

Examining the Efficiency of Incremental Rehearsal Oral
and Written Procedures for Spelling

Dissertation

In partial fulfillment of the requirements for the degree Doctor of Philosophy in the
Graduate School of The Ohio State University

By

Dru Garcia, M.B.A.

Graduate Program in Education and Human Ecology

The Ohio State University

2012

Dissertation Committee:

Laurice Joseph, Advisor

Moirra Konrad

Sheila Morgan

Copyrighted by

Dru E. Garcia

2012

Abstract

The ability to spell words correctly is a skill that is necessary for success in school and adult life. Mastery of spelling skills continues to be difficult for a significant number of students. Students with spelling difficulties need to be identified early and receive proper instruction in order to catch up with their peers. The current educational environment, with large class sizes and many curricular demands, results in the need for spelling interventions that are both effective and efficient. Research is needed to identify techniques that aid in the acquisition of spelling skills and that deliver meaningful improvements in an efficient manner.

Several studies have revealed that the incremental rehearsal technique within a drill exercise can render positive outcomes and high retention rates of learning. Incremental rehearsal has been effective for helping students improve on word recognition and math facts. There have been no studies that have examined the effects of incremental rehearsal on spelling performance. Moreover, there have not been any studies that examined different topographies of response with the incremental rehearsal procedure. Different topographies of responding, such as a written response versus an oral response, may significantly influence the efficiency of an intervention.

The following study aimed to determine the effectiveness and efficiency of two incremental rehearsal spelling interventions, specifically, incremental rehearsal oral intervention and incremental rehearsal written intervention. The study will compare these

two types of incremental rehearsal methods on students' acquisition of spelling words and the rate of spelling words.

Specifically, the study examined acquisition, rate, delayed recall and generalization. It examines the use of incremental rehearsal for teaching spelling across two response topographies.

Results of the study indicated positive effects for both instructional conditions. Both incremental rehearsal procedures used within a spelling context resulted in an increase in spelling performance for students. Both conditions were effective, yet incremental rehearsal oral resulted in faster learning rates. In terms of social validity, an equal number of students preferred oral and written incremental rehearsal methods.

Vita

1988..... B.S. Business, Miami University
1994..... M.B.A The Ohio State University
1994 Graduate Associate,
The Ohio State University

Fields of Study

Major Field: Education

Table of Contents

Abstract	ii
Vita.....	iv
List of Tables	vii
List of Figures	viii
Chapter 1: Introduction	1
Chapter 2: Review of Literature	17
Chapter 3: Methodology	52
Chapter 4: Results	70
Chapter 5: Discussion	131
Appendix A: Letter to Parents	176
Appendix B: Consent for Participation in Research	178
Appendix C: IRO Intervention Script	180
Appendix D: IRW Intervention Script	182
Appendix E: Session Record Form	185
Appendix F: IRO Treatment Integrity Form	190

Appendix G: IRW Treatment Integrity Form	192
Appendix H: Social Validity Student Questionnaire	194
Appendix I: Social Validity Teacher Questionnaire	196
Appendix J: Spelling Words Taught per Instructional Condition	198

List of Tables

Table 4.1	Cumulative Number of Spelling Words Learned During Instructional Sessions and Spelled Correctly on Weekly Probes	73
Table 4.2	Summary of Cumulative Spelling Words Learned during Instruction, Time in Sessions and Average Learning Rate.....	96
Table 4.3	Summary of Cumulative Words Spelled Correctly on Weekly Probes, Time in Sessions and Average Learning Rate	109
Table 4.4	End of Study Delayed Recall of Spelling Words, Delayed Recall Rate, and Delayed Recall Percentage	124
Table 4.5	Number of Words Generalized (WG) and Percentage of Words Generalized (PWG) for each Student	127
Table 4.6	Summary of Number of Words Generalized, Time in Sessions and Rate of Generalization (GR)	128

List of Figures

Figure 4.1	Number of Words Spelled Correctly on Weekly Probes for Andy	75
Figure 4.2	Number of Words Spelled Correctly on Weekly Probes for Annakin	76
Figure 4.3	Number of Words Spelled Correctly on Weekly Probes for Lex	77
Figure 4.4	Number of Words Spelled Correctly on Weekly Probes for Orin	78
Figure 4.5	Number of Words Spelled Correctly on Weekly Probes for Annabella	79
Figure 4.6	Number of Words Spelled Correctly on Weekly Probes for Debbie	80
Figure 4.7	Number of Words Spelled Correctly on Weekly Probes for Group	81
Figure 4.8	Cumulative Words Spelled Correctly on Weekly Probes for Andy	82
Figure 4.9	Cumulative Words Spelled Correctly on Weekly Probes for Annakin	83
Figure 4.10	Cumulative Words Spelled Correctly on Weekly Probes for Lex	84
Figure 4.11	Cumulative Words Spelled Correctly on Weekly Probes for Orin	85
Figure 4.12	Cumulative Words Spelled Correctly on Weekly Probes for Annabella	86
Figure 4.13	Cumulative Words Spelled Correctly on Weekly Probes for Debbie	87
Figure 4.14	Cumulative Words Spelled Correctly on Weekly Probes for Group	88
Figure 4.15	Mean Percentage of Words Spelled Correctly on Weekly Probes for Andy	89

Figure 4.16	Mean Percentage of Words Spelled Correctly on Weekly Probes for Annakin	90
Figure 4.17	Mean Percentage of Words Spelled Correctly on Weekly Probes for Lex.....	91
Figure 4.18	Mean Percentage of Words Spelled Correctly on Weekly Probes for Orin.....	92
Figure 4.19	Mean Percentage of Words Spelled Correctly on Weekly Probes for Annabella.....	93
Figure 4.20	Mean Percentage of Words Spelled Correctly on Weekly Probes for Debbie	94
Figure 4.21	Mean Percentage of Words Spelled Correctly on Weekly Probes for Group.....	95
Figure 4.22	Learning Rate During Spelling Instruction for Andy	97
Figure 4.23	Learning Rate During Spelling Instruction for Annakin	98
Figure 4.24	Learning Rate During Spelling Instruction for Lex.....	99
Figure 4.25	Learning Rate During Spelling Instruction for Orin.....	100
Figure 4.26	Learning Rate During Spelling Instruction for Annabella	101
Figure 4.27	Learning Rate During Spelling Instruction for Debbie	102
Figure 4.28	Average Learning Rate During Spelling Instruction for Andy	103
Figure 4.29	Average Learning Rate During Spelling Instruction for Annakin	104
Figure 4.30	Average Learning Rate During Spelling Instruction for Lex.....	105
Figure 4.31	Average Learning Rate During Spelling Instruction for Orin.....	106
Figure 4.32	Average Learning Rate During Spelling Instruction for Annabella	107
Figure 4.33	Average Learning Rate During Spelling Instruction for Debbie	108

Figure 4.34	Rate of Words Spelled Correctly on Weekly Probes for Andy	110
Figure 4.35	Rate of Words Spelled Correctly on Weekly Probes for Annakin	111
Figure 4.36	Rate of Words Spelled Correctly on Weekly Probes for Lex	112
Figure 4.37	Rate of Words Spelled Correctly on Weekly Probes for Orin.....	113
Figure 4.38	Rate of Words Spelled Correctly on Weekly Probes for Annabella.....	114
Figure 4.39	Rate of Words Spelled Correctly on Weekly Probes for Debbie	115
Figure 4.40	Rate of Words Spelled Correctly on Weekly Probes for Group.....	116
Figure 4.41	Average Rate of Words Spelled Correctly on Weekly Probes for Andy	117
Figure 4.42	Average Rate of Words Spelled Correctly on Weekly Probes for Annakin	118
Figure 4.43	Average Rate of Words Spelled Correctly on Weekly Probes for Lex.....	119
Figure 4.44	Average Rate of Words Spelled Correctly on Weekly Probes for Orin.....	120
Figure 4.45	Average Rate of Words Spelled Correctly on Weekly Probes for Annabella.....	121
Figure 4.46	Average Rate of Words Spelled Correctly on Weekly Probes for Debbie	122
Figure 4.47	Average Rate of Words Spelled Correctly on Weekly Probes for Group.....	123

Chapter 1: Introduction

This chapter reviews relevant background information related to the current study. In addition, the statement of the problem, the purpose of the study, the research questions and the significance of the study are discussed.

Background

Spelling skills are important for a variety of reasons, but a particularly salient reason is that there is social pressure associated with accurate spelling. The ability to spell correctly is highly valued in a literate society (Scott & Brown, 2001). Furthermore, spelling is conspicuous, and people are not reluctant in passing judgment on poor spellers (Smith, 2004). According to the National Commission on Writing for America's Families, Schools and Colleges (2005), poor spelling on an employment application is very likely to be the difference between acceptance and rejection of an applicant. Poor spelling may be viewed as representing unintelligent or careless behavior (Alber & Walshe, 2004).

In addition, spelling is important for reading acquisition. It has been proposed that spelling is a foundation of reading (Venezky, 1980) and that spelling is an integral part of learning the language (Joshi, Treiman, Carreker, & Moats, 2008). Sufficient evidence exists to support that spelling instruction helps children read better. Specifically, six individual studies highlight correlations from .68 to .86 indicating strong relationships between spelling and reading (Ehri & Wilce, 1982; Greenberg, Ehri & Perin,

1997; Griffith 1987, 1991; Jorm 1981; Juel, Griffith, & Gough, 1986). Furthermore, a recent study (Conrad, 2008) found that spelling practice activities help students make orthographic representations and help students to become better readers and spellers in tandem. This study found that when a group of students only participated in spelling exercises, they performed well in both spelling and reading, whereas a group of students who participated in reading exercises performed well in reading, but not in spelling. This evidence indicated reading practice does not guarantee progress in spelling; however, spelling practice influences reading and spelling performance. Additional research shows that learning to spell and read relies on similar underlying knowledge; therefore, learning how to spell helps children better understand how to read (Ehri, 2000). Furthermore, Uhry and Shepard's (1993) six-month study indicated that first graders who received spelling instruction improved their ability to read and decode familiar words. Simply put, learning to spell helps support memory for recognizing whole words, which is useful in both spelling and sight reading. Thus, learning to spell enhances the ability to read (Moats, 2006).

Helping children with learning to spell is certainly worth educators' time and effort, as it aids in children's overall development of literacy skills. The National Center for Educational Statistics (NCES) found that only 32% of fourth graders read at the proficient level for the 2006-2007 period. Sixty-six percent of fourth graders were ranked at the basic level of reading, indicating only partial mastery of fundamental skills. Students who experience reading difficulties in primary grades are more likely to drop out of school prior to graduation (Jimerson, Egeland, Sroufe, & Carlson, 2000). Children who experience reading difficulty fall further behind peers over time (Stanovich, 1986).

Early literacy development is linked to overall academic success (Good, Kaminski, Simmons, & Kame'enui 2001).

Aside from the connections between spelling and reading, spelling supports other skills necessary for academic and employment success. Spelling ability is related to composition length and quality (Graham, Berninger, Abbot, & Whitaker, 1997). Students who spell poorly write fewer words (Ehri, 1989) and may receive poor grades or job evaluations (Joshi et al. 2008). Written work can be compromised when too much of the student's effort is devoted to the cognitive process of spelling (Singer & Bashir, 2004). Furthermore, Graham, Morphy, Harris, Fink-Chorzempa, Saddler, Moran, and Mason (2008) reported that 27% of students, on average, have difficulty with spelling.

To further convince others about the importance of spelling as a needed skill, it is necessary to firmly acknowledge that significant spelling difficulties are issues that cannot be merely solved with spell-check computer programs. Spell-check programs are primarily designed as a tool for correcting typos – which helps adequate spellers only. Spell-check does not take into consideration the context or the definitions of words, nor grossly misspelled words. Studies showed that spell-check only sufficiently corrects spelling errors 25-80% of the time – which could never compensate for truly poor spellers (Joshi et al., 2008).

Early in a student's academic career, academic intervention is essential for those students performing below benchmarks. Spelling problems in the early years of schooling will persist throughout the elementary years if left untreated (Juel, 1988). Research suggests a window of limited opportunity exists for meaningful literacy interventions to occur – specifically, by the end of first grade (McCormick, 1999).

Ineffective first grade instruction can lead to poor performance for the rest of the child's school career (LaParo & Pianta, 2000). It is estimated that 75% of students who read below grade level in first grade will continue as poor readers throughout high school (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996). For young children the evidence is clear – in terms of interventions, time is of the essence (Moats, 2006).

Spelling Instruction

Spelling can be taught to children in a variety of ways. Many spelling instruction techniques exist, and these techniques vary in their effectiveness and efficiency of outcomes.

Direct instruction, or explicit instruction, provides a structured, teacher-directed experience to assist students in learning and practicing new skills (Duffy & Roehler, 1986). In broad terms, direct spelling instruction, when compared to a “natural approach” (teaching spelling only when the need arises), as well as access to needed external resources (such as a dictionary), renders the strongest outcomes for student spelling instruction (Graham, 1999). Critical aspects of learning to spell include memory for spelling words (lexical knowledge), skills needed to check for correct spelling (phonics and the alphabetic principle) and external resources. Direct instruction on phonological awareness, phonics for spelling, strategies for unknown words and awareness of spelling rules help struggling spellers learn (Graham, 1999; Graham, Harris, Fink-Chorzempa, & MacArthur, 2003). Success with spelling instruction is dependent upon meeting individual student's needs (Graham & Harris, 2002).

An impressive number of experimental spelling studies reveal immediate corrective feedback produces improved spelling performance. Specifically, two

experimental studies, Cates, Dunne, Erkfriz, Kivisto, Lee and Wierzbicki (2007) and Erion, Davenport, Rodax, Scholl and Hardy (2009) both utilized immediate corrective feedback as a core feature of spelling interventions and produced improved spelling performance. Experimental studies also reveal the importance of multiple practice opportunities within spelling instruction. Graham and Harris (2002) revealed that providing poor spellers with additional spelling instruction and testing yielded greater gains in spelling, writing, and reading than extra math instruction. Conrad (2008) found that students demonstrated an increase in the number of words spelled correctly with repeated reading and spelling practice.

Commonly utilized spelling instruction in the schools currently includes the use of a weekly spelling list with an end-of-the-week test, and using a basal spelling instruction program that includes phonemic awareness, phonics and spelling (Graham et al., 2008). As teachers face many time constraints throughout the day, it is critical that instructional methods be efficient as well as effective. Currently, researchers have become very interested in exploring efficiency and as well as effectiveness of instruction.

Effectiveness and Efficiency Research

Any foundational academic skill deficit must be addressed quickly. Interventions that address deficits need not only to be effective (or result in an acquisition of skill), but also efficient in order to prevent a student from falling further behind. Instructional efficiency can be defined as the amount of learning that occurs over the length of time it takes to implement an intervention (Skinner, 2008). Skinner, Fletcher, and Henington (1996) recommend enhanced learning rates for pupils who are behind their peers academically. Although many interventions are effective in improving learning, not all

are equally efficient (Cates, Skinner, Watson, Meadows, Weaver, & Jackson, 2003). The Cates et al. (2003) study utilized a learning rate to determine efficiency of instruction. More specifically, the research utilized words mastered per minute of instruction for the measurement of instructional efficiency. For each session, learning rates were calculated by dividing the total amount of words mastered by the total amount of instructional time in seconds. For each condition, the number of words mastered per minute was added across session to obtain a cumulative learning rate that could be compared to instructional effectiveness data (words mastered across conditions).

Various studies have analyzed the effectiveness and efficiency of intervention methods for mathematics (e.g., Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997; Skinner, Ford & Yunker, 1991), reading (e.g., Nist & Joseph, 2008; Skinner, Belfiore, & Watson, 2002) and spelling (e.g., Cates, et al., 2003). Although the question of efficiency has become more of an interest, there is still much more research needed to analyze the efficiency of academic interventions.

Some research studies have found improving response efficiency allows for an increased learning rate. Specifically, when students gave verbal responses rather than written responses overall performance efficiency increased (Schisler, Joseph, Konrad, & Alber-Morgan, 2010; Skinner, Ford, & Yunken, 1991; Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997). Also, a study comparing two tape-recorded reading interventions (one with words presented at five second intervals and the other presenting words in rapid succession) revealed that the faster intervention resulted in a quicker learning rate for students (Skinner, Belfiore, & Watson, 1995). Finally, studies where students were instructed to give verbal answers rather than written, reduced the time

spent on the intervention, but did not reduce the level of performance of the students (Skinner, Ford, & Yunken, 1991; Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1992).

Drill and Practice

Repetition is often thought of as the *mother* of learning all skills. Interestingly, various research supports this premise. Repetition, in terms of drill and practice, refers to presenting new material over and over until the information is learned, or is automatic for the student (Cooke, Guzaukas, Pressley, & Kerr, 1993). Repetitive drill or practice has been identified as the most effective method to increase learning (Symonds & Chase, 1992). Drill models are effective and quick interventions and can be used with individual children (Burns, 2007a). Practitioners are encouraged to utilize drill formats with high repetitions to facilitate initial learning as well as successful retention of new information (Daly, Hintze, & Hamler, 2000). Drill tasks, which emphasize basic skill acquisition, lead to retention (Burns, 2004). Higher levels of opportunities to respond within tasks increase retention (Burns, 2007a). Fluency and maintenance have been enhanced with high rates of responding (Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997). Increasing speed of performance occurs through practicing individual items (Cohen, Servan-Schreiver & McCelland, 1992). Drill and practice methods have been found to be effective with differing populations, including students with emotional and behavioral disorders (Lovitt & Hansen, 1976), cognitive disabilities (Skinner & Shapiro, 1989), and learning disabilities (Skinner, Turco, Beatty & Rasavage, 1989). Various drill and practice methods are available to use. Although traditional and the most often utilized drill method consists of 100% unknown items, another drill method, incremental

rehearsal (IR), utilizes a ratio of known and unknown items within the drill. This technique has been found to be especially effective for the retention of newly learned items.

Incremental Rehearsal

A drill approach initially developed to teach vocabulary, incremental rehearsal (IR) (Tucker, 1989), has yielded impressive results. Incremental rehearsal often utilizes 90% known tasks to 10% unknown (but other percentages can be used as well); it introduces each unknown item one at a time, and presents the new item multiple times.

The method of utilizing known items within instruction has been thoroughly researched. Instruction that includes known items within an assignment can increase student preference for the assignment and student engagement (Cates & Skinner, 2000; Skinner, Fletcher, Wildmon, & Belfiore, 1996; Wildmon, Skinner, & McDade, 1998; McCurdy, Skinner, Grantham, Watson, & Hindman, 2001). Interspersing known with unknown items has been shown to yield superior outcomes versus the usage of unknown material only (MacQuarrie, Tucker, Burns, & Hartman, 2002). Learning activities are commonly a series of discrete tasks, and students may be more motivated to complete work on assignments that are interspersed with items they have already mastered because of the reinforcement experience the known items provide (Burns, Ardoin, Parker, Hodgson, Klingbeil, & Scholin, 2009). Manipulating task difficulty may increase the likelihood of a desired behavior occurring (Gickling & Armstrong, 1978; Gunter, Denny, Jack, Shores & Nelson, 1993; Umbreit, Lane, & Dejud, 2004). Instructional techniques that increase the likelihood that a student will fully participate in academic tasks may also increase the rate of learning and decrease inappropriate behavior (Skinner, 2002). Skinner

also discovered that on-task behavior was substantially higher with ED students when a high ratio of known to unknown tasks was utilized (Skinner, Hurst, Teeple & Meadows, 2002). Research has concluded that a student's preference for the instructional material may increase if known items are included.

IR has been found to result in significantly better mastery, fluency and retention than other drill models that utilized lower percentages of known-to-unknown tasks (MacQuarrie, Tucker, Burns, & Hartman, 2002). Also, IR has been reported to result in positive effects when used to acquire academic skills such as letter naming (Bunn, Burns, Hoffman, & Newman, 2005), high frequency words (Joseph, 2006a) and single-digit multiplication facts (Burns, 2005). IR uses high repetitions, gradual introduction of new items, high rates of success (due to high number of known items), and adequate spacing to move more unknown items from short-term to long-term memory (MacQuarrie et al., 2002). Literature supports the basic concepts of IR, such as errorless learning (Browder & Shear, 1996), automaticity (Jones & Christensen, 1999) and spaced repetition (Dempster, 1991). In addition, self-regulation processes such as goal setting and attention focusing are encouraged during IR tasks because IR promotes self-observation, and students have frequent opportunities to gauge their progress (Platten, 2010). When instructional effectiveness is assessed, more students learned to read more words under the IR condition vs. a more challenging interspersal condition (which uses larger unknown item ratios) or traditional drill (100% new material presented over and over) procedure (Nist & Joseph, 2008). Performance ability under IR was found independent of measured verbal ability (MacQuarrie et al., 2002). In a recent study, which replicated the MacQuarrie et al., (2002) experiment, Burns and Boice (2009) found IR led to the

best retention versus a traditional drill and a drill containing 60% known items (interspersal procedure). A meta-analytic review by Burns (2004) suggested that the largest median effect size was found with intervention studies that used 10% unknown to 90% known ratios.

The IR procedure consists of repeated exposure to known and unknown items. Specifically, the first unknown item is presented, followed by the first known item, followed by the first unknown item once again and followed by the first and the second known items. The first unknown item is presented and then followed by the first, second and third known items and so on. Once the first unknown item completes the “folding in” (Shapiro, 2004) process with the nine known items, the ninth known item is removed and the first unknown word now becomes the first known item. A new unknown item is then presented. The procedure is repeated until all unknown items are presented with this method.

Although the effectiveness of IR has been proven, the efficiency of the IR procedure has been an area of research interest and concern. Skinner, Belfiore and Watson (2002) propose that it is important to consider efficiency (student learning rate) when selecting interventions. Prior research on various ratios of unknown-to-known items within a drill task has revealed that the more unknown material relative to the known material, the greater increase in learning rates (Roberts & Shapiro, 1996). In other words, higher amounts of known material included with unknown material results in higher percentage of material retained; however, it may lead to less total material learned in the short-term. Indeed, a higher percentage of known material may lead to less items initially learned, however, it may result in better retention (MacQuarrie et al.,

2002). IR has consistently been shown to increase acquisition and retention (Burns, Dean, & Foley, 2004; Joseph, 2006a; Burns & Boice, 2009; Nist & Joseph, 2008).

IR sessions may take up to twice as long as other interspersed approaches, such as the 50% known and unknown ratio (Drill Sandwich), but lead to better results (MacQuarrie et al., 2002). Burns and Dean (2005) found IR approach required approximately 10-15 minutes longer to complete versus a Drill Sandwich and traditional drill approach (100% unknown items), yet the increase in the amount of instructional time was eclipsed by the effectiveness of the IR procedure. IR requires almost twice as much time to execute when compared to an 83% known condition; however, the IR condition again outperformed various other ratios utilizing greater than 10% unknown items (Burns & Dean, 2005). An unusual finding was that although the IR condition takes longer to complete, it was linked to an increase of on-task behavior (Burns & Dean, 2005). This finding is in direct conflict with the accepted premise that the longer a task takes, the more likely off-task behavior will occur (Darch & Gersten, 1985).

Cates and colleagues (2003) defined efficiency as the number of words mastered/acquired per minute of instructional time. Cates et al. compared learning rate and learning for teaching spelling to primary grade children. These researchers found that the traditional drill method to teaching spelling was more efficient over two other interspersal procedures. One of the interspersal procedure used 6 unknown words and 18 known, in terms of three sets of known words presented prior to one unknown. The other interspersal procedure involved a more difficult ratio of known-to-known words – three unknown words were presented followed by three known words. The third procedure, traditional drill, used 100% unknown words. These researchers examined which of the

three conditions produced the greatest cumulative words spelled and cumulative rate of words spelled. The conditions were presented in an alternating fashion across sessions. Cumulative rates were calculated by multiplying the sum of words learned per session by sixty seconds and dividing that sum by the total instructional time. In contrast, when words maintained, not simply mastered or learned are considered, results may become less clear (Burns & Sterling-Turner, 2010). A study by Burns and Sterling-Turner (2010) found that the IR condition required 2.5 times more instructional time than the traditional drill but was almost 3 times more effective. In summary, although efficiency is an important consideration in instruction given a typical school day, it should not be the only reason why one method is chosen over another (Schmidgall & Joseph, 2007).

Given that teachers frequently allocate a certain amount of time to each instructional segment, it is key to identify which types of interventions are likely to produce the greatest achievement in the shortest time. Further research is needed to determine which methods of teaching are the most effective and efficient. Social validity in terms of student acceptance is also a key aspect of successful instruction. Students who perceive a strategy as effective are more likely to use it in the future (Komarraju & Karau, 2002).

Topography of Responding

Research indicates spelling is typically assessed with having children write words to dictation (e.g., Both-deVries & Bus, 2008; Lombardino, Bedford, Fortier, Brandi, & Carter, 1997; McBride-Change, 1998; Ouellette & Senechal, 2008). Evidence indicates that older children spell more accurately with writing versus an oral response (Jorm & Schoknecht, 1981; Tenney, 1980). Treiman and Bourassa (2000) reported written

spelling performed superior to oral spelling in general education first-grade students and second-grade students (kindergarteners showed no significant difference). However, Puranik and Apel (2010) found preschool age children with the ability to write 19 or more letters spelled equally well across three different conditions, orally, by writing, or by using letter tiles. Specifically, the researchers manipulated the motoric and memory demands of the spelling task by having 104 public and private preschool children (ages 3 years 7 months to 5 years 11 months and of various SES) spell single words using letter tiles, orally and by writing. Prior to reaching a certain level of orthographic mastery (the ability to write 19 letters), tile spelling was superior to oral and written spelling and oral spelling was superior to written spelling.

Additional studies utilizing topography of response for spelling instruction would be very useful. There is a research need to further determine the possible influence of the type of activity used for spelling assessments, and how that task selection helps or hinders a young student's spelling skills.

Statement of the Problem

Many and various studies have indicated that incremental rehearsal within a drill exercise can render effective outcomes and high retention rates. Specifically, MacQuarrie et al. (2002) found incremental rehearsal led to better retention versus methods that consist of lower known to unknown ratios. Burns and Dean (2005) found that a 90% known condition led to higher retention and percentage of on-task behavior. Whereas it is clear that incremental rehearsal has consistently yielded effective results across numerous studies and is a highly promising technique, what is currently missing from the body of research is a thorough look at incremental rehearsal's effectiveness across

various types of academic tasks such as spelling. The effectiveness of incremental rehearsal has been studied when teaching children to read and solve math problems. However, it has not been examined on teaching children to spell. Moreover, there have not been any studies that examined different topographies of response with the incremental rehearsal procedure. Different topographies of responding, such as a written response versus an oral response, may significantly influence the efficiency of an intervention. One form of responding may result in higher learning rates over other forms when students are initially learning a skill. In other words, students may be able to learn more content and skills within the allocated instructional time period using one form of responding over another. Various research across different academic activities has indicated an increased efficiency when using an oral response (Skinner, Ford & Yunker, 1991; Skinner, Belfiore, Mace, Williams-Wilson & Johns, 1997; Schisler, Joseph, Konrad, & Alber-Morgan, 2010). Using an oral versus a written topography may result in different learning rates for spelling instruction when using incremental rehearsal. Because time is of the essence when teaching students to learn academic skills, it is critical researchers examine how interventions are implemented and that they determine the most efficient way of implementing an intervention. With regard to incremental rehearsal, researchers have demonstrated its overall effectiveness on acquisition, retention and generalization of content and skills. However, researchers have yet to determine the differential effects of implementing this intervention using two different types of response topographies.

Purpose of the Study

The primary purpose of this study is to examine the instructional effectiveness and efficiency of two spelling interventions on students' words spelled accurately and cumulative learning rate. Specifically, the study will examine which of the two instructional spelling conditions (incremental rehearsal using an oral response and incremental rehearsal using a written response) is most efficient given the measure of instructional time across sessions. This study expands previous IR studies in terms of examining the effectiveness and efficiency of IR. Specifically, the study investigates learning, delayed recall, and generalization effects as well as the rates associated with each. It investigates the use of incremental rehearsal within a new context (spelling) across two response topographies and also collects social validity data.

Research Questions

For purpose of this investigation, the following questions will be posed:

- 1) Which method, incremental rehearsal oral or incremental rehearsal written helps children spell the most words correctly?
- 2) Which method, incremental rehearsal oral or incremental rehearsal written helps children spell the most words correctly per minute of instruction?
- 3) Which method, incremental rehearsal oral or incremental rehearsal written helps children retain spelling words on a delayed recall probe?

- 4) Which method, incremental rehearsal oral or incremental rehearsal written helps children retain spelling words accurately per minute of instructional time on a delayed recall probe?
- 5) Which method, incremental rehearsal oral or incremental rehearsal written, yields the most generalization of accurately spelled words presented in sentences?
- 6) Which method, incremental rehearsal oral or incremental rehearsal written, yields the most generalization to accurately spelled words presented in sentences per minute of instruction?
- 7) Which method, incremental rehearsal oral or incremental rehearsal written, is viewed as most useful for teachers?
- 8) Which method, incremental rehearsal oral or incremental rehearsal written, is viewed as most useful for students?

Significance of the Study

Although incremental rehearsal is an established intervention, teaching spelling using IR across two different response topographies represents a new application of this intervention. This study will contribute to the body of knowledge by validating or invalidating IR across two different response topographies as an intervention to effectively and efficiently improve children's spelling skills.

Chapter 2: Review of Literature

The following chapter provides an overview of related literature regarding the importance of spelling as a skill as well as effective methods and interventions for teaching spelling to primary grade students. Specifically, spelling instructional methods that incorporate explicit and systematic phonemic awareness, phonics and alphabetic skill training, immediate corrective feedback, multiple practice opportunities, and small group instruction, among others, were found effective for improving spelling skills. In addition, overviews of drill and incremental rehearsal procedures, as well as topography considerations, are discussed. These subjects are discussed within the context of their instructional effectiveness and efficiency.

Importance of Spelling Skills

Why is spelling important? Many reasons exist, but a particularly salient reason is that there is social pressure associated with accurate spelling. The ability to spell correctly is highly valued in a literate society (Scott & Brown, 2001). Furthermore, spelling is conspicuous, and people feel comfortable passing judgment on poor spellers (Smith, 2004). According to the National Commission on Writing for America's Families, Schools and Colleges (2005), poor spelling on an employment application is very likely to be the difference between acceptance and rejection of an applicant. Poor spellers may be viewed as unintelligent or careless (Alber & Walshe, 2004).

Unfortunately, spelling is one of the most difficult skills in written communication to master (Wanzek, Vaughn, Wexler, Swanson, Edmonds, & Kim, 2006). Spelling ability indicates a sophisticated knowledge of letters, sounds and syllable patterns (Bear & Templeton, 1998). Defined another way, spelling is a multifaceted skill that encompasses phonological awareness, morphological awareness (root word meanings), semantics and orthographic knowledge (consistent letter sequencing patterns) (Moats, 1984). Spelling includes layers of knowledge: (a) alphabetic understanding, (b) pattern understanding, and (c) meaning (Bear, Invernizzi, Templeton, & Johnston, 2008). In addition, children's spelling performance, phonological skill and alphabetic knowledge appear intertwined and may develop in concert with one another (Cassar & Trieman, 2004).

Spelling skill is considered important for reading acquisition. It has been proposed that spelling is the foundation of reading (Venezky, 1980). Specifically, Venezky found that the earliest educational records (beginning the sixteenth century up until the end of the nineteenth century) indicated spelling instruction was intimately tied to reading instruction (i.e., whole words were presented for reading and spelling instruction in tandem). Spelling is also an integral part of learning the language (Joshi, Treiman, Carreker, & Moats, 2008). The symbiotic relationship of spelling and reading is supported by research. Ehri (1997) found high correlations across grade levels suggesting spelling, word reading and identifying misspellings use similar processes. Berninger, Abbott, Rogan, Reed, Abbott, Brooks, Vaughn, and Graham (1998) found spelling instruction improved word recognition for struggling second-grade spellers. Okyere, Heron, and Goddard (1997) found that spelling instruction enhanced students'

ability to read the words that shared similar phonemes and alphabetic patterns as the words they learned to spell. Ehri (2000) identified six individual studies highlighting correlations from .68 to .86 indicating strong relationships between spelling and reading. Ehri and Wilce (1987) also found word decoding practice improved the spelling performance of kindergartners and first graders. O'Connor and Jenkins (1995) reported children progress faster in reading and spelling when they receive spelling instruction in early grades. Additional research shows that learning to spell and learning to read rely on similar underlying knowledge and therefore, learning how to spell helps children better understand reading (Ehri, 2000). Furthermore, Uhry and Shepard (1993) found that first graders who received spelling instruction improved their ability to read and decode familiar words. Children who enter first grade knowing many letter names and sounds perform significantly better in spelling and reading (Roberts & Meiring, 2006). Simply put, learning to spell helps support memory for whole words, which is useful in both spelling and sight word reading. Thus, learning to spell enhances the ability to read (Moats, 2006).

If spelling can aid with the attainment of literacy skills for some children, it certainly is an area worth attention. It is well understood that literacy is essential to successfully functioning in our society. The National Center for Educational Statistics (NCES, 2008) found only 32% of fourth graders read at the proficient level for the 2006-2007 period. Sixty-six percent of fourth graders were ranked at the basic level, indicating only partial mastery of fundamental skills.

In addition to the connections between spelling and reading, spelling supports other necessary skills needed for success, particularly writing. Written expression is

required for academic achievement (Christensen, Thurlow, Ysseldyke, & McVicar, 1989). Spelling is related to written expression and, therefore, is a key component of a student's academic program (Wanzek et al., 2006). Spelling ability is related to composition length and quality (Graham et al., 1997). Spelling difficulties can interfere with other composing processes (Berninger, 1999). Failure to rapidly and accurately spell may interfere with putting ideas into writing (Graham, Harris, & Fink-Chorzempa, 2002). Students who spell poorly write fewer words (Ehri, 1989) and may receive poor grades or job evaluations (Joshi et al., 2008). Spelling difficulties may influence the words a student selects. Students are less likely to choose words they cannot spell (Graham & Harris, 2002). Written work can be compromised when too much of the student's effort is devoted to thinking about how to spell words (Singer & Bashir, 1999). Poor spelling can influence perceptions about a child's competence as a writer (Graham, Harris, Fink-Chorzempa, & MacArthur, 2003). Difficulties with spelling may lead children to avoid writing, and therefore, develop a belief that they cannot write, leading to arrested writing development (Graham, 1999). Juel (1988) found spelling performance attributed to 29% of the variance in first-grade children's writing scores. The effects that difficulty in spelling has on composition include poor writing fluency and poor writing quality (Scott & Brown, 2001).

To persuade educators and researchers of the importance of spelling as a critical skill, it is necessary to firmly acknowledge that significant spelling difficulties are issues that cannot be solved with spell-check computer programs. Spell-check programs are primarily designed as a tool for correcting typos – which helps adequate spellers only. Spell-check does not take into consideration context or definitions of words, nor grossly

misspelled words. Studies show spell-check only sufficiently corrects spelling errors 25-80% of the time – which could never compensate for truly poor spellers (Joshi, et al., 2008). Spell-checker technology does not eliminate the need to proofread (Scott & Brown, 2001).

Spelling weaknesses must be addressed early. Early in a student's academic career, academic intervention is essential for those students performing below benchmarks. Spelling problems in the early years of schooling will persist throughout the elementary years if left untreated (Juel, 1988). Spelling instruction integrated into a beginning reading program can help students improve their spelling and reading (Santoro, Coyne, & Simmons, 2006). It is unlikely that poor spellers will “catch up” given enough time (Scott & Brown, 2001). Spelling must be taught effectively in primary grades to help minimize constraints on reading skills such as word attack and word recognition (Graham et al., 2002). Ineffective first-grade instruction can lead to poor performance for the rest of the child's school career (LaParo & Pianta, 2000). When children begin to develop difficulties with spelling, these difficulties need to be identified and addressed quickly before the problem becomes established (Graham, 1999). So for young children the evidence is clear – in terms of interventions, time is of the essence (Moats, 2006).

Spelling Instruction Techniques

What is important to know about spelling and spelling instruction? Two basic theories for spelling instruction exist: the spelling is “caught” approach and the spelling is “taught” approach. Specifically, spelling-is-caught approach occurs when students are engaged in reading and writing activities. In contrast, spelling-is-taught approach consists of using direct, systematic spelling instruction (Graham, 2000). Spelling-is-

taught (Schlagel, 2007) includes memorization (word lists), generalization (rules, skills), and developmental exercises (word activities such as word sort). Based on a review of 60 studies, existing evidence provides little support that teachers should rely on an “is caught” or natural approach with children, especially those who find spelling challenging (Graham, 1999). Berninger et al. (1998) found teachers who are required to teach literacy using whole word programs do not rely strictly on such “natural” approaches and continued with formal spelling instruction. Teaching spelling skills only when the need arises (natural learning approach) is reactive rather than proactive (Graham, 1999). The claim that direct teaching of spelling is ineffective is inconsistent with research (Graham & Weintraub, 1996). Butyniec-Thomas and Woloshyn (1997) found that students demonstrated better spelling performance when spelling instruction and reading instruction were used together.

Other critical aspects of learning to spell include memory for spelling words (lexical knowledge), skills needed to generate and check plausible spellings (such as phonics and the alphabetic principle) and external resources to ensure correct spelling when writing. In terms of specific spelling instruction, teaching phonological awareness, phonics for spelling, strategies for spelling unknown words, and spelling rules are empirically validated as effective with struggling spellers (Graham, 1999; Graham et al., 2003). The National Reading Panel (2000) reports that instruction in phonemic awareness and phonics improves spelling outcomes for students. Explicit instruction (providing simple explanations and demonstrations) for phonics results in better spelling, reading and comprehension performance (Christensen & Bowey, 2005). Foorman, Francis, Novy, and Liberman (1991) reported that first graders who received letter-sound

training 45 minutes per day improved spelling faster than those who received 15 minutes of training per day.

Success in teaching spelling depends, in part, on providing spelling instruction that matches children's individual needs (Graham & Harris, 2002). Effective teaching cannot begin until the teacher understands what a student knows and what he/she is ready to learn (Bear, Invernizzi, Templeton, & Johnston, 2008). Spelling instruction methods that use multifaceted activities and procedures are the recommended approach for spelling instruction (Graham, 1999; Graham et al., 2008; Schlagel, 2007). Providing instruction in small groups has been found to be effective for children at risk for academic failure (Elbaum, Vaughn, Hughes, & Moody, 2000). Spelling instruction should be pleasant and interesting. Utilizing student participation in word choices to be studied, peer study groups, guided discovery of patterns and games which practice spelling skills all help engage students (Harris, Graham, Gentry, & Zutell 1998; Graham, Harris, & Loynachan, 1996). Wanzek et al. (2006) synthesized 19 studies on spelling and reading interventions for LD children and found better results with spelling interventions that utilized explicit instruction (such as systematic study and spelling strategies), multiple practice opportunities, and immediate feedback. Santoro et al. (2006) reported that teachers should introduce skills systematically and correspondingly increase levels of difficulty and decrease support (i.e., scaffolding), and provide multiple practice opportunities with immediate corrective feedback for students at risk for academic failure. Torgesen (2000) argues that if early instruction consisted of explicit and systematic phonemic awareness training, the rate of disability identification would

decrease substantially. Professional development for teachers is needed in order to produce competent student spellers (Fresch, 2007).

A commonly used approach to teaching spelling is providing students with a spelling list to memorize for a weekly test. Different approaches for selecting words include teaching commonly misspelled words, teaching children words most likely to be used in their writing, or teaching words with related patterns (e.g., ee and ea for long e sound) (Graham, 1999). Teachers create spelling list words from published series, students' writing, high frequency words, and district requirements (Pressley, Rankin, & Yokoi, 1996).

Another instructional method, invented spelling, encourages children to ignore correct spelling of words in order to increase the amount and quality of children's writing. Snow, Burns, and Griffith (1998) indicated that young children naturally engage in inventing their spelling. Young children may discover relationships between sounds and letters through invented spelling. Thus, young children invent spelling naturally until they are directly taught conventions of spelling (Sipe, 2001). Unfortunately, children who continue to rely on invented spelling in the primary and elementary grades have more misspelled words versus students who are given direct instruction in spelling (Clarke, 1988; Gettinger, 1993). Perhaps a good use of invented spelling is that it can serve as an evaluation tool that may help teachers determine appropriate instruction in spelling and phonics (Bear et al., 2008).

Instructional practices in spelling that have been validated through research-validated procedures include practices such as *test-study-test* or *corrected test method* (Graham, 1983). The test-study-test approach includes taking a pretest to identify

incorrect spellings, studying the correct spellings and taking the test again. The corrected test method requires spelling errors to be immediately corrected by the student.

McGuffin, Martz, and Heron (1997) found error self-correction effective for third graders at risk for spelling failure vs. copying a modeled word correctly five times. Existing studies indicate younger children with spelling difficulties and disabilities can improve spelling performance using error self-correction (Viel-Ruma, Houchins, & Fredrick, 2007). According to Wanzek et al. (2006) effective interventions which resulted in enhanced spelling performance for students with learning disabilities include error correction, reducing the number of spelling words taught, Constant Time Delay and Cover, Copy, and Compare procedures, weekly word lists with multiple practice opportunities, and structured peer tutoring. Edwards (2003) highlighted the importance of physically writing words as students learn to spell; physically representing letters and words improves spelling performance.

Empirically supported evidence also exists for the following procedures which enhance the performance of weak spellers: reduction in number of words studied each week, re-teaching skills/strategies, games, peer learning, word sort activities, computer programs that teach spelling, and praise/reinforcement (Graham, 1999). The use of spell check, proofreading and feedback on misspellings was found empirically validated in helping weak spellers during writing activities (Graham, 1999). Word study and word sort have been acknowledged as evidence-based instruction and can be included in daily spelling routines. Specifically, these activities can include sorting words by differences, similarities, sound patterns, or meanings and conducting word hunts for words with similar properties. Joseph (2000) reports word sort activity as especially viable for

helping first graders spell words accurately. Students need exposure to a plethora of opportunities to manipulate word features. Students may be exposed to entire groups of words that are spelled in a similar way (Bear et al., 2008). Word study approaches allow students to see relationships among words and therefore, do not rely solely on memorizing spelling words (Fresch, 2000).

Frequently utilized, current (yet traditional) spelling instruction often includes basal spelling programs sequenced by phonological and morphological aspects (sounds/symbols, patterns, rhyming, syllables, and synonyms). Research on effective phonological instruction concludes that including a developmental progression from easy phonological activities (such as rhyming exercises) to more advanced phonemic awareness exercises (such as addition and deletion of sounds) are critical and should be introduced as early as feasible; unfortunately, popular basal reading series often fail to follow this developmental progression (Al Otaiba, Kosanovich-Grek, Torgensen, Hassler, & Wahl, 2005). An interesting finding in the study by Schuele, Justice, Cabell, Knighton, Kingery, and Lee (2008) revealed that kindergarten teachers were unlikely to shift from low level rhyme instruction to higher level phonemic awareness activities, even when their kindergarten students' test results indicated that they had mastered rhyme skills. Schuele et al. hypothesize this may have been due to the fact that the kindergarten teachers were less experienced with higher level phonemic awareness instruction. Spelling is primarily a linguistic skill (Moats, 1994), and therefore, phonemic awareness and phonics can be an effective means to improve spelling. Cunningham, Perry, Stanovich, and Stanovich (2004) report that, unfortunately, teachers' knowledge of phonics is not as comprehensive or advanced as teachers estimate their knowledge to be.

Studies by Moats (1994) and Bos, Mather, Dickson, Podhajski, and Chard (2001) suggested that teachers have a very weak grasp of phonological concepts and phonics. According to some researchers, whole class spelling instruction (versus ability groups) has been found to be less effective, yet it is the predominant method that teachers use (Invernizzi & Hayes, 2004). Furthermore, Johnston (2001) found that although teachers were dissatisfied with their students' spelling skills, they appeared to lack the knowledge needed to teach spelling more effectively.

Other traditional spelling instruction activities may include alphabetizing; dictionary exercises, writing sentences, and word find (Goddard & Heron, 1998; Heron, Okyere, & Miller, 1991). Scott and Brown (2001) identified 3 general categories of spelling instruction: memorizing weekly word lists, word sorting activities, and spelling integrated with writing (utilizing teachable moments). A national writing survey conducted by Graham, Harris, Fink-Chorzempa, and MacArthur (2003) found that most primary grade teachers taught spelling. In this writing study, invented spelling, direct instruction of spelling words, phonics for spelling, and strategies for unknown words were among those approaches reported as being provided on a weekly basis.

According to Loomer, Fitzsimmons, and Sterge, (1990), spelling instruction should occur between 60 to 75 minutes per week. Unfortunately, a sizeable proportion of teachers spend less than this recommended amount of time teaching spelling (Graham et al., 2008). In addition, whereas teachers report that they use a variety of evidenced-based, research-supported spelling instruction practices, 27% of students on average have difficulty spelling – thus it can be concluded that the teachers' spelling instruction methods are largely ineffective (Graham et al., 2008).

Experimental Spelling Studies 2000-2010

Experimental spelling studies conducted over the last decade have uncovered several key findings. The majority of these findings have also been empirically validated in earlier decades. First, the studies indicated that phonemic awareness and phonics instruction are important and critical components of spelling instruction. Four experimental studies have found phonemic awareness and/or phonics instructional components effective for teaching spelling. Qi and O'Connor (2000) examined letter-sound decoding, segmenting, and blending exercises versus first-sound identification and rhyming exercise with kindergarten students and found both effective for spelling progression. Roberts and Meiring (2006) researched phonics instruction with first graders through a spelling context or through a literature context. Phonics instruction within spelling instruction was overall found to be the most effective. Craig (2006) investigated interactive writing using phonics, alphabet skills, and word building versus phonological game interventions with kindergarten students; both were found effective for spelling progression. Arra and Aaron (2001) compared linguistic instruction (discussing the linguistic nature of spelling mistakes) to visual instruction only (flashcard review without linguistic explanation) with second graders. The linguistic instruction was found to be the most effective spelling instruction. Findings from these studies indicated that the conditions that consisted of phonemic awareness and/or phonics instruction had strong effects on spelling performance.

Second, recent studies incorporated immediate corrective feedback as a core instructional component of spelling instruction. Specifically, spelling or phonemic awareness practice with immediate verbal correction was found to be a characteristic in

several relatively recent experimental studies. As one example, Conrad (2008) used flashcards for reading and spelling instruction; both conditions provided immediate corrective feedback to the participating second graders. Overall, the spelling instruction was found most effective for generalizing reading and spelling. Noell, Connell, and Duhon, (2006) used first graders to investigate whole word reading instruction with immediate feedback versus an oral spelling exercise with immediate modeling of correct spelling. Both groups had gains, but the oral spelling exercise resulted in overall more generalization of learning. Cates, Dunne, Erkfritz, Kivisto, Lee, and Wierzbicki (2007) used two conditions with immediate correction for misspelled words. The first condition, cover-copy-compare, included presenting the word, covering the word, asking the student to spell the word and if incorrect, the student uncovered the word, compared his spelling to the correct spelling and wrote the word out correctly 3 times. The other condition presented the word, asked the student to spell the word and if incorrect, the correct spelling was immediately provided to the student and the student was asked to write out the word three times. All third-grade students in the study learned more under the first condition (which asked the student to actively compare his work against the correct spelling). The Erion, Davenport, Rodax, Scholl, and Hardy (2009) design required second and third-grade students to immediately compare their written spelling word with the correctly spelled word, and upon a discrepancy, the student rewrote the word between one and three times, depending on the condition. For this study, results were equivalent in terms of spelling words learned. In both studies involving cover, copy and compare techniques (Cates et al., 2007 and Erion et al., 2009) immediate corrective feedback was a key component in producing improved spelling performance.

Third, systematic explicit spelling instruction, or “taught” not “caught” instruction, was consistently found to be effective in recent studies. Specifically, in terms of spelling performance, students who received explicit spelling instruction within a linguistic instruction method outperformed students who received flashcard drills (Arra & Aaron, 2001). In another study, students who received explicit phonics/alphabetic skills within writing training outperformed students in the class who received general spelling curriculum (Craig, 2006). When explicit phonics/phonemic awareness spelling training was compared to story-book reading and beginning reading skills training, kindergarten students who received explicit phonics/phonemic awareness training within spelling practice performed better in spelling than students who received story-book reading with training on beginning reading skills (Santoro, Coyne, & Simmons, 2006). Interestingly, when phonics coupled with spelling versus phonics coupled with a literature context were compared on first-grade students’ spelling performance, students who received a phonics approach within spelling instruction outperformed students who received phonics approach within a literature context (Roberts & Meiring, 2006), and first-grade students who received an oral spelling model outperformed students who receive a whole word reading model (Noell, Connell, & Duhon, 2006). In addition, Noell, Connell and Duhon (2006) felt whole word approaches (especially for struggling spellers) should ideally be used to supplement spelling instruction and not replace explicit spelling instruction (phonemic awareness, phonics and alphabetic principles).

Fourth, in terms of evaluating the most productivity of instructional time spent, spelling instruction appears to provide more overall benefits in terms of spelling and reading when compared to reading instruction alone. Two recent studies indicated that

although spelling supports reading performance and reading supports spelling performance the influence of one on the other is not the same. Generalizations are stronger from spelling to reading (Noell, Connell, & Duhon, 2006) and educational transfers from spelling to reading significantly outperformed the educational transfers from reading to spelling (Conrad, 2008). Whereas this is not an indicator or suggestion that reading instruction should be discontinued and only spelling instruction should be taught, it does underscore how very important spelling as a skill is, and that it must become more of a priority in the classroom.

Fifth, providing students with multiple practice opportunities was found to be a critical component in these most recent spelling instruction studies. For instance, when a cover, copy and compare intervention was implemented (Erion et al., 2009) students demonstrated better retention of spelling words when incorrect words were copied 3 times versus 1 time. Additional spelling instruction such as word sort, word hunt, games, peer study, and additional spelling tests yielded greater gains in spelling, writing and reading than traditional spelling instruction which predominantly utilizes a weekly spelling list to memorize (Graham & Harris, 2002). Conrad (2008) utilized repeated reading and spelling practice to increase words read and spelled correctly. The second-grade participants provided with repeated spelling practice versus those with repeated reading practice exhibited the ability to spell and read, versus the reading group became proficient in reading only. Re-teaching skills and strategies through multiple practice opportunities appears a logical course of action.

Additionally, within the last decade, spelling research has focused on the use of word study and small group work. Of the recent studies that were reviewed in this paper,

the majority (90%) of the studies consisted of teaching students in small groups (5 students or fewer) whereas over half (70%) of the studies had some type of word study instruction (discussing how words are similar/dissimilar) embedded within an intervention.

Drill Exercises and Learning

It is a popular and often espoused belief that practice makes perfect, or that repetition is the mother of skill. Interestingly, various research supports these frequently touted premises. Repetitive drill or practice has been identified as the most effective method to increase learning (Symonds & Chase, 1992). Drill models are effective and efficient interventions, which can be used with individual children (Burns, 2007a). Practitioners are encouraged to use drill formats with high repetitions to facilitate initial learning, and successful retention of new information as rehearsal is found to be linked to the number of practice trials (Daly, Hintze, & Hamler, 2000). Drill tasks, which emphasize basic skills, lead to retention (Burns, 2004). Tasks that included higher levels of opportunities to respond within tasks increased retention (Burns, 2007a). Fluency and maintenance have been enhanced with high rates of responding (Skinner, Belfiore, Mace, Williams-Wilson, & Johns, 1997). Increasing speed of performance occurs through practicing individual items (Cohen, Servan-Schreiber & McClland, 1992).

Although plenty of practice opportunities are important, difficulty level of tasks within the drill is an important consideration. Matching the difficulty of tasks to student skill level increases completion and time on-task (Gickling & Rosenfield, 1995). Tasks that incorporate easy items with more challenging items increase the probability that more tasks will be performed (Burns, Ardoin, Parker, Hodgson, Klingbeil & Scholin,

2009). Increasing the ratios of known-to-unknown drill items has been shown to improve the number of items students learn (Roberts & Shapiro, 1996), increase students' positive perceptions of assignments (Cates & Skinner, 2000), and increase student engagement (McCurdy, Skinner, Grantham, Watson, & Hindman, 2001). Neef, Iwata, and Page (1980) and Dunlap (1984) found that students preferred procedures that included known content over instructional procedures that did not. Research has shown that less challenging ratios of known-to-unknown items (i.e., more known items to unknown items) leads to better retention (Cooke & Reichard, 1996). Burns (2004) reported through an empirical analysis of 13 drill unknown-to-known ratios that the most challenging known-to-unknown ratios (< 50% known items) resulted in weaker performance. Increasing rates of responding (through the use of known items within an instructional drill set) reduces latency in initiating target (unknown) tasks (Cates et al., 2003). Tasks that consist of a combination of easier items with difficult items help students increase their confidence and motivation to complete assignments (Skinner, 2002). For instance, researchers found that interspersing easier problems with more challenging math problems increases students' rate of math assignment completion (Skinner, Fletcher, Wildmon, & Belfiore, 1996).

Incremental Rehearsal

A drill approach developed to teach vocabulary, incremental rehearsal (IR) (Tucker, 1989), has yielded positive results. Incremental rehearsal consists of a high percentage of known tasks and a lower percentage of unknown tasks. The unknown items are introduced one at a time, and each unknown item is presented multiple times. IR has been found to result in significantly better mastery, fluency and retention than other drill

models that use higher percentages of unknown-to-known tasks with third graders (MacQuarrie, Tucker, Burns, & Hartman, 2002). IR has positive effects on the acquisition of academic skills such as letter naming for preschoolers (Bunn, Burns, Hoffman, & Newman, 2005), high frequency words for second graders utilizing Title I services (Joseph, 2006a) and single-digit multiplication facts for third-grade LD math students (Burns, 2005). IR uses high repetitions, gradual introduction of new items (ratio of unknown-to-known remains at the original known-to-unknown percentages), a high rate of success (due to high number of known items), and adequate spacing to move more unknown items from short-term to long-term memory (MacQuarrie et al., 2002). Literature supports the basic concepts of IR, such as errorless learning (Browder & Shear, 1996), automaticity (Jones & Christensen, 1999), and spaced repetition (Dempster, 1991). When instructional effectiveness is assessed, more first-grade students with reading difficulties learned to read more words under the IR condition versus an interspersal condition (which uses a larger percent unknown item ratio) or traditional drill (100% new material presented over and over) procedure (Nist & Joseph, 2008). Performance ability under IR was found independent of measured verbal ability (MacQuarrie et al., 2002). In a recent study, which replicated the MacQuarrie et al., (2002) experiment, Burns and Boice (2009) found IR led to the best retention vs. a traditional drill and a drill containing 60% known items (interspersal procedure) for seventh graders with disabilities. A meta-analytic review by Burns (2004) reports that the largest median effect size was found with intervention studies that used 10% unknown to 90% known ratios.

The IR procedure consists of repeated exposure to known and unknown items. In the following example, IR will be discussed within the context of presenting 90% known items and 10% unknown items. Each unknown item is presented nine times incrementally among nine known items. Specifically, the first unknown item is presented, followed by the first known item, followed by the first unknown item once again and followed by the first and the second known items. The first unknown item is presented and then followed by the first, second and third known items and so on. Once the first unknown item completes the “folding in” (Shapiro, 2004) process with the nine known items, the ninth known item is removed and the first unknown item now becomes the first known item. A new unknown item is then presented. The procedure is repeated until all unknown items are presented with this method. An outline of the specific steps involved in the incremental rehearsal procedure is provided below.

Steps in Incremental Rehearsal Procedure

Present first unknown item

Present first known item

Present first unknown item

Present first and second known items

Present first unknown item

Present 1st, 2nd, 3rd known items

Present first unknown item

Present 1st, 2nd, 3rd, 4th known items

Present first unknown item

Present 1st, 2nd, 3rd, 4th, 5th known items

Present first unknown item

Present 1st, 2nd, 3rd, 4th, 5th, 6th known items

Present first unknown item

Present 1st, 2nd, 3rd, 4th, 5th, 6th, 7th known items

Present first unknown item

Present 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th known items

Present first unknown item

Present 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th known items

Previous unknown item becomes the first known item, the 9th known item is removed and a new first unknown item is introduced.

A further consideration when using the IR process is a student's acquisition rate. The amount of new information a student can learn at one time must be considered in tandem with the level of challenge of the instruction (Gickling & Thompson, 1985). Acquisition rate is the amount of new information an individual student is able to rehearse and recall (Burns, 2001); and acquisition rates are met at varying levels per student (Burns & Dean, 2005). In terms of acquisition rate, educators will need to determine the abilities of the individual student to ensure that the appropriate amount (not too many or too few) of unknown items is presented (Burns, 2007b). Burns (2005) suggests that when using the IR technique, the size of the unknown item set must be based on the student's acquisition rate. From Burn's perspective, this can simply mean the amount of new or unknown items introduced is continued until the student makes three errors while rehearsing the new, unknown item. As an example, the instructor may

intend to rehearse ten new spelling words, however she notices at word eight the student incorrectly spells the target word three times in a row. At this point, the intervention would be discontinued until the next intervention session. Understanding and responding to student instructional level is an important consideration before and during the implementation of interventions, because if a student's frustration level is too high, it may likely impact the intervention's effectiveness. This unfortunate result would not be due to the structure of the intervention, but because the content level was too challenging for the student (i.e., selecting items too difficult for the participant) and prevented the student from gaining the needed skills.

Additional considerations when choosing IR as an intervention include evaluating the time required to execute the intervention and personnel needed to execute the intervention. Time requirements of a 10 unknown word/vocabulary process can take approximately from 15 to 25 minutes to implement (Burns, 2005; Burns & Boice, 2009). Research consistently has examined IR in a one-to-one instructional approach. Specifically, instructional aides, parents or peers were trained to implement the procedure (Burns, 2005).

IR Study Participants

Historically, the majority of IR studies have addressed acquisition and retention of words read, primarily with regular education or students with learning disabilities (Burns, 2007a). However, incremental rehearsal has been used and studied across a variety of academic skills, including single-digit multiplication facts, sight words, vocabulary, Esperanto words, letter names, and sounds. Participants with a variety of differing characteristics have participated in these studies. Grade levels represented in various

research studies include: preschoolers/kindergartners, 1st, 2nd, 3rd, 4th, 7th and 8th graders. Ability levels of participants within studies include average students, below average IQ students, moderate MR students, SLD students (reading, math, and writing), those receiving remedial reading services (Title I) and students identified as having some disability. Participants of IR studies included male, female, Caucasian, African American, Asian, Somalian, and Hispanic students. In terms of SES, various student participants were eligible for reduced price/free lunch (Burns & Sterling-Turner, 2010; Burns & Boice, 2009; Nist & Joseph, 2008; Burns, 2007a; Burns, 2007b; MacQuarrie et al., 2002; Burns & Dean, 2005; Burns, Dean, & Foley, 2004; Burns, 2005; Joseph, 2006a; Bunn, Burns, Hoffman, & Newman, 2005).

Retention, Maintenance, Generalization of IR

Retention is a strong selling point of IR. Although challenging ratios may lead to higher acquisition rates (more total material learned in the short term), IR has been proven to yield better retention. MacQuarrie et al. (2002) found third-grade students retained significantly more sight words with IR up to 30 days after the intervention ended (vs. traditional drill or Drill Sandwich procedures). Joseph (2006a) reported that second-grade Title I students retained 90% of the words learned and were able to read the words in a passage three days later. Burns (2007a) reported 72-92% retention rate using IR for sight words with a second-grade student with moderate MR. A study by Burns and Sterling-Turner (2010) was consistent with previous research and found IR led to better retention than traditional drill for fourth-grade students (Burns & Boice, 2009; MacQuarrie et al., 2002; Nist & Joseph, 2008).

Compared to other drill options, IR has impressive maintenance results. Although acquisition is only one phase of learning, maintenance of items learned is an important aspect of effectiveness. Maintenance in addition to rate of learning must be considered when selecting interventions (Burns & Sterling-Turner, 2010). Maintenance is the phase in which the child can accurately and fluently complete the task, without re-teaching, following a delay after the initial acquisition and proficiency (Alberto & Troutman, 2003). Nist and Joseph (2008) compared IR with a more challenging interspersal and traditional drill practice procedures and measured next-day retention, maintenance, and generalization performance of first graders. They found that these first graders learned more words under the IR procedure than traditional drill or interspersal (unknown items > 10%).

Various IR research studies that taught word recognition consistently led to increased generalization as indicated by greater oral reading fluency and comprehension (Burns, 2007a; Burns, Dean, & Foley, 2004; MacQuarrie et al., 2002). Nist and Joseph (2008) found better generalization with IR versus other drill procedures. The study concluded that all students generalized the highest percentage of words under the IR intervention compared to both traditional drill and interspersal procedures.

IR and Recent Studies

Many experimental studies have demonstrated the effectiveness of IR. Recent studies in particular have done an impressive job of discerning IR's true outcomes and strengths. Burns (2007a) taught five new sight words per condition over four weeks to a nine-year-old male child diagnosed with moderate MR. One instructional condition consisted of high OTR (10% unknown; 90% known items) and the other instructional

condition consisted of moderate OTR (50% unknown; 50% known) within an alternating treatment design. Retention of the sight words increased over baseline for both conditions. However, the student retained approximately 40% to 60% of the words from the moderate OTR condition versus 72% to 92% with the high OTR condition. Furthermore, the high OTR condition outperformed the moderate condition with no overlapping data points between students' performance across conditions.

Nist and Joseph (2008) studied three instructional conditions: traditional drill (TD), interspersal and IR, using flashcards to facilitate word recognition with six, general education, first-grade students whose sight word reading skills were behind their peers. Over four weeks, using an alternating treatment design with counterbalancing of instructional conditions, acquisition, maintenance and generalization, students' performance was assessed in terms of learning levels (Skinner, 2008). Specifically, number of words read correctly, number of words maintained, number of words read correctly in sentences and the rate of learning to read words were evaluated. Opportunities to respond across conditions were held constant. Results indicated TD was more efficient, with participants acquiring more words per minute of instructional time; however, IR resulted in more total words learned, maintained and generalized. It was of critical importance, in this case, to present not only acquisition data but also maintenance and generalization data in order to uncover the true, long-term outcomes of the IR intervention. The Nist and Joseph (2008) study found greater increases in learning levels under the IR procedure confirming earlier findings (Burns et al., 2004; MacQuarrie et al., 2002).

In another recent study, Burns and Boice (2009) intended to replicate MacQuarrie et al. (2002) by investigating differential effects of instructional conditions on a number of words retained and the relationship between IQ and words retained for each condition. Traditional drill, interspersal and incremental rehearsal conditions were used to instruct participants on 27 Esperanto International Language (Richardson, 1988) words (9 words per condition). In contrast to the MacQuarrie study, however, Burns and Boice's sample included 20 children with below average IQ who were diagnosed with a disability. The study results indeed supported the earlier MacQuarrie et al. (2002) study. The IR condition led to 2 to 3 times more words retained than traditional drill or interspersal procedures. The Burns and Boice (2009) data again suggested high known-to-unknown ratios of words using high opportunities to respond led to highest retention. It also led to the lowest correlation with IQ vs. the other conditions. This indicated that students with MR performed better under IR than predicted given their IQ levels.

Burns and Sterling-Turner (2010) expanded IR research further by comparing 2 different measures of efficiency using larger sample sizes. Traditional drill and IR conditions were compared when teaching 12 unknown Esperanto words (6 words each condition) to children. The study measured the number of words learned per session and the number of words retained after one week delay. Participants were 25 regular education fourth-grade students. IR again led to better retention than traditional drill, a finding that was consistent with previous studies (Burns & Boice, 2009; Nist & Joseph, 2008; MacQuarrie et al., 2002). IR required 2.5 times more instruction time, but was 3 times more effective than traditional drill. As was indicated in the Nist and Joseph (2008)

study, maintenance must be considered in order to effectively evaluate the true outcome of IR.

In an effort to further extend the research on IR, Coddington, Archer, and Connell (2010) recently evaluated the effectiveness of IR on math computation performance. In this study, a multiple-probe design across multiplication problem sets for one participant was examined. The researchers measured digits correct per minute and percentage of digits correct on problems targeted during treatment and response maintenance sessions. Treatment measures on generalized skills included single skill mastery probes, fractions and word problem exercises. The participant was a seventh-grade 12-year-old general education student referred for difficulty with basic multiplication facts. The IR intervention resulted in the participant achieving accurate and fluent performance on the intervention target facts. This performance was maintained over time and generalized to other math computations (fractions and word problems).

Strengths of the IR procedure are many. Specifically, IR has been shown to provide excellent retention, maintenance and generalization of unknown items. IR provides significant opportunities to respond through multiple trials. The intervention builds confidence with a high percentage of known items resulting in positive reinforcement. In some instances, IR has been shown to be independent of IQ and verbal ability. It has been effective with various discrete academic skills, from reading to math. IR incorporates effective teaching methods such as corrective feedback, modeling, background knowledge, and mastery. Lastly, the execution of IR can also be used in peer tutoring procedures or in a game context (Joseph, 2006a).

IR's main weakness is its efficiency, in terms of time commitment and the rate at which students acquire new information. However, retention, maintenance and generalization results may tend to eclipse this fact. Still, the efficiency factor of incremental rehearsal will likely continue to be an important consideration when choosing an intervention, at least when considering Tier 1 and possibly Tier 2 interventions (Burns & Sterling-Turner, 2010). In addition, the IR procedure as formatted requires one-to-one interaction which may not always be possible within the school day.

IR and Efficiency

Although the effectiveness of IR is indisputable, the efficiency of the IR procedure has been a topic of continued research and discussion. Skinner, Belfiore, and Watson (2002) propose that it is important to consider efficiency (student learning rate) when selecting interventions. Previous research on various ratios of unknown-to-known items within a drill task has revealed that the more unknown material relative to the known material, the greater increase in learning rates (Roberts & Shapiro, 1996). Although higher known material results in a higher percentage of learned and retained material, (MacQuarrie et al., 2002), time spent in presenting known material could be spent in presenting more unknown material (Nist & Joseph, 2008). Even though IR sessions may take up to twice as long as other interspersed approaches, such as the 50% known and unknown ratio (Drill Sandwich), IR leads to better results with regards to acquisition and retention of skills (MacQuarrie et al., 2002). Burns and Dean (2005) found IR approach required approximately 10-15 minutes longer to complete versus a Drill Sandwich and traditional drill approach (100% unknown items), yet the increase in

amount of instructional time was eclipsed by the effectiveness of the IR procedure. The IR intervention (which utilized 10% unknown items) requires almost twice as much time to execute when compared to an 83% known condition, however, the IR condition again outperformed various other ratios that consisted of greater than 10% unknown items (Burns & Dean, 2005). A peculiar finding was that whereas the IR condition takes longer to complete, it was linked to an increase of on-task behavior (Burns & Dean, 2005); this finding is in direct conflict with the accepted premise that the longer a task takes, the more likely off-task behavior will occur (Darch & Gersten, 1985).

In the Cates et al. (2003) study, efficiency was defined as the number of spelling words mastered per time spent. These researchers found the traditional drill process to be more efficient over interspersal procedure; however, when words maintained, not simply mastered are considered, results may become less clear (Burns & Sterling-Turner, 2010). A study by Burns and Sterling-Turner (2010) found the IR condition required 2.5 times more instructional time than traditional drill but was almost 3 times more effective. In summary, although efficiency is an important consideration in instruction, given a typical school day, it should not be the only reason why one method is chosen over another (Schmidgall & Joseph, 2007).

Incremental Rehearsal and Spelling Intervention

As discussed previously, an incremental rehearsal intervention provides numerous trials with a majority percentage of known content. The intervention has repeatedly demonstrated strong retention, maintenance and generalization of new items over a variety of academic skills. It, however, has not been frequently used in a spelling context. As reviewed previously, research indicates that spelling interventions that involve explicit instruction, immediate corrective feedback, multiple practice opportunities, praise and reinforcement, and small group instruction, among others are effective. These specific components are all found in some form within the IR intervention. In addition, it appears a sizeable number of teachers are not spending the recommended amount of class time to explicitly teaching spelling. The IR method may be a way that teachers can ensure sufficient time is devoted to teaching spelling.

Instructional Efficiency

Today's teachers are required to cover large amounts of information in a very efficient manner (Braden, 2002). Academic interventions, in turn, must also provide the greatest amount of learning in the shortest amount of time. In addition, whereas most referred students are learning, they may be doing so at slow rates. Therefore, the focus of instruction should be to increase the rate at which students are learning (Skinner, Fletcher, & Henington, 1996).

Instructional efficiency has been defined as the level of acquisition attained per minute of total instructional time (Cates et al., 2003). This measurement can also be referred to as the rate of acquisition. Skinner, Belfiore, and Watson (1995) report that rate is best measured by dividing the total amount of learned items by the time required to

learn the new items. Skinner (2008) reports that in addition to learning levels (number of items learned), researchers should make it a priority to include measurement of learning rates (how long did it take to learn the items) in order to accurately evaluate the effectiveness of the intervention research.

According to Skinner, Fletcher, & Henington (1996), learning rates can be improved with either increasing the quality of learning or increasing the quantity of trials, or by increasing both. In other words, quality of the intervention can be strengthened resulting in a need for fewer trials, or the quantity of trials can be increased. For example, quality of learning could be improved by selecting the most effective and efficient intervention available; or in contrast, by increasing the quantity of trials with a less effective intervention, effective results could be realized, just not as efficiently.

Although the efficiency and learning rates of an intervention are important factors, current research has not been able to pinpoint with consistency which drill methods (including incremental rehearsal) are more efficient when maintenance and generalization are taken into account. Certain studies indicate the highest number of unknown items results in better results (Cates et al., 2003; Nist & Joseph, 2008) or learning rates were highest when more new items were presented in the review material (Cooke et al., 1993; Cooke & Reichard, 1996; Roberts & Shapiro, 1996; Roberts, Turco, & Shapiro, 1991). However, the majority of these conclusions were based on short-term retention only. Maintenance and generalization, especially when considering rate of learning, should also be included in the analysis.

Topography of Responding

Researchers have suggested that by altering topography of response learning rates may increase (Greenwood, Delquadri, & Hall, 1984; Kirk, McCarthy, & Kirk, 1968; Skinner, Ford, & Yunker, 1991). Skinner et al. (1991) suggested verbal responses resulted in quicker learning rates because using verbal response was more efficient due to the increased number of learning trials, which in turn, increased learning.

Various academic skills, one being reading comprehension, have been researched to compare different topographies of response. In one study, which compared oral retelling (oral response), written retelling (written response), and passage review comprehension strategies, reading comprehension performance was better under the oral and written retelling conditions. Specifically, the oral retelling proved most efficient for answering comprehension questions for the participating third graders (Schisler, Joseph, Konrad & Alber-Morgan, 2010). In another study, Skinner et al. (1997) investigated written responding versus verbal responding with 2 students (10 years and 11 years old) with behavior disorders and found the math (single digit multiplication) intervention which required oral responding resulted in larger increases in learning rates than the intervention involving written responding.

Additional research studies have indicated differences in spelling outcomes due to the type of response used for spelling assessments. The traditional and most frequently used manner of assessing spelling for young children in the schools is via handwriting (e.g., Both-deVries & Bus, 2008; Lombardino, Bedford, Fortier, Carter & Brandi, 1997; McBride-Chang, 1998; Ouellette & Senechal, 2008). A currently unanswered question remains regarding spelling instruction for young children: What if the traditional manner

of assessing spelling via handwriting for young children is not optimal? Additional findings in this area could impact the tasks selected for spelling assessments, as well as add to the understanding of how spelling develops (Puranik & Apel, 2010).

Spelling is typically assessed with having children write words to dictation (e.g., Both-deVries & Bus, 2008; Lombardino, Bedford, Fortier, Carter & Brandi, 1997; McBride-Chang, 1998; Ouellette & Senechal, 2008). Evidence indicates that older children spell more accurately with writing vs. an oral response (Jorm & Schoknecht, 1981; Tenney, 1980). Treiman and Bourassa (2000) reported written spelling was superior to oral spelling for general education first-grade students and for general education second-grade students; however, no significant differences were evident for kindergarteners. In contrast, Puranik and Apel (2010) found preschool age children, with the ability to write 19 or more letters, spelled equally well across three different conditions, orally, by writing, or by using letter tiles. Additional studies would be very useful to further determine the possible influence of the type of task and topography used for spelling assessments, and how that selection helps or hinders a young student's spelling skills.

Conclusion

Twenty-seven percent (27%) of students struggle with spelling (Graham et al., 2008). Unfortunately, scant scientific data are available on the effectiveness of contemporary spelling practices with young children nationwide (Graham et al., 2008). Educators and researchers are asking for more effective spelling instruction (Alber & Walshe, 2004). In addition, requests for RTI and research-based instructional practices are continuing (Nies & Belfiore, 2006).

Research indicates that students can benefit from spelling instruction and can be taught strategies to improve spelling (Graham, 1999). Results reveal that explicitly taught spelling instruction that incorporates multi-faceted approaches were investigated and found effective. Teachers can find ways to embed these various techniques into daily curriculum. Specifically, spelling instruction that includes immediate corrective feedback (verbal or self corrected), and multiple practice opportunities, among other components, were found to be effective. Furthermore, the inter-relationship between spelling, reading and writing learning should be leveraged by instructionally interweaving the teaching of these subjects together whenever possible.

The most frequently teacher-reported spelling instruction methods were spelling lists with weekly tests and basal spelling instruction programs including phonemic awareness, spelling and phonics skills. Based on this type of instruction, teachers were unhappy with the results. Teachers report they are frustrated and concerned with the challenge of teaching spelling, as well as the results from their teaching (Fresch, 2007). Unfortunately, research indicates many teachers fail to make adaptations for struggling spellers and are unsure of how to help improve a student's spelling performance.

Additionally, research shows practice, in the form of multiple opportunities to respond, is effective in acquiring academic skills. In addition to providing opportunities to respond, an appropriate level of difficulty must be taught to students in order to motivate them to engage in learning new content. IR is a method that incorporates providing numerous trials at students' instructional levels as known items are interspersed with unknown items. Whereas efficiency, in terms of rate of acquisition, has been a major concern with the IR procedure, the strong retention, maintenance and

generalization data appear to eclipse this criticism. Incremental rehearsal demonstrates strong results across a variety of academic skills for students, including those with disabilities. Incremental rehearsal leverages effective principles of teaching including: corrective feedback, opportunities to respond, modeling, background knowledge, mastery, generalization, errorless learning, and positive reinforcement. In addition, although an individual student's academic and behavioral needs, as well as the educator's time and cost situations must be addressed before the selection of an intervention, it is important to acknowledge that efficiency considerations must be balanced with effectiveness. In light of this, the IR intervention is an empirically-supported intervention that has shown to be effective in meeting long-term skill acquisition outcomes and should be in the toolbox of intervention options available to educators.

Topography of responding within an instructional spelling context is also an important consideration. Selecting the most effective topography for spelling instruction for young students will likely increase the overall effectiveness and efficiency of the spelling intervention.

The need for spelling intervention has been noted in the literature. The incremental rehearsal intervention has been effective in helping students improve their reading and math skills. Incremental rehearsal includes many of the instructional components necessary for successful spelling instruction and is a promising technique to use for helping students attain spelling skills.

In addition, most recent research has emphasized not only a need for effectiveness research but also efficiency research for instructional interventions. The following study will aim to determine the effectiveness and efficiency of two IR spelling interventions,

specifically, incremental rehearsal oral intervention and incremental rehearsal written intervention. The study will evaluate new spelling words learned as well as the rate at which the spelling words are learned across oral and written topographies of incremental rehearsal.

Chapter 3: Methodology

This chapter illustrates the methods of the study. Specifically, participants, participant selection, setting, experimenter, materials, definition and measurement of the dependent variables, independent variables, and experimental design are discussed. In addition, interscorer agreement, treatment integrity, and social validity are described.

Participants

Participants included students and teachers. Student participants included one first-grade and five second-grade students from a private, Catholic elementary-middle school in Central Ohio. Teacher participants included one first-grade and two second-grade teachers who instruct the student participants in their classrooms. In order to ensure confidentiality, participants were given pseudonyms. Student participants included Andy (7-year, 10-month-old Caucasian male); Annakin (7-year, 9 month-old-Caucasian male); Lex (8-year, 8-month-old Caucasian male); Orin (8-year, 4-month-old Caucasian male); Annabella (8-year, 6-month-old Caucasian female); and Debbie (6-year, 11-month-old Caucasian female). The mean age for the six student participants was 8 years, with an age range of 6 years, 11 months to 8 years, 8 months.

The participants' school consisted of grades K-8 with an approximate number of 848 students enrolled. Family socioeconomic status within the school was predominantly middle class. Five percent (5%) of students were considered economically disadvantaged and qualified for the National School Lunch Program and/or received

scholarship funds. Approximately 4% of the population was identified as having educational disabilities. Reported student racial background was described as follows: African-American – 1%, Asian/Pacific Islander – 4%, Hispanic – 1%, and Caucasian – 94%.

Participant Selection

The first step in participant selection was to obtain approval to conduct the study from school administrators and the university's Institutional Review Board. Potential participants were students at risk for spelling difficulties identified through teacher referral. Assent and consent from parents, students, and teachers were obtained by the examiner.

Teachers eligible to participate received information describing the purpose of the research, details of the study, instruction provided to students and their role in the research if they chose to participate. Teachers were informed that participation required referring students from their class that were at risk for spelling delays, arranging schedules and allowing students to leave their classroom at an agreed upon time, and completing a social validity questionnaire. Teachers were informed that they would not be responsible for executing the daily spelling interventions, and that all data collected from the students and teachers would be confidential. Teachers who chose to participate signed a consent form. Then the teachers were asked to refer a total of fifteen students (between all of the participating teachers) who they identified as at risk for experiencing difficulty with spelling.

Parents of the fifteen referred students received information detailing the nature of the study, issues of confidentiality, and how results were reported (see Appendix A). In

addition, a consent form (see Appendix B) for permitting their child to participate in the study was sent to the parents. Parental written consent was a requirement to participate in the study; no student was allowed to be included without it. Signed consent forms were returned to the student's teacher or main office. Teachers and students also provided verbal assent in order to participate in the study.

The Spelling subtest of the Kaufman Test of Educational Achievement, Second Edition, (KTEA-II) (Kaufman & Kaufman, 2004) was used to assess the students' spelling ability. Children who earned a standard score of no higher than 91 or a classification of Below Average (14th percentile) were eligible to be included in the study. Students who met criteria were given the opportunity to assent or decline participation. Six students met criteria for participation in the study. Standard scores on the spelling subtest for each participant were as follows: Andy earned a standard score of 91 (27th percentile), Annakin earned a standard score of 85 (16th percentile), Lex earned a standard score of 87 (19th percentile), Orin earned a standard score of 82 (12th percentile), Annabella earned a standard score of 82 (12th percentile), and Debbie earned a standard score of 89 (23rd percentile).

The KTEA-II is a nationally normed, individually administered multiple subject comprehensive test consisting of 14 subtests that assess listening, speaking, reading, writing, spelling and mathematic skills. KTEA-II provides an assessment with high validity and reliability. The KTEA-II spelling subtest's split-half reliability coefficient is reported as .93 (for first grade) and .95 (for second grade) - a desirable standard. Assessment scoring is based on a mean of 100 and a standard deviation of 15. For the

participant screening portion of this study, only the spelling subtest was used. The spelling subtest measures the child's ability to spell words correctly.

Setting

A private office at the participants' elementary school was used to conduct the instructional interventions. The area provided adequate lighting as well as a quiet working environment free from external distractions. The interventions took place at a circular table that comfortably seated the experimenter and the participant.

Experimenter

The researcher was a female doctoral candidate in the School Psychology program at The Ohio State University. Through previous experiences, training and course work, the experimenter was exposed to adequate training in the administration of the dependent measures and the experimental intervention conditions of the study. The researcher administered, scored, and interpreted the results of all assessments during the screening, treatment, long-term retention (delayed recall), and generalization phases of the study, as well as executing all intervention activities. The researcher also was responsible for obtaining consent from parents and teachers, as well as assent from students.

Independent Observers

An Ohio State University school psychology Ph.D. graduate conducted interobserver agreement procedures for 100% of the spelling probe responses of this study. Before scoring began, the independent observer was sufficiently trained by the researcher. Training involved an explanation of the purpose of the study, intervention conditions, procedures, and dependent measures. Each scored item was compared to

determine whether the experimenter and observer agreed on the students' responses across spelling probes, delayed recall probes and generalization measures. Specifically, weekly spelling probes, delayed recall probes, and generalization spelling probes were scored independently. Agreement was reached when both the observer and experimenter correctly scored a response.

Materials

Study materials included paper, pencils, data recording forms, a digital kitchen timer, and index cards with words displayed in black, size 72 Cambria font.

Pre-assessment

Students who returned signed parent consent forms were screened by the examiner to determine what words they could spell (known) and those they could not (unknown). The pre-assessment screener was administered to identify target words for instruction. Specifically, it consisted of randomly selected three-letter words from a list of 150 first-grade words, and four-letter words from a list of 150 second-grade words. Word lists were obtained from Dolch Spelling Lists and local school websites. Words were presented once in random order to each student individually. The format was a traditional written spelling test in which the word was presented in isolation and then stated in a sentence followed by another oral presentation of the word in isolation. For example, if the student was requested to spell the word "cat," the student heard, "spell cat; the cat chased the dog; cat." After the word was presented orally in isolation, the experimenter began timing how long it took the student to write the word. Words spelled correctly in writing within five seconds were considered "known" and were eligible to be used in both the oral and written incremental rehearsal experimental conditions. Words

not spelled correctly within five seconds were considered “unknown” and randomly selected to be taught in one of the two experimental conditions. No corrective feedback was provided for correct and incorrect responses.

Definition and Measurement of the Dependent Variables

Dependent variables in this study were defined as the number of words spelled correctly and the number of words spelled correctly per minute of instructional time. Thus, instructional effectiveness and instructional efficiency were measured. Delayed recall of spelling words and generalization were also assessed in this study.

Instructional Effectiveness. Instructional effectiveness, or skill acquisition, was measured as the number of words spelled correctly during intervention sessions, on weekly spelling probes, on long-term retention of words acquired (delayed recall) probes and on generalization assessments. Specifically, during intervention sessions “unknown” words were presented to the child utilizing the incremental rehearsal technique. The IR drills were used until the child learned the unknown word as indicated by 2 consecutive correct answers. Next, weekly spelling probes were administered through a traditional written spelling test to determine whether the student was able to spell the words taught under the respective intervention conditions. Each weekly spelling probe consisted of administering the targeted “unknown” words that were taught and learned on the three instructional sessions prior to administering the probe. Those words were then shuffled and presented one-by-one to the student. Words were counted as correct when the whole word was spelled correctly within five seconds. Words were recorded as incorrect if they were spelled only partially or if the student took longer than five seconds to respond. During intervention training, in order for the spelling word to be considered learned and

used in the weekly spelling probe, a student had to spell it accurately on the last two consecutive trials during either of the two treatment phases. Responses were counted as incorrect if a student spelled only part of the word or if the word was not spelled within five seconds from the time it was presented. Responses were considered correct if the whole word was spelled correctly within five seconds. For example, the word 'sat' spelled as a whole word was counted correct. An example of an incorrect response would be spelling the word 'sat' as 'st.' The experimenter kept track of and recorded correct and incorrect responses during each session and each condition. Words spelled incorrectly on the weekly probes were considered "unknown" and were re-taught in their respective instructional condition. The experimenter also calculated and recorded participants' percentage of correctly spelled words on probes for each condition.

Instructional Efficiency. Instructional efficiency, or rate of learning, was measured as the number of words learned per minute of instruction. On the weekly spelling probe previously mentioned words spelled correctly per minute of instruction were assessed. Specifically, each day's instructional intervention encounters were timed in seconds and recorded. At the end of the week's instructional sessions, total seconds for each condition were combined allowing for calculation of minutes spent on each instructional condition for the week. For each condition, learning rate was calculated by dividing the number of words spelled correctly by the total amount of time it took to implement the instructional intervention. Cumulative learning rates across sessions for each condition was also calculated and compared to the instructional effectiveness data. Specifically, if a student spelled one word correctly during the first session of the incremental rehearsal oral method and spelled three words correctly during the second

session of the incremental rehearsal oral method, then the cumulative rate was four words over the entire time spent executing two incremental rehearsal oral sessions.

Delayed Recall of Spelling Words. The experimenter administered an additional spelling probe to all participants one week after all intervention phases ended. This measure was used to determine if the correct spelling of words during the intervention phase was retained after this phase ended. The items on this measure consisted of only the words that were spelled correctly on the weekly spelling probes. Those words were presented in random order and the student was asked to spell each one using the same administration procedures as those described for the weekly spelling probe. The experimenter recorded whether or not the student was able to spell the word. No corrective feedback was provided. Words were considered recalled when the student correctly spelled the word within five seconds from the time the word was presented. The experimenter calculated, by respective instructional condition, the percentage of correctly spelled words on the delayed recall spelling probe. Retention rates on correctly spelled words that were taught under each instructional condition were assessed by calculating the number of words retained, and dividing that sum by the cumulative amount of instructional time (minutes per session).

Generalization. To understand whether the students were able to generalize words spelled correctly on the weekly spelling probes to other contexts, a measure of generalization was administered to each participant. The participants were given a probe consisting of sentences. Students were asked to fill in the blank of the sentences containing the learned (as evidenced by correct spelling on weekly probes) “unknown” words that were targeted for instruction under instructional conditions. The sentences

were printed in black on white paper and consisted of four to eight basic words including the unknown word. For example, a student was presented with a worksheet with a sentence which said, “Did ____ see that?” The researcher told the student “Today, we are going to do spelling exercises in a new way. I will read this sentence to you and then you will fill in the blank by writing the word which fits into the blank.” The experimenter then read the sentence “Did you see that?” and pointed to each word including the blank as she read it a total of 2 times; the student then had five seconds to write the correct spelling of the word into the blank. Learned words were considered generalized when the student wrote the correct spelling of the word into the blank within five seconds. Generalization was calculated by dividing the number of correct responses by the total number of responses and multiplying that sum by 100. To determine generalization rate, the number of words spelled correctly on the generalization probe was divided by the cumulative amount of instructional time (in seconds).

Interobserver Agreement

An Ohio State University school psychology Ph.D., trained in the procedures of each experimental condition, independently scored 100% of the responses across all participants. This was accomplished by providing the independent observer with copies of all ungraded spelling probes and answer keys. Several types of calculations can be used for interobserver agreement analysis. The first calculation for interobserver agreement utilized the following formula:

$$\frac{\textit{Agreements}}{\textit{Agreements} + \textit{Disagreements}} * 100$$

Item-by-item comparisons were made for each participant across all probes. Each time both the experimenter and observer recorded that a target word was spelled correctly or incorrectly an agreement was scored. Disagreement was scored each time only one (observer or experimenter) recorded that the word was spelled correctly or incorrectly. Interobserver agreement between the experimenter and independent observer was 97% for the items on the pre-assessment (i.e., identification of unknown and known words), on intervention sessions, on weekly spelling probes, on delayed spelling probes and on generalization probes. In order to avoid possible inflation by extreme scores or high variability, another calculation, occurrence and nonoccurrence agreements, was additionally calculated. The occurrence agreement calculation used was as follows:

$$\frac{A_{occurrence}}{A_{occurrence} + D_{occurrence}} * 100$$

Occurrence agreement between the experimenter and independent observer was 91% for the items on the pre-assessment (i.e., identification of unknown and known words), on intervention sessions, on weekly spelling probes, on delayed spelling probes and on generalization probes. The Nonoccurrence agreement calculation was as follows:

$$\frac{A_{nonoccurrence}}{A_{nonoccurrence} + D_{nonoccurrence}} * 100$$

Nonoccurrence agreement was defined as each time both experimenter and observer recorded that a word was spelled incorrectly. Disagreement was scored when only one (observer or experimenter) recorded that the word was spelled incorrectly.

Nonoccurrence agreement between the experimenter and observer was 84%.

Independent Variables

Independent variables in this study consisted of two intervention conditions: incremental rehearsal oral and incremental rehearsal written. Each session of each intervention condition was timed. Timing began when the first unknown word was presented, and timing ended for both intervention conditions when the unknown target words were learned, indicated by two correct spelling responses. Specifically, unknown words were considered learned when spelled correctly within five seconds two consecutive times during the incremental rehearsal process for the targeted word. For both intervention conditions, praise for correct responses was standardized. Verbal praise was provided by the examiner following a correct response (see Appendices C and D). Verbal praise across both conditions consisted only of the phrases “nice work” or “good job.” Standardizing type of verbal praise provided to the participants across each condition minimized the potential confounding effects that this variable may have had on measuring the amount of instructional time it took to implement each instructional condition. For instance, if the examiner provided detailed praise during one condition and then minimal praise during another, the amount of instructional time provided during the conditions would vary. The following is a detailed description of each instructional condition.

Incremental Rehearsal Oral. Incremental rehearsal is a drill method that consists of presenting a ratio of known-to-unknown words. The number of known-to-unknown words utilized for this experiment was four known to one unknown word. A total of two unknown words were taught using the incremental ratio of one unknown to four known ratio, per each instructional condition per each session. The researcher began by saying

“Listen carefully; I am going to show you a word, then ask you to spell it. Next, I will ask you to spell more words, ready?” The first unknown word was presented to the student. Specifically, the examiner showed the unknown word on an index card (e.g., cat), said the word, spelled the word while pointing to the letters, and then asked the student, “Now spell cat with me” and again pointed to the letters “c-a-t” while the index card was still displayed and the participant said the letters aloud with the researcher. Next, the index card was removed from sight and then the participant was asked to spell the word on their own (“Now, you spell cat”). The child was given five seconds to orally spell the word. Feedback was “good job” or “nice work” for correct responses. Incorrect responses resulted in the child hearing “listen again” thereby the process was repeated again to the child. Specifically, the unknown word would again be reviewed by presenting the card with the unknown word on it, stating the word, spelling the word by pointing to the letters, and asking the child to spell the word along with the experimenter. After an initial correct spelling, the experimenter then began to use the previously identified four known words which were shuffled for random order. The first known word was then presented for the child to orally spell, (“spell dog”). Next, the first unknown word was presented again, and the child was asked to spell the unknown word. This is followed by presentation of the first known word, and then a second known word for the child to spell. Again, the first unknown word was presented, and the pattern continued until the child learned the word. The repetitions of incremental rehearsal instruction were not discontinued until the child learned the word, indicated by two consecutive correct answers within the presentation of four known words or after the presentation of four known words, whichever came first. After the unknown word was

learned, it became the first known word and the last known word was removed. The first unknown word was then treated as the first known word. Verbal praise was provided for all correct responses (i.e., “good job” or “great work”). Corrective feedback was given to the child any time a word was spelled incorrectly or if the child did not respond within five seconds. Corrective feedback constituted the examiner providing the correct spelling of the word orally as well as displaying the target card again (i.e., cat; c-a-t; cat). Words were considered mastered (learned) during the intervention when the student correctly orally spelled each target word two consecutive times within the presentation of the four known words or after, whichever came first. The newly learned targeted words were then used as known words in the next instructional condition (see Appendix C for script).

During the IR oral condition, the target word was presented incrementally until it was spelled correctly two times. Once this occurred, the word became the first known word and the last known word was removed. The procedure continued with the presentation of a new unknown word. If the word was not spelled correctly two consecutive times within the four known word exercise, then the word continued to be administered following the oral IR procedure until it was spelled correctly two times consecutively. Specifically, the final ratio of the exercise, 4 unknown to one unknown words would be repeatedly administered until the word was mastered.

Incremental Rehearsal Written. Incremental rehearsal written condition consisted of the same procedures as the incremental rehearsal oral condition with of the exception of topography of response. In the incremental rehearsal written condition, the spelling answers were written out. A ratio of one unknown to four known words was presented during each instructional session under this condition. A total of two unknown words

were taught in this incremental ratio of one unknown to four known words during each session under this condition. Specifically, the first unknown word was presented and then the child was given five seconds to write the word out (not counting any erasing time). The first known word was then presented for the child to spell. Next, the first unknown word was presented again, and the child was asked to spell the word in written form. This was followed by the presentation of the first known word, and then a second known word for the child to spell. Again, the first unknown word was presented, and the pattern continued until the child learned the word. After the unknown word was mastered, it became the first known word and the last known word was removed. Verbal praise was provided for correct responses (i.e., “good job” or “great work”). Corrective feedback was given to the child any time a word was spelled incorrectly or if the child did not respond within five seconds. Corrective feedback constituted the examiner providing the correct spelling of the word orally (i.e., cat; c-a-t; cat) as well as displaying the word on the card. Words were considered learned when the student correctly spelled in writing each of the target words two times consecutively within the presentation of the four known words or after, whichever came first. The newly learned targeted words were then used as known words in the instructional condition. Words not spelled correctly continued to be presented in this instructional condition (see Appendix D for script) until they were learned. If at any time the participant’s writing was unclear, the student was asked to verbally state what the writing was intended to represent.

Specifically, during the IR written condition, the target word was presented incrementally until it was spelled correctly two times consecutively. If the word was not spelled correctly two times within the four known word presentation, the word continued

to be administered following the written IR procedure until it was spelled correctly two times consecutively. Once this occurred, the word became the first known word and the last known word was removed. The procedure continued with the presentation of a new unknown word.

Experimental Design

A single subject, alternating treatments research design was utilized to compare the effects of the intervention treatment conditions on student learning and learning rate. Alternating treatment research designs are believed effective for analyzing two instructional conditions over a short period of time (Cooper, Heron, & Heward, 2007). Single subject designs require graphing behavior which allows for visual inspection of data points to reveal changes in behavior that correlate with changes in treatment conditions over time. Participants' performance is continually compared with his or her own previous performance. Single subject design allows for frequent data collection and repeated measurement, which may detect nuances of performance patterns across time.

An alternating treatment design is sufficient for comparing the effects of two intervention approaches on student spelling performance. Independent variables within the design are quickly alternated in a counterbalanced fashion. Alternating treatment designs are time efficient, may guard against sequence effects, and do not require interruption of instruction. The main limitation of the design, specifically the effect of one treatment influencing the effects of another treatment, was minimized with counterbalancing instructional interventions throughout the instructional phase.

Procedures

Participants were exposed to two experimental conditions per daily session. Conditions were counterbalanced across sessions to minimize sequence effects. Specifically, Day 1 - IRO/IRW; Day 2 - IRO/IRW; Day 3 - IRW/IRO week one and then the reversed order executed on week two and so on. A digital kitchen timer was used to ensure that the total length of each intervention was captured in minutes. The experimenter utilized a form to record whether or not the target word was spelled correctly each time it was presented during the intervention (see Appendix E).

Intervention instructional sessions for each condition always began on Monday and continued through Wednesday during each week for five weeks. On each day, students received both instructional conditions. On Thursdays, the students were administered a weekly spelling probe (a traditional written spelling test) on the words learned from the previous three days during both instructional conditions. No new instruction took place on Thursdays; only weekly spelling probe data was collected on Thursday. After all instructional conditions ended, generalization probes were administered. One week after instructional conditions ended a delayed recall of spelling words probe was administered to all the participants.

Students and teachers were asked to complete social validity surveys after all intervention instruction and tasks were completed.

Treatment Integrity

Procedural integrity data were collected by an OSU Ph.D. graduate in school psychology. Procedural integrity checklists were designed for each instructional condition (see Appendices F and G). Sessions (approximately 20%) were randomly

selected under each instructional condition to be observed. Specific items on the incremental rehearsal oral checklist included: “Examiner starts timer” and “Examiner states ‘I am going to show you a word then ask you to spell it. Next, I will ask you to spell more words, ready?’” Specific items on the incremental rehearsal written checklist included “Examiner records correct and incorrect responses” and “Examiner tracks total intervention time.” The observer circled “yes” if the researcher executed the procedural step correctly and “no” if the researcher did not execute the procedure as documented on the recording form. Various items answered “yes” or “no” by the observer included additional details such as whether the researcher followed the script in an exacting manner and utilized the appropriate responses/feedback.

Social Validity

When interventions are perceived as worthwhile, educators and students will be more likely to utilize them. In an effort to determine if the interventions that were implemented in this study were useful, information was collected via a survey from student and teacher participants. Specifically, a student questionnaire (see Appendix H) and a teacher questionnaire (see Appendix I) were used to assess the social acceptability of each instructional method.

Teacher participants in the study were provided with the scripts of each intervention as well as a social validity questionnaire. Teachers indicated their opinions by answering Likert-scale questions regarding the details of the intervention. Items included such questions as “Which methods would you consider using in the classroom as part of your instruction to teach spelling?” and “Which instructional methods would be most effective in enhancing student spelling performance?” Other items focused on

whether the teacher felt students would enjoy the intervention and if they felt the intervention would be valid. Teacher surveys were returned directly to the researcher.

Student participants also completed a questionnaire utilizing Likert-scale questions. The experimenter orally read the items on the questionnaire, as the student followed along and read the items silently to themselves. The students then indicated their response on their own copy of the questionnaire. The student survey included questions such as “Did you enjoy doing these spelling exercises?” and “Did doing these spelling exercises help you spell better?” Additional items inquired about which intervention they preferred and which intervention they’d choose to participate in again. The completed student questionnaires were submitted directly to the experimenter.

Chapter 4: Results

This chapter reviews research results for each question posed at the outset of the project. Initially, interobserver agreement and treatment integrity results are described. Next, descriptive statistics and visual analysis of graphed data are reported according to the specific research questions. Descriptive statistics and visual analysis of data are typically reported when evaluating single subject research data.

Interobserver Agreement

An Ohio State University Ph.D. graduate in the school psychology program, who was trained in the procedures of each experimental condition, independently scored 100% of the responses across all participants. Interobserver agreement can be calculated in a number of ways. The following formula illustrates one way that interobserver agreement can be calculated:

$$\frac{\textit{Agreements}}{\textit{Agreements} + \textit{Disagreements}} * 100$$

Each time both the experimenter and observer recorded that a target word was spelled correctly or incorrectly an agreement was scored. Disagreement was scored each time only one (observer or experimenter) recorded that the word was spelled correctly or incorrectly. Interobserver agreement between the experimenter and independent observer was 97% for weekly probe sessions, delayed recall, generalization and identification of known/unknown words results. In order to avoid possible inflation by extreme scores or

high variability, another calculation, occurrence and nonoccurrence agreements, was also calculated. The Occurrence agreement calculation used was as follows:

$$\frac{A_{occurrence}}{A_{occurrence} + D_{occurrence}} * 100$$

Occurrence agreement between the experimenter and independent observer was 91% for the weekly probe sessions, delayed recall, generalization and identification of known/unknown words results. The Nonoccurrence agreement calculation was as follows:

$$\frac{A_{nonoccurrence}}{A_{nonoccurrence} + D_{nonoccurrence}} * 100$$

Each time both experimenter and observer recorded that a word was spelled incorrectly, agreement was scored. Disagreement was scored when only one (observer or experimenter) recorded that the word was spelled incorrectly. Nonoccurrence agreement between the experimenter and observer was 84% for daily intervention sessions.

Treatment Integrity

To ensure that the experimenter implemented all research procedures correctly, treatment integrity data were collected on approximately 20% of the sessions. A treatment integrity checklist was provided to the independent observer (see Appendices F and G). The treatment integrity checklist consisted of specific procedural steps to be used in the implementation of each instructional condition. The observer circled “yes” on the checklist if the researcher correctly implemented the step, “no” if the researcher did not correctly implement the step or “NA” if the step was not applicable to the condition.

Treatment integrity was 100% across all observed sessions. Procedures which were monitored included the introduction and execution of the intervention steps, starting the clock at the beginning of each session and providing specific feedback depending on participant responses (specific positive feedback when a response was correct or corrective feedback for words spelled incorrectly or if responses were not executed within the required 5 second time frame).

Research Question Number One

Which method, incremental rehearsal oral or incremental rehearsal written, helps children spell the most words correctly?

Table 4.1 displays the total number of total spelling words learned during the instructional sessions for all six students under the incremental rehearsal oral and incremental rehearsal written experimental conditions. In addition, Table 4.1 provides the total number of words spelled correctly on weekly probes across all students for both instructional approaches. Data indicated that students as a group learned a total of 360 words during instructional sessions. Variability occurred with the number of words spelled correctly on weekly probes across the conditions. It appears that the students as a group correctly spelled a slightly greater number of words under the incremental rehearsal written condition as compared to the incremental rehearsal oral condition.

Table 4.1

Cumulative Number of Spelling Words Learned During Instructional Sessions and Spelled Correctly on Weekly Probes

Student	IRO Sessions	IRW Sessions	IRO Weekly Probes	IRW Weekly Probes
Andy	30	30	26	24
Annakin	30	30	22	24
Lex	30	30	26	26
Orin	30	30	26	25
Annabella	30	30	20	23
Debbie	30	30	22	22
Group	180	180	142	144

Note. IRO = Incremental rehearsal oral, IRW = Incremental rehearsal written

Figures 4.1 through 4.6 provide the number of words spelled correctly for both conditions on weekly probes across weekly probe sessions for each of the participants. Data for the participants, specifically, Andy, Annakin, Lex, Orin, Annabella and Debbie, showed consistent patterns of spelling acquisition for both the incremental rehearsal oral and incremental rehearsal written instructional conditions.

Figure 4.1 represents the number of words spelled correctly on weekly probes for Andy. Andy participated in 5 weekly spelling probe sessions. Initially, the data revealed slight variability in spelling performance between the conditions, with incremental rehearsal written resulting in more words spelled correctly. Beginning with the second week, there was an overlap in spelling performance between the two experimental

conditions. Similar trends in data points between the two conditions indicated that both conditions were effective for Andy. In terms of words spelled correctly, incremental rehearsal oral condition performed only slightly better than incremental rehearsal written for Andy.

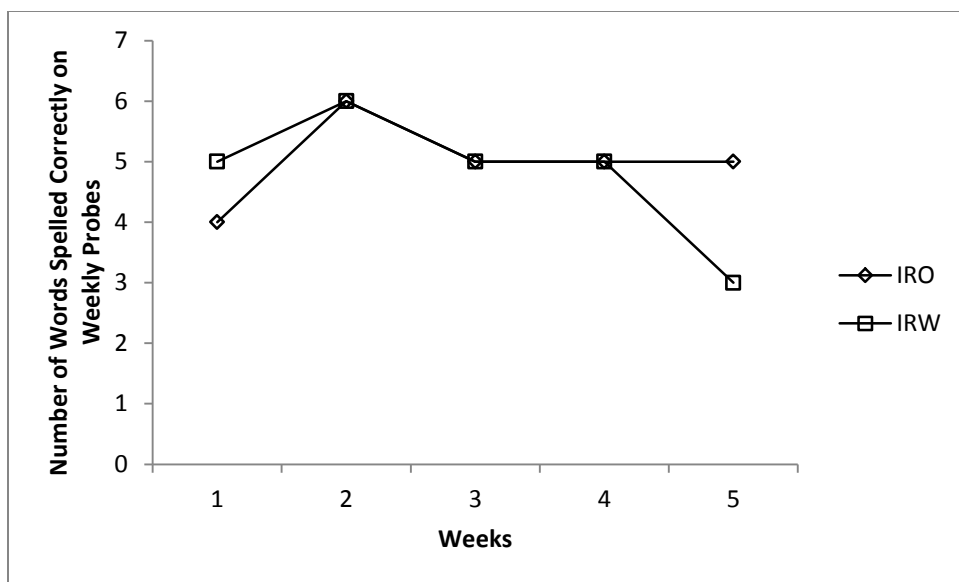


Figure 4.1
Number of Words Spelled Correctly on Weekly Probes for Andy

Figure 4.2 represents the number of words spelled correctly on weekly probes for Annakin. Annakin participated in 5 weekly spelling probe sessions. Initially, Annakin correctly spelled more words that were taught under the incremental rehearsal oral condition. During weeks two and three, Annakin demonstrated similar performance across both instructional conditions. On the final two weeks, Annakin correctly spelled more words that were taught under the incremental rehearsal written condition. In terms of words spelled correctly, overall, Annakin performed slightly better under incremental rehearsal written condition than under the incremental rehearsal oral condition.

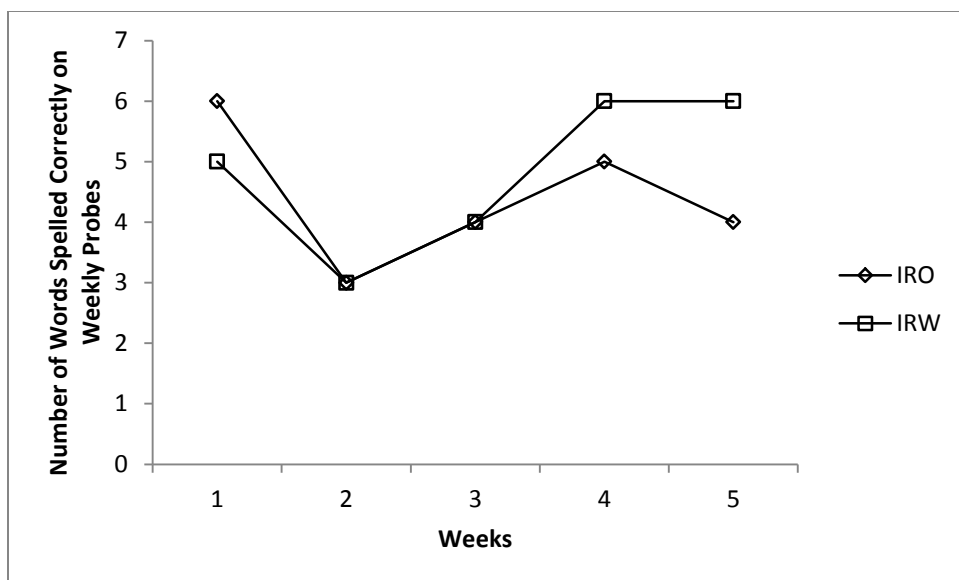


Figure 4.2
Number of Words Spelled Correctly on Weekly Probes for Annakin

Figure 4.3 represents the number of words spelled correctly on weekly probes for Lex. Lex participated in 5 weekly spelling probe sessions. On week 1, Lex spelled more words correctly that were taught under the incremental rehearsal oral. On week 2, he spelled more words correctly that were taught under the incremental rehearsal written. Performance was similar between the conditions on weeks 3, 4, and 5. Overall, the data indicated that both instructional conditions were effective for Lex.

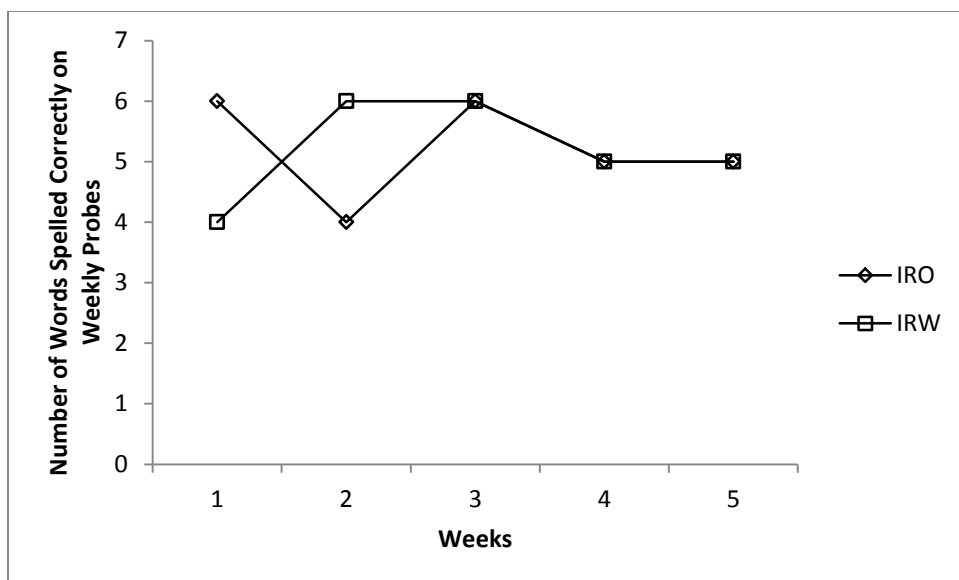


Figure 4.3
Number of Words Spelled Correctly on Weekly Probes for Lex

Figure 4.4 represents the number of words spelled correctly on weekly probes for Orin. Orin participated in 5 weekly spelling probe sessions. On weeks 1 and 2, Orin spelled more words correctly that were taught under the incremental rehearsal oral procedure. On week 3, Orin spelled more words correctly that were taught under the incremental rehearsal written procedure. On weeks 4 and 5, he demonstrated similar performance between the conditions.

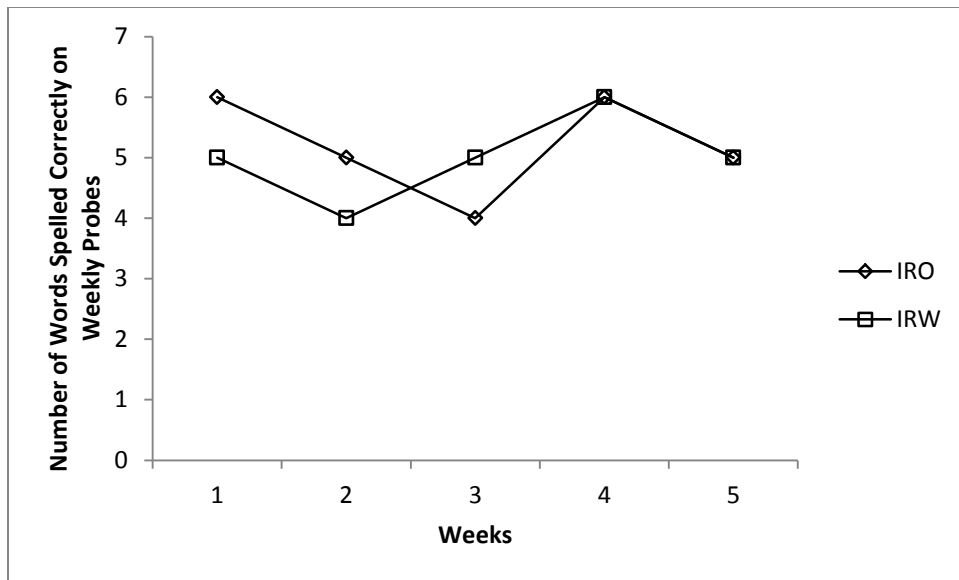


Figure 4.4
Number of Words Spelled Correctly on Weekly Probes for Orin

Figure 4.5 shows the number of words spelled correctly on weekly probes across conditions for Annabella. Annabella participated in 5 weekly spelling probe sessions. Annabella spelled more words correctly that were taught under the incremental rehearsal oral procedure on week 1. On weeks 2 and 3, she spelled more words correctly that were taught under the incremental rehearsal written procedure. On week 4, her performance was similar between the conditions. On week 5, she spelled more words correctly that were taught under the incremental rehearsal written procedure. Overall, Annabella appeared to respond more favorably to the incremental rehearsal written procedure.

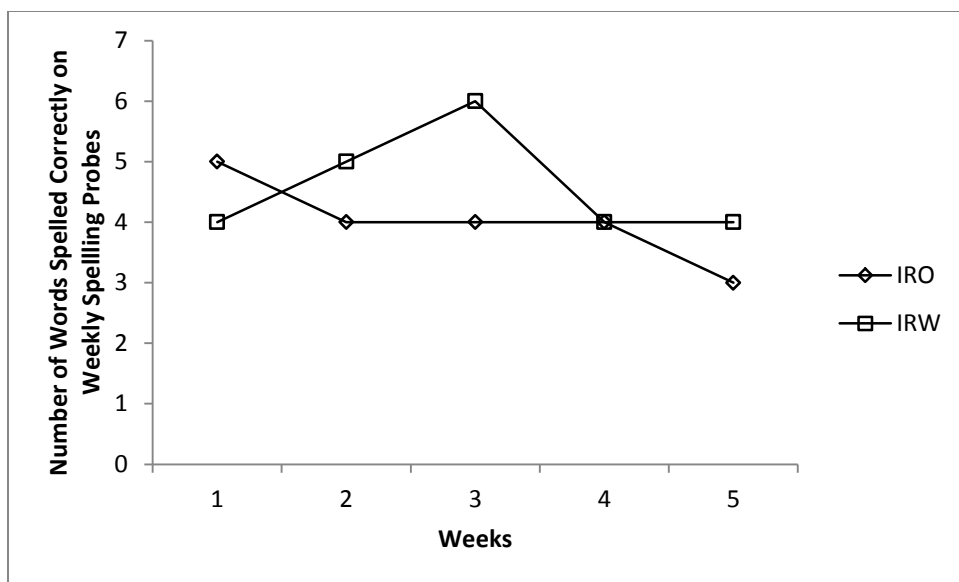


Figure 4.5
Number of Words Spelled Correctly on Weekly Probes for Annabella

Figure 4.6 represents the number of words spelled correctly on weekly probes for Debbie. Debbie participated in 5 weekly spelling probe sessions. Over the probe sessions, Debbie's spelling performance increases across both conditions. On week 1, Debbie spelled more words correctly that were taught in the incremental rehearsal written condition. On week 2, she spelled more words correctly that were taught in the incremental rehearsal oral condition. On weeks 3 and 4, she spelled more words correctly that were taught in the incremental rehearsal written condition, and she spelled more words correctly that were taught in the incremental rehearsal oral condition on week 5.

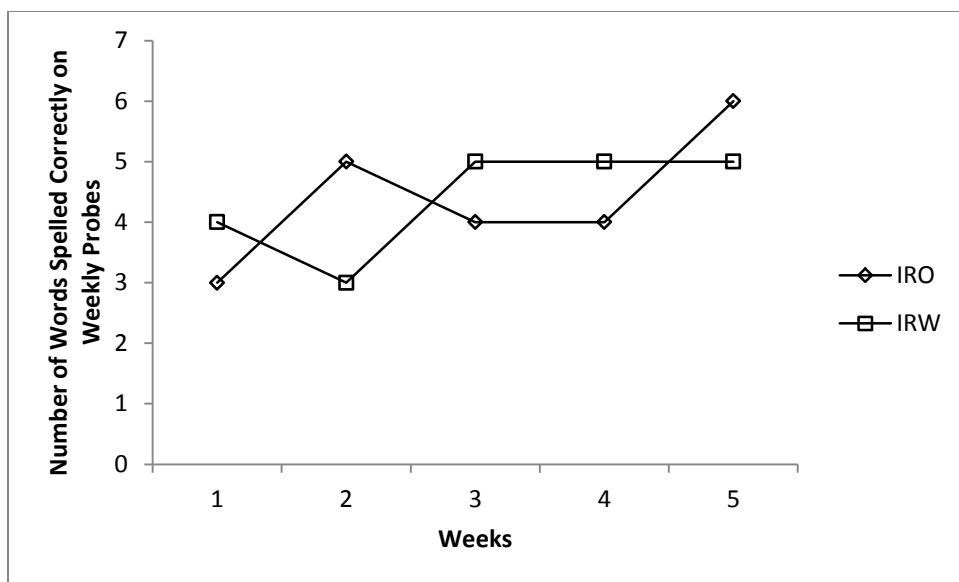


Figure 4.6
Number of Words Spelled Correctly on Weekly Probes for Debbie

Data collapsed for the group provide information to determine which instructional condition was more effective in terms of words spelled correctly for students as a group. Figure 4.7 display data across participants for both conditions. Each student participated in an identical number of weekly probes. Data indicated that students as a group had noticeable variability in spelling performance across conditions. Students as a group spelled more words correctly that were taught under the incremental rehearsal oral procedure on week 1. On week 2, there seemed to be overlap in spelling performance across conditions for students as a group. On weeks 3 and 4, students as a group spelled more words correctly that were taught in the incremental rehearsal written condition. On week 5, students as a group spelled more words correctly that were taught in the incremental rehearsal oral condition.

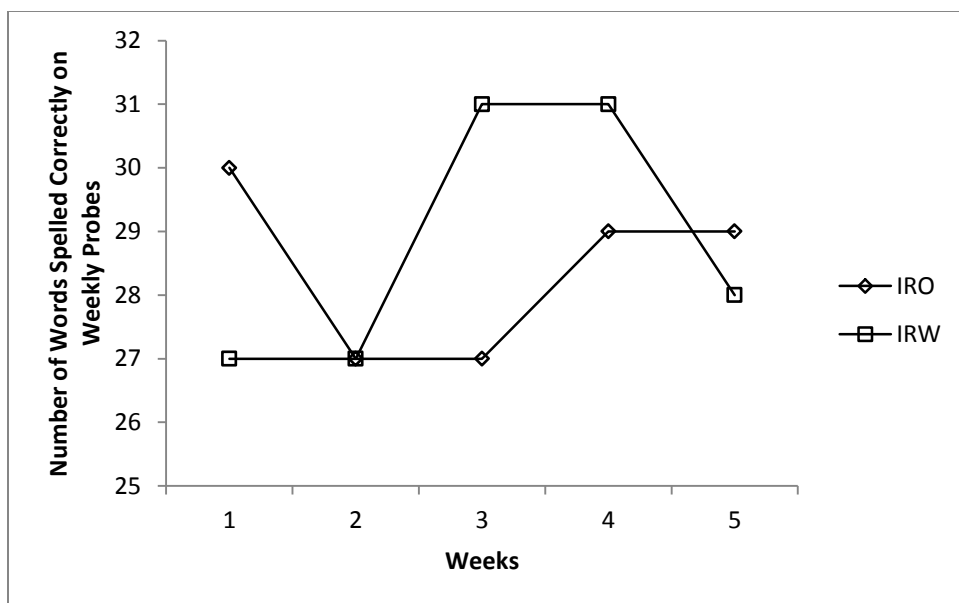


Figure 4.7
Number of Words Spelled Correctly on Weekly Probes for Group

Figures 4.8 through 4.14 display the cumulative number words spelled correctly across weekly probe sessions for each participant. The pattern of performance indicated that students learned to spell similar amounts of words correctly across both incremental rehearsal oral and written conditions. Thus, both conditions were similarly effective for teaching students to spell words correctly.

Figure 4.8 shows the cumulative number of words spelled correctly on weekly probes for Andy. The data display an increasing trend for words spelled correctly with both incremental rehearsal oral and incremental rehearsal written procedures. In Andy's case, spelling performance on weekly spelling probes was equivalent across incremental rehearsal oral condition and incremental rehearsal written conditions.

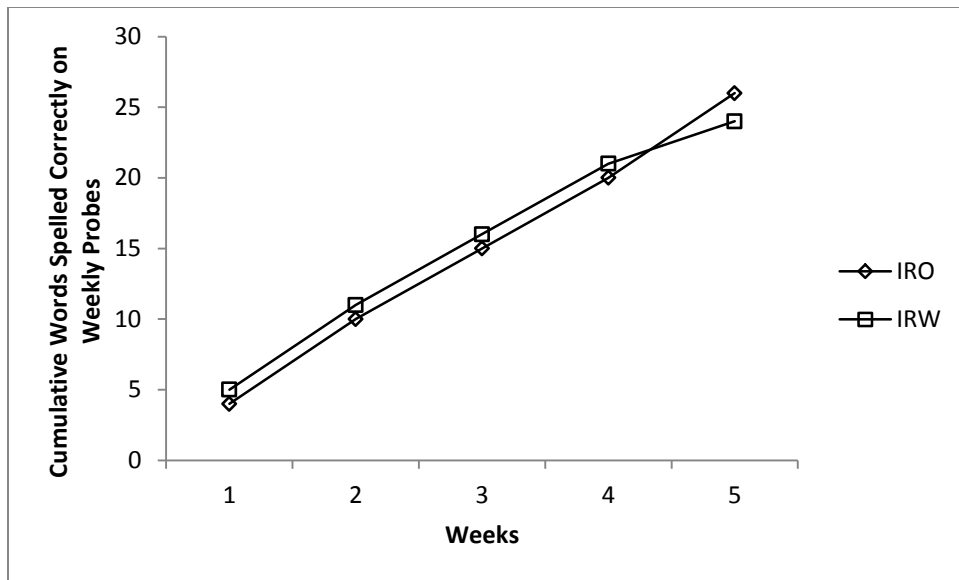


Figure 4.8
Cumulative Words Spelled Correctly on Weekly Probes for Andy

Figure 4.9 displays the cumulative number of words spelled correctly on weekly probes for Annakin. Annakin also had an increasing trend for words spelled correctly. His performance on weekly spelling probes was similar across incremental rehearsal oral and incremental rehearsal written conditions.

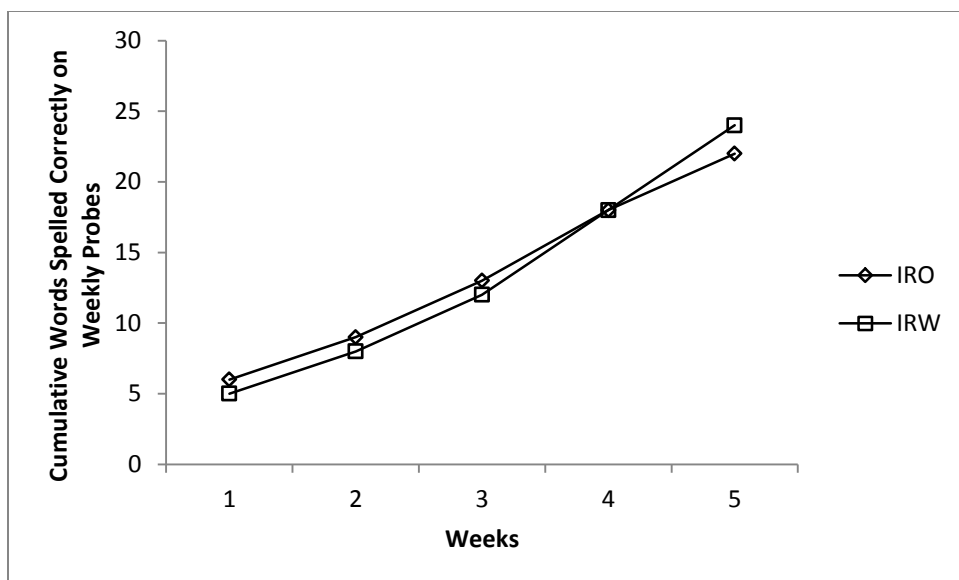


Figure 4.9
Cumulative Words Spelled Correctly on Weekly Probes for Annakin

Figure 4.10 presents the cumulative number of words spelled correctly on weekly probes for Lex. A similar pattern is seen to the previous figures for Andy and Annakin. Lex showed an increasing trend for words spelled correctly for each condition. Lex's performance on weekly spelling probes was similar across both instructional conditions.

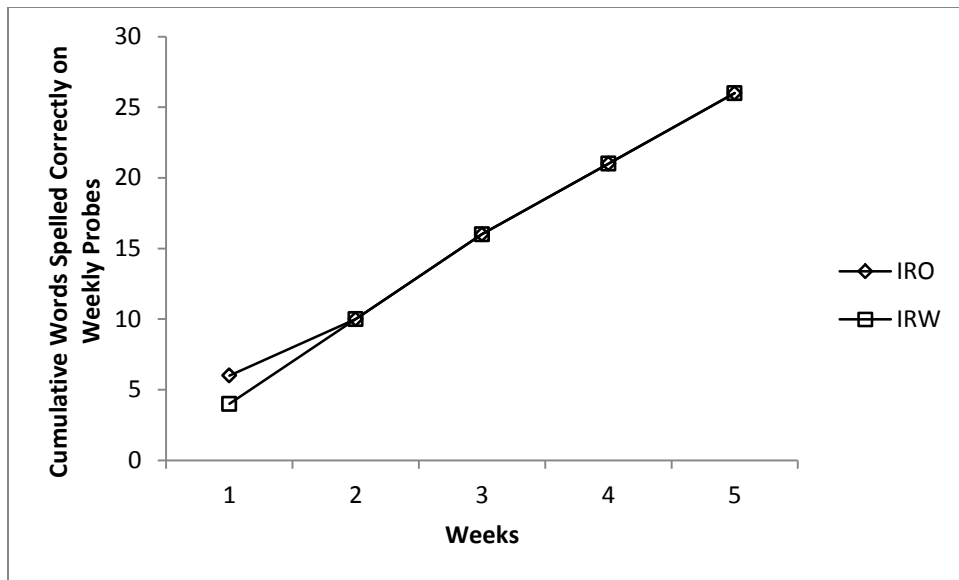


Figure 4.10
Cumulative Words Spelled Correctly on Weekly Probes for Lex

Figure 4.11 shows the cumulative number of words spelled correctly on weekly probes for Orin. Like other participants, the trend for words spelled correctly increases across both instructional conditions. Orin appears to have performed equally well under each condition.

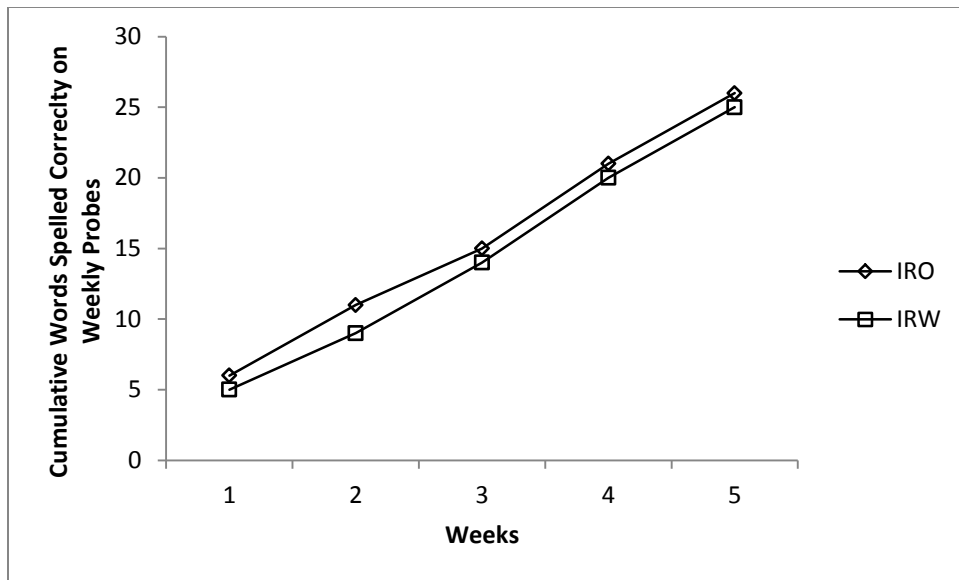


Figure 4.11
Cumulative Words Spelled Correctly on Weekly Probes for Orin

Figure 4.12 presents the cumulative number of words spelled correctly on weekly probes for Annabella. The data show a similar pattern to the other participants of increased words spelled correctly. Annabella correctly spelled cumulatively more spelling words under the incremental rehearsal written than the incremental rehearsal oral condition.

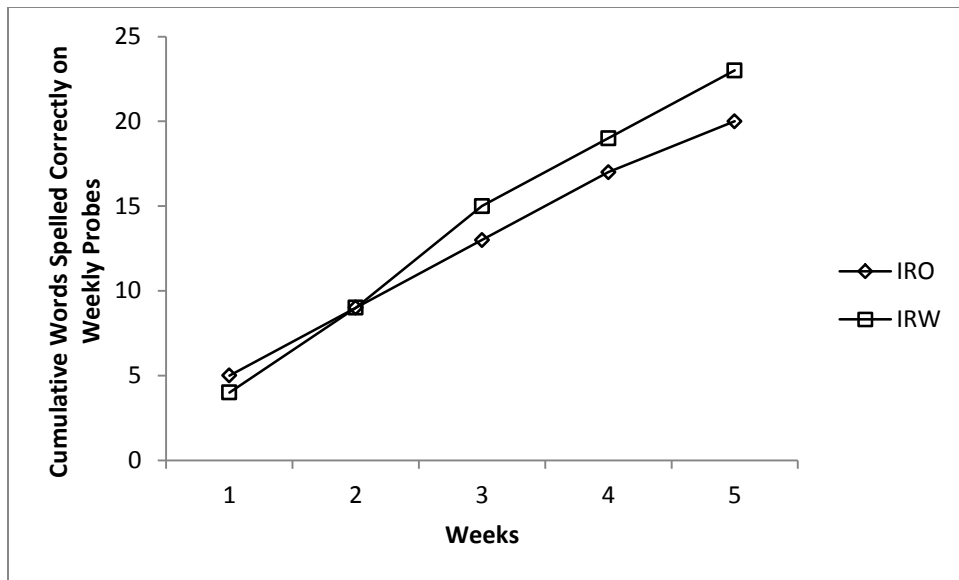


Figure 4.12
Cumulative Words Spelled Correctly on Weekly Probes for Annabella

Figure 4.13 shows the cumulative number of words spelled correctly on weekly probes for Debbie. Debbie's data indicated an increasing trend in correct spelling words across both conditions. The data revealed that Debbie correctly spelled a similar amount of spelling words in both conditions.

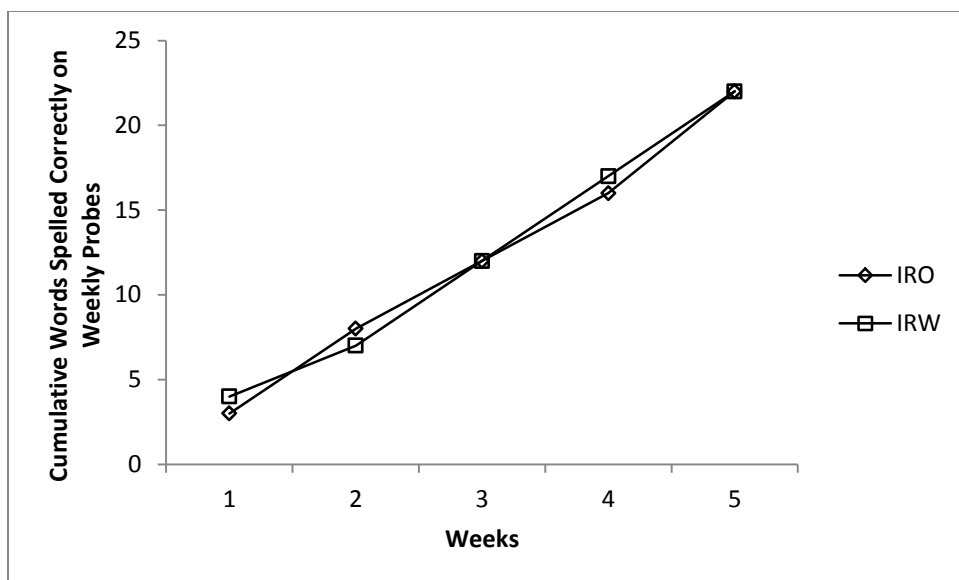


Figure 4.13
Cumulative Words Spelled Correctly on Weekly Probes for Debbie

In order to assess which instructional condition was more effective in terms of the number of cumulative words spelled correctly among students as a group (see Appendix J on words used), the data were collapsed into group data. Figure 4.14 shows the data across participants for both instructional conditions. Each student participated in the same number of sessions. The data were presented across students' performance on weekly probes. The data showed a very slight increase in the number of words spelled correctly during the incremental rehearsal written condition as compared to the incremental rehearsal oral condition. In other words, students tended to learn to spell the same amount of words that were taught under both conditions over the course of the study.

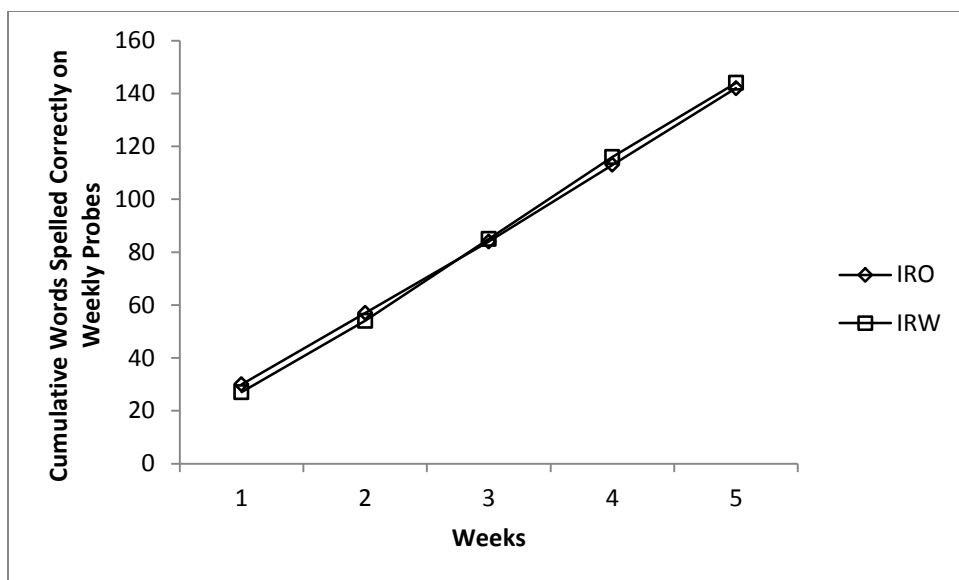


Figure 4.14
Cumulative Words Spelled Correctly on Weekly Probes for Group

Figure 4.15 displays the percentage of words Andy spelled correctly on weekly probes. Data show Andy generally correctly spelled similar percentages of words across conditions on weeks 2, 3, and 4. On week 5, he spelled a higher percentage of words that were taught under the incremental rehearsal oral condition.

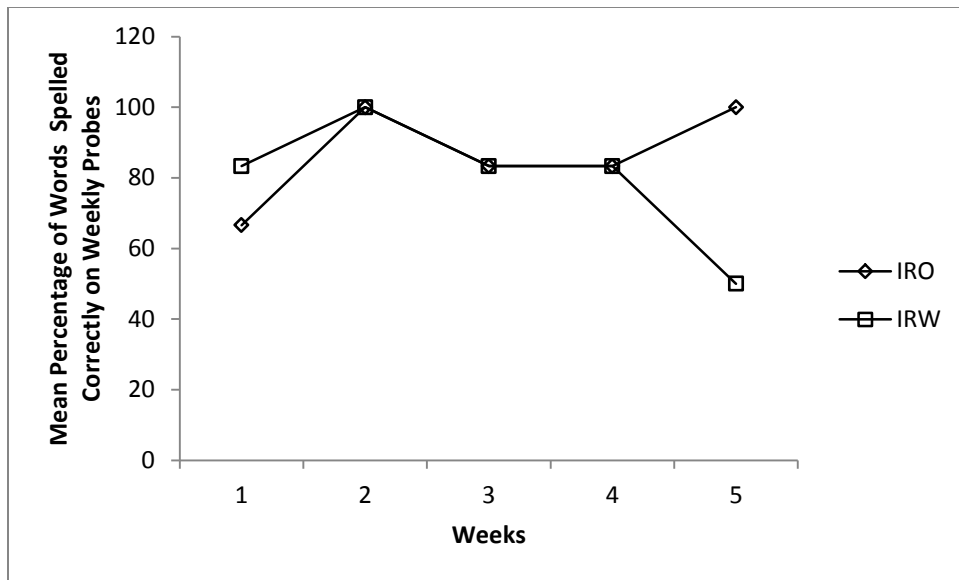


Figure 4.15
Mean Percentage of Words Spelled Correctly on Weekly Probes for Andy

Figure 4.16 displays the percentage of words Annakin spelled correctly on weekly probes. On week 1, Annakin correctly spelled a higher percentage of words that were taught under the incremental rehearsal oral condition. On weeks 2 and 3, Annakin spelled similar number of words correctly across instructional conditions. The data indicated that Annakin correctly spelled a greater percentage of the words that were taught under the incremental rehearsal written conditions in weeks 4 and 5.

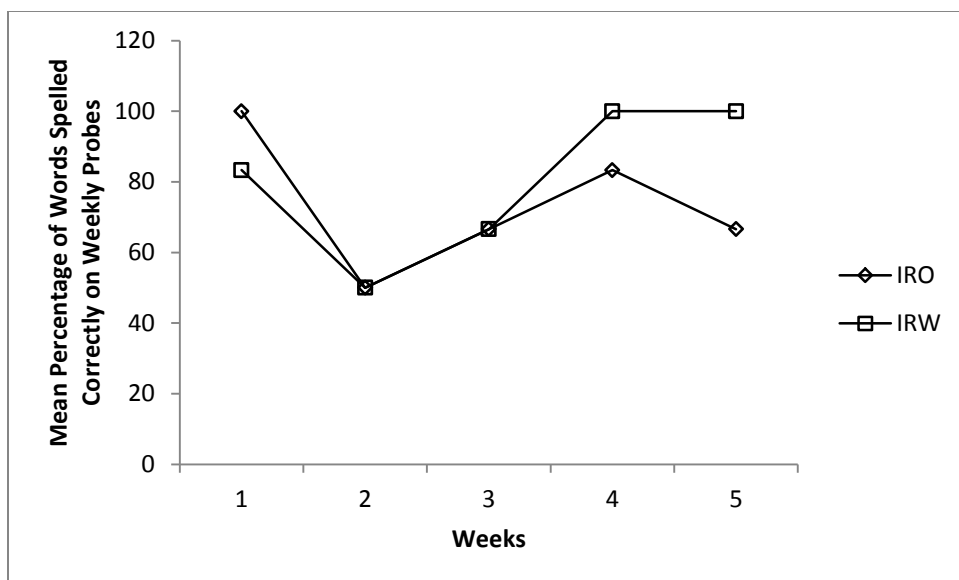


Figure 4.16
Mean Percentage of Words Spelled Correctly on Weekly Probes for Annakin

Figure 4.17 shows the percentage of words Lex spelled correctly on weekly probes. The data indicate generally Lex correctly spelled similar percentages of correct words across both conditions.

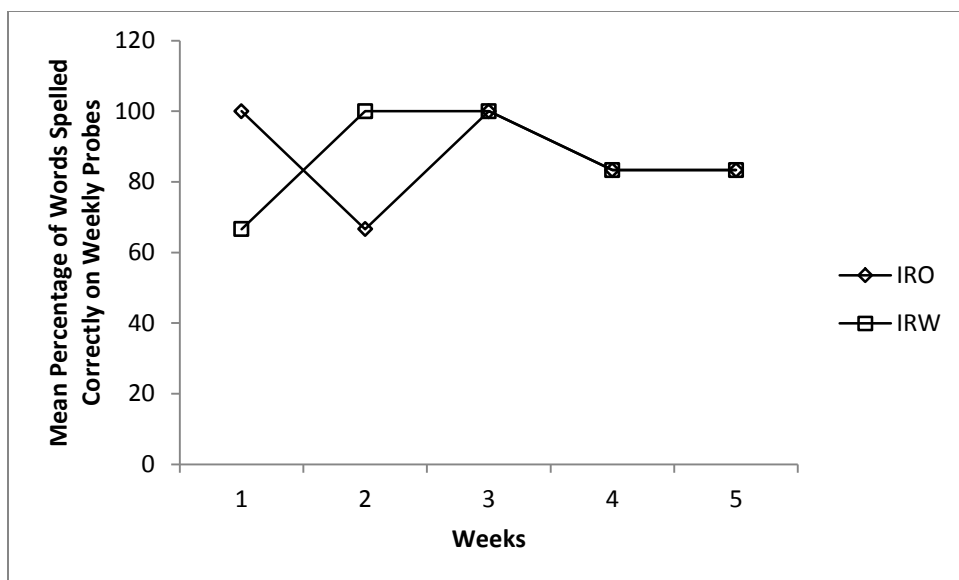


Figure 4.17
Mean Percentage of Words Spelled Correctly on Weekly Probes for Lex

Figure 4.18 displays the percentage of words Orin spelled correctly on weekly probes. Data indicated that on weeks 1 and 2, Orin correctly spelled a greater percentage of words that were taught under the incremental rehearsal oral condition. On week 3, he correctly spelled a greater percentage of the words that were taught under the incremental rehearsal written. On weeks, 4 and 5, he correctly spelled similar percentages of words across instructional conditions.

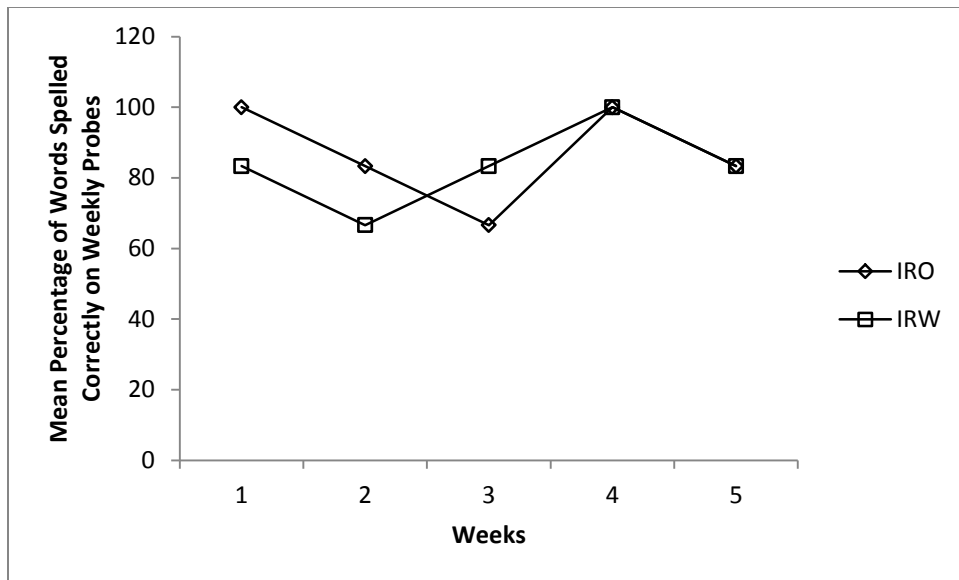


Figure 4.18

Mean Percentage of Words Spelled Correctly on Weekly Probes for Orin

Figure 4.19 displays the percentage of words Annabella spelled correctly on weekly probes. The data show Annabella correctly spelled a greater percentage of words that were taught under the incremental rehearsal written condition on weeks 2, 3, and 5.

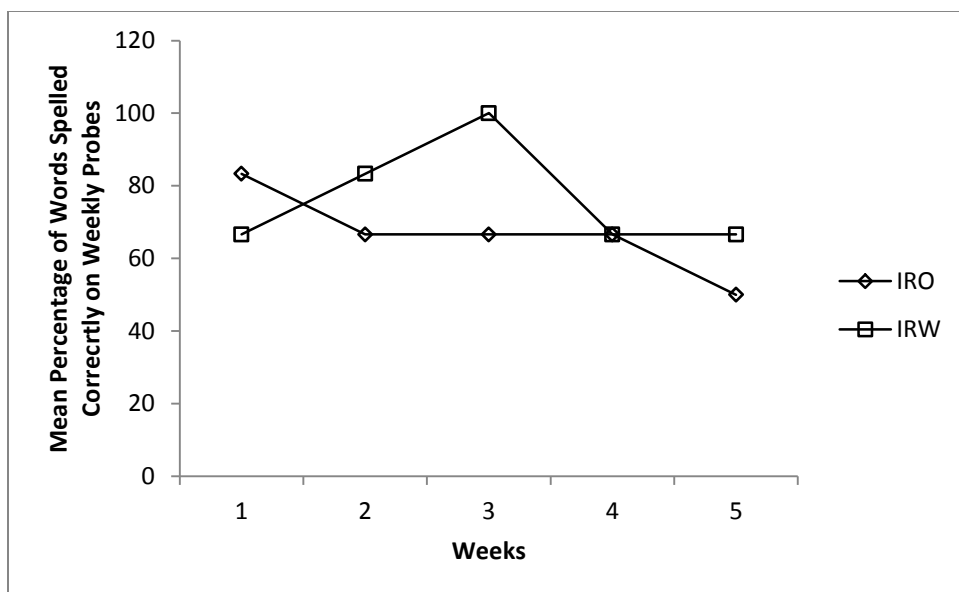


Figure 4.19
Mean Percentage of Words Spelled Correctly on Weekly Probes for Annabella

Figure 4.20 shows the percentage of words Debbie spelled correctly on weekly probes. Data indicated that Debbie correctly spelled a greater percentage of words under the incremental rehearsal written condition on weeks 1, 3, and 4. On weeks 2 and 5, she correctly spelled more words that were taught under the incremental rehearsal oral condition.

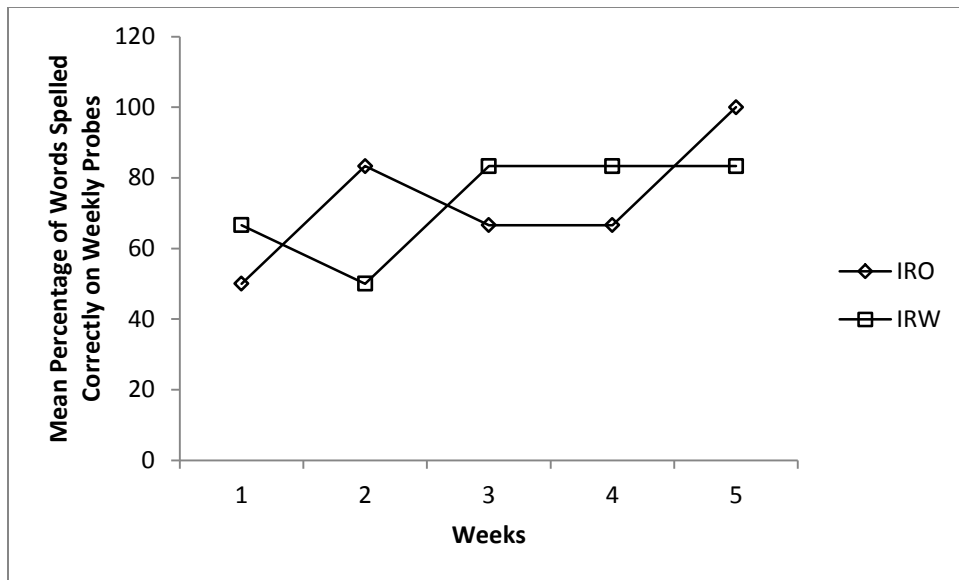


Figure 4.20
Mean Percentage of Words Spelled Correctly on Weekly Probes for Debbie

In order to understand which instructional condition was more effective in terms of the percentage of words spelled correctly among students as a group, data were collapsed into group data. Figure 4.21 shows the data across participants for both instructional conditions. Data were averaged across all students' performance on weekly probes across instructional conditions. The data revealed that on average, students correctly spelled a slightly higher percentage of words that were taught under incremental rehearsal written condition.

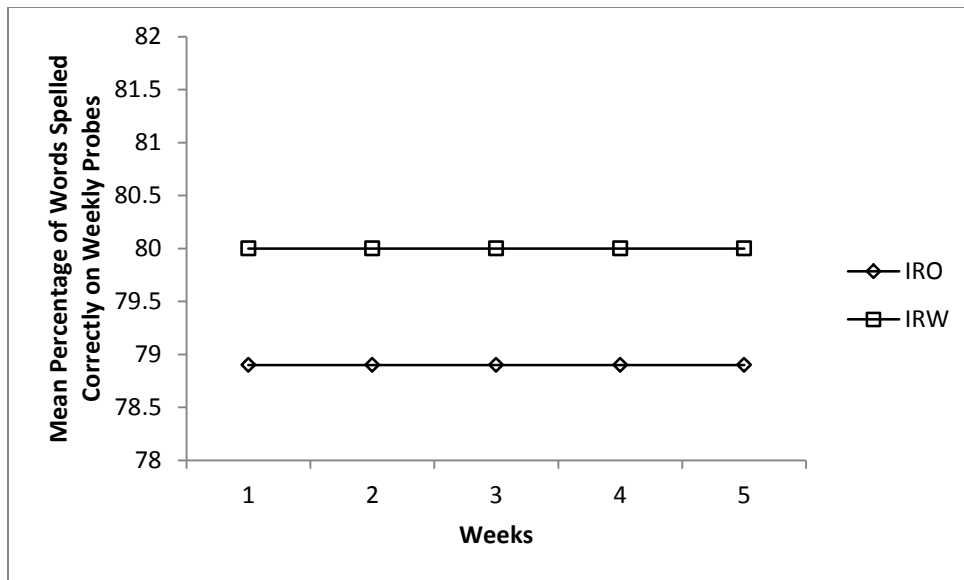


Figure 4.21
Mean Percentage of Words Spelled Correctly on Weekly Probes for Group

Research Question Number Two

Which method, incremental rehearsal oral or incremental rehearsal written helps children spell the most words correctly per minute of instructional time?

Table 4.2 provides a summary of the cumulative number of words spelled correctly, total time engaged in each condition, and the average learning rate (i.e., number of spelling words learned per minute of instruction time) of spelling words under each instructional condition by each participant and by students as a group.

Table 4.2

Summary of Cumulative Spelling Words Learned during Instruction, Time in Sessions and Average Learning Rate

Student	IRO			IRW		
	Words	Time	Rate	Words	Time	Rate
Andy	30	59	.51	30	69	.43
Annakin	30	67	.45	30	65	.46
Lex	30	47	.64	30	70	.43
Orin	30	45	.67	30	75	.40
Annabella	30	48	.63	30	87	.34
Debbie	30	63	.48	30	95	.32
Group	180	329	.55	180	461	.39

Note. IRO = Incremental rehearsal oral, IRW = Incremental rehearsal written

Further data analysis is shown in Figures 4.22, 4.23, 4.24, 4.25, 4.26 and 4.27, allowing for visual analysis for each participant.

Figure 4.22 shows the rate at which Andy learned spelling words per minute of daily instructional sessions. Data indicated that Andy generally learned spelling words at a greater rate under the incremental rehearsal oral condition than under the incremental rehearsal written condition. Specifically, he learned more words per minute of instruction with incremental rehearsal oral procedure for 11 out of 15 daily sessions.

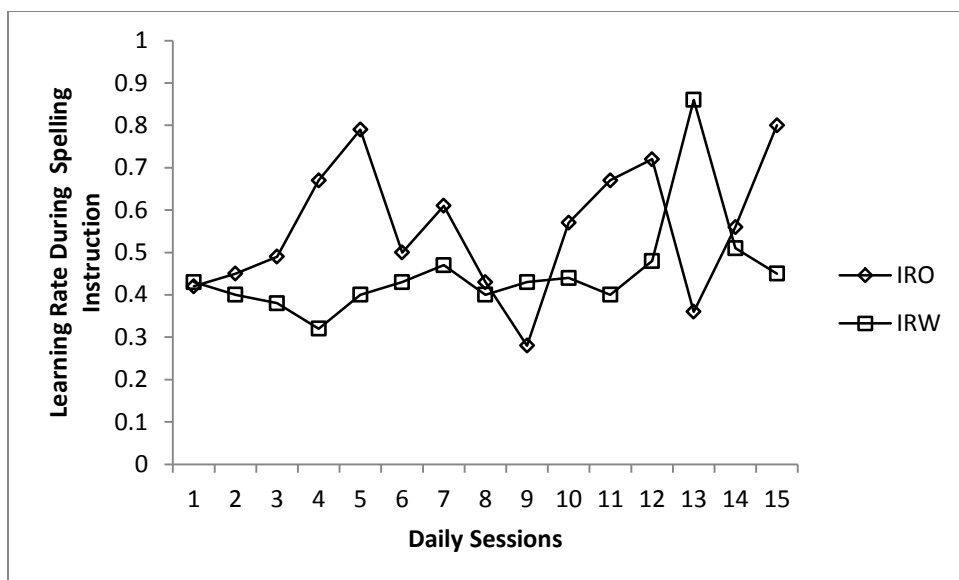


Figure 4.22
Learning Rate During Spelling Instruction for Andy

Figure 4.23 displays the rate at which Annakin learned spelling words per minute of daily instructional sessions. Data indicated that Annakin generally demonstrates similar learning rates across incremental rehearsal oral and incremental rehearsal written instruction. He learned to correctly spell more words per minute with incremental rehearsal written for 6 out of 15 daily sessions and learned to spell more words per minute with incremental rehearsal oral for 9 out of 15 daily sessions.

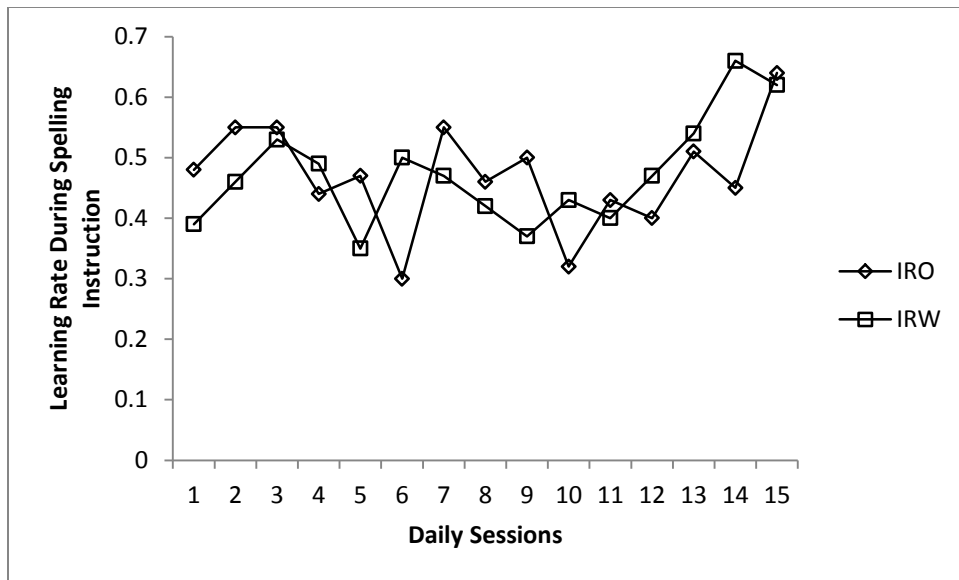


Figure 4.23
Learning Rate During Spelling Instruction for Annakin

Figure 4.24 presents the rate at which Lex learned spelling words per minute of daily instructional sessions. The data showed that Lex generally learned to correctly spell words at a greater rate during the incremental rehearsal oral condition. He learned a greater rate of spelling words per minute under incremental rehearsal oral for 14 of the 15 daily sessions.

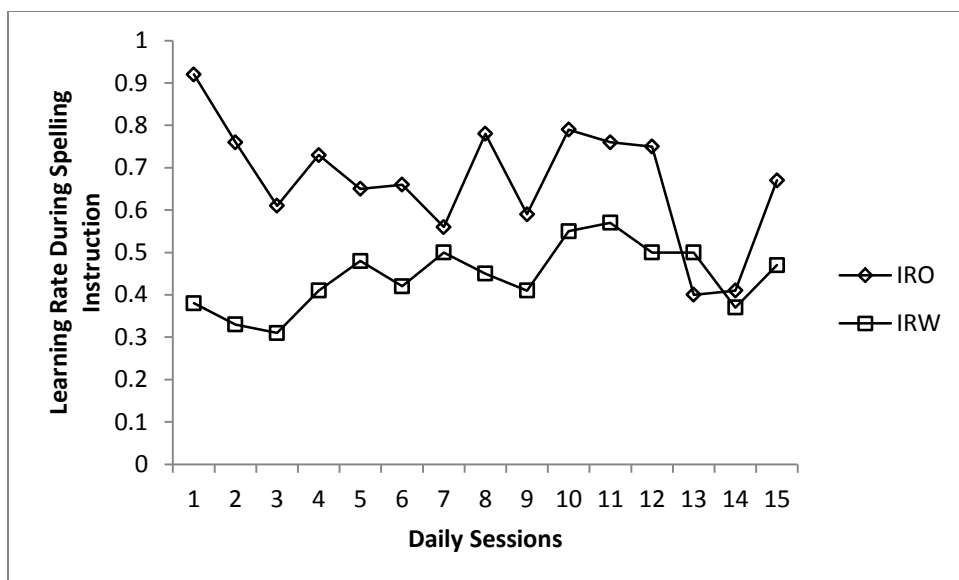


Figure 4.24
Learning Rate During Spelling Instruction for Lex

Figure 4.25 presents the rate at which Orin learned to spell words per minute of daily instructional sessions. The data showed Orin learned to spell words at a greater rate during the incremental rehearsal oral condition. He learned to spell words at a greater rate under incremental rehearsal oral condition for 15 of the 15 daily sessions.

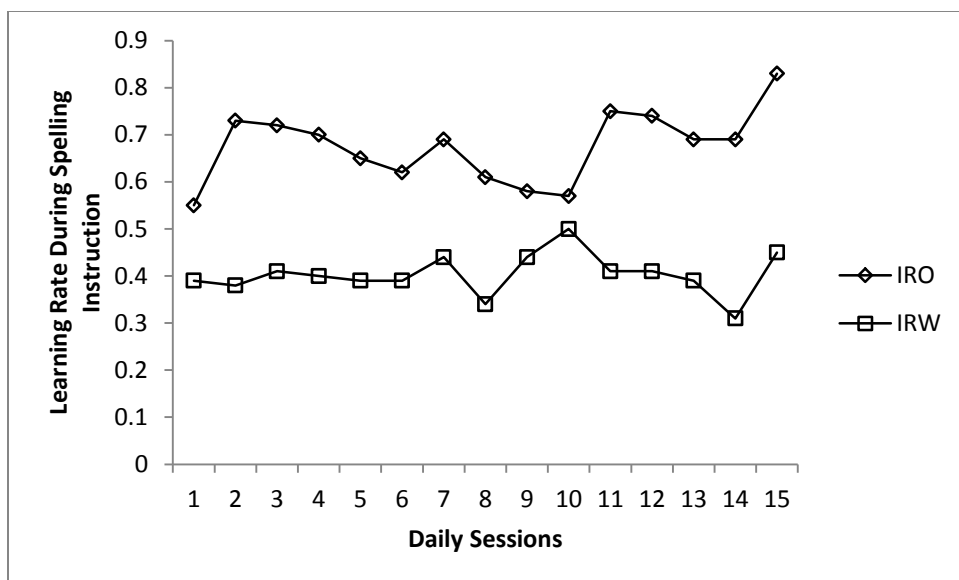


Figure 4.25
Learning Rate During Spelling Instruction for Orin

Figure 4.26 displays the rate at which Annabella learned to spell words per minute of daily instructional sessions. Data indicated that Annabella learned to spell words at a greater rate during the incremental rehearsal oral condition. Specifically, she spelled more words per minute under incremental rehearsal oral for 15 of the 15 daily sessions.

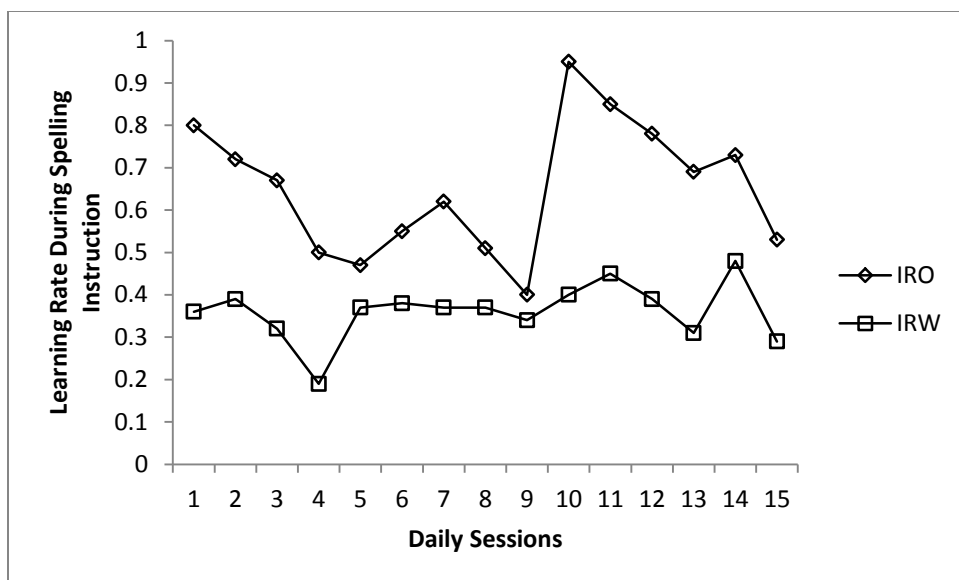


Figure 4.26
Learning Rate During Spelling Instruction for Annabella

Figure 4.27 shows the rate at which Debbie learned spelling words per minute of daily instructional sessions. Data indicated that Debbie learned to spell words at a greater rate under the incremental rehearsal oral condition. She learned to spell more words per minute of instruction with incremental rehearsal oral procedure for 12 out of 15 daily sessions.

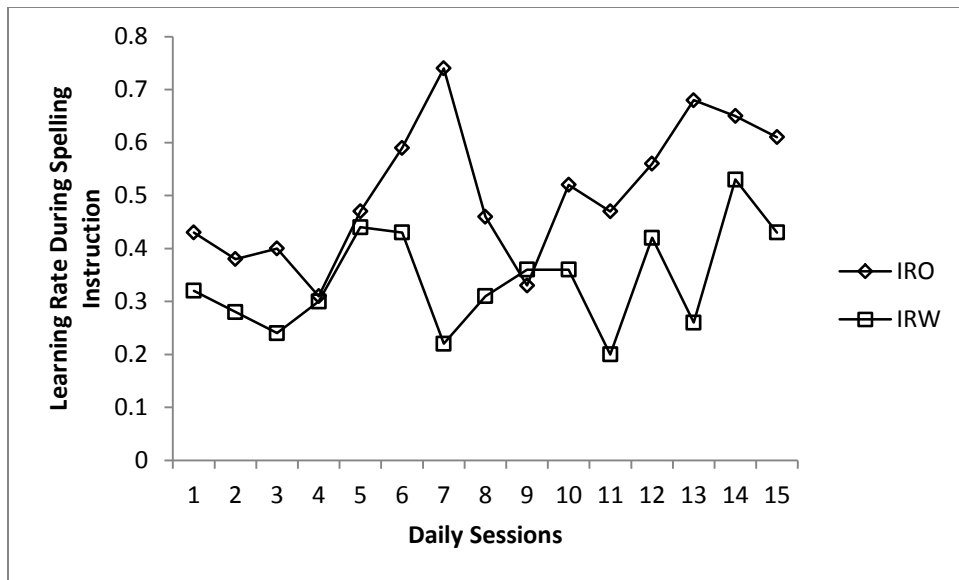


Figure 4.27
Learning Rate During Spelling Instruction for Debbie

Figure 4.28 revealed that Andy's average rate of correctly spelling words during instruction was higher under the incremental rehearsal oral condition than under the incremental rehearsal written condition.

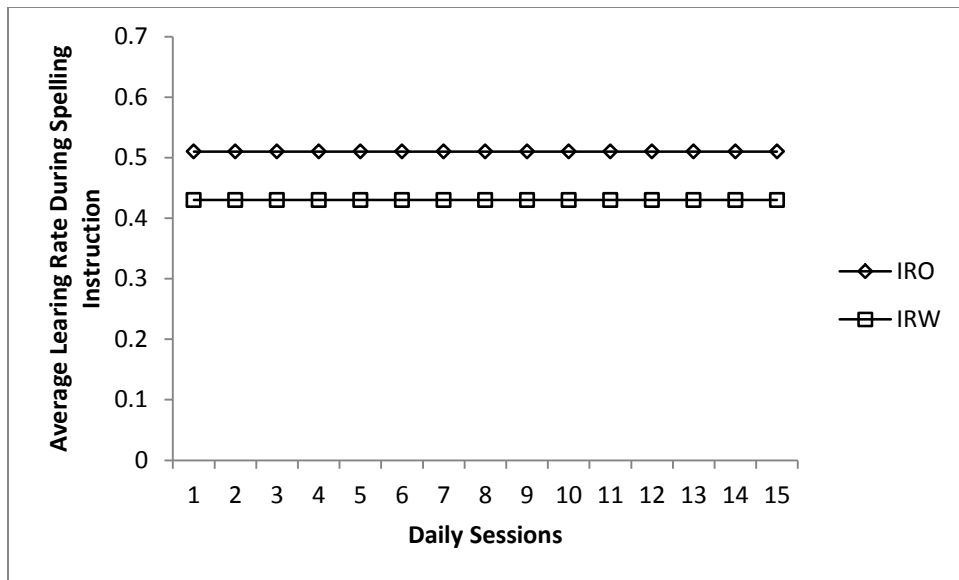


Figure 4.28
Average Learning Rate During Spelling Instruction for Andy

Figure 4.29 demonstrates that Annakin's average learning rate during spelling instruction was similar between the conditions, specifically, .46 for incremental rehearsal written and .45 for incremental rehearsal oral.

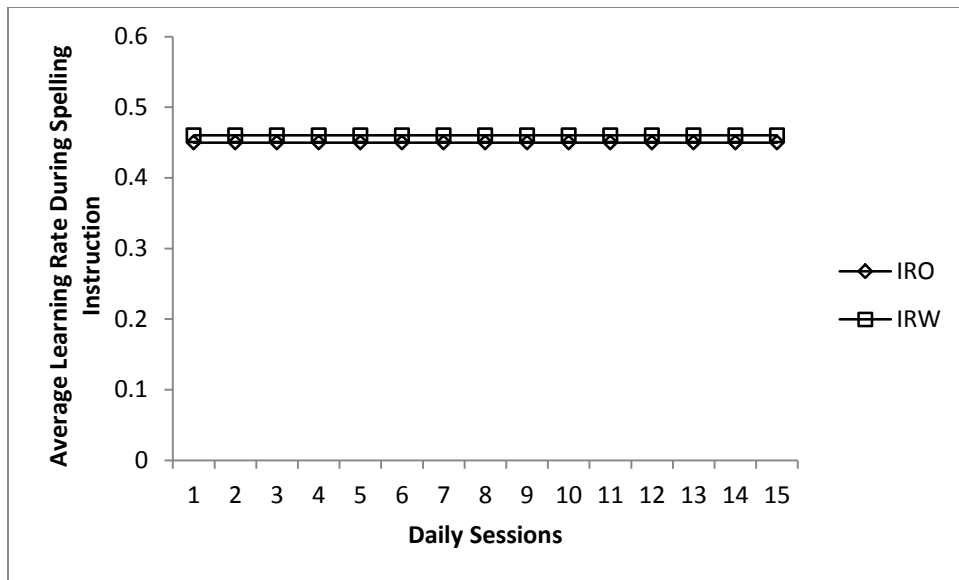


Figure 4.29
Average Learning Rate During Spelling Instruction for Annakin

Figure 4.30 revealed that Lex's average rate of learning to correctly spell words during spelling instruction was higher under incremental rehearsal oral than under incremental rehearsal written condition.

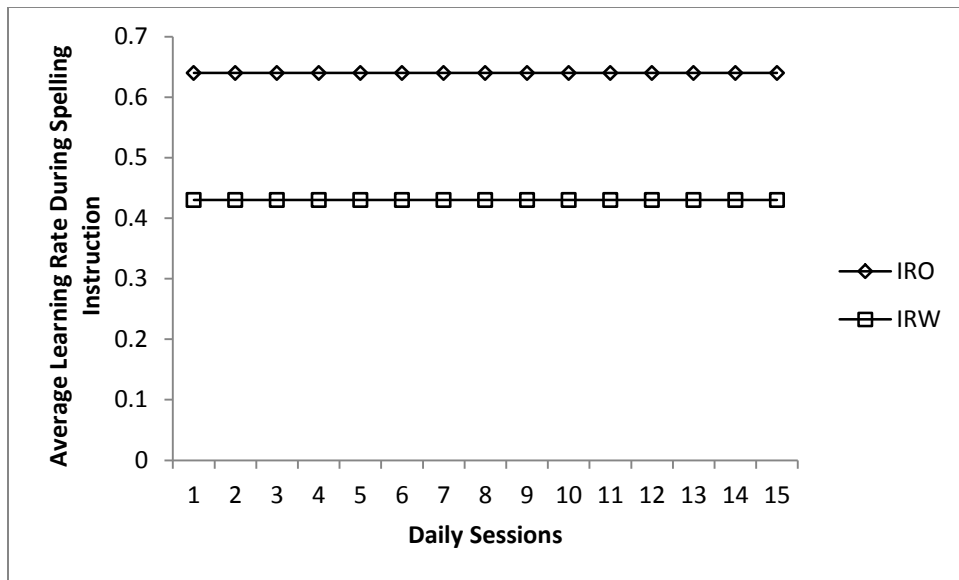


Figure 4.30
Average Learning Rate During Spelling Instruction for Lex

Figure 4.31 indicated that Orin's average rate of spelling words was higher under the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

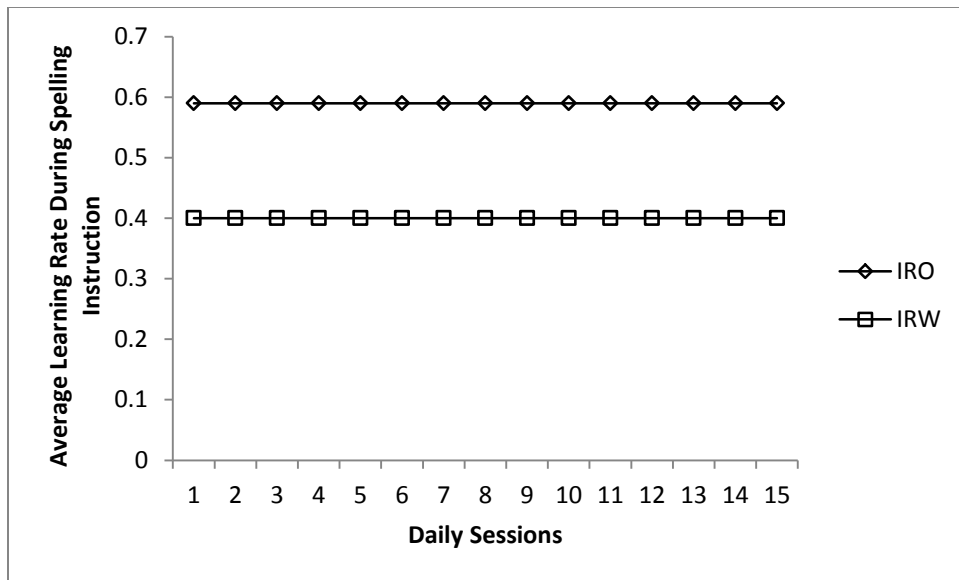


Figure 4.31
Average Learning Rate During Spelling Instruction for Orin

Figure 4.32 indicated that Annabella's average rate of correctly spelling words was higher under incremental rehearsal oral condition compared to the incremental rehearsal written condition.

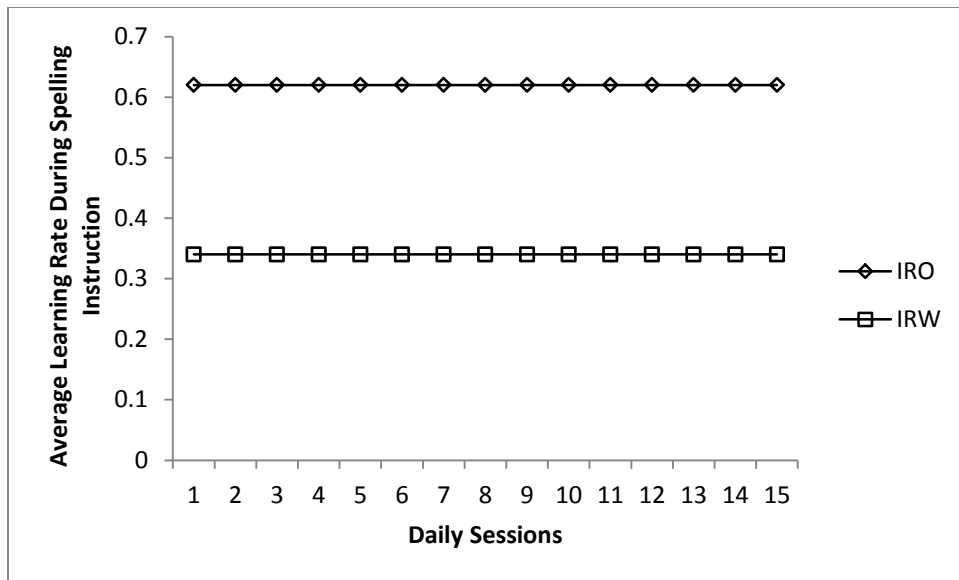


Figure 4.32
Average Learning Rate During Spelling Instruction for Annabella

Figure 4.33 revealed that Debbie's average rate of correctly spelling words was higher under the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

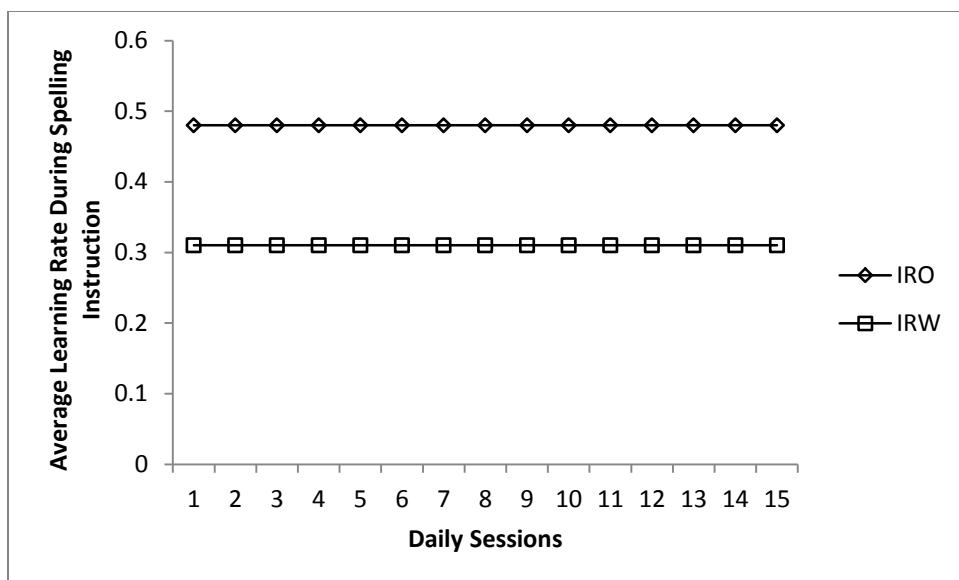


Figure 4.33
Average Learning Rate During Spelling Instruction for Debbie

Table 4.3 displays the cumulative number of words spelled correctly on weekly probes for all six students corresponding to incremental rehearsal oral and incremental rehearsal written procedures. In addition, it provides the total time engaged in each condition and the average rate (i.e., number of words spelled correctly on weekly probes per minute of instruction time) of spelling words correctly under the two instructional conditions, by each participant and by participants as a group.

Visual depiction of data is shown in Figures 4.34, 4.35, 4.36, 4.37, 4.38, 4.39, and 4.40 for each participant and for the participants as a group.

Table 4.3

Summary of Cumulative Words Spelled Correctly on Weekly Probes, Time in Sessions and Average Learning Rate

Student	IRO			IRW		
	Words	Time	Rate	Words	Time	Rate
Andy	26	59	.44	24	69	.35
Annakin	22	67	.33	24	65	.37
Lex	26	47	.55	26	70	.37
Orin	26	45	.58	25	75	.33
Annabella	20	48	.42	23	87	.26
Debbie	22	63	.35	22	95	.23
Group	142	329	.43	144	461	.31

Note. IRO = Incremental rehearsal oral, IRW = Incremental rehearsal written

Figure 4.34 shows the rate at which Andy spelled words correctly on weekly probes per minute of instruction received. The data revealed that Andy generally learned to spell words at a greater rate with incremental rehearsal oral condition on weeks 2, 4, and 5. His performance was similar across conditions on weeks 1 and 3.

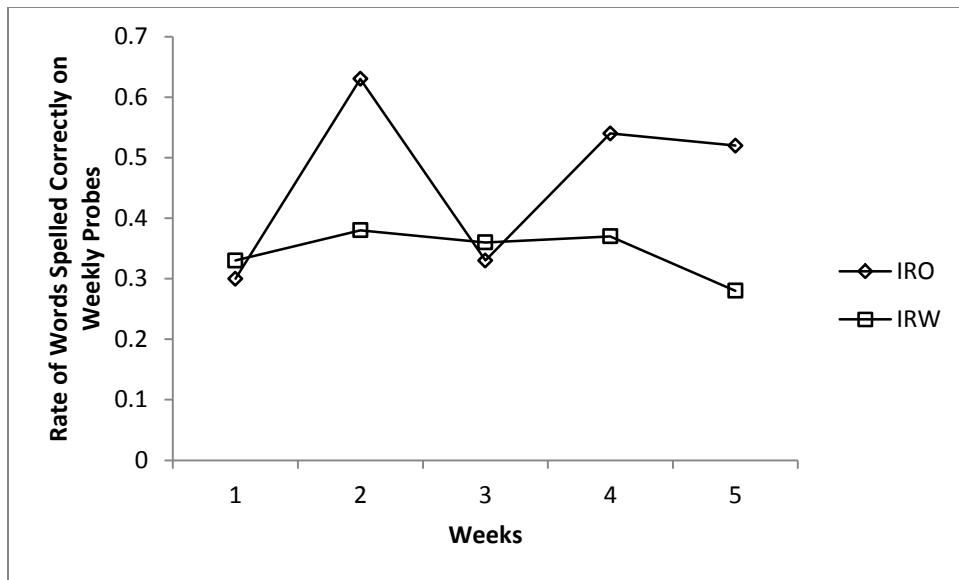


Figure 4.34
Rate of Words Spelled Correctly on Weekly Probes for Andy

Figure 4.35 shows the rate at which Annakin spelled words correctly on weekly probes per minute of instruction received. The data revealed that Annakin learned spelling words at a greater rate with incremental rehearsal written condition. He learned at a greater rate with incremental rehearsal written for 3 out of the 5 weekly probes.

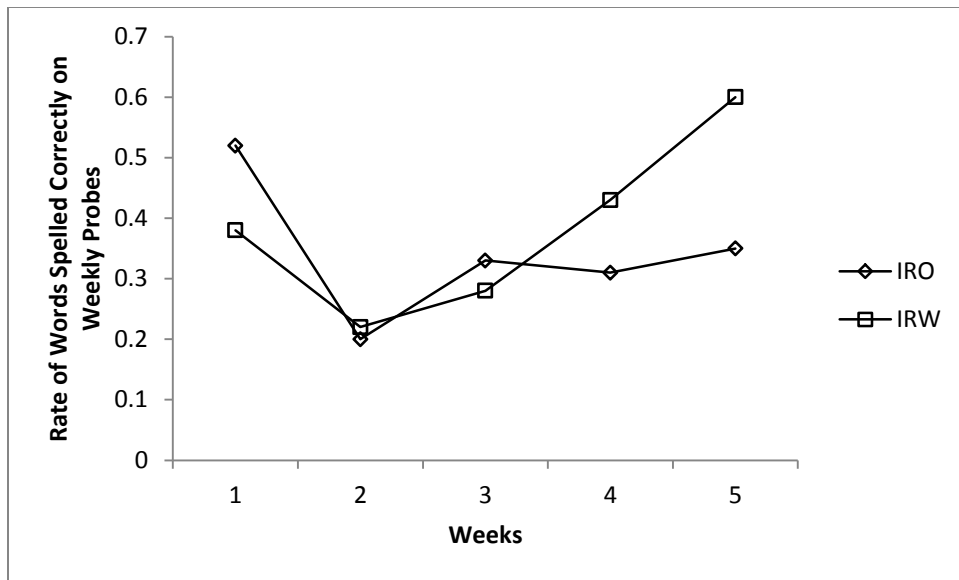


Figure 4.35
Rate of Words Spelled Correctly on Weekly Probes for Annakin

Figure 4.36 shows the rate at which Lex spelled words correctly on weekly probes per minute of instruction received. The data reveal Lex generally learned spelling words at a greater rate with incremental rehearsal oral condition. He learned at a greater rate with incremental rehearsal oral for 3 out of the 5 weekly probes.

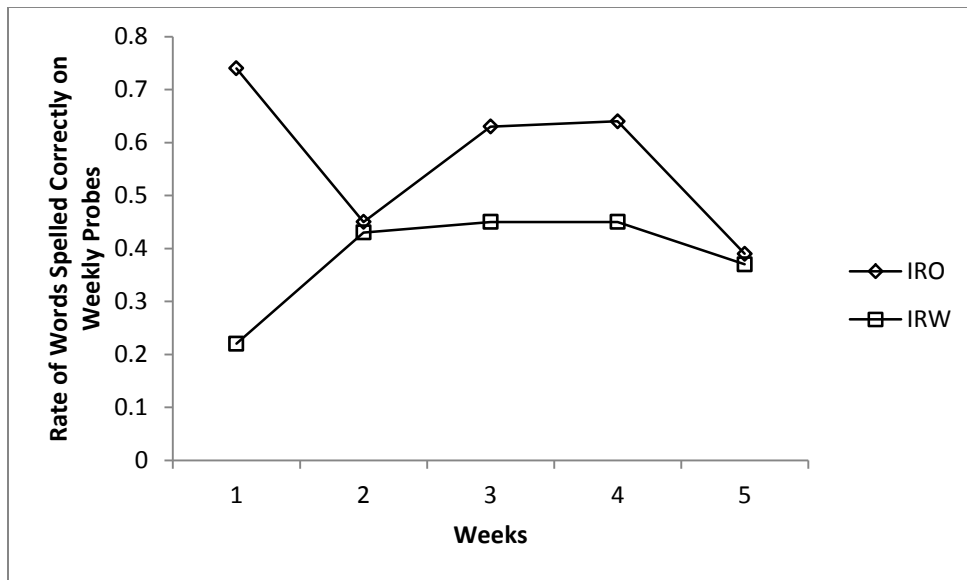


Figure 4.36
Rate of Words Spelled Correctly on Weekly Probes for Lex

Figure 4.37 shows the rate at which Orin spelled words correctly on weekly probes per minute of instruction received. The data reveal Orin learned spelling words at a greater rate with incremental rehearsal oral condition. He learned at a greater rate with incremental rehearsal oral for 5 out of the 5 weekly probes.

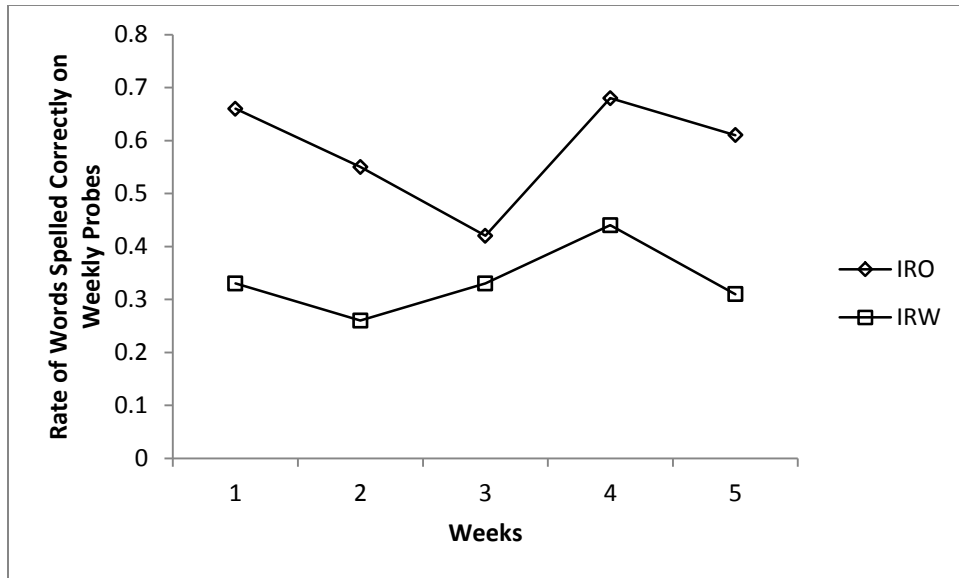


Figure 4.37
Rate of Words Spelled Correctly on Weekly Probes for Orin

Figure 4.38 shows the rate at which Annabella spelled words correctly on weekly probes per minute of instruction received. The data reveal Annabella generally learned spelling words at a greater rate with incremental rehearsal oral condition. She learned at a greater rate with incremental rehearsal oral for 4 out of the 5 weekly probes.

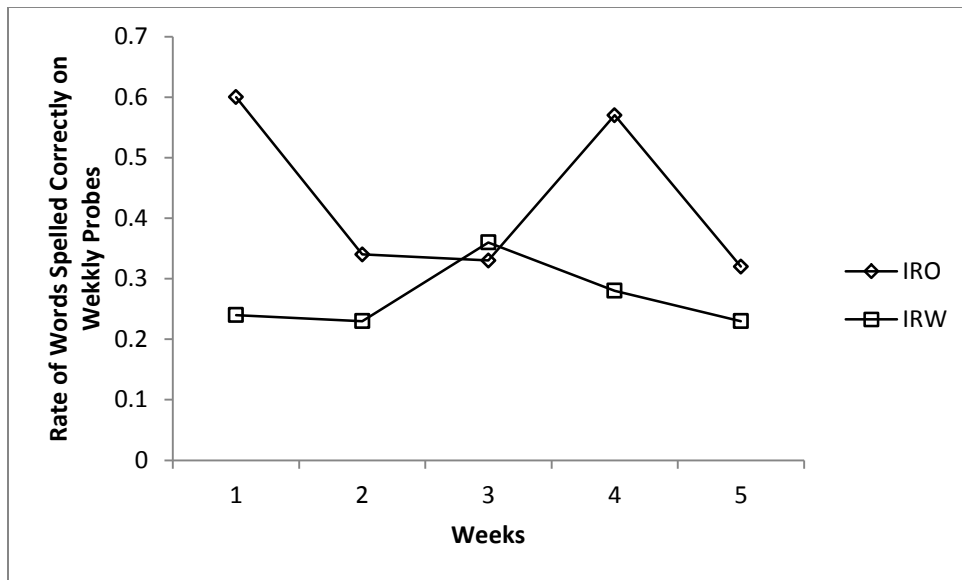


Figure 4.38
Rate of Words Spelled Correctly on Weekly Probes for Annabella

Figure 4.39 shows the rate at which Debbie spelled words correctly on weekly probes per minute of instruction received. The data reveal Debbie learned spelling words at a greater rate with incremental rehearsal oral condition. She learned at a greater rate with incremental rehearsal oral for 5 out of the 5 weekly probes.

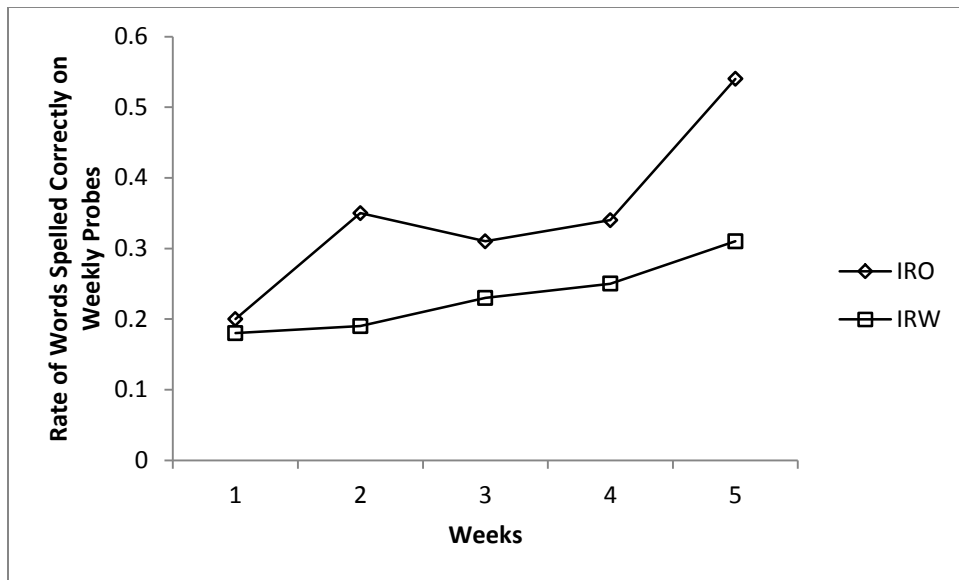


Figure 4.39
Rate of Words Spelled Correctly on Weekly Probes for Debbie

Collapsed data indicate which instructional condition performed at a greater rate of correct spelling words on weekly probes for the group. Figure 4.40 shows data across participants for both conditions. Each student participated in an identical number of weekly probes. Data display students as a group had a greater rate of words spelled correctly on weekly probes under the incremental rehearsal oral condition.

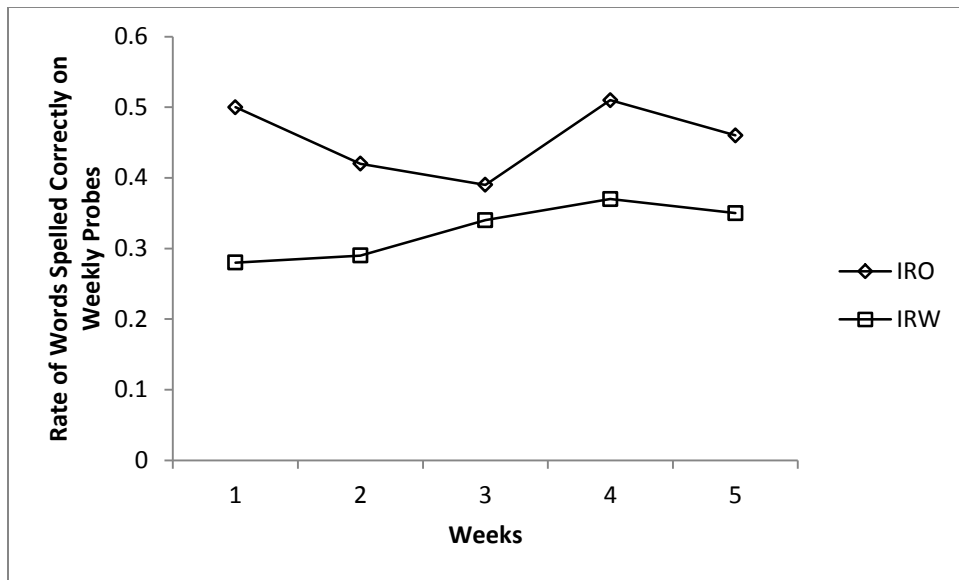


Figure 4.40
Rate of Words Spelled Correctly on Weekly Probes for Group

Figure 4.41 reveals Andy's average rate of words spelled correctly on weekly probes. Andy's average rate of words spelled correctly on weekly probes was higher for the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

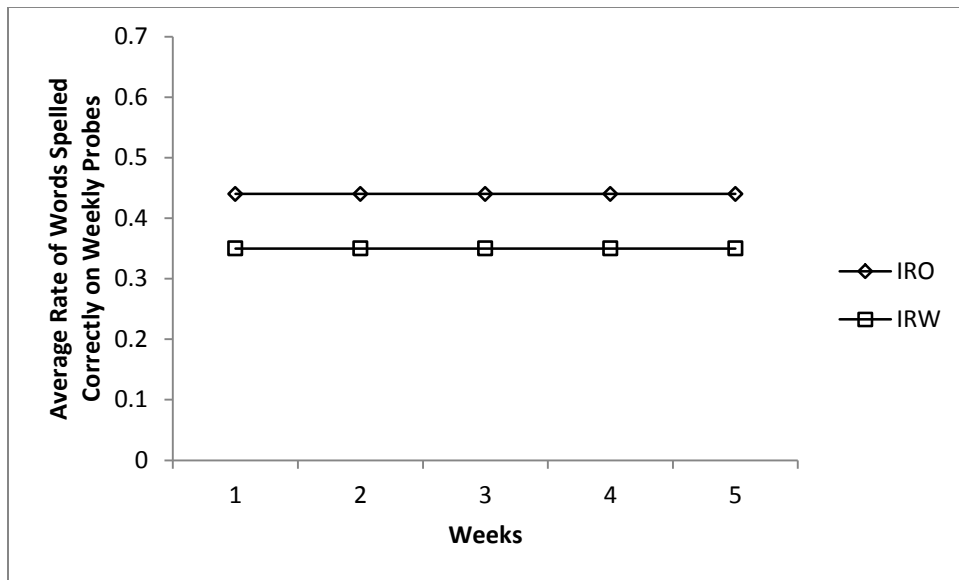


Figure 4.41
Average Rate of Words Spelled Correctly on Weekly Probes for Andy

Figure 4.42 reveals Annakin's average rate of words spelled correctly on weekly probes. Andy's average rate of words spelled correctly on weekly probes was higher for the incremental rehearsal written condition compared to the incremental rehearsal oral condition.

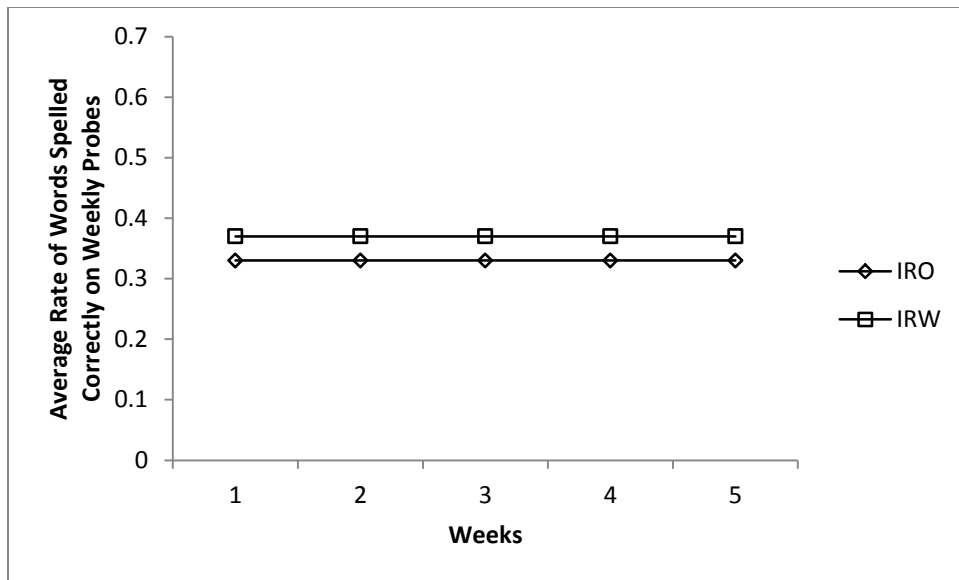


Figure 4.42

Average Rate of Words Spelled Correctly on Weekly Probes for Annakin

Figure 4.43 revealed Lex's average rate of words spelled correctly on weekly probes. Lex's average rate of words spelled correctly on weekly probes was higher for the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

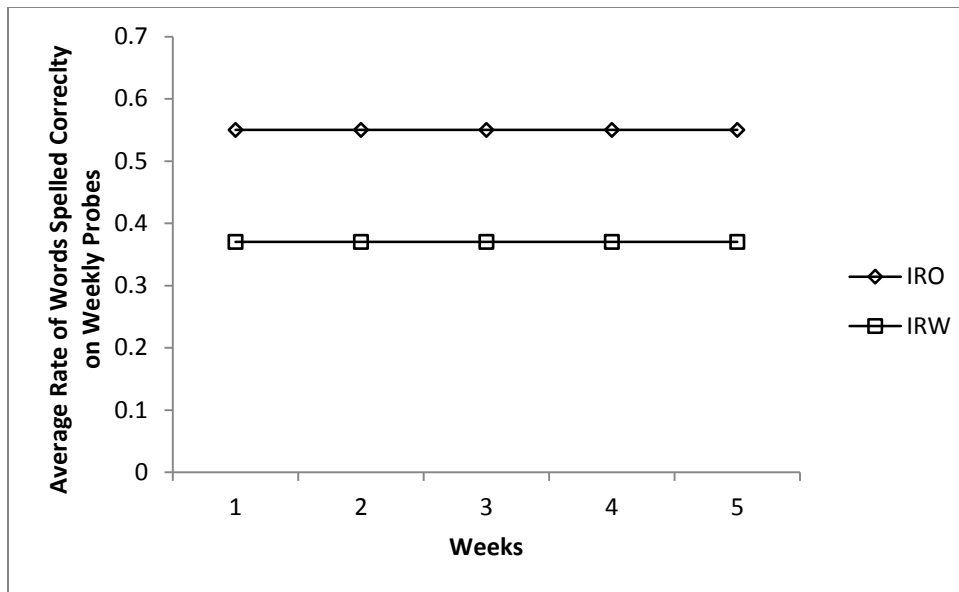


Figure 4.43
Average Rate of Words Spelled Correctly on Weekly Probes for Lex

Figure 4.44 revealed Orin's average rate of words spelled correctly on weekly probes. Orin's average rate of words spelled correctly on weekly probes was higher for the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

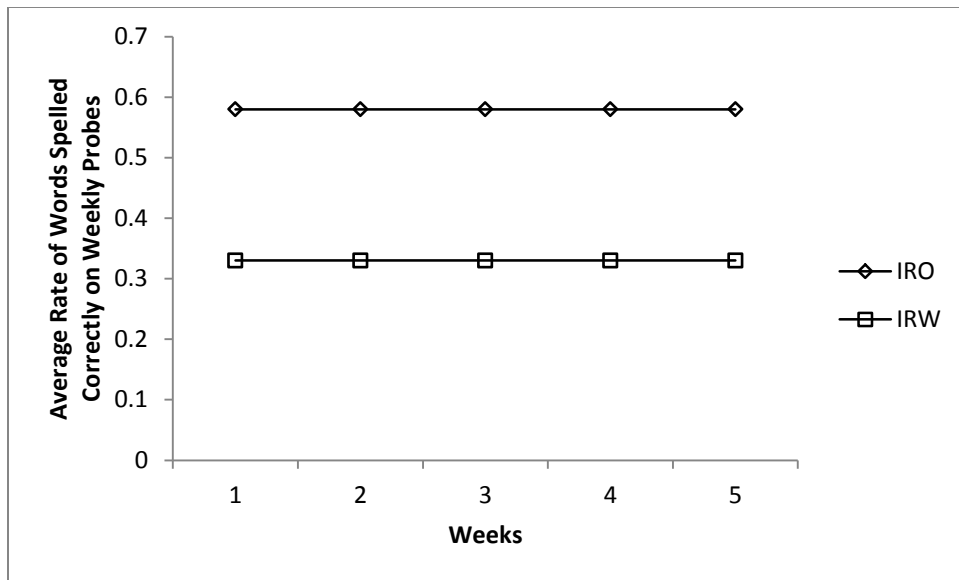


Figure 4.44
Average Rate of Words Spelled Correctly on Weekly Probes for Orin

Figure 4.45 revealed Annabella's average rate of words spelled correctly on weekly probes. Annabella's average rate of words spelled correctly on weekly probes was higher for the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

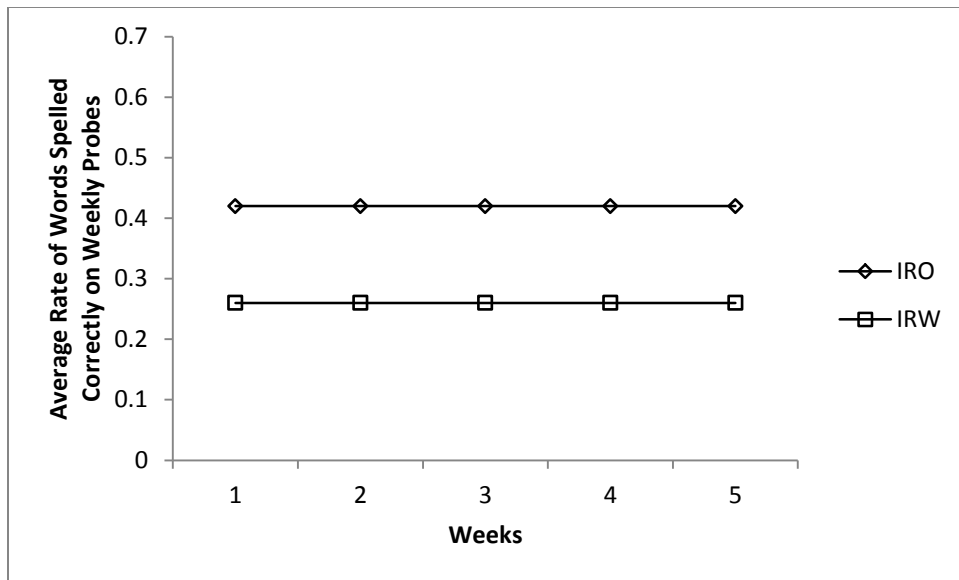


Figure 4.45
Average Rate of Words Spelled Correctly on Weekly Probes for Annabella

Figure 4.46 reveals Debbie's average rate of words spelled correctly on weekly probes. Debbie's average rate of words spelled correctly on weekly probes was higher for the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

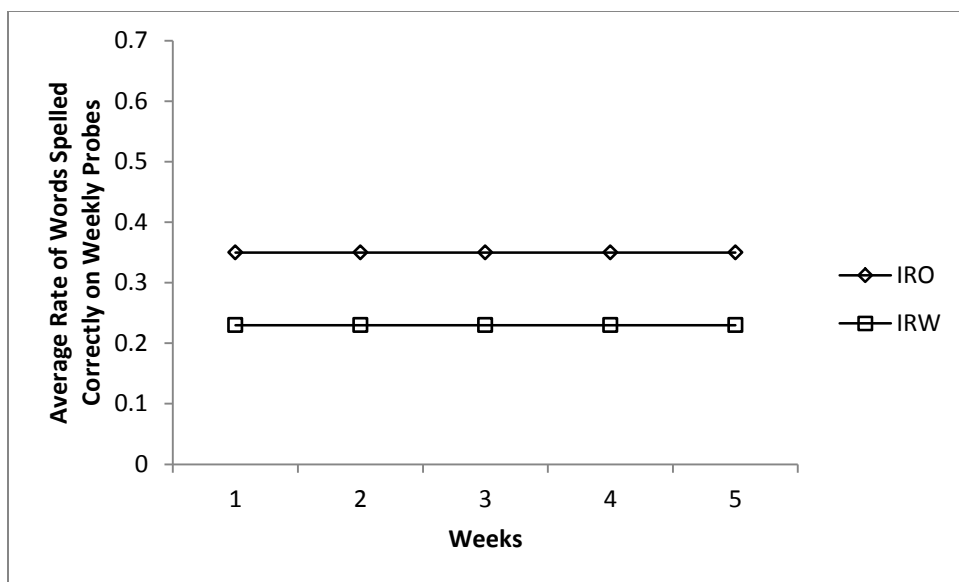


Figure 4.46
Average Rate of Words Spelled Correctly on Weekly Probes for Debbie

Figure 4.47 provides collapsed group rate data. Students as a group correctly spelled a higher average rate of words that were taught under the incremental rehearsal oral condition than under the incremental rehearsal written condition.

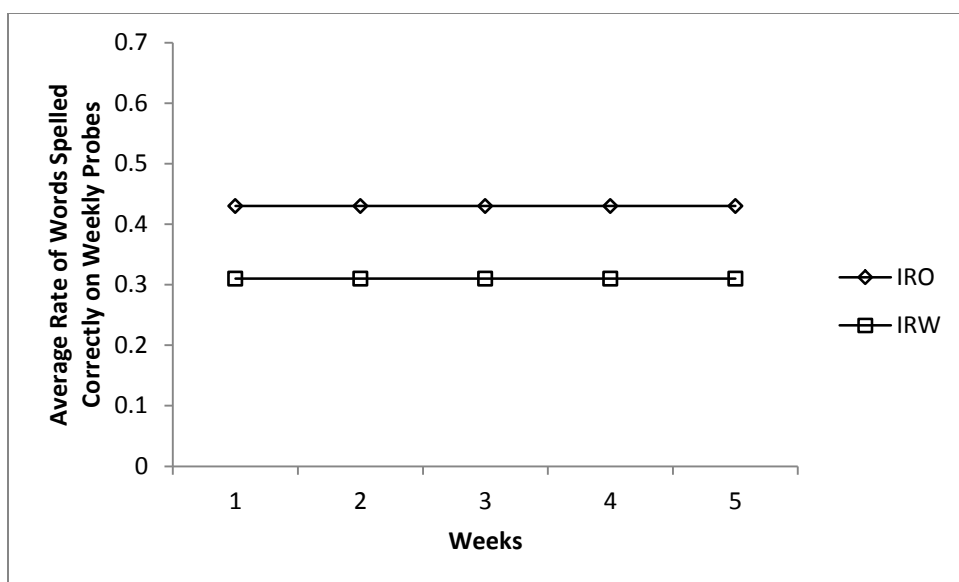


Figure 4.47

Average Rate of Words Spelled Correctly on Weekly Probes for Group

Research Question Number Three

Which method, incremental rehearsal oral or incremental rehearsal written helps children better spell more words correctly on a delayed recall probe?

Research Question Number Four

Which method, incremental rehearsal oral or incremental rehearsal written helps children correctly spell more words at a higher rate?

Table 4.4 shows the cumulative number of words spelled correctly on an end-of-study delayed recall spelling test utilizing the words that participants spelled correctly on the weekly spelling probes. In addition, it provides total time engaged in each instructional condition and the average delayed recall rate (i.e., number of words spelled correctly on the end-of-study delayed recall spelling test per minute of instruction time) across two conditions, by participants and by participants as group.

Table 4.4

End-of-Study Delayed Recall of Spelling Words, Delayed Recall Rate, and Delayed Recall Percentage

Student	Delayed Recall of Spelling Words		Delayed Recall Rate		Delayed Recall Percentage	
	IRO	IRW	IRO	IRW	IRO	IRW
Andy	26	19	.44	.28	100	79
Annakin	12	14	.18	.22	55	58
Lex	23	24	.49	.34	88	92
Orin	19	21	.42	.28	73	84
Annabella	15	13	.31	.15	75	57
Debbie	16	16	.25	.17	73	73
Group	111	107	.34	.23	78	74

Note. IRO = Incremental rehearsal oral, IRW = Incremental rehearsal written

End-of-Study Delayed Recall

End-of-study data indicated that Andy recalled 100% of the spelling words under the incremental rehearsal oral condition and 79% under the incremental rehearsal written condition. Annakin recalled 55% of the spelling words under the incremental rehearsal oral condition and 58% under the incremental rehearsal written condition. Lex recalled 88% of the spelling words under the incremental rehearsal oral condition and 92% under the incremental rehearsal written condition. Orin recalled 73% of the spelling words under the incremental rehearsal oral condition and 84% under the incremental rehearsal written condition. Annabella recalled 75% of the spelling words under the incremental rehearsal oral condition and 57% under the incremental rehearsal written condition. Debbie recalled equal amounts of spelling words under each condition (i.e., 73%). The

students as a group recalled an average of 78% of the spelling words that were taught under the incremental rehearsal oral condition and 74% of the words that were taught under the incremental rehearsal written condition. Only words that were spelled correctly on the weekly probes were included on the delayed recall probes.

Delayed recall spelling rates were analyzed by dividing the number of cumulative words recalled by the cumulative amount of instructional time for each instructional condition. Five out of the six students recalled a higher rate of words that were learned under the incremental rehearsal oral condition than under the incremental rehearsal written condition. As a group, delayed spelling recall rates were greater for words that were taught under the incremental rehearsal oral condition compared to the incremental rehearsal written condition.

Research Question Number Five

Which method, incremental rehearsal oral or incremental rehearsal written helps students generalize more spelling words in sentences?

Table 4.5 represents the number of cumulative spelling words generalized across the participants and for participants as a group, percentage generalized across participants and participants as a group by instructional condition.

Specifically, participants, at the end of the study, were given sentences utilizing the words spelled correctly from the weekly probes. The sentences had a single blank space where the student wrote in the target spelling word. After the researcher read the sentence, the participants filled in the blank with a word which they had previously spelled correctly on a weekly probe. Spelling words were considered generalized when the participant accurately spelled the word within the context of the sentence.

Generalization data was taken during the week of the last instructional phase. Overall, generalization to spelling words correctly in sentences varied, with 3 students generalizing more spelling words that were taught under the incremental rehearsal oral condition and the other 3 generalizing more spelling words that were taught under the with incremental rehearsal written condition. Students as a group generalized spelling more words that were taught under the incremental rehearsal oral (79.8%) when compared to incremental rehearsal written (77.6%).

Table 4.5

Number of Words Generalized (WG) and Percentage of Words Generalized (PWG) for each student

Student	IRO		IRW	
	WG	PWG	WG	PWG
Andy	23	88.4	19	82.6
Annakin	14	63.6	14	60.8
Lex	26	96.2	25	100
Orin	21	77.7	19	82.6
Annabella	13	65	16	69.5
Debbie	18	81.8	15	68.1
Group	115	79.8	108	77.6

Note. IRO = Incremental rehearsal oral, IRW = Incremental rehearsal written

Research Question Number Six

Which method, incremental rehearsal oral or incremental rehearsal written results in the most generalization of accurately spelled words presented in sentences per minute of instruction?

Information was gathered from generalization student activity to answer this research question. Table 4.6 displays the total words generalized, the total minutes used for each instructional condition, and the rate of generalization. Generalization rates ranged from .16 to .55 per minute of instructional time. As a group, participants had a higher generalization rate with words that were taught under the incremental rehearsal oral condition (.35) than under the incremental rehearsal written condition (.23).

Table 4.6

Summary of Number of Words Generalized, Time in Sessions and Rate of Generalization (GR)

Student	IRO			IRW		
	Words	Time	GR	Words	Time	GR
Andy	23	59	.40	19	69	.28
Annakin	14	67	.21	14	65	.22
Lex	26	47	.55	25	70	.38
Orin	21	45	.47	19	75	.25
Annabella	13	48	.27	16	87	.18
Debbie	18	63	.29	15	95	.16
Group	115	329	.35	108	461	.23

Note. IRO = Incremental rehearsal oral, IRW = Incremental rehearsal written

Research Question Number Seven

Which method, incremental rehearsal oral or incremental rehearsal written is viewed as most useful by teachers?

Three teachers of the study's participants completed a social validity survey after all spelling activities were completed. The survey utilized six questions with Likert-type scale response options (see Appendix I). Responses to questions such as "Do you feel as though the instructional methods appear valid and appropriate for helping students to improve spelling performance" and "Which instructional methods would be most effective in enhancing student spelling performance" were presented to determine the social validity for the instructional approaches. Two teachers did not notice a difference in the students' spelling performance during the instruction phase, selecting the "not really" answer when asked if a students' overall spelling performance was

affected. In contrast, one teacher felt her students overall spelling performance changed “a little bit.” When asked to compare incremental rehearsal oral procedure to incremental rehearsal written procedure, two teachers thought oral incremental rehearsal would be the more enjoyable of the two conditions for the students. All of the teachers felt incremental rehearsal written would be the most effective method of the two conditions. Two of the three teachers replied that the written incremental rehearsal would be the more efficient of the two methods. One teacher felt that both incremental rehearsal instructional conditions were “valid and appropriate,” one teacher felt the conditions were “a little bit” valid and appropriate, and one did not know, replying she had not seen the results of the research. One teacher would consider using the incremental rehearsal written procedure in the classroom, one teacher would consider using the incremental rehearsal oral procedure in the classroom, and one teacher did not know, because she had not seen the results of the research.

Every student participant was instructed in the same office location. After the completion of all spelling activities for the project, the students completed a social validity interview questionnaire. Seven questions were read aloud to the students who followed along on their own copy of the questionnaire. Inquiries such as, “Did you enjoy these spelling exercises,” “Did doing these spelling exercises help you to spell better,” “Did doing these spelling exercises help you to spell words,” and “Which of the spelling exercises did you think was most helpful” were used to determine the social validity of the incremental rehearsal oral and incremental rehearsal written spelling instruction.

Results reveal that five of the six students enjoyed the spelling intervention

activities. Three students (Andy, Lex and Orin), replied that they, “Yes, very much” enjoyed the spelling exercises whereas two students (Annabella and Debbie) replied, “Yes” to the same question. All students felt the spelling exercises helped them spell better with four selecting “Yes, very much” (Andy, Lex, Orin, and Annabella) and two students (Annakin and Debbie) selecting “Yes” to this question. Five students felt the exercises helped them spell words, with three replying, “Yes, very much” (Andy, Orin and Debbie) and 2 replying “Yes” to the question (Lex and Debbie). Next they were asked if they felt these spelling exercises would help other students spell better. Two students replied, “Yes, very much” (Lex and Orin), two replied, “Yes” (Annabella and Debbie) and one replied, “A little bit” (Andy). In total, three students (Lex, Orin and Debbie) felt incremental rehearsal oral was most helpful and three (Andy, Annakin and Annabella) felt incremental rehearsal written was most helpful. Two students (Lex and Orin) would choose to use incremental rehearsal oral exercises again, two (Annakin and Annabella) chose incremental rehearsal written and two (Andy and Debbie) students chose both.

Chapter 5: Discussion

This chapter presents a discussion about the results of the study, which evaluated the effectiveness and efficiency of two variations of the incremental rehearsal technique on spelling performance. Results are discussed in terms of the research questions initially posed. In addition, comparison to previous research, implications for practice, limitations and directions for future research are discussed.

The purpose of this study was to examine the instructional effectiveness and efficiency of two variations of the incremental rehearsal procedure for teaching spelling to students. Specifically, the study examined which of the two instructional spelling conditions, incremental rehearsal using an oral response (IRO) or incremental rehearsal using a written response (IRW), was the most effective and efficient on students' spelling acquisition and rate. This study expands the methods and findings of previous IR studies, and in addition, provides new information on the use of IR within a spelling context utilizing two different topographies. Delayed recall, generalization and social validity data were also examined.

Instructional Effectiveness

The initial research question focused on which method, IRO or IRW, helped students spell the most words correctly. Weekly spelling probe results indicated positive effects for both conditions as evidenced by previously unknown words spelled correctly by the students in the study. The IRW condition resulted in a slightly greater number of words spelled correctly for participants as a group. Specifically, two out of the six students spelled slightly more words correctly based on results of the weekly spelling probes. Although this slight increase would not be qualified as a considerable difference, one explanation for this difference may be that the act of writing helps some students become better spellers. Edwards (2003) highlighted the importance of physically writing words as students learn to spell; physically representing letters and words improved spelling performance. In addition, success in teaching spelling depends, in part, on providing spelling instruction that matches children's individual needs (Graham & Harris, 2002).

The act of writing the words during instruction and practice matched what the students were expected to do on their weekly spelling test.

As indicated above, overall, both conditions appeared to be effective for teaching students to spell words correctly. Various characteristics of the IR process may explain the reason students performed in a similar fashion across the two conditions, IR oral and IR written. Specifically, IR is a method, whether utilizing an oral or written response, which leverages several principles of effective teaching. One of these principles is giving corrective feedback on student performance. In other words, letting students know when an answer is incorrect and then supplying the correct answer. During the IR intervention

process, when an item is incorrectly responded to, the correct answer is given immediately. Specifically, IR was found effective when used prior to reading passages to introduce new or challenging words to students before they interacted with them in text (Burns, Dean, & Foley, 2004) or used for words initially read inaccurately (Joseph, 2006a).

Another effective teaching principle, opportunities to respond (OTR), gives students the amount of practice they need to gain skills. Increasing opportunities to respond has been found to enhance academic skills (Greenwood, Delquadri, & Hall, 1984). Increasing opportunities to respond supports automaticity, and automaticity of basic skills is a necessity that leads to better performance of complex tasks (Jones & Christensen, 1999). Automaticity of math facts appear closely linked to opportunities to respond (Burns, 2005). Opportunities to respond focuses on increasing student engagement and increasing the number of correct student responses, which leads to increased performance (Haydon, Mancil, Van Loan, 2009; Blackwell & McLaughlin, 2005). The IR process utilizes active student engagement and provides the student the opportunity to get the majority of answers correct because of the high percentage of known items within the set. MacQuarrie et al. (2002) attributes the IR procedure's success to increases of opportunities to respond. Burns and Dean (2005) reported that increased opportunities to respond when learning an unknown word during the IR procedure led to higher recall of the unknown word; which is consistent with previous research linking opportunities to respond to recall (Daly et al., 2000). A study by Burns (2007a) found that teaching sight words to a moderate MR student using an IR procedure with higher OTR outperformed an IR condition with moderate OTR. Both IR conditions

led to increased scores compared to baseline; however, higher levels of OTR within the IR condition were found to increase retention. Burns concluded when all else is held relatively constant, higher levels of OTR within IR can increase retention. Furthermore, Nist and Joseph (2008) concluded that IR success over interspersal procedures or traditional drill were driven by the IR “folding in” process which creates additional opportunities for students to practice words that were recently mastered. The researchers explained the discrepancy between its conclusion and the Burns (2007a) study by reflecting on the participant characteristics. Nist and Joseph (2008) concluded that participants with MR (such as used in the Burns study) likely needed more OTR, whereas, average or close-to-average cognitive functioning students (such as used in the Nist and Joseph study) are more easily affected by the effect of the drill ratios alone. The current study, which uses students without identified disabilities, such as in the Nist and Joseph study, supports this premise. Specifically, whereas the IR process traditionally uses a higher known-to-unknown ratio, each participant in this study was drilled initially with 4 known words and 1 unknown word, and yet, the process still resulted in unknown spelling words learned and maintained.

Incremental rehearsal utilizes other effective teaching methods and principles within its process. Another principle is modeling, or performing an act to be imitated. Modeling is a critical component of instruction. IR incorporates modeling through the initial presentation of the unknown item. For example, if IR was used for a spelling exercise, the instructor could present the first unknown word “car” by speaking the word, showing the word on an index card, using it in a sentence and spelling the word out for the student. IR also consists of the use of student background knowledge when

providing new instruction. Background knowledge, or prior knowledge, can be defined as basic skills previously learned (Joseph, 2006b). IR utilizes background knowledge through the presentation of known, prerequisite items while introducing new material.

Incremental rehearsal incorporates three other effective teaching components: errorless learning, mastery and generalization. Errorless learning is a learning technique that reduces and minimizes the opportunity for students to respond incorrectly while simultaneously promoting mastery of skills (Mueller, Palkovic, & Maynard, 2007). IR utilizes a high percentage of known items during instruction, thereby, minimizing errors a student makes as skills are acquired. Mastery, or promoting proficiency of tasks evidenced by effortlessness and fluency, can be gained through the repetitive nature of IR (Joseph, 2006b). IR introduces the first new item and provides multiple times to practice the new item. In addition, the over-learning effect afforded by IR (trials over and over) has been shown to help maintenance and generalization of skills (McCormick, 2003).

Finally, an often misunderstood, yet, extremely important principle of effective teaching instruction that IR utilizes is the concept of positive reinforcement. Positive reinforcement does not always require tangible items such as a gift or a treat for a job well done. Positive reinforcement can also come in the form of students knowing through verbal praise that they produced accurate responses and completed a task. IR incorporates positive reinforcement through positive verbal feedback for correct answers. Perhaps more important, though, is the student's experience and satisfaction of knowing a high percentage of the answers in a set. Making assignments easier with immediate feedback and reinforcement delivered frequently results in better student engagement (Neef, Mace, Shea, & Shade, 1992; Cooke, Guzaukas, Pressley, & Kerr, 1993). The

completion of each individual task within a set may increase the rate of completion and that of reinforcement (McCurdy, Skinner, Grantham, Watson, & Hindman, 2001). IR is a great tool to provide lots of positive reinforcement (majority of known content provides a generous number of correct answers) and thereby, motivates students to learn new content. As in the studies described above, the current study participants received immediate verbal praise for correct answers during the IR process resulting in positive effects for learning previously unknown spelling words.

Although IR has not been used frequently in a spelling context, the IR process also reflects many of the characteristics of other successful spelling interventions. Specifically, Wanzek et al. (2006) discovered better spelling performance results for children with learning disabilities when they were provided with multiple practice opportunities and immediate corrective feedback. Multiple practice opportunities, such as when students practice copying spelling words 3 times versus 1 time, resulted in better retention (Erion, Davenport, Rodaz, Scholl, & Hardy, 2009). Immediate corrective feedback was found to produce improved spelling performance (Cates, Dunne, Erkfritz, Kivisto, Lee, & Wierbecki, 2007). The current study supports this finding as the IR spelling intervention process provided multiple practice opportunities and immediate corrective feedback that resulted in the learning and maintenance of previously unknown spelling words. Providing abundant opportunities to respond or practice may be more influential than the type of response topography used, which may explain why there were only slight differences between the current study's two conditions.

Instructional Efficiency

The next research question was to determine which method, IRO or IRW, helped children spell the most words correctly per minute of instruction time executed. This is an important factor, because facilitators may often make better decisions selecting interventions when learning rates are considered (Bramlett, Cates, Savina, & Lauinger, 2010). In addition, when working with lower achieving students, teachers prefer simpler and less time-consuming instruction methods (Bender, Vail, & Scott, 1995). Skinner, Belfiore and Watson (2002) propose that it is important to consider efficiency (student learning rate) when selecting interventions. An examination of the current study's instructional efficiency data indicated the incremental rehearsal oral procedure was more efficient than the incremental rehearsal written. Specifically, efficiency, or rate of words spelled correctly, was calculated by dividing the number of words spelled correctly by the time spent on instruction per session as well as cumulatively across sessions. Study participants as a group displayed higher rates of words spelled correctly under the IRO procedure based on weekly spelling probe results. In addition, five of the six students participating exhibited higher rates of words spelled correctly with the IRO procedure. These results can be interpreted in the context of the time required for the act of writing. Spelling words by writing them down typically may take longer than orally spelling the same or a similar word.

Whereas short-term learning is important, delayed recall of newly learned items and generalization of items learned is also extremely important. Any efficiency conclusions also must address the longer-term maintenance and generalization effects that students experience from an intervention. In this study, students as a group recalled,

one week post instruction, nearly an equal number of words across the two conditions, with incremental rehearsal oral resulting in a slightly greater number of words being recalled. In terms of generalization, students as a group performed nearly equally across conditions, with incremental rehearsal oral resulting in a slightly greater number of words generalized.

Delayed Recall

The next question posed was to determine which instructional method, IRO or IRW, helped children spell the most words correctly on a delayed recall probe. In order to determine effectiveness of an intervention, the students' performance on maintenance or recall of newly learned items is a key measure. Specifically, delayed recall data were collected one week after the completion of all instructional activity. Spelling words learned during the instruction phase and correctly spelled on the weekly probes were presented in random order for the students to spell on a previously described traditional spelling test. Delayed recall results for IRO and IRW, in terms of words spelled correctly one week later, indicated both interventions resulted in recall. As a group, only slightly more words were recalled under the IRO condition. Individually, two participants recalled more words under the IRO condition, three participants recalled more under the IRW condition and one student recalled an equal number of words under both IRO and IRW conditions.

Other studies using IR found similarly strong results for recall and maintenance. MacQuarrie et al. (2002) found students retained significantly more sight words with IR up to 30 days out (vs. traditional drill or Drill Sandwich procedures). Joseph (2006a) reported that students who used IR retained 90% of words learned and read the words in

passage three days later. Burns (2007a) reported 72-92% retention rate using IR for sight words with a student with moderate MR. A study by Burns and Sterling-Turner (2010) was consistent with previous research and found IR led to better retention than traditional drill (Burns & Boice, 2009; MacQuarrie et al., 2002; Nist & Joseph, 2008). IR historically has impressive maintenance results. In a study by Nist and Joseph (2008) utilizing next-day retention, maintenance, and generalization probes, students learned more words under the IR procedure than traditional drill or interspersal procedure.

The current study results indicated both the written and oral variation produced nearly similar amounts of recall of spelling words. In contrast, other spelling studies did not indicate such similar results. One study indicated that older children spell more accurately with writing vs. an oral response (Jorm & Schoknecht, 1981; Tenney, 1980). In addition, Treiman and Bourassa (2000) reported written spelling performed superior to oral spelling in emerging general education first-grade students and in general education second-grade students (kindergarteners showed no significant difference). However, Puranik and Apel (2010) found preschool age children, with the ability to write 19 or more letters, spelled equally well across three different conditions, orally, by writing, or by using letter tiles.

The fourth question was to determine which method, IRO or IRW, helped children recall spelling words accurately per minute of instructional time. As discussed above, a delayed recall probe was used to collect the data. Recall rates were calculated by using the number of spelling words recalled and dividing that number by the cumulative amount of instructional spent on each instructional condition (IRO or IRW). Five out of six student participants recalled a higher rate of spelling words under the

incremental rehearsal oral condition versus incremental rehearsal written when accounting for instructional time. The recall rate for students as a group was .34 words per minute for incremental rehearsal oral and .23 words per minute for incremental rehearsal written. These results indicated that the incremental rehearsal oral procedure may result in a greater number of words recalled per minute of instructional time. IR sessions may take up to twice as long as other interspersed approaches, such as the 50% known and unknown ratio (Drill Sandwich), but lead to better results (MacQuarrie et al., 2002). Burns and Dean (2005) found IR approach required approximately 10-15 minutes longer to complete versus a Drill Sandwich and traditional drill approach (100% unknown items), yet the increase in amount of instructional time was eclipsed by the effectiveness of the IR procedure. IR requires almost twice as much time to execute when compared to an 83% known condition, however, the IR condition again outperformed various other ratios utilizing greater than 10% unknown items (Burns & Dean, 2005). An unusual finding was that although the IR condition takes longer to complete, it was linked to an increase of on-task behavior (Burns & Dean, 2005); this finding is in direct conflict with the accepted premise that the longer a task takes, the more likely off-task behavior will occur (Darch & Gersten, 1985).

Cates and colleagues (2003) defined efficiency as number of words mastered/acquired the quickest, and in doing so found the traditional drill process to be more efficient over interspersal procedure; however, when words maintained, not simply mastered, are considered, results may become less clear (Burns & Sterling-Turner, 2010). A study by Burns and Sterling-Turner (2010) found the IR condition required 2.5 times more instructional time than traditional drill but was almost 3 times more effective. In

summary, although efficiency is an important factor in instruction given a typical school day, it should not be the only reason why one method is chosen over another (Schmidgall & Joseph, 2007).

Generalization

The next two research questions focused on which method, incremental rehearsal oral or incremental rehearsal written, resulted in the most generalization for students as evidenced by correctly spelling words presented in a sentence format, as well as the generalization rate of words spelled correctly presented in sentences per minute of instruction time. To determine if students could spell the learned word not only in isolation but also in other contexts, a generalization assessment consisted of asking students to write one of the spelling words that were taught in a blank space in the context of a sentence. The blank space in a sentence was to be filled in with one of the previously unknown words the student learned through the instructional intervention. Generalization was calculated as the percentage of correctly spelled words in the blank spaces (i.e., dividing the number of correctly spelled words by the total number of responses x 100). Generalization rate was determined by number of words generalized by the cumulative amount of instructional time executed under each condition.

As a group, slightly more words were generalized under the incremental rehearsal oral condition than the incremental rehearsal written condition. For students as a group, data indicated that 79.8% of words were generalized for IRO versus 77.6% of words that were generalized for the incremental rehearsal written condition. Four of the six students generalized more words under the incremental rehearsal oral condition. One

student generalized more words with the incremental rehearsal written condition and another had equal words generalized across conditions.

Group spelling word generalization rate was higher for incremental rehearsal oral condition, .35 spelling words generalized per minute versus .23 spelling words generalized per minute for the incremental rehearsal written procedure. Individually, five out of the six participants generalized spelling words at a higher rate with the incremental rehearsal oral condition.

Social Validity

The final two questions inquired about which intervention, incremental rehearsal oral or incremental rehearsal written, was viewed as the most useful for teachers and students. A teacher questionnaire (see Appendix I) and student-rating questionnaire (see Appendix H) assessed the social acceptability of each instructional condition. Three teachers who taught the participating students, one first-grade teacher and two second-grade teachers, completed the teacher questionnaire. One of the three teachers indicated they noticed a difference in their students' spelling and would consider using the incremental rehearsal procedure (specifically, one oral and one written) in the classroom. Two teachers felt the instruction techniques were valid and appropriate. Two teachers felt incremental rehearsal oral would be the most enjoyable for students and two felt incremental rehearsal written would be the most efficient. All teachers felt incremental rehearsal written would be most effective.

The student questionnaire results revealed five of the six students reported that they enjoyed the spelling intervention activities. All six students felt the exercises helped them spell better. Five out of six students felt the exercises helped them spell words. Four

out of the six participating students felt the spelling exercises would help other students spell better. When asked if they would choose to do the exercises again (after the experimenter presented the two types of instruction again to refresh the student's memory), two students chose incremental rehearsal oral, two chose incremental rehearsal written and two responded they would choose to do both conditions again.

Incremental rehearsal oral and written procedures were perceived similarly from the student point of view; both were seen as helping the students spell better, and an equal number of students preferred the oral intervention versus preferring the written intervention versus willingness to use both interventions. In contrast, all the teachers felt incremental rehearsal written would be most effective whereas two out of the three felt incremental rehearsal written would be most efficient. In addition, two out of three teachers felt incremental rehearsal oral would be most enjoyable. The disparity between the teacher and student perceptions may indicate that the experience of administering the IR intervention versus just reading about the IR intervention could result in different perceptual assumptions. Specifically, it appears the teachers hold the belief that writing out spelling answers may help a student better memorize new information. Indeed, there is research that does support this premise (Jorm & Scholknect, 1981; Tenney, 1980). In this case, however, it appears the IR intervention may be effective enough for some students to see improved spelling performance without the extra step of writing the word out, thereby increasing the efficiency of spelling instruction and practice time. In other words, in some cases, a student may be able to learn to spell previously unknown words through incremental rehearsal without the act of writing included within the instruction.

Comparison to Previous Research Studies

This study expands the methods and findings of previous studies examining the efficiency and effectiveness of IR across different academic skills. In addition, it provides new and unique information on the use of IR within a spelling context while using two different response topographies, oral response and written response.

Incremental Rehearsal. Many prior studies have demonstrated the effectiveness of IR. Recent studies in particular have done an impressive job of discerning IR's true outcomes and strengths. Burns (2007a) taught five new sight words per condition over four weeks to a nine-year-old male child diagnosed with moderate MR. The two instructional conditions involved high OTR (10% unknown; 90% known items) or moderate OTR (50% unknown; 50% known) within an alternating treatment design. Retention of the sight words increased over baseline for both conditions. However, the student retained approximately 40-60% of words from the moderate OTR condition versus 72-92% with the high OTR condition. Furthermore, the high OTR condition produced better results than the moderate condition with no overlapping data points. Nist and Joseph (2008) studied three instructional conditions: traditional drill (TD), interspersal and IR, involving flashcards to facilitate word recognition with six, general education, first-grade students whose sight word reading skills were behind peers. Over four weeks, using an alternating treatment design with counterbalancing of conditions, acquisition, maintenance, and generalization results were assessed in terms of learning levels (Skinner, 2008). Specifically, number of words read correctly, number maintained, number read correctly in sentences and the rate of learning were evaluated. Opportunities to respond across conditions were held constant. Results indicated TD was more

efficient, with participants acquiring more words per minute; however, IR resulted in more total words learned, maintained, and generalized. It was of critical importance, in this case, to present not only acquisition data but also maintenance and generalization data in order to uncover the true, long-term outcomes of the IR intervention. The Nist and Joseph (2008) study found greater increases in learning levels under the IR procedure confirming earlier findings (Burns et al., 2004; MacQuarrie et al., 2002). Similarly, the current study found IR effective when used within a spelling context to help students learn previously unknown words, recall and generalize them.

In another recent study, Burns and Boice (2009) intended to replicate MacQuarrie et al. (2002) by investigating differential effects of instructional conditions on number of words retained and the relationship between IQ and words retained for each condition. Traditional drill, interspersal and incremental rehearsal conditions were used to instruct participants on 27 Esperanto International Language (Richardson, 1988) words (9 words per condition). In contrast to the MacQuarrie study, however, Burns and Boice's sample included 20 children with below average IQ who were diagnosed with a disability. The study results indeed supported the earlier MacQuarrie et al. (2002) study. The IR condition led to 2 to 3 times more words retained than traditional drill or interspersal procedures. The Burns and Boice (2009) data again suggest high known-to-unknown words utilizing high opportunities to respond led to highest retention. It also led to the lowest correlation with IQ vs. the other conditions, indicating that IR can be effective with students who are below average in intelligence. Although the students in the current study were not identified as students with disabilities, some appeared to struggle more

than others during the intervention. However, the results indicated all the students benefitted in terms of learning, recall and generalization of spelling words.

Burns and Sterling-Turner (2010) expanded IR research further by comparing two different measures of efficiency using larger sample sizes. Traditional drill and IR conditions were utilized to teach 12 unknown Esperanto words (six words each condition). The study measured number of words retained after one week, the total number of words learned, words learned per session, and the number of words retained after one-week delay. Participants were 25 regular education fourth-grade students. IR again led to better retention than traditional drill, a finding that was consistent with previous studies (Burns & Boice, 2009; Nist & Joseph, 2008; MacQuarrie et al., 2002). IR required 2.5x more instruction time, but was 3x as effective as traditional drill. As was indicated in the Nist and Joseph (2008) study, maintenance must be considered in order to effectively evaluate the true outcome of IR. The current research supports the positive outcomes regarding effectiveness results of past studies. In addition, it expands the effectiveness results to include spelling instruction across response topographies.

Retention and Maintenance of IR

According to past studies, retention is a strong selling point of IR. Whereas challenging ratios may lead to higher acquisition rates (more total material learned in the short term), IR has been proven to yield better retention. MacQuarrie et al. (2002) found students retained significantly more sight words with IR up to 30 days after instruction ended (vs. traditional drill or Drill Sandwich procedures). Joseph (2006a) reported that students retained 90% of words learned and read the words in passage three days later. Burns (2007a) reported 72-92% retention rate using IR for sight words with a student

with moderate MR. A study by Burns and Sterling-Turner (2010) was consistent with previous research and found IR led to better retention than traditional drill (Burns & Boice, 2009; MacQuarrie et al., 2002; Nist & Joseph, 2008).

Compared to other drill options, impressive maintenance results have been realized when IR was implemented with students. Acquisition is only one phase of learning. Maintenance of content and skills learned is an important aspect of instructional effectiveness as well. Maintenance in addition to acquisition and rate of learning must be considered when selecting interventions (Burns & Sterling-Turner, 2010). Maintenance is the phase in which the child can accurately and fluently complete the task, without re-teaching, following a delay after the initial acquisition and proficiency (Alberto & Troutman, 2003). In a study by Nist and Joseph (2008) utilizing next-day retention, maintenance, and generalization probes, students learned more words under the IR procedure than traditional drill or interspersal (unknown items > 10%). The current study supports the positive outcomes regarding retention/maintenance of past studies, and in addition, expands the use of IR to spelling instruction across response topographies.

Generalization

Various IR research studies, which taught word recognition, consistently led to increased generalization as indicated by greater oral reading fluency and comprehension (Burns, 2007a; Burns, Dean, & Foley, 2004; MacQuarrie et al., 2002). Nist and Joseph (2008) found better generalization with IR versus other drill procedures. The study concluded all students generalized the highest percentage of words under the IR intervention compared to the both traditional drill and interspersal procedures. In terms of

generalization, the current study also had positive effects, as did past studies, and expanded the use of IR to spelling instruction across response topographies.

Topography

Research has determined when topography is altered, learning rates can be increased (Greenwood, Delquadri, & Hall, 1984; Kirk, McCarthy, & Kirk, 1968; Skinner, Ford, & Yunker, 1991). Specifically, verbal response was found to result in quicker learning rates. This increase in learning efficiency was driven by the increase in learning trials due to the time a verbal response took to be emitted versus a written response (Skinner et al., 1991).

Oral responding across such skills as reading and math has resulted in better efficiency of learning (Schisler, Joseph, Konrad & Alber-Morgan, 2010; Skinner, Belfiore, Mace, Williams-Wilson, and Johns, 1997). In terms of spelling, although the most frequently utilized manner of assessing spelling for young children is via handwriting, and the written format appears to work best for older students, results may not be as clear for young children. Specifically, Puranik and Apel (2010) found preschool age children with the ability to write 19 letters or more spelled equally well by using either of the following methods: (a) orally (b) written or (c) with tiles. In terms of the current study, findings were relatively similar with regards to acquisition between an incremental rehearsal oral response and incremental rehearsal written response. However, more efficient learning for first and second graders, in terms of rate of words spelled correctly on the weekly probe, delayed recall probe and generalization measures was found under the incremental rehearsal oral condition.

This chapter discusses the results of the study with regards to current and previous studies that found IR to be effective and efficient, especially in terms of long-term results. Specifically, IR has been shown to provide excellent retention, maintenance and generalization of unknown items. IR provides significant opportunities to respond through multiple trials. The intervention builds confidence with a high percentage of known items resulting in positive reinforcement. In some instances, IR has been shown to be independent of IQ and verbal ability. It has been effective with various discrete academic skills, from reading to math. IR incorporates effective teaching methods such as corrective feedback, modeling, background knowledge, and mastery, as discussed previously. Lastly, the execution of IR can also be used in peer tutoring procedures or in a game context (Joseph, 2006a). The current study differed from previous studies. The current study involving IR consisted of teaching students spelling across two different response topographies. As indicated previously, whereas both IR conditions were effective in teaching spelling, the IR oral condition was clearly found to be the most efficient.

Spelling is a more time intensive activity than sight word reading, when considering the time required to spell the word out in writing. It is a distinct possibility that first and second graders could easily tire if asked to write too many spelling words. Therefore, to compare the two intervention procedures, the current study utilized only two unknown words to four known words for each condition per each day. Under this design, children were not provided with as many trials as some previous IR studies that involved higher ratios of known to unknown content, such as 10% unknown to 90% known items (i.e., using one unknown spelling word to nine known spelling words).

Although the children in the current study were instructed until the target word was learned initially, the majority of words were learned well before nine known words were presented. This reduction in review of the new item could have influenced the effectiveness of IR in the current study. Specifically, the over-learning that is provided with a longer IR intervention as well as the process of moving information from short to long-term memory may be less effective with the shorter intervention. On the other hand, for students without disabilities, such as the participants in this study, the efficiency of a shorter intervention may prove to be more valuable.

As alluded to before, IR's main weakness is believed to be its efficiency, in terms of time commitment and the rate at which students acquire new information when compared to other interventions, such as traditional drill and practice. However, retention, maintenance and generalization results may tend to eclipse this fact. Still, the efficiency factor of incremental rehearsal will likely continue to be an important consideration when choosing an intervention, at least when considering Tier 1 and possibly Tier 2 interventions (Burns & Sterling-Turner, 2010). In addition, the IR procedure as formatted requires one-to-one interaction. This may not always be possible within the school day.

Limitations

Limitations do exist within the design of the current study. The small sample size of only six students reduces the external validity of the study. Therefore, the study cannot help predict whether other students would experience similar learning and learning rates. In addition, the sample did not reflect a diverse population. The majority of the students who attended the school where the study took place were Caucasian, and 100% of the

participants of the study were Caucasian. Generality of results would require a more diverse population. In addition, the students were selected for participation; therefore, random sampling was not part of the research study.

A further limitation is that only first and second grade students were included in the study. A larger sample including students of various grades, ages and abilities would enable the researcher to better generalize results of the instructional conditions.

Another limitation centers on one of the participants of the study. Although one student was well able to participate and experience the benefits of the intervention (as indicated by his early performance during the instructional phase) his behavior frequently interfered and prevented him from doing his best work. Therefore, the positive results of the study may be slightly underestimated, due to the effect that his frequent “won’t do” attitude had on his performance.

In terms of methodology, no control condition or no comparison condition involving another type of intervention other than IR was examined in the current study. In addition, no baseline was used in the research design. In order to examine multiple treatment interference (Cooper, Heron, & Heward, 2007), or one treatment influencing the other treatment, a final phase of only the most effective and efficient intervention condition could have been implemented.

Implications for Practice

There are important implications for educational practitioners as a result of this study. Both conditions, IRO and IRW, had positive results for the students in terms of words spelled correctly. Students with spelling difficulties could benefit from either of these instructional techniques. The instructional efficiency finding of the study is

important, as it indicates the importance of focusing on the amount of instructional time involved and how the corresponding learning rate is affected (Cates, Burns, & Joseph, 2010).

An additional aspect of the efficiency finding is that within the IR process, when using spelling, the participants learned to spell more words within a minute of instructional time with the IRO procedure. This is an interesting finding, as past research supports the commonly held belief that the best way to teach spelling involves writing. In this case, the opposite was found; IRO was just as effective, however, more efficient than IRW. This could have implications for teachers with regards to spelling instruction.

Directions for Future Research

The current study is the first to examine spelling instruction within the IR context using two response topographies. Because teachers continue to need to gain efficiencies throughout the school day, instructional efficiency of the two conditions were selected to be examined as well.

Additional research could examine a multitude of issues. Specifically, how to differentiate the IR procedure to answer further important questions such as (a) the most efficient and effective way to introduce/incorporate incremental rehearsal to teach spelling for young children; (b) understanding the different needs of low skilled or average learners and how to modify incremental rehearsal for spelling to meet those individual needs; (c) reformatting the incremental rehearsal procedure for spelling to be used in a whole class or small group environment. In addition, more variations of IR studies to include (a) replication of this study using different academic skills; (b) the willingness of teachers to use the IR intervention technique for spelling; (c) replication of

this study using a more diverse sample with longer intervals; (d) professional development models to ensure correct implementation of IR for spelling for young children; and (e) a comparison of effectiveness between IRO, IRW and other instructional spelling techniques.

Summary

The current study resulted in positive effects for both instructional conditions. Both IR rehearsal procedures used within a spelling context resulted in an increase of positive spelling performance for students. Both conditions were effective, yet IRO resulted in faster learning rates. In terms of social validity, an equal number of students preferred either IRO or IRW or both. When asked about spelling, teachers, in general, have revealed that they are frustrated and challenged to teach the subject; and, they are often disappointed with the results of their efforts (Fresch, 2007). Whereas an individual student's academic and behavioral needs must be addressed within the time allotted for instruction in a given school day, it is important to balance the need for efficiency with effectiveness. Various response topographies within IR can have positive effects across diverse learners, resulting in better efficiency. Specifically, some students may benefit more from an oral response IR intervention, although other students may benefit more from a written response IR intervention. Although incremental rehearsal can be viewed as time intensive, it is an empirically supported intervention that has been shown through a variety of research studies to support long-term skill acquisition, and it should be in the toolbox of intervention options available to educators.

References

- Al Otaiba, S., Kosanovich-Grek, M.L., Torgesen, J. K., Hassler, L., & Wahl, M. (2005). Reviewing core kindergarten and first-grade reading programs in light of no child left behind: An exploratory study. *Reading & Writing Quarterly*, 21, 377-400.
- Alber, S. R., & Walshe, S. E. (2004). When to self-correct spelling words: A systematic replication. *Journal of Behavioral Education*. 13(1), 51-66.
- Alberto, P. A., & Troutman, A. C. (2003). *Applied behavior analysis for teachers* (6th ed.). Upper Saddle River, NJ: Merrill/Prentice Hall.
- Arra, C. & Aaron, P. (2001). Effects of psycholinguistic instruction on spelling performance. *Psychology in the Schools*, 38(4), 357-363.
- Bear, D. R., Invernizzi, M., Templeton, S., & Johnston, F. (2008). *Words their way: Word study for phonics, vocabulary, and spelling instruction*. (4th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
- Bear, D. R., & Templeton, S. (1998). Explorations in developmental spelling: Foundations for learning and teaching phonics, spelling and vocabulary. *The Reading Teacher*, 52(3), 222-242.
- Bender, W.N., Vail, C.O. & Scott, K. (1995). Teachers' attitude toward increased mainstreaming: Implementing effective instruction for students with learning disabilities. *Journal of Learning Disabilities*, 28(2), 87-94, 120.

- Berninger, V. (1999). Coordinating transcription and text generalization in working memory during composing: Automatic and constructive processes. *Learning Disability Quarterly*, 22(2), 99-112.
- Berninger, V., Abbott, R., Rogan, L., Reed, E., Abbott, S., Brooks, A., Vaughn, K., & Graham, S. (1998). Teaching spelling to children with specific learning disabilities: The mind's ear and eye beat the computer or pencil. *Learning Disability Quarterly*, 21(2), 106-122.
- Blackwell, A., & McLaughlin, T. (2005). Using guided notes, choral responding and response cards to increase student performance. *The International Journal of Special Education*, 20(2), 1-5.
- Bos, C., Mather, N., Dickson, S., Podhajski, B., & Chard, D. (2001). Perceptions and knowledge of preservice and inservice educators about early reading instruction. *Annals of Dyslexia*, 51(1), 97-120.
- Both-de Vries, A., & Bus, A. G. (2008). Name writing: A first step to phonetic writing? Does the name have a special role in understanding the symbolic function of writing? *Literacy Teaching and Learning*, 12(2), 37-55.
- Braden, J. L. (2002). Best practices for school psychologists in educational accountability: High stakes testing and educational reform. In A. Thomas & J. Grimes (Eds.), *Best practices in school psychology* (4th ed., pp. 301-321). Bethesda, MD: National Association of School Psychologists.
- Bramlett, R., Cates, G. L., Savina, E., & Lauinger, B. (2010). Assessing effectiveness and efficiency of academic interventions in school psychology journals: 1995-2005. *Psychology in the Schools*, 47(2), 114-125.

- Browder, D. M., & Shear, S. M. (1996). Interspersal of known items in a treatment package to teach sight words to students with behavior disorders. *The Journal of Special Education, 29*(4), 400-413.
- Bunn, R., Burns, M. K., Hoffman, H. H., & Newman, C. L. (2005). Using incremental rehearsal to teach letter identification with a preschool-aged child. *Journal of Evidence Based Practice for Schools, 6*, 124-134.
- Burns, M. K. (2001). Measuring sight-word acquisition and retention rates with curriculum-based assessment. *Journal of Psychoeducational Assessment, 19*(2), 148-157.
- Burns, M. K. (2004). Empirical analysis of drill ratio research: Refining the instructional level for drill tasks. *Remedial and Special Education, 25*(3), 167-173.
- Burns, M. K. (2005). Using incremental rehearsal to increase fluency of single-digit multiplication facts with children identified as learning disabled in mathematics computation. *Education and Treatment of Children, 28*(3), 237-249.
- Burns, M. K. (2007a). Comparison of opportunities to respond within a drill model when rehearsing sight words with a child with mental retardation. *School Psychology Review, 22*(2), 250-263.
- Burns, M. K. (2007b). Reading at the instructional level with children identified as learning disabled: Potential implications for response-to-intervention. *School Psychology Quarterly, 22*(3), 297-313.

- Burns, M. K., Ardoin, S. P., Parker, D. C., Hodgson, J., Klingbeil, D. A., & Scholin, S. E. (2009). Interspersal technique and behavioral momentum for reading word lists. *School Psychology Review, 38*(3), 428-434.
- Burns, M. K., & Boice, C. H. (2009). Comparison of the relationship between words retained and intelligence for three instructional strategies among students with below-average IQ. *School Psychology Review, 38*(2), 284-292.
- Burns, M. K., & Dean, V. J. (2005). Effect of drill ratios on recall and on-task behavior for children with learning and attention difficulties. *Journal of Instructional Psychology, 32*(2), 118-126.
- Burns, M. K., Dean, V. J., & Foley, S. (2004). Preteaching unknown key words with incremental rehearsal to improve reading fluency and comprehension with children identified as reading disabled. *Journal of School Psychology, 42*, 303-314.
- Burns, M. K., & Sterling-Turner, H. (2010). Comparison of efficiency measures for academic interventions based on acquisition and maintenance. *Psychology in the Schools, 47*(2), 126-134.
- Butyniec-Thomas, J., & Woloshyn, V. (1997). The effects of explicit-strategy and whole- language instruction on students' spelling ability. *Journal of Experimental Education, 65*(4), 291-302.
- Cassar, M., & Treiman, R. (2004). Developmental variations in spelling: Comparing typical and poor spellers. In C. A. Stone, E.R. Silliman, B. Ehren, & K. Apel (Eds.), *Handbook of language and literacy: Development disorders*. New York: Guilford.

- Cates, G. L., Burns, M. K., & Joseph, L. (2010). Introduction to the special issue: Efficiency and the impact on learning and data-based decision making. *Psychology in the Schools, 47*(2), 111-113.
- Cates, G., Dunne, M., Erkfritz, K., Kivisto, A., Lee, N., & Wierzbicki, J. (2007). Differential effects of two spelling procedures on acquisition, maintenance, and adaption to reading. *Journal of Behavioral Education, 16*, 71-82.
- Cates, G. L., & Skinner, C. H. (2000). Getting remedial mathematics students to prefer homework with 20% and 40% more problems: An investigation of the strength of interspersing procedure. *Psychology in the Schools, 37*(4), 339-347.
- Cates, G. L., Skinner, C. H., Watson, S. T., Meadows, T. J., Weaver, A., & Jackson, B. (2003). Instructional effectiveness and instructional efficiency as considerations for data-based decision making: An evaluation of interspersing procedures. *School Psychology Review, 32*(4), 601-616.
- Christensen, C. A., & Bowey, J. A. (2005). The efficacy of orthographic rime, grapheme-phoneme correspondence and implicit phonics approaches to teaching decoding skills. *Scientific Studies of Reading, 9*(4), 327-439.
- Christensen, S., Thurlow, M., Ysseldyke, J.E., & McVicar, R. (1989). Written language instruction for children with mild handicaps: Is there enough quantity to ensure quality? *Learning Disabilities Quarterly, 12*(3), 219-229.
- Clarke, L. K. (1988). Invented versus traditional spelling in first graders' writings: Effects on learning to spell and read. *Research in the Teaching of English, 22*(3), 281-309.

- Codding, R.S., Archer, J., & Connell, J. (2010). A systematic replication and extension of using incremental rehearsal to improve multiplication skills: An investigation of generalization. *Journal of Behavioral Education, 19*(1), 93-105.
- Cohen, J. D., Servan-Schreiber, D., & McClelland, J. L. (1992). A parallel distributed processing approach to automaticity. *American Journal of Psychology, 105*(2), 239-269.
- Conrad, N. (2008). From reading to spelling and spelling to reading: Transfer goes both ways. *Journal of Educational Psychology, 100*(4), 869-878.
- Cooke, N. L., Guzaukas, R., Pressley, J.S., & Kerr, K. (1993). Effects of using a ratio of new items to review items during drill and practice: Three experiments. *Education and Treatment of Children, 16*(3), 213-234.
- Cooke, N. L., & Reichard, S. M. (1996). The effects of different interspersal drill ratios on acquisition and generalization of multiplication and division facts. *Education and Treatment of Children, 19*(2), 124-142.
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River, New Jersey: Pearson Education, Inc.
- Craig, S.A. (2006). The effects of an adapted interactive writing intervention on kindergarten children's phonological awareness, spelling, and early reading development: A contextualized approach to instruction. *Journal of Educational Psychology, 98*(4), 714-731.
- Cunningham, A. E., Perry, K. E., Stanovich, K.E. & Stanovich, P.J. (2004). Disciplinary knowledge of K-3 teachers and their knowledge calibration in the domain of early literacy. *Annals of Dyslexia, 54*(1), 139-167.

- Daly III, E. J., Hintze, J. M., & Hamler, K. R. (2000). Improving practice by taking steps toward technological improvements in academic interventions in the new millennium. *Psychology in the Schools*, 37(1), 61-72.
- Darch, C., & Gersten, R. (1985). The effects of teacher presentation rate and praise on LD students' oral reading performance. *British Journal of Educational Psychology*, 55(3), 295-303.
- Dempster, F. N. (1991). Synthesis of research on reviews and tests. *Educational Leadership*, 48(7), 71-76.
- Duffy, G., & Roehler, L. (1986). Constraints on teacher change. *Journal of Teacher Education*, 35, 55-58.
- Dunlap, G. (1984). The influence of task variation and maintenance tasks on the learning and affect of autistic children. *Journal of Experimental Child Psychology*, 37(1), 41-64.
- Edwards, L. (2003). Writing instruction in kindergarten: Examining an emerging area of research for children with writing and reading difficulties. *Journal of Learning Disabilities*, 36(2), 136-148.
- Ehri, L.C. (1989). The development of spelling knowledge and its role in reading acquisition and reading disability. *Journal of Learning Disabilities*, 22(6), 356-365.
- Ehri, L. C. (1997). Learning to read and learning to spell are one and the same, almost. In C. Perfetti, L. Rieben, & M. Fayol (Eds.), *Learning to spell: Research, theory, and practice across languages* (pp. 237-269). Mahwah, NJ: Erlbaum.

- Ehri, L. C. (2000). Learning to read and learning to spell: Two sides of a coin. *Topics in Language Disorders, 20*(3), 19-36.
- Ehri, L. C., & Wilce, L. S. (1982). Recognition of spellings printed in lower and mixed case: Evidence for orthographic images. *Journal of Reading Behavior, 14*, 219-230.
- Ehri, L. C., & Wilce, L.S. (1987). Does learning to spell help beginners learn to read words? *Reading Research Quarterly, 22*(1), 47-65.
- Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. W. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology, 92*(4), 605-619.
- Erion, J., Davenport, C., Rodax, N., Scholl, B., & Hardy, J. (2009). Cover-copy-compare and spelling: One versus three repetitions. *Journal of Behavioral Education, 18*, 319-330.
- Foorman, B. R., Francis, D., Novy, D., & Liberman, D. (1991). How letter-sound instruction mediates progress in first-grade reading and spelling. *Journal of Educational Psychology, 83*(4), 456-469.
- Francis, D.J., Shaywitz, S.E., Stuebing, K.K., Shaywitz, B.A., & Fletcher, J.M. (1996). Developmental lag versus deficit models of reading disability: A longitudinal, individual growth curves analysis. *Journal of Educational Psychology, 88*, 3-17.
- Fresch, M. J. (2000). What we learned from Josh: Sorting out word sorting. *Language Arts, 77*(3), 232-240.

- Fresch, M. J. (2007). Teachers' concerns about spelling instruction: A national survey. *Reading Psychology, 28*, 301-330.
- Gettinger, M. (1993). Effects of error correction on third graders' spelling. *Journal of Educational Research, 87*(1), 39-45.
- Gickling, E. E., & Armstrong, D. L. (1978). Levels of instructional difficulty as related to on task behavior, task completion, and comprehension. *Journal of Learning Disabilities, 11*, 559-566.
- Gickling, E., & Rosenfield, S. (1995). Best practices in curriculum-based assessment. In Thomas & J. Grimes (Eds.), *Best practices in school psychology III* (pp. 587-595). Bethesda, MD: National Association of School Psychologists.
- Gickling, E., & Thompson, V. (1985). A personal view of curriculum-based assessment. *Exceptional Children, 52*(3), 205-218.
- Goddard, Y. L., & Heron, T. E. (1998). Please, teacher, help me learn to spell better: Teach me self-correction. *Teaching Exceptional Children, 30*(6), 38-43.
- Good, R. H., Kaminski, R., Simmons, D., & Kame'enui, E. J. (2001). Using Dynamic Indicators of Basic Early Literacy Skills (DIBELS) in an outcomes-driven model: Steps to reading outcomes. *Oregon Schools Study Council Bulletin, 44*(1), 3-24.
- Graham, S. (1983). Effective spelling instruction. *The Elementary School Journal, 83*(5), 560-567.
- Graham, S. (1999). Handwriting and spelling instruction for students with learning disabilities: A review. *Learning Disability Quarterly, 22*(2), 78-98.
- Graham, S. (2000). Should the natural learning approach replace spelling instruction? *Journal of Educational Psychology, 92*(2), 235-247.

- Graham, S., Berninger, V., Abbott, R., Abbott, S. P. & Whitaker, D. (1997). Role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology*, 89(1), 170-182.
- Graham, S., & Harris, K. R. (2002). Prevention and intervention for struggling writers. In M. Shinn, H. Walker, & G. Stoner, (Eds.), *Interventions for academic and Behavior Problems II: Preventive and remedial approaches* (pp. 589-610). Bethesda, MD: National Association of School Psychologists.
- Graham, S., Harris, K. R., & Fink-Chorzempa, B. (2002). Contribution of spelling instruction to the spelling, writing, and reading of poor spellers. *Journal of Educational Psychology*, 94(4), 669-686.
- Graham, S., Harris, K. R., Fink-Chorzempa, B., & MacArthur, C. (2003). Primary grade Teachers' instructional adaptations for struggling writers: A national survey. *Journal of Educational Psychology*, 95(2), 279-292.
- Graham, S., Harris, K. R., & Loynachan, C. (1996). The directed spelling thinking activity: Application with high frequency words. *Learning Disabilities Research and Practice*, 11, 34-40.
- Graham, S., Morphy, P., Harris, K.R., Fink-Chorzempa, B., Saddler, B., Moran, S., & Mason, L. (2008). Teaching spelling in the primary grades: A national survey of instructional practices and adaptations. *American Educational Research Journal*, 45(3), 796-825.
- Graham, S., & Weintraub, N. (1996). A review of handwriting research: Progress and prospects from 1980 to 1994. *Educational Psychology Review*, 8(1), 7-87.

- Greenberg, D., Ehri, L., & Perin, D. (1997). Are word reading processes the same or different in adult literacy students and 3rd-5th graders matched for reading level? *Journal of Educational Psychology*, 89, 262-288.
- Greenwood, C. R., Delquadri, J., & Hall, R. V. (1984). Opportunity to respond and student academic achievement. In W.L. Heward, T. E. Heron, S. S. Hill & Trap-Porter (Eds.), *Focus on behavior analysis in education* (pp. 58-88). Columbus, OH: Merrill.
- Griffith, P.L. (1987). *The role of phonological and lexical information in word recognition and spelling*. Unpublished doctoral dissertation, University of Texas, Austin.
- Griffith, P. L. (1991). Phonemic Awareness Helps First Graders Invent Spellings and Third Graders Remember Correct Spellings. *Journal of Reading Behavior*, 23, 2, 215-33.
- Gunter, P. L., Denny, K. R., Jack, S. L., Shores, R. E., & Nelson, C. M. (1993). Aversive stimuli in academic interactions between students with serious emotional disturbance and their teachers. *Behavioral Disorders*, 18, 265–274.
- Harris, K., Graham, S., Gentry, R., Zutell, R. (1998). *Spell it – Write*. Columbus, OH: Zaner Bloser.
- Haydon, T., Mancil, G. R., & Van Loan, C. (2009). Using opportunities to respond in a general education classroom: A case study. *Education and Treatment of Children*, 32(2), 267-278.
- Heron, T. E., Okyere, B. A., & Miller, A. D. (1991). A taxonomy of approaches to teach spelling. *Journal of Behavioral Education*, 1(1), 117-130.

- Invernizzi, M., & Hayes, L. (2004). Developmental-spelling research: a systematic imperative. *Reading Research Quarterly, 39*(2), 216-228.
- Jimerson, S., Egeland, B., Sroufe, L. A., & Carlson, E. (2000). A prospective longitudinal study of high school dropouts: Examining multiple predictors across development. *Journal of School Psychology, 38*, 525-549.
- Johnston, F. R. (2001). Exploring classroom teachers' spelling practices and beliefs. *Reading Research and Instruction, 40*, 143-155.
- Jones, D., & Christensen, C. A. (1999). Relationship between automaticity in hand writing and students' ability to generate written text. *Journal of Educational Psychology, 91*(1), 44-49.
- Jorm, A. F. (1981). Children with reading and spelling retardation: Functioning of whole-word and correspondence-rule mechanisms. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 22*, 2, 171-78.
- Jorm, A. F., & Schoknecht, C. (1981). Role of visual word recognition checks in children's spelling. *Australian Journal of Psychology, 33*, 393-403.
- Joseph, L. M. (2000). Developing first graders' phonemic awareness, word identification and spelling: A comparison of two contemporary phonic instructional approaches. *Reading Research and Instruction, 39*(12), 160-169.
- Joseph, L. M. (2006a). Incremental rehearsal: A flashcard drill technique for increasing retention of reading words. *The Reading Teacher, 59*(8), 803-807.
- Joseph, L. M. (2006b). *Understanding, Assessing, and Intervening on Reading Problems*. Bethesda, MD: National Association of School Psychologists.

- Joshi, R.M., Trieman, R., Carreker, S. & Moats, L.C. (2008). How words cast their spell: Spelling is an integral part of learning the language, not a matter of memorization. *American Educator, Winter*, 6-42.
- Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology*, 80(4), 437-447.
- Juel, C., & Griffith, P.L., & Gough, P. B. (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology*, 78(4), 243-255.
- Kaufman, A. S., & Kaufman, N. L. (2004). *K-TEA II: Kaufman Test of Educational Achievement: Comprehensive Form Manual*. Bloomington, MN: Pearson.
- Kirk, S.A., McCarthy, J.J., & Kirk, W.D. (1968). *Illinois Test of Psycholinguistic Abilities*. Urbana, IL: University of Illinois Press.
- Komaraju, M., & Karau, S. J. (2008). Relationships between the perceived value of instructional techniques and academic motivation. *Journal of Instructional Psychology*, 35, 70-82.
- LaParo, K.M., & Pianta, R. C. (2000). Predicting children's competence in the early school years: A meta-analytic review. *Review of Educational Research*, 70(4), 443-484.
- Lombardino, L.J., Bedford, T., Fortier, C., Brandi, J., & Carter, J. (1997). Invented spelling: Developmental patterns in kindergarten children and guidelines for early literacy intervention. *Language, Speech, and Hearing Services in Schools*, 28(4), 333-343.

- Loomer, B., Fitzsimmons, R., & Sterge, M. (1990). *Spelling research and practice: Teacher's Edition*. Iowa City, IA: Useful Learning.
- Lovitt, T. C., & Hansen, C. L. (1976). The use of contingent skipping and drilling to improve oral reading and comprehension. *Journal of Learning Disabilities*, 9(3), 481-487.
- MacQuarrie, L. L., Tucker, J. A., Burns, M. K., & Hartman, B. (2002). Comparison of retention rates using traditional, drill sandwich, and incremental rehearsal flash card methods. *School Psychology Review*, 31(4), 584-595.
- McBride-Chang, C. (1998). The development of invented spelling. *Early Education & Development*, 9, 147-160.
- McCormick, S. (1999). *Instructing students who have literacy problems*. (3rd ed.). Englewood Cliffs, NJ: Prentice-Hall.
- McCormick, S. (Ed.). (2003). *Instructing Students Who Have Literacy Problems*. Upper Saddle River, NJ: Prentice Hall.
- McCurdy, M., Skinner, C. H., Grantham, K., Watson, T. S., & Hindman, P. M. (2001). Increasing on-task behavior in an elementary student during mathematics seatwork by interspersing additional brief problems. *School Psychology Review*, 30(1), 23-32.
- McGuffin, M. E., Martz, S. A. & Heron, T. E. (1997). The effects of self-correction versus traditional spelling on the spelling performance and maintenance of third grade students. *Journal of Behavioral Education*, 7(4), 463-476.

- Moats, L. C. (1984). Assessment of spelling in learning disabilities research. In G. R. Lyon (Ed.), *Frames of reference for assessment of learning disabilities: New views on measurement issues* (pp. 333-349). Baltimore: York Press.
- Moats, L. C. (1994). The missing foundation in teacher education: Knowledge of the structure of spoken and written language. *Annals of Dyslexia*, 44(1), 81-102.
- Moats, L. C. (2006). How spelling supports reading and why it is more regular and predictable than you may think. *American Educator*, Winter, 12-42.
- Mueller, M., Palkovic, C., & Maynard, C. (2007). Errorless learning: Review and practical applications for teaching children with pervasive development disorders. *Psychology in the Schools*, 44(7), 691-700.
- National Center for Education Statistics. (2008). The nation's report card: Reading 2007 (NCES 2006-497). Washington, DC: U.S. Department of Education.
- National Commission on Writing for America's Families, Schools and Colleges. (2005). *Writing: A powerful message from state government*. Retrieved from http://www.writingcommission.org/prod_downloads/writingcom/powerful-message-from-state.pdf.
- National Reading Panel. (2000). *Teaching children to read: Report of the subgroups*. Washington, DC: National Institute of Child Health and Development.
- Neef, N. A., Iwata, B. A., & Page, T. J. (1980). The effects of interspersal training versus high density reinforcement on spelling acquisition and retention. *Journal of Applied Behavior Analysis*, 13, 153-158.

- Neef, N. A., Mace, F. C., Shea, M. C., & Shade, D. (1992). Effects of reinforcer rate and reinforcer quality on time allocation: Extension of matching theory to educational settings. *Journal of Applied Behavior Analysis*, 25, 691-699.
- Nies, K. A., & Belfiore, P. J. (2006). Enhancing spelling performance in students with learning disabilities. *Journal of Behavioral Education*, 15, 163-170.
- Nist, L., & Joseph, L. M. (2008). Effectiveness and efficiency of flashcard drill instructional methods on urban first-grades' word recognition, acquisition, maintenance and generalization. *School Psychology Review*, 37(3), 294-308.
- Noell, G. H., Connell, J. E., & Duhon, G. J. (2006). Spontaneous response generalization during whole word instruction: Reading to spell and spelling to read. *Journal of Behavioral Education*, 15, 121-130.
- O'Connor, R. E., & Jenkins, J. R. (1995). Improving the generalization of sound/symbol knowledge: Teaching spelling to kindergarten children with disabilities. *Journal of Special Education*, 29(3), 255-275.
- O'Connor, R. E., & Jenkins, J. (1999). Prediction of reading disability in kindergarten and first grade. *Scientific Studies of Reading*, 3(2), 159-197.
- Okyere, B. A., Heron, T. E., & Goddard, Y. (1997). Effects of self correction on the acquisition, maintenance, and generalization of the written spelling of elementary school children. *Journal of Behavioral Education*, 7(1), 51-69.
- Ouellette, G. P., & Senechal, M. (2008). A window into early literacy: Exploring the cognitive and linguistic underpinnings of invented spelling. *Scientific Studies of Reading*, 12, 195-219.

- Platten, P. (2010). *Initiation of the self-regulated feedback loop: The effects of feedback and strategy modification on vocabulary learning, motivational beliefs and self-regulation processes*. (Unpublished doctoral dissertation). University of Wisconsin-Milwaukee, Wisconsin.
- Pressley, M., Rankin, J., & Yokoi, L. (1996). A survey of instructional practices of primary teachers nominated as effective in promoting literacy. *Elementary School Journal*, 96(4), 363-384.
- Puranik C., & Apel K. (2010). Effect of assessment task and letter writing ability on preschool children's spelling performance. *Assessment for Effective Intervention*, 36(1), 46-56.
- Qi, S., & O'Connor, R. (2000). Comparison of phonological training procedures in kindergarten classrooms. *The Journal of Educational Research*, 93(4), 226-233.
- Richardson, D. (1988). *Esperanto: Learning and using the international language*. Cerrito, CA: Esperanto League for North America.
- Roberts, M. L., & Shapiro, E. S. (1996). Effects of instructional ratios on students' reading performance in a regular education program. *Journal of School Psychology*, 34(1), 73-91.
- Roberts, M. L., Turco, T.L., & Shapiro, E.S. (1991). Differential effects of fixed instructional ratios on students' progress in reading. *Journal of Psychoeducational Assessment*, 9, 308-318.
- Roberts, T. A., & Meiring, A. (2006). Teaching phonics in the context of children's literature or spelling: Influences on first-grade reading, spelling, and writing

- and fifth-grade comprehension. *Journal of Educational Psychology*, 98(4), 690-713.
- Santoro, L. E., Coyne, M. D., & Simmons, D. C. (2006). The reading-spelling connection: Developing and evaluating a beginning spelling intervention for children at risk of reading disability. *Learning Disabilities Research & Practice*, 2(2), 122-133.
- Schisler, R., Joseph, L. M., Konrad, M., Alber-Morgan, S. R. (2010). Comparison of the effectiveness and efficiency among oral and written retellings and passage review as strategies for comprehending text. *Psychology in the Schools*, 47, 135-152.
- Schlagel, B. (2007). Best practices in spelling and handwriting. In S. Graham, C. MacArthur, & J. Fitzgerald (Eds.), *Best practices in writing instruction* (pp. 179-201). New York: Guilford.
- Schmidgall, M., & Joseph, L. M. (2007). Comparison of phonic analysis and whole word reading on first graders' cumulative words read and cumulative reading rate: An extension in examining instructional effectiveness and efficiency. *Psychology in the Schools*, 44(4), 319-332.
- Schuele, C. M., Justice, L. M., Cabell, S. Q., Knighton, K., Kingery, B., & Lee, M.W. (2008). Field-based evaluation of two-tiered instruction for enhancing kindergarten phonological awareness. *Early Education and Development*, 19(5), 726-752.
- Scott, C. M., & Brown, S. L. (2001). Spelling and the speech-language pathologist: There's more than meets the eye. *Seminars in Speech and Language*, 22(3), 197-207.

- Shapiro, E. (2004). *Academic skill problems: Direct assessment and intervention* (3rd ed.). New York: Guilford Press.
- Singer, B., & Bashir, A. (1999). What are executive functions and self-regulation and what do they have to do with language-learning disorders? *Language, Speech, & Hearing Services in Schools, 30*(3), 265-273.
- Singer, B., & Bashir, A. (2004). Developmental variations in writing composition skills. In C. A. Stone, E.R. Silliman, B. Ehren, & K. Apel (Eds.), *Handbook of language and literacy: Development disorders*. New York: Guilford.
- Sipe, L. (2001). Invention, convention, and intervention: Invented spelling and the teacher's role. *The Reading Teacher, 55*(3), 264-273.
- Skinner, C. H. (2002). An empirical analysis of interspersal research: Evidence, implications, and applications of the discrete task completion hypothesis. *Journal of School Psychology, 40*(4), 347-368.
- Skinner, C. H. (2008). Theoretical and applied implications of precisely measuring learning rates. *School Psychology Review, 37*(3), 309-314.
- Skinner, C. H., Belfiore, P. J., Mace, H. W., Williams-Wilson, S., & Johns, G. A. (1997). Altering response topography to increase response efficiency and learning rates. *School Psychology Quarterly, 12*, 54-64.
- Skinner, C. H., Belfiore, P.J., & Watson, T. S. (1995). Assessing the relative effects of interventions in students with mild disabilities: Assessing instructional time. *Assessment in Rehabilitation and Exceptionality, 2*, 207-220.

- Skinner, C. H., Belfiore, P.J., & Watson, T. S. (2002). Assessing the relative effects of interventions in students with mild disabilities: Assessing instructional time. *Journal of Psychoeducational Assessment, 20*(4), 346-357.
- Skinner, C. H., Fletcher, P. A., & Henington, C. (1996). Increasing learning trial rates by increasing student response rates. *School Psychology Quarterly, 11*, 313-325.
- Skinner, C. H., Fletcher, P. A., Wildmon, M., & Belfiore, P.J. (1996). Improving assignment preference through interspersing additional problems: Brief versus easy problems. *Journal of Behavioral Education, 6*(4), 427-436.
- Skinner, C. H., Ford, J. M., & Yunker, B. D. (1991). An analysis of instructional response requirements on the multiplication performance of behavior disordered students. *Behavioral Disorders, 17*, 56-65.
- Skinner, C.H., Hurst, K.L., Teeple, D.F., & Meadows, S.O. (2002). Increasing on-task behavior during mathematics independent seat-work in students with emotional disturbance by interspersing additional brief problems. *Psychology in the Schools, 39*, 647–659.
- Skinner, C. H., & Shapiro, E. S. (1989). A comparison of taped-words and drill interventions on reading fluency in adolescents with behavior disorders. *Education and Treatment of Children, 12*, 123-133.
- Skinner, C. H., Turco, T. L., Beatty, K. L., & Rasavage, C. (1989). Cover, copy, and compare: An intervention for increasing multiplication performance. *School Psychology Review, 18*, 212-220.
- Smith, F. (2004). *Understanding reading*. (6th ed.) Mahwah, NJ: Lawrence, Erlbaum.

- Snow, C. E., Burns, M. S., & Griffith, P. (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Stanovich, K.E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, 21(4), 360-407.
- Symonds, P. M., & Chase, D. H. (1992). Practice vs. motivation. *Journal of Educational Psychology*, 84(3), 282-289.
- Tenney, Y. J. (1980). Visual factors in spelling. In U. Frith (Ed.), *Cognitive processes in spelling* (pp. 215–229). San Diego, CA: Academic Press.
- Torgesen, J. K. (2000). Individual differences in response to early interventions in reading: The lingering problem of treatment resisters. *Learning Disabilities Research & Practice*, 15(1), 55-64.
- Treiman, R. and Bourassa, D. (2000). Children's written and oral spelling. *Applied Psycholinguistics*, 21, 183-204.
- Tucker, J. A. (1989). Basic flashcard technique when vocabulary is the goal. Unpublished teaching materials, School of Education, University of Chattanooga. Chattanooga, TN: Author.
- Uhry, J. K., & Shepard, M. J. (1993). Segmentation/spelling instruction as part of a first grade reading program: Effects on several measures of reading. *Reading Research Quarterly*, 28(13), 219-233.
- Umbreit, J., Lane, K. L., & Dejud, C. (2004). Improving classroom behavior by modifying task difficulty: The effects of increasing the difficulty of too-easy tasks. *Journal of Positive Behavior Interventions*, 6, 13-20.

- Venezky, R. L. (1980). From Webster to Rice to Roosevelt. In U. Frith (Ed.), *Cognitive Processes in Spelling*. London: Academic Press.
- Viel-Ruma, K., Houchins, D. & Fredrick, L. (2007). Error self-correction and spelling: Improving the spelling accuracy of secondary students with disabilities in written expression. *Journal of Behavioral Education, 16*, 291-301.
- Wanzek, J., Vaughn, S., Wexler, J., Swanson, E. A., Edmonds, M., & Kim, A. (2006). A synthesis of spelling and reading interventions and their effects on the spelling outcomes of students with LD. *Journal of Learning Disabilities, 39*(6), 528-543.
- Wildmon, M. E., Skinner, C. H., & McDade, A. (1998). Interspersing additional brief easy problems to increase assignment preference on mathematics reading problems. *Journal of Behavioral Education, 8*, 337-346.

Appendix A

Letter to Parents

Letter Requesting Parent/Guardian Permission

Dear Parent(s)/Guardian(s),

As a professor at the Ohio State University, I have worked collaboratively on projects with a variety of school systems to help children improve their academic achievement. I would like to invite your child to participate in a study I am conducting in spelling. Upon your voluntary written consent, your child will have the opportunity to participate in a study designed to compare the effectiveness of two different teaching methods on your child's spelling performance. As part of the study, your child will receive the following two instructional methods: incremental rehearsal oral spelling intervention and incremental rehearsal written spelling interventions (both present one unknown word prior four known words). All children who participate in this study will be administered the KTEA-II tests of Achievement to determine basic spelling skills.

The primary goal of the study is to determine which of the two interventions is most effective in helping children to increase their word spelling learning rate. The study will take place at St. Paul's Elementary. Granted permission, your child will participate in approximately four sessions per week for approximately 15 to 20 minutes of their school day. Children participating in this study will not be removed from their classrooms during critical instructional time or during specials such as music class, physical education, etc. All identifying information will be kept confidential. Students will be given code numbers so that names will not be used on any data recording sheets or forms. Participation in this study is completely voluntary, and you have the right to remove your child from participating at any time without penalty.

The principal investigator in this study is Dr. Laurice Joseph, Associate Professor of School Psychology at The Ohio State University. The interventions will be conducted by a doctoral candidate in the School Psychology program at The Ohio State University. If you agree to have your child participate, we believe that you will find this experience valuable for your child in regard to helping him/her improve his/her spelling performance.

If you have any questions, please feel free to contact Dr. Laurice Joseph at XXX-XXXXXXX.

Sincerely,

Laurice Joseph, Ph.D.
The Ohio State University
Associate Professor of School Psychology
School of Physical Activity and Educational Services

Appendix B

Consent for Participation in Research

Consent For Participation In Research

I consent for my child's participation in the study entitled: Examining Instructional Efficiency of Incremental Rehearsal Oral and Written Procedures for Spelling

Laurice Joseph, Principal Investigator, or her authorized representative, Dru Garcia, has provided information regarding the purpose of the study, the educational procedures to be followed, and the expected duration of my child's participation. In addition, possible benefits of the study have been described.

I acknowledge that I have had the opportunity to obtain any needed information regarding the study and that any questions I have raised have been answered to my full satisfaction. Furthermore, I understand that my child is free to withdraw consent at any time and to discontinue participation in the study without prejudice.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:

Signed:

(Participant)

Signed:

Signed:

*(Principal Investigator or her
Authorized representative)*

(Person authorized to consent for participant)

Witness:

Appendix C
IRO Intervention Script

Incremental Rehearsal Oral

Examiner starts timer and shuffles four known spelling words for random ordering. Examiner states, “I am going to show you a word then ask you to spell it. Next, I will ask you to spell more words, ready?”

Examiner shows an index card with the unknown word on it, says the word, spells the word by pointing to each letter and says “Now spell (word) with me” and points to each letter as the letter is spoken. Student and researcher are speaking each letter in tandem. The index card is then removed and the examiner says “*Now you spell (word)*”. If the student spells it correctly, the examiner makes statements like, “*Nice work, good job.*” If spelled incorrectly, the instructor says, “*listen again...*” and repeats the instruction. Then the first known word is presented for the child to spell. Next, the first unknown word is presented again, followed by the first known word, and then a second known word for the child to read. Again, the first unknown word is presented, until the pattern is concluded. Once the student and instructor get through all of the words, the first target word becomes a known word (placed in the 5th position), and the last known word is taken out of the pile and replaced with the second target word.

Appendix D

IRW Intervention Script

Incremental Rehearsal Written

Examiner starts timer and shuffles four known spelling words for random ordering. Examiner states, “I am going to show you a word then ask you to spell it by writing it down. Next, I will ask you to spell more words by writing them down, ready?”

Examiner shows an index card with the unknown word on it, says the word, spells the word by pointing to each letter and says “Now write (word) as I point to the letters” and points to each letter as the letters are spoken. The student writes down each letter as the letter is spoken. The index card is removed and the examiner says “*Now you spell (word)*”. If the student writes it correctly, the examiner makes statements like, “*Nice work, good job.*” If spelled incorrectly, the instructor says, “*listen again*” and repeats the instruction. Then the first known word is presented for the child to spell. Next, the first unknown word is presented again, followed by the first known word, and then a second known word for the child to read. Again, the first unknown word is presented, until the pattern is concluded. Once the student and instructor get through all of the words, the first target word becomes a known word (placed in the 5th position), and the last known word is taken out of the pile and replaced with the second target word.

IR Procedure

1. Present first unknown word.
Present first known word.

2. Present first unknown word.
Present first known word.
Present second known word.

3. Present first unknown word.
Present first known word.
Present second known word.
Present third known word.

4. Present first unknown word.
Present first known word.
Present second known word.
Present third known word.
Present fourth known word.

5. Present first unknown word.
Present first known word.
Present second known word.
Present third known word.
Present fourth known word.
Present fifth known word.

6. Present first unknown word.
Present first known word.
Present second known word.
Present third known word.
Present fourth known word.
Present fifth known word.
Present sixth known word.

Appendix E
Session Record Form

ORAL STUDENT # _____ SESSION _____

START TIMER

“I am going to show you a word, then ask you to spell it. Next, I will ask you to spell more words. Ready?”

SHOW UNKNOWN CARD

“_____, (point) _____, Now spell “_____” with me.”
(point) “_____”

PUT CARD DOWN

“Now you spell _____”

“Good Job or Listen again”

K spell _____

U spell _____

K spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____
spell _____

SHOW UNKNOWN CARD

“_____, (point) _____, Now spell “_____” with me.”
(point) “_____”

PUT CARD DOWN

“Now you spell _____”

“Good job or Listen again”

K spell _____

U spell _____

K spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____
spell _____

WRITE DOWN TIME

WRITTEN STUDENT # _____ SESSION _____

START TIMER

“I am going to show you a word and ask you to spell it by writing it down. Next, I will ask you to spell more words by writing them down. Ready?”

SHOW CARD

“ _____, (point) _____ ” “Now write _____ as I point to the letters,
_____”

PLACE CARD DOWN

“Now you spell _____” (point to paper)

“Good Job or Listen Again”

K spell _____

U spell _____

K spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____
spell _____

SHOW UNKNOWN CARD

“_____, _____ (pointing)” “Now write “_____” as I point to the letters, _____

PLACE CARD DOWN

“Now you spell _____” (point to paper)

“Good job or listen again”

K spell _____

U spell _____

K spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____

U spell _____

K spell _____
spell _____
spell _____
spell _____

WRITE DOWN TIME!

Appendix F
IRO Treatment Integrity Form

TREATMENT INTEGRITY CHECKLIST: Incremental Rehearsal Oral

- | | | | |
|---|-----|----|-----|
| 1. Examiner starts timer and shuffles four known spelling words for random ordering. | Yes | No | N/A |
| 2. Examiner states, "I am going to show you a word then ask you to spell it. Next, I will ask you to spell more words, ready?" | Yes | No | N/A |
| 3. Examiner presents the target word and asks student to spell the word, "Now you spell _____". | Yes | No | N/A |
| 4. If the word is correct, examiner makes statements like " <i>Nice work, good job.</i> " If incorrectly spelled, examiner says, " <i>listen again...</i> " and repeats the word. | Yes | No | N/A |
| 5. Next, first known word is presented, then first unknown word, first known and second known, etc. | Yes | No | N/A |
| 6. Examiner records correct and incorrect responses. | Yes | No | N/A |
| 7. Examiner tracks total intervention time. | Yes | No | N/A |

Total Procedural Integrity: _____

Appendix G

IRW Treatment Integrity Form

TREATMENT INTEGRITY CHECKLIST: Incremental Rehearsal Written

- | | | | |
|---|-----|----|-----|
| 1. Examiner starts timer and shuffles four known spelling words for random ordering. | Yes | No | N/A |
| 2. Examiner states, "I am going to show you a word and ask you to spell it by writing it down. Next, I will ask you to spell more words by writing them down, ready?" | Yes | No | N/A |
| 3. Examiner presents the target word and asks student to spell the word, "Now you spell _____". | Yes | No | N/A |
| 4. If the word is correct, examiner makes statements like " <i>Nice work, good job.</i> " If incorrectly spelled, examiner says, " <i>listen again...</i> " and repeats the word. | Yes | No | N/A |
| 5. Next, first known word is presented, then first unknown word, first known and second known, etc. | Yes | No | N/A |
| 6. Examiner records correct and incorrect responses. | Yes | No | N/A |
| 7. Examiner tracks total intervention time. | Yes | No | N/A |

Total Procedural Integrity: _____

Appendix H

Social Validity Student Questionnaire

Social Validity Student Questionnaire

1. Did you enjoying doing these spelling exercises?

Yes, very much Yes A little bit Not really Not at all
2. Did doing these spelling exercises help you to spell better?

Yes, very much Yes A little bit Not really Not at all
3. Did doing these spelling exercises help you to spell words?

Yes, very much Yes A little bit Not really Not at all
4. Do you think that doing these spelling exercises would help other students to spell better?

Yes, very much Yes A little bit Not really Not at all
5. Which of the spelling exercises did you think was the most helpful?

Incremental Rehearsal Oral Incremental Rehearsal Written
6. Which of the three spelling exercises would you choose to do again?

Incremental Rehearsal Oral Incremental Rehearsal Written Both

Appendix I

Social Validity Teacher Questionnaire

Social Validity Teacher Questionnaire

1. Did you notice any difference in your student's overall spelling performance while he/she was participating in this study?

Yes, very much Yes A little bit Not really Not at all

2. After examining the description of each intervention (attached), which instructional method do you think students would find most enjoyable?

Incremental Rehearsal Oral Incremental Rehearsal Written

3. Which instructional methods would be most effective in enhancing student spelling performance?

Incremental Rehearsal Oral Incremental Rehearsal Written

4. Which instructional method used, would be most efficient in enhancing student spelling performance?

Incremental Rehearsal Oral Incremental Rehearsal Written

5. Do you feel as though the instructional methods appear to be valid approaches, or appropriate approaches, for helping students to improve their reading comprehension?

Yes, very much Yes A little bit Not really Not at all

6. Which methods would you consider using in the classroom as part of your instruction to teach reading?

Both Incremental Rehearsal Oral Incremental Rehearsal Written None

Appendix J

Spelling Words Taught per Instructional Condition

Andy IRO	Andy IRW	Annakin IRO	Annakin IRW	Lex IRO	Lex IRW
bump	such	mean	bake	bake	toes
tell	been	mine	bump	hair	been
best	tall	much	been	done	fair
dish	test	came	near	brow	doll
does	talk	does	only	does	tale
them	doll	done	open	mean	draw
full	fell	walk	fast	full	first
tent	fish	pick	want	goes	fear
goes	hand	wash	give	here	mail
help	jump	what	ride	hold	hurt
hurt	kind	when	fell	many	mine
upon	know	seed	work	pale	only
land	very	hand	help	pull	pail
lead	walk	soon	year	said	toad
look	want	high	your	very	door
lake	wash	hurt	said	walk	want
well	many	just	kind	wash	tear
mean	mine	slow	sick	word	sock
went	much	lead	seen	work	cake
need	wish	small	still	lock	tick
word	near	live	made	bowl	less
over	page	make	tall	mess	town
place	work	walk	want	like	bike
won't	pick	wash	what	main	feel
ride	pull	will	when	real	nail
seed	soon	work	year	cool	sail
said	sell	tell	your	hero	fire
sick	shall	very	pull	meat	weak
seen	small	read	sing	fire	calm
still	fear	goes	full	heel	girl

Orin IRO	Orin IRW	Annabella IRO	Annabella IRW	Debbie IRO	Debbie IRW
back	pull	bake	seed	ant	ten
walk	bump	work	bump	aim	toy
read	what	show	won't	art	add
been	show	best	some	try	key
when	come	year	rest	any	cow
sing	went	came	soon	low	ask
dish	rest	come	sell	ate	too
well	done	cold	said	boy	use
some	will	doll	sick	end	was
does	soon	does	don't	far	few
work	doll	slow	draw	why	fly
sell	word	fast	seen	who	get
draw	year	full	first	win	leg
first	goes	form	take	won	log
slow	your	give	test	way	him
full	fell	goes	talk	zoo	now
seen	help	good	tent	out	how
high	hold	here	hurt	too	see
hurt	jump	kind	know	men	den
kind	test	lake	look	new	our
lead	that	walk	many	ill	fry
mean	must	much	wash	her	old
them	then	need	what	son	lie
need	near	near	when	saw	say
only	over	page	went	own	mow
very	pick	pick	will	sew	for
don't	sick	pull	work	fun	spy
fill	grow	won't	word	dew	low
tell	won't	want	lead	eat	one
much	each	make	read	two	toe