 30-minute session per day for four days per week, following the Institute of Education Sciences' (Gersten et al., 2008) recommendation of providing intervention for 20 to 40 minutes three to five days per week. The intervention sessions included 10 weeks and three days of intervention. The total number of intervention sessions was 43, which included three 15-minute introductory sessions (Sessions A, B, and C), 20 30-minute sessions, and then one repeated cycle of the same 20 30-minute sessions. Interventionists exited a student from the intervention once he or she had reached the middle-of-year PSF first grade cut score of 40 and NWF-CLS goal of 43 for first grade three times each.

Two advanced graduate student research assistants from a school psychology Ph.D. program assisted with intervention training and data collection. Each of them had coursework and fieldwork experience with intervention implementation, curriculum based assessment tools, and research methods. They also delivered PAVII with first grade

students prior to this study. Both assistants were employed as RtI specialists for the same Southern Californian school district at the time of this study and had provided staff trainings, presentations, and consultative support to educators. Their support activities included providing trainings for DIBELS Next measures and modeling how to administer these tools. One research assistant conducted a one-hour training involving a presentation addressing the rationale for providing the intervention, training on the essential components of the intervention, a demonstration of the intervention with the interventionists, and practice with the training group. Two research assistants conducted treatment integrity observations for all interventionists using a treatment integrity checklist (See Appendix) that includes a Likert scale rating for each of the components for each activity in the observed session. The same research assistants and two additional research assistants collected inter-rater reliability data for all teachers who collected beginning-of-year and mid-year screening data.

Behavior Management

The present study also included a behavior management component. Researchers have found that engagement is an important mediating variable between instruction and academic achievement (Greenwood, Terry, Marquis, & Walker, 1994). That is, when students are engaged during instruction, they are less likely to participate in incompatible off-task behaviors such as talking. Furthermore, the absence of a behavior management component for interventions, including phonological awareness interventions, can result in difficulties with behavior management (Lane et al., 2007). Simonson et al. (2013) listed various evidence-based practices for effective behavior management, including the

following: high structure and predictability, a physical arrangement that minimizes distraction, active supervision, a high rate of opportunities to respond, direct instruction, and error corrections. Finally, interventionists posted, taught, reviewed, and provided feedback on expectations. Behavior management is particularly important for intervention students because the students with the lowest academic skills benefit more from engagement than their classmates (Carini, Kuh, & Klein, 2006). These studies suggest the importance following behavior management strategies to increase academic engagement.

The behavior management components of PAVII were research-based recommendations, particularly those of Simonsen et al. (2013). On the first day of intervention, the interventionists described the following behavior expectations verbally: "Hands and feet to yourself," "Eyes on the teacher," and "Bottom in your seat." They then showed the students the picture corresponding to each picture and modeled the appropriate behaviors. Throughout each session, the interventionist pointed to the pictures when praising appropriate behaviors whenever possible and when redirecting problem behaviors such as touching peer, looking around the room or at peers, and standing. The interventionists reviewed these expectations briefly before each session because clearly explaining, modeling, and reinforcing appropriate behaviors and systematically responding to disruptive behavior reduces the level of disruptive behaviors in elementary schools (Nelson, 1996). At the end of each 30-minute session, they provided a percentage rating for each student reflecting how well each student followed the group rules. If a student's percentage of time following the rules was 75 percent or

higher, the student received a prize. After five weeks of providing students the opportunity to earn a prize after each of the four sessions, the interventionists only offered the opportunity to earn prizes three out of four sessions each week to avoid satiation.

Measures

Data Collection

The participating school district collected DIBELS Next screening data three times per year in September, January, and May. For this study, to ensure consistency, the same two research assistants administered Phoneme Segmentation Fluency (PSF) to all first grade students at the participating school at the beginning and middle of the year. They also administered DIBELS Next Nonsense Word Fluency (NWF) and easyCBM Word Reading Fluency (WRF). Descriptions of these measures are below.

DIBELS Next

Student participants were identified based on first grade students' fall DIBELS Next (Dynamic Indicators of Basic Early Literacy Skills Next; Good & Kaminski, 2011) Phoneme Segmentation Fluency (PSF) screening scores. DIBELS consists of brief measures of four basic reading skills: phonemic awareness, phonics, fluency, and comprehension. These are curriculum-based measures used to identify children in kindergarten through sixth grade who are at-risk for reading failure. The DIBELS scores fall into three risk categories: At or Above Benchmark, indicating an 80 to 90 percent likelihood of achieving later early literacy goals, Below Benchmark, indicating a 40 to 60 likelihood of achieving later reading goals, and Well Below Benchmark, which suggests

a student is 10 to 20 percent likely to reach these goals. The school created four small intervention groups of five to six students (three groups of five students and one group of six), which is consistent with the number range of three to five that Torgesen (2005) recommended for small group sizes. The interventionists who volunteered to participate received a Target gift card in the amount of $25. Informed consent was obtained from all intervention participants' parents or guardians, and assent was obtained from all intervention participants.

Phoneme Segmentation Fluency (PSF)

PSF is a one-minute, individually administered DIBELS Next measure of phonemic awareness for kindergarten and first grade students. During this test, the assessor reads words individually and the student produces the sounds in each word. The score is the number of correctly identified sound segments produced in one minute. The participants' fall screening PSF scores were used as the assignment variable that determined which students would receive intervention. Their winter PSF scores were also used in the regression discontinuity analysis as a post-intervention test to determine whether PAVII had an effect on the students' phonemic awareness scores. The inter-rater reliability for PSF was .96, the concurrent criterion-related validity with Nonsense Word Fluency was .51 for the middle of the year, and the two-week alternative form reliability for kindergarten was .44 (Good et al., 2011). The DIBELS Next developers calculated validity scores for both Phoneme Segmentation Fluency and Nonsense Word Fluency based on scores on the Group Reading Assessment and Diagnostic Evaluation Tool

(GRADE; Williams, 2001).

Nonsense Word Fluency (NWF)

Although the intervention targets PA, it was expected that the students' phonics skills would grow because the development of phonemic awareness is a precursor to the development of phonics skills (Adams, 1990) and because previous studies have found at least one result suggesting the transfer of phonemic awareness skills to phonics skills (Healy et al., 2005; Arellano, 2013, Vanderwood et al., 2013). NWF was used as an outcome measure. NWF is a one-minute DIBELS Next, individually administered measure of alphabetic principle and basic phonics skills for kindergarten through second grade students. During this test, the assessor asks the student to read nonsense vowel-consonant and consonant-vowel-consonant words. The test is scored based on the number of correct letter sounds and whole words read. Good et al. (2011) provided validity and reliability data for NWF in its technical manual. The inter-rater reliability for NWF was .99. Compared to the DIBELS Next composite score, the predictive criterion-related validity coefficient for NWF was .47 for Correct Letter Sounds. The predictive criterion-related validity coefficient for NWF correct letter sounds with the GRADE was .56 for first grade students at the end of the school year. The two-week alternative form reliability for kindergarten was .71 (Good et al., 2011).

easyCBM Word Reading Fluency (WRF)

While NWF is a measure of alphabetic principle and basic phonics skills, the number of correct letter sounds does not account for the skills required for blending the sounds together (Fuchs, Fuchs, & Compton, 2004). Word Reading Fluency (WRF) is a

measure of fluency of reading individual words and is a better tool for assessing early reading development in first grade than NWF based on concurrent and predictive validity (Fuchs, Fuchs, & Compton, 2004). WRF was administered before and after the intervention. While NWF measures phonics skills without the influence of other factors such as sight word recognition, WRF measures decoding and sight word reading (Wray, Cheng-Fei, Saez, Alonzo, & Tindal, 2013). WRF is a one-minute test during which the student reads real words on a list of decodable and common sight words. It was developed for kindergarten through third grade students based on Dolch word lists used to determine the grade-level appropriate words (Alonzo & Tindal, 2007). A score on a WRF passage is the number of words read correctly within a minute. Errors and skipped words are counted as incorrect. (Jamgochian et al., 2010). Alternate form reliability for first grade students ranged from .95 to .96 (Alonzo & Tindal, 2007).

PAVII Treatment Integrity Checklist

The treatment integrity checklist is an objective measure of the extent to which an interventionist followed the important components of the PAVII during one session. The two graduate students who collected data for Vanderood, Tung, and Arellano's (2013) study created this treatment integrity checklist for their study. They created a list of components described in the PAVII manual. The principal investigator for the current study adapted this checklist to include more items, add a Likert scale for each rating, and to provide explicit treatment integrity calculation directions with an example. To complete a treatment integrity checklist, an observer views one full session of PAVII and selects a score from a three-item Likert scale corresponding to 0 (Never), 1 (Sometimes),

and 3 (Always) for each component. Components include “Interventionist reads all definitions listed in listen plan,” “Interventionist uses a hand signal to elicit unison responses,” and “Interventionist accurately models all phonemes.” When the observer completes the treatment integrity checklist, he or she calculates the final treatment integrity score by dividing the total number of points awarded divided by the total number of possible points. See Appendix for the complete treatment integrity checklist.

Treatment Acceptability Scale

To measure acceptability, the Intervention Rating Profile-15 (IRP-15; Martens, Witt, Elliott, & Darveaux, 1985) was adapted to include statements directly related to reading intervention rather than a behavior intervention. The IRP-15 is used to assess teachers’ acceptability of an intervention and is a shortened version of the Intervention Rating Profile (IRP; Witt, Martens, & Elliot, 1984). As displayed in Appendix B, the IRP-15 includes statements (e.g., “I liked the procedures used in this intervention.”) to which participants respond on a six-point Likert scale, with higher scores ranging from 1 for Strongly Disagree to 6 for Strongly Agree, indicating that higher scores are associated with a higher acceptability rating. The IRP-15 was designed to measure “general acceptability” and in a principal components factor analysis, it yielded one primary factor with item loadings rating from .82 to .95, and its reliability using Cronbach’s alpha was .98 (Martens, Witt, Elliott, & Darveaux, 1985, p. 193).

Analytical Method

Analysis 1: Regression Discontinuity Design

A quasi-experimental design, regression discontinuity (RD), was used to evaluate the effectiveness of the intervention (See Figures 2 and 3). While the randomized controlled trial (RCT) design is considered the gold standard research design, others are available that are also appropriate for reading intervention research and can be used to make conclusions about causal relationships between interventions and outcome measures. The random assignment component of RCT designs ensures that the treatment and comparison groups are equivalent so that differences in outcomes can be attributed to the treatment rather than to other factors. However, because random assignment for reading interventions is not always feasible in a school setting, researchers can use RD to evaluate causal relationship. RD allows researchers to test causal hypotheses about manipulable causes without random assignment and is one of the strongest quasi-experimental designs because it involves known assignment procedures (Shadish, Cook, & Campbell, 2002; Trochim, 1984). Research suggests that RD studies reproduce the results of randomized experiments conducted on the same topic, suggesting that RD is a generally robust design (Cook & Wong, 2008). Additionally, causal inferences from RD designs can be as credible as those from randomized experiments (Lee, 2008).

Through RD, the investigator assigns participants to either an intervention or comparison condition based on a predetermined cutoff score on an assignment variable. Participants who score below a pre-set cutoff value receive the treatment, and participants who score at or above the cutoff score do not receive the treatment. For example, if the

cutoff score is 20 on a pre-test assessment, all individuals who scored between 0 and 19 would receive the treatment, while the other individuals who scored 20 and higher would not receive the treatment. The researcher determines whether the intervention was effective by comparing the regression lines for the treatment and comparison groups. If the difference in mean outcomes between the regression lines for the treatment and comparison group units (e.g., students) is significant, the investigator can conclude that the intervention had an effect. That is, if a significant discontinuity exists at the cutoff score between the intervention and comparison group regression lines, the intervention had an effect on student outcomes. If a significant discontinuity does not exist at the cutoff score between the intervention and comparison group lines, as in Figure 3, the intervention did not have an effect on student outcomes.

The main assumption of the RD design is that all treatment and comparison students would have the same relationship between their pre-test and post-test scores in the absence of treatment (Trochim, 1984). However, there are five additional assumptions required for RD (Trochim, 1984). First, the cutoff score criterion must be followed without any misassignment relative to the cutoff score. When identifying students for intervention, for instance, the researcher must only use the cutoff score to determine group membership and cannot assign students to groups based on factors such as teacher judgment. Second, the statistical analysis applied provides the correct model for the data. For example, if there is a linear relationship between the pre-test measure and the post-test measure, the RD model must be estimated as a linear model. Failure to accurately specify the model would result in a misspecified, inefficient model. For the present study,

linearity was examined statistically with the inclusion of quadratic terms in the first model. If the quadratic terms were not significant, they were removed from the model. Third, a sufficient number of observations exist in the comparison group. Fourth, both groups originate from a single pretest distribution. The cutoff value then divides this original distribution into two groups. Finally, the assigned conditions are provided to the intervention and comparison groups uniformly. That is, the intervention group participants received the same amount of intervention instruction, and the comparison group participants did not receive any intervention.

For this study, a regression discontinuity design was used to identify students based on their performance on the assignment variable. Students who scored 0 through 26 received intervention. These cutoff scores were based on the beginning-of-year cutoff scores and the number of students who scored in each score range. All students who received intervention scored in either the Below Benchmark or Well Below Benchmark range based on the DIBELS Next score ranges. As previously discussed, students who score in the Well Below Benchmark range are about 10 to 20 percent likely to reach the next benchmark score or be successful in reading without intervention support, and students who score in the Below Benchmark range are about 40 to 60 percent likely to reach the next benchmark score or be successful in reading without intervention.

Research Questions 1a and 1b. To address the first two research questions, which aim to identify the extent to which there is a significant difference between the intervention students and their comparison group on (a) phonemic awareness outcomes and (b) phonics outcomes, the main effect coefficients were evaluated for the phonemic

awareness model and the phonics model. This question focuses on whether a difference will result between the treatment group and the comparison group on students' phonemic awareness and phonics skills. Ordinary least squares regression was used, and PA and phonics were analyzed separately.

Data Analyses An RD analysis was used to address research questions 1a and 1b.

$$y_i = \beta_0 + \beta_1 x_i^* + \beta_2 z_i + \beta_3 x_i^* z_i + \beta_4 x_i^{*2} + \beta_5 x_i^{*2} z_i + e_i$$

Where:

y_i = outcome measure for individual i (i.e., DIBELS PSF, DIBELS NWF, or easyCBM WRF)

β_0 = y-intercept for the comparison group regression line at cutoff

β_1 = slope parameter

x_i^* = pre-test score for individual i minus the value of the cut-off, x_0 (i.e., $x_i^* = x_i - x_0$)

β_2 = treatment effect estimate (i.e., main effect)

z_i = assignment variable (1 if treatment participant; 0 if comparison participant)

β_3 = linear interaction effect (difference in slopes between the lines of the two groups)

β_4 = quadratic pretest coefficient

β_5 = quadratic interaction

e_i = random error for individual i

The equation above was used to examine phonemic awareness outcomes for one model, phonics outcomes for a second model, and fluency outcomes for a third model. The inclusion of multiple covariates is not problematic for the regression discontinuity design

and can simply be added to the regression equation; the only restrictions are that they must not be the assignment variable and that they are not caused by the outcome variable (Judd & Kenny, 1981). With covariates in the model, the results are more efficient and result in higher conclusion validity. The analysis procedures followed the guidelines of Jacob, Zhu, Somers, and Bloom's (2012) and Trochim (1984) based on the assumption that the statistical analysis applied provides the correct model for the data. First, the researcher conducted regression analyses for the simple linear, linear interaction, quadratic, and quadratic interaction models and compared estimates of standard error of the estimate, R-square values, and p-values. If a model with higher-order terms was identified as the model that best fit the data, nonsignificant parameters were removed to reduce the standard error. It is important to follow these methods to identify the best fitting model for estimating treatment effects and ensure that the model is not misspecified with too many or too few parameter estimates (Jacob et al., 2012). Accurate model specification allows for an unbiased estimation of treatment effects (Trochim, 1984).

Analysis 2: Treatment Integrity

For the second research question, two research assistants assessed treatment integrity using the intervention treatment integrity checklist. This checklist contains a list of the components that should be present during each intervention session, and the integrity score reflects the percentage of components the interventionist implemented. All interventionists were observed once. The ideal range of integrity scores would be from 80 to 100 percent (e.g., Sanetti & Kratochwill, 2008). The treatment integrity checklist (See

Appendix) consists of a list of required intervention components for each activity as well as for the corrective procedure. The intervention observer rates the presence of each component on a Likert scale ranging from 0 to 2 (0=Never observed, 1=Sometimes observed, 3=Always observed). The overall treatment integrity score was calculated as the total number of points awarded for observed components divided by the total possible number of points. The number was then be divided by 100 to produce a percentage.

Analysis 3: Treatment Acceptability

For the final research question, the examiner collected anonymous teacher rating from all interventionists. The primary researcher collected treatment acceptability data using an adapted form of the Intervention Rating Profile-15 (IRP-15; Martens, Witt, Elliott, & Darveaux, 1985), which assesses teachers' acceptability of an intervention (See Appendix B). All interventionists completed this scale once individually and confidentially after the intervention groups had ended but before they learned that the purpose of the study.

Expected Outcomes of PAVII

Hypotheses

Based on current research on the efficacy of PAVII and of phonemic awareness interventions provided before second grade, the following hypotheses describe the expected results of this study:

Hypothesis for Research Question 1a. It was hypothesized that there would be a significant difference between the intervention students and the comparison group on phonemic awareness.

Hypothesis for Research Question 1b. Given the results of previous studies examining the transfer of PA to phonics and alphabetic principle (e.g., Adams, 1990; Ball & Blachman, 1991) and the effects of PAVII on both phonemic awareness and phonics outcomes (Healy et al., 2005; Vanderwood et al., 2013) it was hypothesized that there will be a significant difference between the intervention students and their comparison group for phonics skills. It was hypothesized that there would be a significant difference between the intervention students and their comparison group on both nonsense word (i.e. NWF) and sight word (i.e. WRF) outcomes.

Hypothesis for Research Question 2. Given that past research with the 12-session version of PAVII was implemented in a small group of six students with an average integrity of 98 percent and that this intervention was designed to be easily implemented (Vanderwood et al., 2013), it was hypothesized that teachers would implement PAVII with a high degree of integrity of at least 90 percent with the small groups of students.

Hypothesis for Research Question 3. Previous research has found that treatments tend to have higher acceptability when they involve less time and are less restrictive, necessary, and likely to be most effective (Miltenberger, 1990). Teachers have also rated interventions as more favorable when they are less complex and less time-consuming (Elliott, Witt, Galvin, & Peterson, 1984). Due to the explicit, scripted, and straightforward structure of PAVII and its intended simplistic directions with step-by-step directions, a verbatim script, and a limited amount of time and materials required, it was

hypothesized that interventionists would provide an average treatment acceptability score of 80 percent positive ratings or higher.

CHAPTER 4: RESULTS

Introduction

This chapter presents the results of the regression discontinuity analysis. First the procedures used to prepare the dataset will be reviewed. Second, a power analysis will be conducted. Third, the dataset will be described and an explanation for how missing data were addressed will be provided. Finally, the steps followed in the regression discontinuity analysis, treatment integrity, and treatment acceptability will be described. Finally, the outcomes of all analyses will be revealed.

Assumptions

All assumptions were considered when viewing the final data. The first assumption of the RD design is that all treatment and comparison students would have the same relationship between their pre-test and post-test scores in the absence of treatment (Trochim, 1984). Previous evidence suggested a linear relationship between these scores (Trochim, 1984), and the data for all variables confirmed this assumption. Second, the cutoff score criterion must be followed without any misassignment relative to the cutoff score. When identifying students for the current intervention, only the cutoff score determined group membership and the PI did not assign students to groups based on any other factors, including teacher judgment. Third, the statistical analysis applied is assumed to provide the correct model for the data. For example, if there is a linear relationship between the pre-test measure and the post-test measure, the RD model would be estimated as a linear model. For the present study, linearity was examined statistically with the inclusion of quadratic terms in the final model. If the quadratic terms were not

significant, this suggests the data are linear and the quadratic terms were removed from the model. If the quadratic terms were significant, these terms remained in the model. Fourth, a sufficient number of observations must exist in the comparison group. Based on power guidelines for regression discontinuity designs, a total sample size of 68 is required to be able to detect a large effect size (Cappelleri, Darlington, & Trochim, 1994). The sample sizes, including both treatment and comparison group participants, were *N*=108 (pre-intervention PSF), and *N*=107 (post-intervention PSF), *N*=107 (post-intervention NWF), and *N*=107 (post-intervention WRF). Fifth, both groups originate from a single pretest distribution. For this study, the students were identified as intervention or comparison group students based on their beginning-of-year PSF scores. The final assumption is that the assigned conditions were provided to the intervention and comparison groups uniformly. In this study, the intervention group participants received the same amount of intervention, and no students from the comparison group participants received the intervention. The intervention students received the same number of intervention sessions for the same number of days over the same number of weeks.

Power Analysis

Cappelleri, Darlington, and Trochim (1994) provided power curves for small, medium, and large effect sizes across multiple types of research designs, including regression discontinuity designs. They also provided sample size recommendations associated with various power estimates. The sample size estimate for this study was determined based on the power level of .80 for large effects with regression discontinuity designs displayed in Figure 3 of Cappelleri and colleagues' paper (p. 151). These

researchers used the Fisher Z method (Darlington, 1990) to develop an algorithm specific to both cutoff-based randomized controlled trials and the regression discontinuity design (Cappelleri et al. 1994). They applied a Fisher's Z transformation to the partial correlation coefficient between the outcome measure and the treatment status. In this approach, power is "the probability of rejecting the null hypothesis that the true partial correlation between the outcome and treatment variables equals zero if it in fact equals some prespecified alternative" (Cappelleri et al., 1994, p. 144). The following equation represents how this research team calculated power estimates for RD designs:

$$1 - cdfn\left[\frac{fz}{se(fz)}\right] - z\ value$$

Where the following represent each term in the equation above:

cdfn = cumulative density function of a normal distribution

fz = Fisher's Z transformation = .5 ln $\frac{[1+pr]}{[1\ [\ pr]}$

se(fz) = Standard error of fz = $1se(fz) = \frac{1}{\sqrt{\{number\ of\ cases\}-4}}$

z value = z value corresponding to a specified significance level and the direction of the

alternative hypothesis

Based on the guidelines of Cappelleri et al. (1994), for a power level of .80, meaning there is an 80 percent probability of rejecting the null hypothesis that the true partial correlation between the outcome and treatment variables equals 0 if it truly equals some pre-specified alternative, a study using an RD design would require a sample size of 68 to detect a large effect size. The selection of a large effect size was based on past

studies that have found large effect sizes for phonemic awareness interventions (Bus & van IJzendoorn, 1999; Cavanaugh, Kim, Wanzek, & Vaugn, 2004; Ehri et al., 2001; NRP, 2000). For example, Bus and van IJzendoorn (1999) conducted a meta-analysis of phonological awareness intervention studies and calculated an effect size of 1.04 for phonological awareness outcomes. When Cavanaugh et al. (2004) reviewed evaluated the results of interventions with phonological awareness instruction without print, most produced large mean effect sizes of .84 to 4.27. The NRP (2000) and Ehri et al. (2001) each reported a large effect size of .86 for the overall effect size of PA instruction on PA outcomes.

Compared to the samples included in these meta-analyses, the present study's sample is a subgroup of those whose outcomes were measured in the meta-analyses. Bus and van IJzendoorn (1999) included data from preschool through the primary grades. The NRP (2000) also included samples from preschool through the primary grades and included a wide variety of students, including those with and without a reading disability and those at-risk for reading failure. Furthermore, they examined outcomes from PA instruction in individual, small group, and whole class settings. Cavanaugh et al. (2004) analyzed data from kindergarten students. Ehri et al. (2001) analyzed data from preschool through sixth grade who were either at-risk for reading problems or classified as reading disabled. All of these meta-analyses included results from interventions conducted both with only a PA curriculum and those with combined PA and letter-sound correspondence support. The present study evaluated outcomes from an intervention with only PA activities. In addition, all participants were in first grade from a suburban location in

Southern California and identified as at-risk for reading failure. Therefore, the expected effect sizes of PAVII's effect on PA and phonics outcomes have the potential to be large, but because this group of participants is from a specific subgroup, these effect sizes could be smaller.

Preparing the Data for Analysis

The sample included participants from a large school district in Southern California. Students were selected from a school that had not previously implemented PAVII with first grade students and had not already agreed to implement a particular intervention through the school district. The data were screened for data entry errors, missing data, possible outliers, and for normality.

Missing Data

Prior to data analysis, the scores for 25 students, which was 10.3 percent of students, were excluded due to missing beginning-of-year (BOY) data (14 out of 25 or 56 percent of the excluded students) or due to teacher request (11 out of 25 or 44 percent of the students). The BOY data were missing because students either enrolled after the BOY screening or they were not tested for unknown reasons. All students whose teachers requested to exclude their data from analysis belonged to the comparison group and did not receive intervention. These teachers did not want their students to participate in the study either due to severe speech and language difficulties or because they were reading well despite their low phonemic awareness scores at the beginning of the year. Although they agreed to the requirements and design of this study, they refused to allow their students to participate further in the study after their screening data were collected.

Outliers

The dataset was examined for outliers based on scatterplots of the assignment variable and the creation of z-scores for these values. Based on the guidelines from Raykov and Marcoulides (2008), outliers are scores with z-scores greater than 3 or smaller than -3 whose z-scores are disconnected from the z-scores of the other observations. No outliers were identified through this process.

Descriptive Statistics

The participants' demographic information is available in Table 1. Of the intervention students, 57 percent were male, while 43 percent were female. Similarly, in the comparison group, 51 percent were male, and 49 percent were female. Of the intervention students, 7 percent were English language learners, 79 percent only spoke English, and data were not available for 14 percent of these students. Of the comparison students, 6 percent were English language learners, 88 percent only spoke English, and this information was not available for 6 percent of these students. In the intervention group, 50 percent of students were white, 0 percent were Hispanic, 21 percent were Asian, 29 percent were African American, and 0 percent were of mixed ethnic backgrounds. In the comparison group, 32 percent of students were white, 43 percent were Hispanic, 11 percent were Asian, 11 percent were African American, and 2 percent were of mixed ethnic backgrounds. Overall, there were similar percentages of male and female students in intervention and non-intervention groups. There were slightly more English language learners in the intervention group than in the comparison group. There were also more students in the intervention group who were white, Asian, and African

American when compared to the students in the comparison group, and there were more Hispanic students in the comparison group when compared to students in the intervention group.

Inter-rater Reliability

Four research assistants collected inter-rater reliability during beginning-of-year screening and mid-year screening. According to Hartmann et al. (2004), minimum acceptable values of inter-rater agreement range from 80 to 90 percent if measured by percentage agreement. The present study's pre-intervention inter-rater reliability percentages were the following: The average beginning-of-year PSF inter-rater reliability was 95 percent (range: 92-95 percent), which included 4.5 percent of the data. The mid-year average PSF inter-rater reliability was 86.1 percent (range: 58.5-98.6 percent), which included 17.3 percent of the data. The average beginning-of-year NWF inter-rater reliability was 95 percent (range: 92-97 percent), which included 4.5 percent of the data. The average middle-of-year NWF inter-rater reliability score was 97 percent (range: 92-100 percent), which was 4.5 percent of the data. The beginning-of-year average WRF inter-rater score was 100 percent (range: 100-100 percent), which included 4.5 percent of the data. The middle-of-year WRF inter-rater score was 89 percent (range: 90-100 percent), which included 19.1 percent of the scores at this time.

Analysis 1 – Regression Discontinuity

Research Question 1a: Intervention Effects on Phonemic Awareness

Visual inspection of the bivariate distribution between students' PA pre-test scores and students' PA post-test scores revealed a clear discontinuity at the cut-off but

also what appears to be a possible interaction effect (see Figure 4). To examine the statistical significance of this discontinuity, a regression analysis was conducted. First, based on Jacob and colleagues' (2012) guidelines, the appropriate functional form was selected for the regression estimation, starting with a simple linear regression analysis and then adding higher-order polynomials and interaction terms to it. An F-test was then used to eliminate models that were overly restrictive models, and the models were compared in terms of residuals, standard error of the estimate values, R-square values, p-values, and the significance of terms to identify the most appropriate model for the data. While the model containing a quadratic term produced the lowest standard error of the estimate value and the highest R-square value, the quadratic term was not significant, $t(106)=1.43$, $p=.16$. This term was then dropped from the model. However, the final model revealed a significant linear interaction, $t(106) = 3.27$, $p<.01$ (see Table 4).

Research Question 1b: Intervention Effects on Phonics

Visual inspection of the bivariate distribution between students' PA pre-test scores and phonics post-test scores revealed a slight discontinuity at the cut-off, suggesting a possible treatment effect (see Figure 5). However, the regression lines indicated a possible interaction effect as well. To examine the statistical significance of the discontinuity and interaction, regression analysis was conducted again using Jacob, Zhu et al.'s (2012) guidelines for regression discontinuity analyses. When comparing regression models, the simple linear model produced the lowest standard error of the estimate and the lowest p value. The final model revealed that the main effect for Nonsense Word Fluency was not significant, $t(108)= 0.02$, $p=.98$ (see Table 5). This

model accounted for .6 percent of the variance in students' phonics skills and 1.7 percent of the variance in students' phonemic awareness skills.

To further assess students' phonics outcomes, an analysis was conducted with WRF scores as outcomes. Visual inspection of the bivariate distribution between students' PA pre-test scores and students' post-test word fluency scores revealed a clear discontinuity at the cut-off, suggesting a treatment effect (see Figure 6). Based on model comparisons, the simple linear model produced the lowest standard error of the estimate and a lower *p* value when compared to the linear interaction model. The final model indicated that the main effect of the intervention on WRF performance was not significant, $t(108) = .80$, $p = .43$ (see Table 6). This model accounted for 2.9 percent of the variance in students' phonics skills.

Analysis 2: Treatment Integrity

Treatment integrity was measured once for each interventionist (see Table 7). One treatment integrity observation was 2.5 percent of the 40 full sessions (introductory sessions A, B, and C are not included in this number). In total, one research assistant observed each interventionist one time, which was a total of 2.5 percent of all 160 full sessions across all interventionists. It was hypothesized that teachers would implement PAVII with a high degree of integrity of at least 90 percent based on findings from previous studies (Arellano, 2013; Vanderwood et al., 2013). Based on the data, the intervention was delivered with a high degree of integrity by all interventionists. According to Sanetti and Kratochwill (2008), 80 percent treatment integrity is considered high. The interventionists had integrity scores of 94.7 percent, 91 percent, 82 percent, and

99 percent. The average integrity score across the four interventionists was 91.68 percent, as shown in Table 7. Most of the integrity scores were 90 percent or higher, which supports the hypothesis that treatment integrity values would be at least 90 percent.

Analysis 3: Treatment Acceptability

Treatment acceptability was measured based on a rating scale that all interventionists completed after the study ended but before the principal investigator revealed the purpose of the intervention to prevent this information from influencing their rating. It was hypothesized that the interventionists would provide high treatment acceptability ratings of at least an average of 80 percent across raters. Based on the results, the four interventionists rated PAVII with a level of treatment acceptability between 69 percent and 88.1 percent. The average of their ratings was 77.7 percent of 84, the total possible points. Two of the four percentage values were higher than 80 percent. The highest rated items were the following: "This would be an acceptable intervention for a child's phonemic awareness problem" (M= 5.25, SD=.96) and "This intervention would *not* result in negative side-effects for the child" (M= 5.75, SD=.5). The lowest rated item was "This intervention would be appropriate for a variety of children" (M= 3.25, SD=2.22). The results do not support the hypothesis that treatment acceptability ratings would be 80 percent or higher on average. As displayed in Table 8, the average treatment acceptability rating was 65.25, which was 77 percent of the total possible points.

CHAPTER 5: DISCUSSION

Introduction

This section will summarize and discuss the results of this study. It will explain the results for phonemic awareness, phonics, treatment integrity, and treatment acceptability analyses and describe how these findings are consistent or inconsistent with previous research.

Summary of Key Findings

Effect of Intervention on Phonemic Awareness

The results of this study offer preliminary data regarding the efficacy of PAVII and its treatment acceptability. The findings suggest that PAVII's effect on phonemic awareness skills was moderated by students' initial phonemic awareness level. This indicates that PAVII was differentially effective, depending on students' pre-intervention phonemic awareness skills: Students with the highest phonemic awareness skills in the fall benefited more from intervention on phonemic awareness skills than did students with lower phonemic awareness skills. This is similar to the findings of another study that found that children with higher initial scores in phonological analysis developed word-reading skills at a faster rate when controlling for initial level of orthographic skill, age, and treatment (Foorman, Francis, Winikates, Mehta, Schatschneider, & Fletcher, 2009). In addition, Weiner (1994) found that low-achieving participants responded differently to phonemic awareness training than did the middle-achieving participants on a phonemic awareness variable. Furthermore, these results are consistent with Stanovich's (1986) descriptions of a "rich-get-richer" phenomenon in which the children who read well and

have strong vocabularies will read more, expand their vocabularies, and read even better (p. 318). The first grade students who began the school year with higher phonemic awareness skills may have benefited more from PAVII because of this phenomenon. One possible explanation for this result is that these lower performing students may have needed more specialized instruction for a longer period of time to demonstrate significant improvements (Wanzek & Vaughn, 2008).

One possible reason PAVII did not significantly improve students' phonemic awareness skills is that they needed additional time in intervention. Although phonemic awareness instruction is effective in various group sizes, including small groups of five, larger groups, and whole class settings (NRP, 2000), students at-risk for reading also require more intensive support, feedback, and explicit instruction when compared to other learners (Torgesen, 2002). The lower scoring students could have benefited from even more intensive interventions through a change in group size or to a simpler curriculum. This is based on the idea that if a student is not responding to intervention the interventionist evaluates possible environmental causes of the academic problem and uses problem solving to address the problem (Vaughn & Fuchs, 2003). Also, the students in this study could have benefited from an increased intensity of support. The students received intervention for four days per week for a total of 10 weeks and three days. They might have made more progress with five days per week of phonological awareness intervention as did the students in a study by Noe, Spencer, Kruse, and Goldstein (2013). Vaughn, Denton, and Fetcher (2010) reviewed early interventions and recommended tier 2 intervention for first grade students in groups of three to four students delivered four to

five days per week for 20 to 30 weeks. These studies support the notion that students require more intensive support before showing positive effects on skills, which could have been applicable to the PAVII participants.

Another possible reason intervention students' phonemic awareness did not significantly improve is the quality of their tier 1 instruction. For example, the students could have received ineffective core instruction with missing or poor-quality evidence-based practices such as differentiated instruction (Gersten et al., 2008). The students also could have received PAVII support during rather than supplemental to tier 1 instruction. Without high-quality tier 1 support, these students would not have received the universal core phonemic awareness and phonics-based instruction critical to an RtI system (Fuchs & Fuchs, 2006). It is also unclear whether the first grade team used the recommended problem solving strategies to evaluate their students' reading scores and create tier 1 instructional practices and groupings to address their academic needs (Fuchs & Fuchs, 2006). For example, if many students struggled with phonemic awareness based on their screening scores at the beginning of the year, the team could have targeted phonemic awareness more for those students during universal core instruction. Similarly, students who struggled with decoding would have received core instruction with more intensive phonics instruction.

Intervention Effects on Phonics

There was not a significant effect for the intervention on students' phonics skills for nonsense word decoding for intervention students. This was an unexpected result given that in previous studies PAVII had positive effects on students' phonics skills

(Vanderwood et al., 2013; Healy et al., 2005). However, it is consistent with Arellano's (2013) data indicating that PAVII delivered in Spanish did not have a significant effect on students' English phonics skills. These results suggest that PAVII does not effectively improve students' phonics skills. In general, researchers have found that PA skills improve phonics skills (NRP, 2000). However, PAVII does not explicitly teach phonics skills; it presents auditory activities that do not involve letter-sound correspondence lessons. Researchers tend to agree that PA is necessary but not sufficient in teaching children to read (Bus & van IJzendoorn, 1999; Byrne & Fielding-Barnsley, 1993; NRP, 2000). The present results suggest that PAVII is not sufficient to improving phonics skills; the students possibly needed additional direct instruction specifically targeting phonics skills. It may be appropriate for students to receive an intervention such as PAVII and then, once they have met a PA goal they should receive phonics intervention or differentiated instruction through tier one. The students who received PAVII support through Arellano's (2013) groups and those of the present study also received tier one core instruction in their classrooms. It is possible that these students would have benefitted from more intensive differentiated instruction within the classroom. In addition, the students who were in PAVII groups may have required additional time or additional explicit instruction in phonics skills to improve significantly on these scores. The PAVII students received four sessions per week of intervention over 10 weeks and three days. Students who have demonstrated insufficient response to previous intervention may need more specialized instruction for a longer period of time to demonstrate significant improvements in skills (Wanzek & Vaughn, 2008). The PAVII

students may have benefited more if they had received intervention for additional time or with specific adjustments such as an increase in intensity (Batsche et al., 2005) from four days per week to five.

It is possible that there was not a significant effect on phonics through nonword or real word reading because the students needed more time to develop letter-sound correspondence; these students might have needed additional differentiated instruction or intervention for their phonemic awareness skills to transfer to phonics and word reading skills. For instance, the National Research Council (1998) highlighted the importance of the alphabetic principle and phonics in that children must gain an understanding that words consist of letters that map to speech sounds before they can visually recognize words. Although both NWF and WRF measure basic phonics skills, NWF consists of nonsense words, and WRF consists of real words and sight words. The results of this study indicate that PAVII did not have a significant impact on phonics through either the blending of nonsense words with regular decodable words or overall word recognition including words that are not decodable.

Increased time for reading intervention is one of the primary variables to consider when increasing the intensity of an intervention so that students have targeted instruction with adequate feedback and support (Vaughn, Linan-Thompson, & Hickman, 2003). While the NRP (2000) found that the largest gains in reading were associated with interventions that were between five and 18 hours, the NRP also reported that the ideal specific amount of phonemic awareness instruction should be based on individual need. All intervention students received 43 sessions, including three 15-minute introductory

sessions and 40 30-minute sessions of intervention support. Each participant received a total of approximately 21 hours of intervention. It is possible that the students would have responded more to intervention if they had received additional time in intervention. Other possible factors include a lack of treatment integrity throughout the sessions when the research assistants were not observing and student engagement. However, treatment integrity results were high during observations, and while the interventionists reported behavior problems toward the beginning of the study, none of the interventionists reported significant behavior problems throughout the rest of the sessions.

Findings in the Context of Previous PAVII Studies

This study evaluated the effects of a phonological awareness intervention on phonemic awareness, phonics, treatment integrity, and treatment acceptability. In a previous study of PAVII's academic effects on small groups of first grade students, 80 percent of students met exit criteria for both phonemic awareness and phonics measures (Healy et al., 2005). However, their only method of evaluating treatment integrity was that the interventionists used the manualized intervention. In a more recent study, PAVII effectively increased students' phonemic awareness and phonics skills and eliminated the gap in phonemic awareness skills between intervention students and typically performing peers (Vanderwood et al., 2013). Neither of these studies systematically assessed treatment acceptability. Given these results and the literature supporting the effectiveness of PA intervention (e.g., NRP, 2000), it was hypothesized that PAVII would produce positive outcomes on both phonemic awareness and phonics. Additionally, given

research-based recommendations, small groups were expected to produce high literacy skill effects as well as treatment integrity and acceptability outcomes.

This study found that PAVII did not result in a significant main effect for phonemic awareness overall, which is inconsistent with findings from previous research on this intervention. Arellano (2013) found a significant main effect for both English and Spanish PA skills, suggesting that PAVII delivered in Spanish is an effective intervention for improving PA skills. Healy et al. (2005) found that 80 percent of students met exit criteria after 25 intervention sessions. One explanation for the different results of the present study is that Healy and colleagues (2005) presented percentages rather than using a randomized controlled trial study or a quasi-experimental study. Because the present study utilized quasi-experimental methods, it evaluated outcomes with more stringent methods and assessed statistical significance rather than the percentage of students dismissed from intervention. It is possible that while most students met exit criteria in Healy and colleagues' (2005) study, they did not make sufficient improvements in phonemic awareness to suggest a significant effect. For example, the researchers did not use a comparison or control group for score comparison purposes; the students who did not receive intervention might have demonstrated similar improvements in phonemic awareness skills as well simply after receiving core instruction without intervention. Similarly, Vanderwood et al. (2013) reported that 88 percent of students who received support from PAVII met the benchmark goal for PSF and also noted a significant difference between students' pre-intervention and post-intervention phonemic awareness scores. These researchers did not evaluate outcomes using a quasi-experimental or

experimental approach, however, which could explain the different results when compared to those of the present study.

Treatment Integrity Analysis

The creators of PAVII designed it as a scripted and easily implemented intervention; perhaps because of its intentionally simplistic and explicit design it was easy to implement and resulted in high treatment integrity. The high treatment integrity values, with an average of 91.68 percent, are consistent with the results from Arellano (2013), who found that both interventionists delivered the Spanish translation of PAVII with average treatment integrity values of 98 percent and 97 percent. The only ways in which Healy et al. (2005) and Vanderwood et al. (2013) addressed treatment integrity was ensuring the interventionists' use of the manual. Another possible explanation for this result is that the behavior of the groups was acceptable overall, which increased the interventionists' adherence to the script and procedures. At the study's conclusion, none of the teachers shared that they had significant difficulties with their students' behaviors. A third possible explanation is that the interventionists had a high level of experience, patience, or skills regarding behavior management and instructional strategies. Finally, the interventionists might have administered PAVII with a high degree of integrity due to their high level of interest in participating in the study and helping their students. For example, interventionists from the participating school emailed the principal investigator to ask several questions about the intervention and to provide updates regarding how the students were performing, suggesting they were highly involved and interested in these students' learning.

Treatment Acceptability Analysis

The creators of PAVII designed it so that it would be feasible through its highly structured direct instruction format (Vanderwood et al., n.d.). For example, it contains explicit step-by-step directions and color-coded script that only requires the manual rather than manipulatives and other tangible materials. It also typically involves about one hour of training and provides all behavior management directions and materials. Additionally, three introductory sessions were added to the manual based on specific requests from teachers who had used PAVII for several weeks. Based on this intervention's history and development process, one would expect that PAVII, which requires a minimal amount of time to implement and minimal preparation of materials after the creation of the initial behavior expectations, would have a high average treatment acceptability, as defined in this study. However, this study defined high treatment acceptability as 80 percent or higher, and the results produced an average acceptability rating was 77.7 percent. Overall, the interventionists rated PAVII more favorably than unfavorably, but these results are surprisingly lower than expected.

The three studies that evaluated the English (Healy et al., 2005; Vanderwood et al., 2013) and Spanish (Arellano, 2013) versions of PAVII did not examine treatment acceptability. When compared to other studies that have collected data regarding treatment acceptability, the current study's primarily favorable ratings of PAVII were expected. The findings were consistent, for example, with the previous finding that intervention involving less teacher time are more favorable (Witt, Elliott, & Martens,

1984). PAVII required minimal preparation time for the interventionists and did not involve the organization of materials.

Compared to other studies that have evaluated the acceptability of other interventions, the results are mixed. A few studies have reported acceptability percentages that are higher than 77.7 percent. For instance, Tharinger and colleagues (2009) measured treatment acceptability of therapeutic assessment, a combination of psychological assessment and short-term intervention. They determined that their average acceptability rating of 85 percent was "high" (p. 241). Similarly, Fiala and Sheridan (2003) reported their average treatment acceptability regarding a paired reading intervention as 95 percent from the parents' perspective and 80 percent from the children's perspective. Conversely, the treatment acceptability of a different first grade phonological awareness intervention was 62 percent (Lane et al., 2007). However, the interventionists in Lane and colleagues' (2007) study shared that while they liked the intervention's procedures and believed it was beneficial to their students, they believed it was more beneficial for students with mild to medium behavior problems than for students with extreme behavior problems. The extreme behavior problems could have significantly impacted their overall impression of the intervention, and if they had not had students with extreme behavior problems in the intervention, their ratings likely would have been higher. The interventionists in the current study did not report any extreme behavior problems.

The lower acceptability ratings could be attributable to the limited number of interventionists (i.e. four) who rated this intervention and their unique perspectives. It is

possible that the raters misunderstood one or more of the items. Most of these teachers were highly interested in this project and expressed questions and concerns several times throughout the study. This could be an indication that these individuals possibly rated the IRP-15 items more critically than other teachers typically would. For example, the teacher who sent the most emails with questions and concerns about the study, endorsed a rating of 1 for the following statement: "This intervention would be appropriate for a variety of children." This teacher could have interpreted "variety" as inclusive of children with severe disabilities or children without phonemic awareness deficits. In addition, the acceptability ratings could be attributed to the interventionists' perception of PAVII's effectiveness. For instance, perceived barriers to participation in outpatient treatment for antisocial children and their families have influenced treatment acceptability (Kazdin, 2000). One example of a factor that influences treatment acceptability is therapeutic change throughout the therapeutic process. Although Kazdin's (2000) study addressed outpatient treatment and not a reading intervention, perhaps a similar effect occurred throughout the implementation of PAVII. It is possible that the interventionists did not observe what they perceived as significant change, which impacted how favorably they rated PAVII.

Limitations

While this study indicated that PAVII was ineffective in producing significant main effects on students' phonemic awareness, several factors limit the interpretability of the results. First, limited data were collected regarding treatment integrity for the intervention. This means that there is little evidence of whether or not the interventionists

implemented PAVII in the way in which it was originally designed. LeLaurin and Wolery (1992) recommended that for research in early intervention for small group instruction treatment integrity should be conducted for about 20 percent or more of the sessions. However, in this study, a research assistant observed each interventionist during one session each, totaling 9 percent of the sessions. The intervention's limited effectiveness could have resulted from a poor adherence to the intervention manual's steps. With only one observation of each interventionist, it is possible that the interventionists improved their adherence to the intervention script and steps simply because they were aware of being observed (i.e. the Hawthorne effect).

Second, limited inter-rater reliability data are available for the DIBELS Next measures used. Regarding pre-intervention data, inter-rater reliability scores were calculated for all measures, but the percentage of the total scores were between 4.5 percent and 19.1 percent. The research assistants collected inter-rater reliability data for 4.5 percent of the beginning-of-year PSF, NWF, and WRF scores, and the WRF calculations only include data from three of the five intervention teachers. In addition, inter-rater scores are available for 17.3 percent of mid-year PSF scores, 4.5 percent of mid-year NWF scores, and 19.1 percent of mid-year WRF scores. This limited dataset suggests that it is difficult to conclude that the individuals administering pre-intervention and post-intervention tests used the tools with high reliability. Although the available data reflect high inter-rater agreement percentages when compared to the recommendations of Hartmann et al. (2004), who suggested that 80 to 90 percent agreement is sufficient, more data would have provided additional evidence that the

scores are reliable. It is possible, for example, that the dataset does not indicate significant effects on phonemic awareness or on phonics skills because the scores are not reliable.

Third, the sample size and sampling method limit the applicability of the results to a larger population. First, the sample size was not large enough to detect a medium or small effect; it was large enough to detect a large effect based on power analysis recommendations from Cappelleri et al. (1994). PAVII was expected to have a large effect on phonemic awareness skills given the results of previous research that has found large effects for phonological awareness interventions (e.g., Bus & van IJzendoorn, 1999; Cavanaugh et al., 2004; NRP, 2000). Although the current literature has typically found such large effect sizes for phonemic awareness, PAVII could have had a medium or small effect size on outcomes that was undetected due to the limited sample size. In addition, while Bus and van IJzendoorn (1999) calculated a combined effect size of 1.04 for phonological awareness outcomes, they calculated a small effect size of .44 for PA intervention effects for reading outcomes. Similarly, the NRP (2000) also calculated a large effect size of 0.86 for PA outcomes but a moderate effect size of 0.53 for overall reading outcomes. It is possible that PAVII could have had significant effects on phonics skills with a larger sample size capable of detecting a small or medium effect size. However, a larger sample size could have also conversely determined that PAVII was not effective in improving PA or phonics skills. Additional research will need to conduct a study that includes a larger sample size that will be able to detect small, medium, and large effect sizes.

Finally, the sampling method used in this study also hinders the external validity of the results. External validity is the extent to which a causal relationship maintains over a variation of persons, settings, treatments, and outcomes (Shadish, Cook, & Campbell, 2002). Random selection results in a representative sample of the population and ensures generalizability to this larger group of people. Unfortunately, this study used a convenience sampling method that resulted in limited generalizability for its results. The researcher contacted schools that had not been already using a first grade literacy intervention from one school district in Southern California. As a result, the participating school consisted of the following demographic information: Only 7 percent of the intervention groups and 5 percent of the comparison group were English language learners. In contrast, throughout the U.S., 17.1 percent of first grade students were English language learners during the 2013 to 2014 school year (National Center for Education Statistics, 2015). Additionally, 50 percent of the PAVII intervention students and 32 percent of the comparison group students were white. In comparison, throughout the U.S., 49 percent of first grade students were white in 2013 (U.S. Census Bureau, 2014). The only additional races included in this study were Hispanic, Asian, African American, and students of mixed races. This suggests that the results of this study can only be generalized to a predominantly white population of first grade students who only receive their language arts instruction in English. This indicates that white first grade students were overrepresented in this study's sample of intervention students. In summary, the sampling method of this study limits the generalizability of the results beyond the participating sample's community to a large extent.

Implications for the Use of PAVII

Despite its limitations, this study has several implications for practice. First, it is important to continue to evaluate PAVII and other phonemic awareness interventions. Although this study suggests that PAVII is differentially effective for students by producing larger effects for students with higher phonemic awareness skills, the results suggest that it is not effective in significantly increasing students' phonics skills. However, two studies previously found that PAVII effectively produced positive phonemic awareness and phonics outcomes for students (Healy et al., 2005; Vanderwood et al., 2013). It is possible that PAVII was effective in increasing most students' literacy skills but not in significantly improving these skills or that the intervention had a medium effect that this analysis was unable to detect based on this limited sample size. As discussed previously, PAVII targets phonological awareness. Because phonological awareness is a precursor to phonics (Adams, 1990), it is possible that the students required additional time in intervention or additional support in phonics in order to demonstrate a significant improvement in phonics. Also, phonemic awareness is necessary but not sufficient (Bus & van IJzendoorn, 1999; National Reading Panel, 2000).

Additionally, the interaction effect suggests that students with the highest phonemic awareness skills prior to the intervention benefited more from PAVII on phonemic awareness skills than did students with lower phonemic awareness skills. This suggests that the group of students who struggled the most with phonemic awareness was heterogeneous. The students with the strongest phonemic awareness skills within the

lowest performing group may need a different level of support than the students with poorer skills. Progress monitoring allows educators to evaluate students' progress on a specific skill and allow them to make changes to the group (Gersten et al., 2008). In particular, this would allow educators to frequently track students' performance to determine whether there are students who need to continue in intervention as it is, continue with adjustments to the intensity, or exit the intervention.

All treatment integrity scores were high, and most treatment acceptability scores were high, which has important implications. Based on the treatment integrity data from this study, PAVII appears to be easy to implement the way in which it was intended, which is consistent with previous findings regarding paraeducators' ability to demonstrate high treatment integrity when implementing PAVII to first grade students (Vanderwood et al., 2013). Similarly, overall, the treatment acceptability data suggest that the interventionists perceived PAVII as highly acceptable regarding statements such as "I would suggest this intervention to other teachers" and "I liked the procedures used in this intervention." However, it is important to note that the treatment acceptability ratings could have been higher. This suggests that it is important to assess which parts of the intervention are favorable to educators, which can lead to changes to the intervention.

Directions for Future Research

The results of this study provide several recommendations for future research. First, future research examining the effects of phonemic awareness interventions, including PAVII, should focus on examining multiple factors that contribute to students'

success, such as treatment integrity, student engagement, and interventionist characteristics.

Second, further research evaluating the effects of PAVII on both kindergarten and first grade students' early literacy skills will also be important to determining whether schools should use this as an evidence-based intervention. It is recommended that researchers analyze data from a sample large enough to detect medium and small effect sizes because the present study was only able to detect a large effect.

Third, given the favorable perceptions of PAVII and the previous findings suggesting its effectiveness, future studies should continue to evaluate it. This study assessed treatment acceptability for a phonological awareness intervention because research has shown that this is an important factor to consider when evaluating an intervention because it is related to treatment integrity (Mautone et al. 2009). However, high acceptability is not sufficient to ensure continued successful implementation of an intervention. Santangelo (2009) reported that a well-liked program can still be challenging to implement given the various required duties and activities educators must complete each day. For example, the district, principal, and teachers must all align in their ability to support each other and adhere to the requirements of consistent, long-term program implementation. Future research should further explore the role of treatment acceptability and how it interacts with other factors that determine successful program implementation. Researchers could also further investigate this intervention's treatment acceptability to determine how to increase its favorability.

Fourth, future researchers can more closely examine the behavior management component of PAVII. The current system involves evidence-based practices based on recommendations from researchers such as Simonsen et al. (2008), but one way to improve this system is to identify a more systematic and data-based way in which to evaluate student engagement. Currently, the interventionist estimates a percentage of the time during which each student was on task at the end of each intervention session. The limitation with this approach is that the interventionist's estimates are subjective and provide little performance feedback to the children. Given the positive impact of academic engagement on achievement (Nystrand & Gamoran, 1989), it is important to enhance PAVII's current behavior reinforcement system. To further improve the accuracy of these estimates, the interventionist could use methods such as providing students with individualized jars and putting colorful objects such as pom-poms to reward appropriate behaviors. The students could earn access to the treasure box based on the number of objects in their jars.

Conclusion

Given the importance of early literacy intervention, researchers must identify the most effective tools to use to address skills-based deficits. Phonemic awareness is an important skill that leads to the development of letter-sound correspondence (Adams, 1990; NRP, 2000) and typically must be developed before second grade when students must focus on other higher-level literacy skills (Ehri et al., 2001). Although researchers, graduate students, and educators have implemented PAVII to address phonemic awareness deficits among kindergarten and first grade students for at least the past 10

years, few studies have rigorously evaluated it. This study analyzed outcomes using a regression discontinuity design and gathered treatment integrity and treatment acceptability data to further evaluate this intervention. According to the results, there was no effect for first grade students on phonemic awareness or phonics skills, although the students with higher initial phonemic awareness skills tended to have significantly higher phonemic awareness at the end of the intervention. The results provide preliminary evidence regarding PAVII's ease of implementation and mostly favorable treatment acceptability ratings. However, additional research would determine whether PAVII is ineffective or if certain components of it can be improved.

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Table 1

Participant Demographics

	Intervention	Non-Intervention
Gender		
Male	57%	51%
Female	43%	49%
ELL Status		
ELL	7%	6%
English Only	79%	88%
Unknown	14%	6%
Ethnicity		
White	50%	32%
Hispanic	0%	43%
Asian	21%	11%
African American	29%	11%
Mixed	0%	2%
Unknown	0%	2%

Table 2
Activities of one full PAVII Session

Activity 1	Vocabulary
Activity 2	Phoneme Production/Replication
Activity 3	Phoneme Segmentation and Counting
Activity 4	Phoneme Blending
Activity 5	Phoneme Isolation
Activity 6	Rhyming

Table 3
Intervention Group Sizes

Number of students	n=21
Group sizes	3 groups of 5 students 1 group of 6

Table 4
Regression Results for Phoneme Segmentation Fluency

Predictor	Coefficient	Std. Error	t-ratio	p-value
Constant	48.87	1.91	25.65	.00
Pre-test	.10	.09	1.06	.29
Intervention	21.59	5.46	3.96	.00
Interaction	1.60	.46	3.49	.00*

Note. The coefficients reported above are the unstandardized coefficients. The final model consisted of the following: $y_i = \beta_0 + \beta_1 x_i^* + \beta_2 z_i + \beta_3 x_i^* z_i + e_i$, where y_i = outcome measure for individual i (i.e., scores on DIBELS PSF), β_0 = y-intercept for the comparison group regression line at cutoff, β_1 = slope parameter, β_2 = treatment effect estimate (i.e., main effect), β_3 = linear interaction effect, x_i^* = pre-test score for individual i minus the value of the cut-off, x_0 (i.e., $x_i^* = x_i - x_0$), z_i = assignment variable (1 if treatment participant; 0 if comparison participant), and e_i = random error for individual i.
* $p<.01$

Table 5
Regression Results for Nonsense Word Fluency

Predictor	Coefficient	Std. Error	t-ratio	p-value
Constant	75.96	8.50	8.94	.00
Pre-test	.24	.42	.58	.57
Intervention	.32	15.94	0.02	.98

Note. The coefficients reported above are the unstandardized coefficients. The final model consisted of the following: $y_i = \beta_0 + \beta_1 x_i^* + \beta_2 z_i + e_i$, where y_i = outcome measure for individual i (i.e., scores on DIBELS NWF), β_0 = y-intercept for the comparison group regression line at cutoff, β_1 = slope parameter, β_2 = treatment effect estimate (i.e., main effect), x_i^* = pre-test score for individual i minus the value of the cut-off, x_0 (i.e., $x_i^* = x_i - x_0$), z_i = assignment variable (1 if treatment participant; 0 if comparison participant), and e_i = random error for individual i.

Table 6
Regression Results for Word Reading Fluency

Predictor	Coefficient	Std. Error	t-ratio	p-value
Constant	38.48	5.53	6.95	.00
Pre-test	.46	.27	1.68	.10
Intervention	8.25	10.38	.80	.43

Note. The coefficients reported above are the unstandardized coefficients. The final model consisted of the following: $y_i = \beta_0 + \beta_1 x_i^* + \beta_2 z_i + e_i$, where y_i = outcome measure for individual i (i.e., scores on easyCBM WRF), β_0 = y-intercept for the comparison group regression line at cutoff, β_1 = slope parameter, β_2 = treatment effect estimate (i.e., main effect), x_i^* = pre-test score for individual i minus the value of the cut-off, x_0 (i.e., $x_i^* = x_i - x_0$), z_i = assignment variable (1 if treatment participant; 0 if comparison participant), and e_i = random error for individual i.

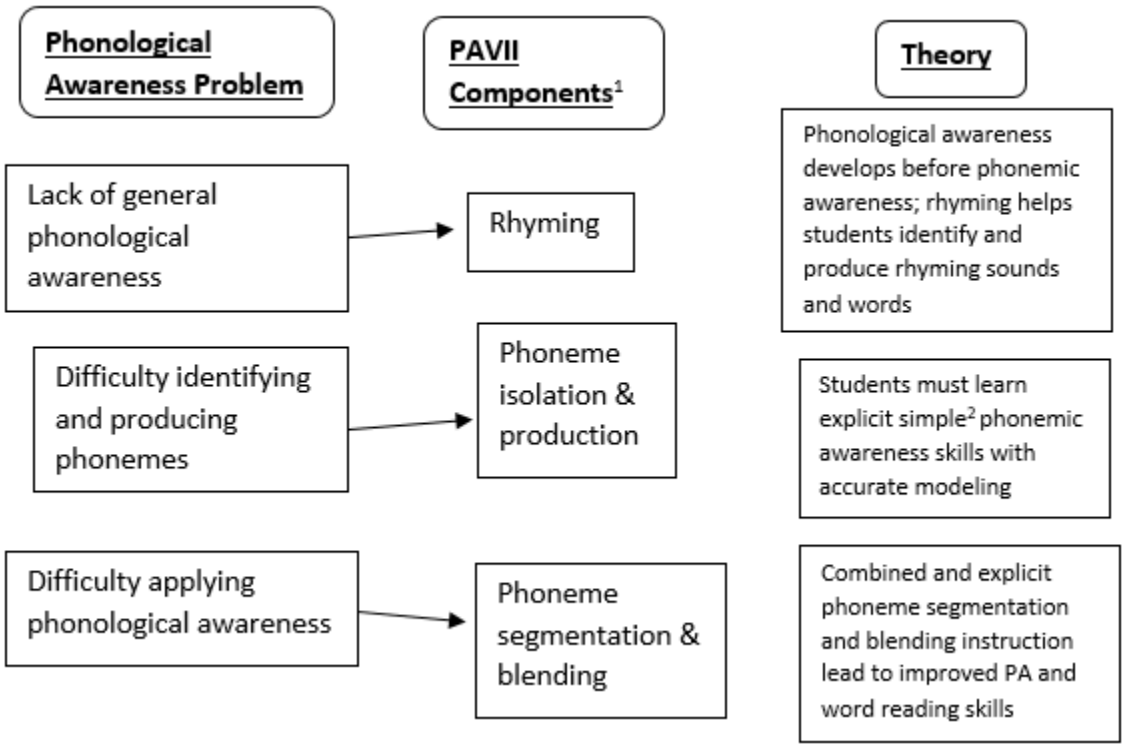
Table 7
Treatment Integrity Results

Number of Interventionists	Mean Rating	SD
4	91.68	7.90

Table 8
Treatment Acceptability Results

Number of Raters	Mean Rating	SD
4	65.25	.83

Figure 1
A Conceptual Framework for how PAVII Addresses Phonological Awareness Deficits



[1] The interventionist presents all PAVII components using a direct instruction model-lead-test format with a systematic error correction procedure and multiple opportunities to respond.
[2] Yopp (1988) described simple phonemic awareness skills as basic skills such as phoneme segmentation, counting, blending, and isolation. PAVII does not include the compound phonemic deletion skills.

Figure 2
Regression Discontinuity Example of a Treatment Effect

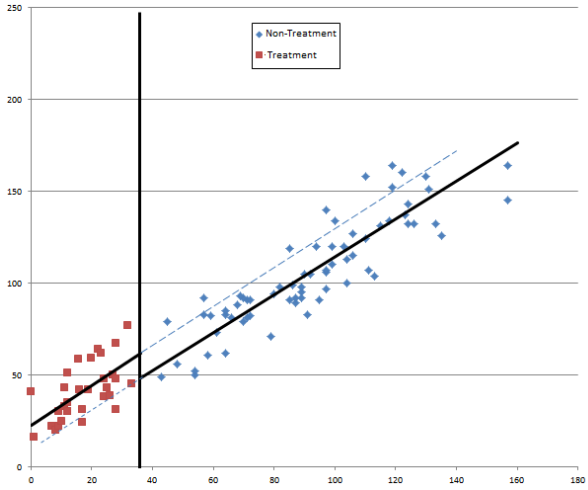


Figure 3
Regression Discontinuity Example of no Treatment Effect

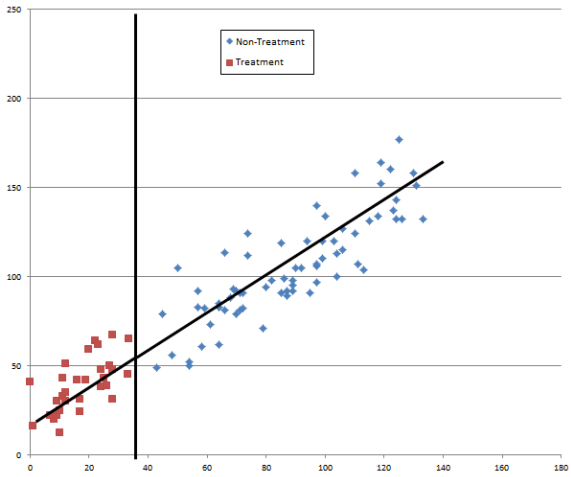


Figure 4

Scatter Plot of Pre-Test and Post-Test PSF Scores

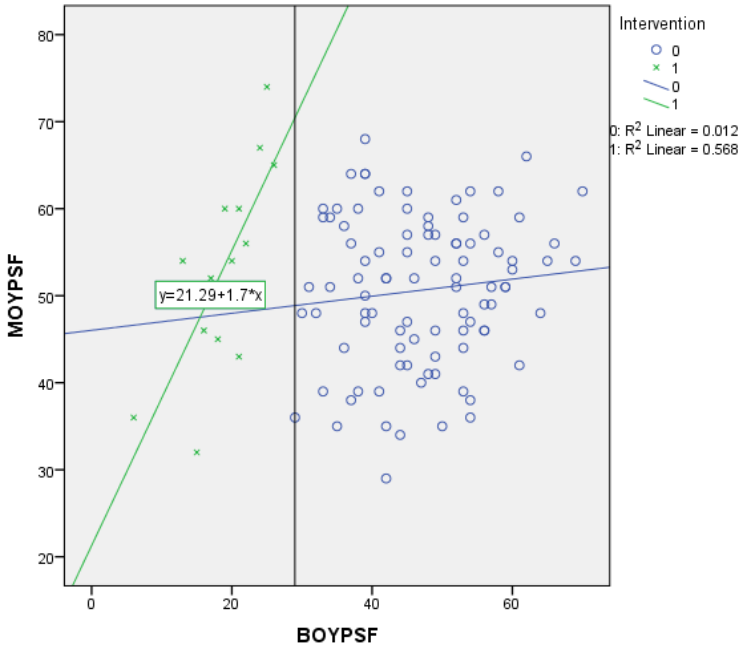


Figure 5

Scatter Plot of Pre-Test PSF and Post-Test NWF Scores

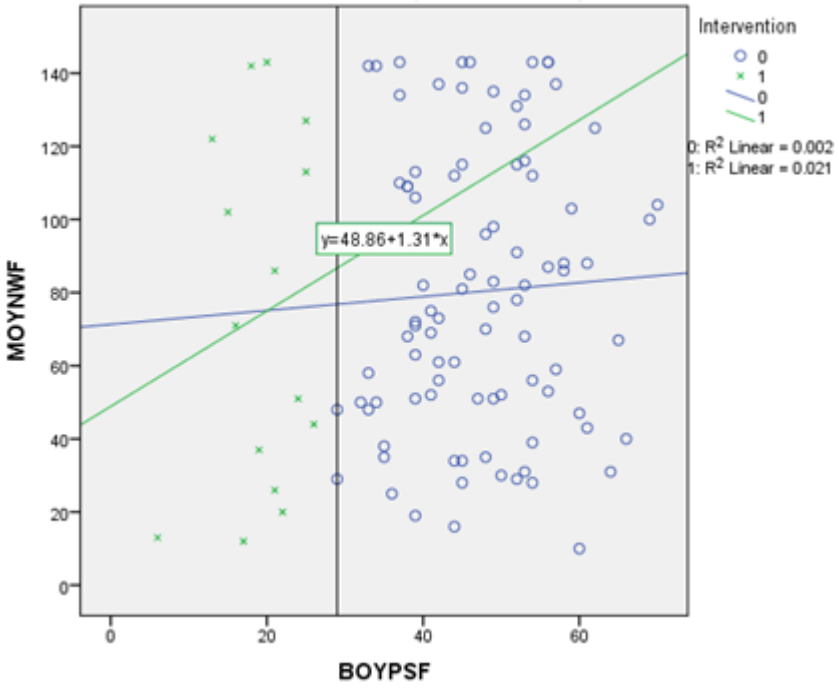
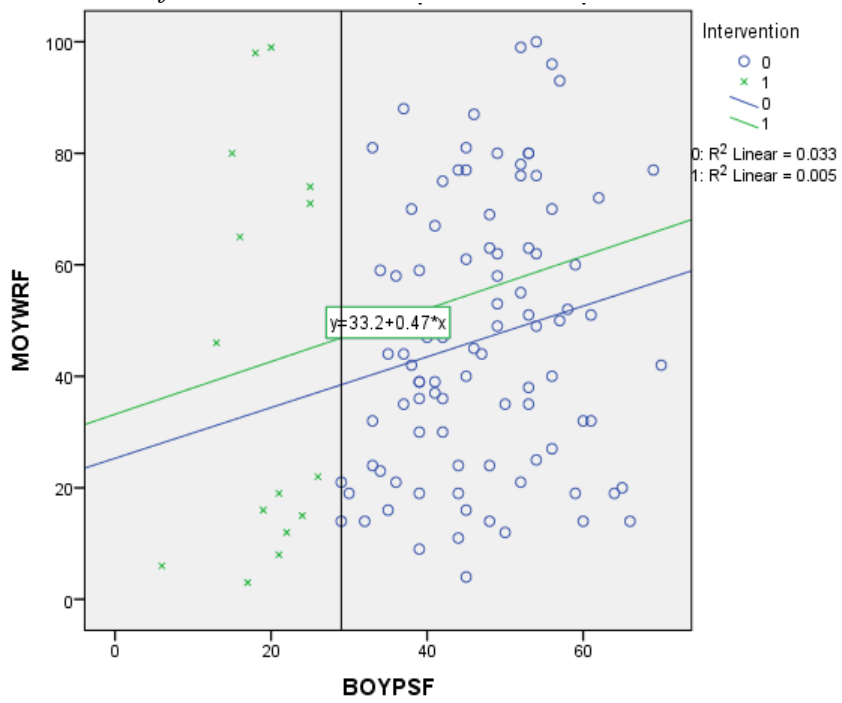


Figure 6

Scatter Plot of Pre-Test PSF and Post-Test WRF Scores



Appendix A

Treatment Integrity Checklist

Interventionist: _____ Date: _____
Observer: _____ Session #: _____
School: _____ # of Students Present: _____
Time: _____:_____-_____:_____ Total Integrity Score: _____ %
Directions:
(1) Circle whether each component was never, sometimes, or always present for each activity on the following pages.
(2) Add the total number of "Points Earned" (See A in the table below)
(3) Divide the total number of points earned by the total possible number of points (See B in the "Points Possible" column below).
(4) Multiply the calculated number by 100 to find the total calculated integrity score.

TOTAL CALCULATIONS:

Required Components	**Points Earned**	**Points Possible**
Vocabulary		11
Phoneme Production		10
Phoneme Segmentation and Counting		13
Phoneme Blending		10
Phoneme Isolation		13
Rhyming		13
Corrective Procedure		6
Totals	= A	76 = B

Total observed components divided by total possible components:
Formula to follow: A / B = ._____

Your calculation: _____ /76 = ._____ x 100 = _____%

***Example*: *70* /76 = .*92* x 100 = *92* %**

Rhyming	**Never**	**Sometimes**	**Always**
1. Interventionist follows the script	0	1	2
2. Interventionist verbally models the rhyme while moving hand across the parts of the arm representing the ending sounds (e.g., "at" in "cat")	0	1	2
3. Interventionist asks students to respond in unison for examples of words that rhyme with the target word	0	1	2
4. Interventionist uses unique hand signals to ask for individual and unison responses	0	1	2
5. Interventionist points to and asks students individually for words that rhyme with target word.	0	1	2
6. Interventionist responds to all correct answers with verbal praise and/or a "high-five"	0	1	2
7. Interventionist completed the Rhyming section	--	--	1
Totals:			

Vocabulary	**Never**	**Sometimes**	**Always**
1. Interventionist reads all definitions listed in lesson plan	0	1	2
2. Interventionist uses unique hand signals for individual and unison responses	0	1	2
3. Interventionist asks for both unison and individual responses	0	1	2
4. Interventionist leads the response with all of the students when indicated in the directions (e.g., for the first word example)	0	1	2
5. Interventionist responds to all correct answers with verbal praise and/or a "high-five"	0	1	2
6. Interventionist completed the Vocabulary section	--	--	1
Totals:			

Phoneme Production	**Never**	**Sometimes**	**Always**
1. Interventionist reads introductory sentence(s) (e.g., "Let's review the sounds we practiced together the last time we met.")	0	--	1
2. Interventionist uses a hand signal to ask for unison responses	0	1	2

3. Interventionist only asks for unison responses for all phonemes	0	1	2
4. Interventionist accurately models all phonemes	0	1	2
5. Interventionist responds to all correct answers with verbal praise and/or a "high-five"	0	1	2
6. Interventionist completed Phoneme Production section	--	--	1
Totals:			

Phoneme Segmentation and Counting	**Never**	**Sometimes**	**Always**
1. Interventionist follows the script	0	1	2
2. Interventionist uses parts of his/her arm to segment the sounds	0	1	2
3. Interventionist asks for unison responses (except when asking for the number of sounds)	0	1	2
4. When asking for the number of sounds, interventionist asks for both unison and individual responses	0	1	2
5. Interventionist uses unique hand signals to ask for individual and unison responses	0	1	2
6. Interventionist responds to all correct answers with verbal praise and/or a "high-five"	0	1	2
7. Interventionist completed the Phoneme Segmentation and Counting section	--	--	1
Totals:			
Phoneme Blending	**Never**	**Sometimes**	**Always**
1. Interventionist reads the definition of blending	0	--	1
2. Interventionist models blending by utilizing parts of his/her arm to segment the words by sound	0	1	2
3. Interventionist models blending using a whole-arm signal	0	1	2
4. Interventionist uses unique hand signals to ask for individual and unison responses	0	1	2
5. Interventionist responds to all correct answers with verbal praise and/or a "high-five"	0	1	2
6. Interventionist completed the Phoneme Blending section	--	--	1
Totals:			

Phoneme Isolation	**Never**	**Sometimes**	**Always**
1. Interventionist follows the script	0	1	2
2. Interventionist models isolation of sounds by utilizing parts of his/her arm	0	1	2
3. Interventionist models whole words by utilizing his/her whole arm	0	1	2
4. Interventionist uses unique hand signals to ask for individual and unison responses	0	1	2
5. Interventionist asks students to isolate sounds in unison and individually	0	1	2
6. Interventionist responds to all correct answers with verbal praise and/or a "high-five"	0	1	2
7. Interventionist completed the Phoneme Isolation section	--	--	1
Totals:			

Corrective Procedure	**Never**	**Sometimes**	**Always**
1. Interventionist corrects student errors by modeling the correct answer and then asks the student(s) for the correct response	0	1	2
2. Interventionist responds to students who do not pay attention by saying, "Let's try it again."	0	1	2
3. Interventionist responds to students who do not respond by saying, "I have to hear everybody."	0	1	2
Totals:			

Appendix B

Name: _____ Date: _____
School Code: ____ (A or B)

Adapted Intervention Rating Profile-15 (IRP-15)

Please rate the intervention along the following dimensions. Please circle the number which best describes your agreement or disagreement with each statement.

	Strongly Disagree	***Disagree***	***Disagree Slightly***	***Slightly Agree***	***Agree***	***Strongly Agree***
1. This would be an acceptable intervention for a child's phonemic awareness problem.	1	2	3	4	5	6
2. This intervention should prove effective in changing a child's phonemic awareness problem.	1	2	3	4	5	6
3. I would suggest this intervention to other teachers.	1	2	3	4	5	6
4. The children's phonemic awareness problems are severe enough to warrant use of this intervention.	1	2	3	4	5	6
5. Most teachers would find this intervention suitable for the phonemic awareness problem described.	1	2	3	4	5	6
6. I would be willing to use this intervention in the classroom setting.	1	2	3	4	5	6
7. This intervention would *not* result in negative side-effects for the child.	1	2	3	4	5	6
8. This intervention would be appropriate for a variety of children.	1	2	3	4	5	6
9. This intervention is consistent with those I have used in classroom settings.	1	2	3	4	5	6
10. The intervention was a fair way to handle the children's phonemic awareness problem.	1	2	3	4	5	6
11. This intervention is reasonable for the academic problem described.	1	2	3	4	5	6
12. I liked the procedures used in this intervention.	1	2	3	4	5	6
13. This intervention is a good way to handle these children's phonemic awareness problem.	1	2	3	4	5	6
14. Overall, this intervention would be beneficial for a child.	1	2	3	4	5	6