GENERALIZATION OF ISOLATED WORD TRAINING TO CONNECTED TEXT: A COMPARISON OF GENERALIZATION STRATEGIES

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Abstract:

This study compared the effects of three generalization strategies utilized during isolated word training on generalization to connected text. The train and hope (TH) generalization strategy was utilized by training accurate responding to target words in isolation using a flashcard intervention and hoping that generalization to connected text would occur in the absence of specific programming. The fluency building (FB) generalization strategy was employed by training accurate and rapid responding to target words. The multiple exemplar (ME) generalization strategy was utilized by practicing the target words in individually and in sentences. Results indicated that all generalization strategies resulted in increased accuracy of words read in isolation and in context. Performance over time was relatively stable across conditions.

Students in the TH condition demonstrated a degree of spontaneous generalization to connected text after receiving two sessions of a flashcard intervention that did not include procedures specifically designed to promote generalization. Results suggested that building accuracy of target words in isolation and hoping for generalization was an effective instructional strategy for many students. While significant performance differences in context between the FB and ME conditions were not observed, implementation of the FB and ME generalization strategies during instruction resulted in a greater degree of generalization connected text than use of the TH strategy. This finding suggests that utilizing generalization strategies during isolated word training that include procedures specifically designed to elicit generalization may be the most effective way to promote generalization to connected text.

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CHAPTER I

INTRODUCTION

Many educators consider reading to be the most crucial skill that elementary students acquire (O'Connor, 2007). Reading difficulties impact a variety of academic tasks, and students who do not receive adequate early instruction may later be incorrectly identified as learning disabled (Lennon & Slesinski, 1999). Educators teach a variety of reading strategies for individual word identification including decoding, prediction using context, and identifying similarities in word structures. Developing a large vocabulary of automatic sight words can in theory improve reading fluency, which in turn increases comprehension potential (Ehri, 2005). Sight words are frequently taught in isolation using flashcards or word walls in early grades, but training accurate and/or fluent responding to individual words does not always result in equivalent in-context accuracy improvements (Martin-Chang, Levy, & O'Neil, 2007; Nist & Joseph, 2008). This disconnect demonstrates the need for explicit strategies that are designed to promote generalization of individual words to connected text.

Generalization

Generalization occurs when a target behavior is exhibited across time, settings, materials, and/or responses without the manipulations/training procedures utilized in treatment (Stokes & Baer, 1977). For example, if a student learns to accurately respond to an addition problem presented using words instead of numbers, generalization has occurred. Educational research has primarily focused on developing instructional methods designed to elicit accurate student responding (Codding & Poncy, 2010). While students must initially learn to generate accurate responses to target stimuli,

accurate responding alone will produce few practical benefits if students fail to generalize. Educators agree that simply responding accurately to individual words presented on flashcards is not sufficient. Students must also be able to quickly identify words in context in order to derive meaning from text, which is the ultimate goal of reading (Lyon & Moats, 1997).

Generalization Programming

Stokes and Baer (1977) delivered an innovative perspective of generalization by describing it not as a passive phenomenon, but as a technology that could be refined and programmed. They advised against relying on the generalization strategy of train and hope (TH), a strategy which consists of teaching a target behavior and hoping that generalization will occur. The primary strategy employed by TH is hope; no specific procedures designed to promote generalization are included during intervention. Stokes and Baer argued that generalization should be viewed as an active and alterable behavior and not simply a passive result of treatment. They outlined several generalization-promoting techniques that were later condensed into three categories: Exploit current functional contingencies, train diversely, and incorporate functional mediators (Stokes & Osnes, 1989).

One method of training diversely is to use multiple exemplars (ME) during instruction. This technique aims to promote generalization by training in a variety of contexts and providing diverse practice opportunities within a response class (Stokes & Osnes, 1989). Utilizing ME interventions has been found to increase generalization of a variety of behaviors including social skills, problem solving skills, picture naming, and conversational speech (Ducharme & Holborn, 1997; Garcia, 1974; Plienis, Hansen, Ford, & Smith, 1987; Salmon, Pear, & Kuhn, 1986).

Training with MEs has also been found to improve generalization of academic skills. Silber and Martens (2010) tested the effects of ME training on generalization of oral reading fluency (ORF) in first and second grade students and found that students in the ME condition exhibited greater fluency gains on generalization passages than controls. Ardoin, Eckert, and Cole (2008) compared students' generalization of ORF after receiving either a repeated reading (RR) intervention or a ME intervention. The ME intervention resulted in significantly larger ORF improvements on medium

word overlap generalization passages. Duhon, House, Poncy, Hastings, and McClurg (2010) used ME training to increase a first grade student's generalization of early literacy skills. Improvements in letter sound fluency after intervention did not generalize to improvements in letter sound blending fluency until a ME strategy was employed.

While not specifically listed in Stokes and Baer's (1977) generalization promoting techniques, fluency building (FB) is another technique that has been successfully used to promote generalization. Baer (1999) stated, "Sometimes behavior changes that seem to need generalization may only need better teaching. Try making the students fluent, and see if they still need further support" (p. 17). While students who are accurate and fluent in a skill are more likely to generalize, additional research is needed to determine the extent to which early skills must be mastered before higher skills can be acquired as previous studies examining the impact of FB on generalization have provided inconclusive results (Martens & Eckert, 2006).

Results of two studies examining the effects of isolated word fluency interventions indicated that students displayed equivalent accuracy percentages of words read in isolation and words read in the generalization context of connected text (Fleishner, Jenkins, & Pany, 1979; Levy, Abello, & Lysynchuk, 1997). Results of a study by Martin-Chang et al. (2007), however, indicated that accuracy performance declined by over 25% when the target words were read in connected text. Additional research is needed to examine the impact of FB on generalization because identification of efficacious teaching strategies can help educators improve the efficiency of academic interventions (Skinner & Daly, 2010).

Rationale

There is a relative shortage of research examining generalization strategies despite the consensus amongst educators that generalizing and integrating academic behaviors across contexts are primary goals of instruction (Skinner & Daly, 2010). Educators often fail to program for generalization and instead assume that generalization will occur after training. The generalization of accurate responding learned in one context to a novel context may not occur in the absence of

programming, however (Stokes & Baer, 1977). Strategies designed to elicit generalization should be implemented at the beginning of an intervention to increase the likelihood of accurate responding across diverse stimuli conditions after treatment ends (Skinner & Daly, 2010).

Several techniques exist for programming generalization, but the majority of research has utilized these methods to target behavior excess problems, and not academic deficits (Skinner & Daly, 2010). Furthermore, the majority of studies utilizing generalization strategies have compared the use of a strategy to the absence of a strategy (control). Additional research is needed to compare the relative effectiveness of generalization strategies to determine which interventions achieve "the most generalized effects in the least intrusive manner while subjecting the endeavor to a rigorous scientific process" (Osnes & Leiblein, 2003, p. 372).

Current Study

This study compared the effects of three generalization strategies: TH, FB, and ME on reading performance in an applied setting. A standard flashcard (SF) intervention was delivered to students in all treatment conditions to build accuracy of target words in isolation. Generalization was defined as target words read accurately in the untrained context of connected text. The TH generalization strategy was utilized by training accurate responding to target words in isolation and hoping that generalization to connected text would occur in the absence of specific programming. The FB generalization strategy was employed during isolated word training by training accurate and rapid responding to target words. The ME generalization strategy was utilized during isolated word training by practicing the target words in different contexts (individually and in sentences). This study also assessed retention of accuracy performance in connected text in addition to accuracy of words read in isolation during the last intervention session. The following research questions were examined:

1. Does implementation of a TH generalization strategy result in spontaneous generalization to connected text?

2. Does degree of generalization to connected text differ based on generalization strategy utilized?
3. Does accuracy of words read in isolation during the last intervention session differ across conditions?
4. Does retention of accuracy performance in connected text (i.e., generalization) differ across conditions?

CHAPTER II

REVIEW OF THE LITERATURE

Federal Legislation Mandating Use of Evidence Based Interventions (EBIs)

The field of education in the United States has been greatly influenced by federal legislation, specifically the No Child Left Behind Act (NCLB, 2001) and the reauthorization of the Individuals with Disabilities Education Improvement Act (IDEA) in 2004. The required use of EBIs in NCLB and the introduction of disability determination based on response to intervention (RTI) in the reauthorization of IDEA, prompted an increased need for research examining the effectiveness of academic interventions (Codding & Poncy, 2010; Rathvon, 2008).

Use of EBIs in reading instruction. Prior to the recent emphasis on using EBIs, educators often selected interventions based on largely on personal experience and familiarity (Rathvon, 2008). NCLB (2001) stipulates that schools implement educational strategies that have been scientifically validated so that all students can achieve sufficient academic performance levels by 2017. The NCLB defines scientifically based reading research as research that:

> (A) applies rigorous, systematic, and objective procedures to obtain valid knowledge relevant to reading development, reading instruction, and reading

difficulties; and

(B) includes research that-

(i) employs systematic, empirical methods that draw on observation or experiment;

(ii) involves rigorous data analyses that are adequate to test the stated hypotheses and justify the general conclusions drawn;

(iii) relies on measurements or observational methods that provide valid data across evaluators and observers and across multiple measurements and observations; and

(iv) has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review. (20 U. S. C. § 6368[6])

Key methodological components that need to be empirically examined in reading interventions include instructional settings, optimal combination of approaches, student-teacher ratios, session length, and teacher specialization (Lyon, 1993). Knowledge of best instructional practices "can enhance the capacity of teachers to meet student needs and the capacity of students to respond to instruction" (Rathvon, 2008, p. 4). Interventions utilizing best practices can effectively support students in general and special education, and response to such interventions can be used to identify students who are at risk for academic failure.

Use of EBIs in disability determination. Prior to the introduction of RTI in the reauthorization of IDEA, students met criteria for a specific learning disability (SLD) if assessments revealed significant divergence between intellectual aptitude and academic

achievement. Several criticisms of the ability-achievement discrepancy model have been noted including its emphasis on pathology and lack of empirically proven reliability and validity, especially with children who have SLDs (Merrell, Ervin, & Gimpel, 2006). IDEA no longer mandates SLD determination based on an ability-achievement discrepancy; students requiring special education can now be identified by their response to "scientific, research-based interventions" (Snyder, 2005, p. 28). Many states and districts through the United States are beginning to employ RTI systems, and effective implementation requires educators to be competent in the development and implementation of EBIs that promote academic success (Rathvon, 2008).

Importance of Reading and Sight Word Instruction

Many educators consider reading to be the most crucial skill that elementary students acquire (O'Connor, 2007). Reading difficulties impact a variety of academic tasks, and students who do not receive adequate early instruction may later be incorrectly identified as learning disabled (Lennon & Slesinski, 1999). Students who do not develop adequate reading skills in elementary school are at risk for high school dropout, and poor reading skills decrease future likelihood of employment success (Snow, Burns, & Griffin, 1998). According to the 2011 National Assessment of Educational Progress (NAEP), 33% of fourth grade students scored at a Below Basic Level, demonstrating an insufficient inability to comprehend grade level text (National Center for Education Statistics, 2011). Teachers must be prepared to face the challenges of educating poor readers and readers with large skill differences within a single classroom due to the increase of at-risk students entering the school systems (Rathvon, 2008).

Educators teach a variety of reading strategies for individual word identification that include decoding, prediction, and analogizing (Ehri, 2005). Decoding refers to applying an understanding of letter-sound correspondence to read written words (Rathvon, 2008). Prediction

consists of utilizing pictures, context, and/or letters as cues to identify words (Snow et al., 1998). Analogizing involves using a known word to name an unknown word based on structural similarities (Goswami, 1986). An example of analogizing would be using the known word *rice* to identify the unknown word *mice*. While such strategies are useful in word identification, developing a large vocabulary of sight words (words read automatically) is also crucial. The additional time required to decode, use context cues, and look for similarities in word structures to identify words can impede comprehension ability (Ehri, 2005). Automatically identifying whole words is "the most efficient, unobtrusive way to read…[and]…building a sight vocabulary is essential for achieving text-reading skill" (Ehri, 2005, p. 170).

Developing a large vocabulary of sight words can in theory improve in context reading fluency, which in turn increases comprehension potential (Ehri, 2005). Fluency, the ability to read correctly and quickly, is important because it promotes comprehension, makes reading less difficult, and the increases the likelihood that students will choose to read (Daly, Chafouleas, & Skinner, 2005). While the primary purpose of reading is understanding what was read, "relating information from a page of print to prior knowledge is exceedingly difficult to do if the text cannot be deciphered quickly, automatically, and effortlessly" (Lyon & Moats, 1977, p. 578).

Sight words emphasized in early grades typically include the most frequently used words in English literature. They can be divided into two categories: decodable words and high frequency words with irregular spellings (O'Connor, 2007). O'Connor stressed that poor readers and students with reading disabilities need "frequent, small doses of instruction" to develop a vocabulary of automatic sight words (p. 82). Sight words are frequently taught in isolation using flashcards or word walls in early grades, but training accurate and/or fluent responding to individual words does not always result in equivalent in-context accuracy improvements (Martin-Chang et al., 2007; Nist & Joseph, 2008). This disconnect demonstrates the need for explicit strategies that are designed to promote generalization of individual sight words to connected text.

Importance of Generalization

Cooper et al. (2007) stated that "a behavior change- no matter how important initially- is of little value to learner if it does not last over time, is not emitted in appropriate settings, or occurs in restricted form when varied topographies are desired" (p. 653). Accurate responding during treatment conditions is not sufficient; the learner must also be able to correctly apply the new behavior in various settings and/or forms after the treatment ends.

History of generalization. The phenomenon of generalization has long been discussed and described amongst psychologists. Skinner (1953) defined generalization not as a behavior but as a term depicting shared stimulus control between similar objects, and described response generalization as an increase in non-reinforced behaviors as the result of reinforcing a target behavior. Baer, Wolf, and Risley (1968) listed generality of behavior change as one of seven essential characteristics of the field of applied behavior analysis (ABA).

Generalization was pragmatically defined by Stokes and Baer (1977) as "the occurrence of relevant behavior under different, non-training conditions (i.e., across subjects, settings, people, behaviors, and/or time)" without the environmental manipulations used in during training (p. 350). They clarified that while some treatment components might need to be utilized in non-training settings to elicit the target behavior, the cost and/or amount of these manipulations must be noticeably less than those used in the initial treatment. Stokes and Baer emphasized that generalization should be viewed as an operant response that could be promoted through specific techniques. While generalization has been conceptualized in different ways throughout history, maintaining and using target behaviors in relevant settings has been and will continue to be a primary goal of psychologists and educators (Cooper et al., 2007).

Types of generalization. Generalization refers to a broad range of behaviors that includes response maintenance, stimulus generalization, and response generalization. Response maintenance occurs when an individual continues to use the target behavior after some or all the treatment conditions used to initially elicit and train the behavior end (Cooper et al., 2007).

Stokes and Osnes (1989) described maintenance as "the durability of effects across time" (p. 338). While some behaviors might only need to be maintained for a specific period of time (i.e., learning dates in history class to pass a test), other behaviors need to be maintained indefinitely (Cooper et al., 2007). Reading is an example of a behavior that an individual must maintain over time in order to function independently.

Stimulus generalization refers to the use of the target behavior in a variety of conditions outside the instructional setting (Mayer et al., 2012). For example, if a student learns to raise his hand before speaking in math class after receiving intervention and then raises his hand before speaking in science class, stimulus generalization has occurred. If all components of an intervention must be implemented in the non-treatment settings in order to elicit the behavior however, stimulus generalization has not been achieved.

Response generalization occurs when an individual produces untrained responses that serve the same function as the target behavior that has been reinforced (Cooper et al., 2007). For example, if a student is reinforced during intervention for greeting a peer by saying, "Hello," and then greets a peer by saying, "Good morning," response generalization has occurred. While the words differed, the function of the behavior remained the same, and the student emitted the new variation of the greeting even though those specific words had not been previously trained or reinforced.

While all three forms of generalization: response maintenance, stimulus generalization, and response generalization have unique characteristics, they are sometimes difficult to distinguish between and frequently occur together (Cooper et al., 2007). All types of generalization can result in significant "economic advantages" if the target behavior and functional forms of the target behavior do not need to be taught in each relevant setting and maintained using all of the manipulations employed during treatment (Mayer et al., 2012, p. 419).

Generalization Strategies

Stokes and Baer (1977) delivered an innovative perspective of generalization in their article, "An Implicit Technology of Generalization," by describing it not as a passive phenomenon, but as a technology that could be refined and programmed. They advised against making the faulty assumption that generalization will naturally occur after a new behavior is trained, an assumption utilized by the strategy called train and hope. Stokes and Baer analyzed around 120 studies that utilized generalization techniques and organized these techniques into nine categories: Train and hope, sequential modification, introduce to natural maintaining contingencies, train sufficient exemplars, train loosely, use indiscriminable contingencies, and program common stimuli.

The strategies listed in Stokes and Baer's (1977) seminal article have since been refined, reorganized, and expanded upon; however, these original categories provide a foundational understanding of generalization strategies. Baer (1999) later emphasized the potential benefits of fluency building, which involves training quick and correct responding to stimuli. This review will describe the primary generalization strategies, while giving examples of effective reading interventions that utilized multiple exemplar (ME) and fluency building (FB) strategies.

Train and hope. The generalization strategy train and hope (TH) consists of teaching a target behavior and hoping that generalization will occur in the absence of specific programming. This phenomenon is often referred to as spontaneous generalization (e.g., Noell, Connell, & Duhon, 2006). Over half of the studies examined by Stokes and Baer (1977) utilized TH. While generalization was achieved in the majority of the studies, the authors postulated that such positive results could have been in part due to underreporting of instances where generalization did not occur. Stokes and Baer urged researchers to detail and evaluate instances of generalization failure because such analyses lead to increased understanding of generalization and the need for generalization technologies. Several studies examining academic performance have documented the absence of adequate generalization when specific programming techniques are

not utilized (e.g., Berends & Reitsma, 2006; Huemer, Landerl, Aro, & Lyytinen, 2008; Shapiro & McCurdy, 1989; Skinner & Daly, 2010; Thaler, Ebner, Wimmer, & Landerl, 2004). Such studies have prompted researchers to develop and improve interventions that are specifically designed to elicit generalization.

Sequential modification. Studies described by Stokes and Baer (1977) that used sequential modification altered a target behavior through treatment, and then measured generalization in various settings. If generalization was not observed in a given setting, sequential modifications were made to the environment until the desired generalization occurred. Meichenbaum, Bowers, and Ross (1968) found that on task behavior of institutionalized female adolescent offenders increased when money was used as a reinforcer during afternoon instructional sessions. The manipulation of giving money for being on task also had to be implemented in the morning sessions before behavior change was observed in that setting. Stokes and Baer noted that behavior analysts frequently implement treatment manipulations in a variety of settings to increase the likelihood of generalized behavior change.

Introduce to natural maintaining contingencies. Stokes and Baer (1977) described the technique of shifting control of behavior from the experimenter to the natural maintaining contingencies in the learner's environment as one of the most reliable generalization strategies. Cooper et al. (2007) stressed that practitioners should "maximize contact with reinforcement in the generalization setting" and described several techniques to increase the likelihood that the target behavior will be reinforced in the generalized setting (p. 635). These techniques include: Teaching behavior to levels required by natural contingencies, using intermittent schedules of reinforcement and delayed rewards, setting behavior traps, asking people in the generalized setting to reinforce the behavior, and teaching the learner to recruit reinforcement.

Train loosely. Stokes and Baer (1977) described training loosely a "relatively simple" strategy that can be viewed as the "negation of discrimination technique" (p. 357). Training loosely consists of altering multiple unessential features of the training environment when

teaching. Examples of teaching loosely provided by Baer (1999) include changing voice tone, time of instruction, room temperature, reinforcers, furniture arrangement, and teaching positions.

Use indiscriminable contingencies. An indiscriminable contingency exists when an individual cannot predict whether or not a target behavior will be reinforced. This technique is designed to promote sufficient levels of responding in the generalization setting (Cooper et al., 2007). Two methods of using indiscriminable contingencies described by Stokes and Baer (1977) included using an intermittent reinforcement schedule and delaying reinforcement. Stokes and Osnes (1989) noted that if "the schedule or circumstances of the delivery of behavior consequences is variable, then generalization may be enhanced" (p. 347).

Program common stimuli. Programming common stimuli consists of incorporating the same stimuli found in the instructional setting in the generalization setting (Stokes & Baer, 1977). Examples of common stimuli in the studies they examined included peers, furniture, academic materials, and training procedures. Cooper et al. (2007) emphasized the importance of examining the generalization setting to pinpoint salient stimuli that can be added to the training setting to promote generalization.

Mediate generalization. This generalization technique involves teaching a specific behavior or using a particular stimulus that serves as a prompt to elicit the target behavior in the generalized setting (Cooper et al., 2007). Strategies involving verbalization, language, and cognitions would be included in this category. Practitioners using language as mediator teach individuals to generate self-mediated verbal stimuli that assist with the production of a target behavior (Stokes & Osnes, 1989). Stokes and Baer (1977) found that language was the most frequently used mediator in the studies they analyzed, but noted that self-management techniques might also be successful in increasing generalization because they could be easily implemented with little additional effort in non-treatment settings. Stokes and Osnes also listed goal setting as a behavior that can be used to mediate generalization.

Train to generalize. Stokes and Baer's (1977) final generalization promoting technique, train to generalize, involves viewing generalization as an operant response, asking the learner to generalize, and reinforcing generalization if it occurs. Simply asking the learner to generalize demands least time and resources of all the strategies, and is sometimes sufficient to produce generalization (Cooper et al., 2007).

Train sufficient exemplars. According to Baer (1999), the error most frequently made by teachers attempting to elicit generalization is to teach "one good example" of the target behavior and "expect the student to generalize from that example" (p. 15). Training with sufficient stimulus exemplars is designed to increase the number of contexts in which the target behavior is omitted by giving the learner opportunities to practice the desired behavior in response to differing antecedent stimuli. Types of stimulus exemplars that can be varied include the particular items being taught, the stimulus context used during training, the instructional setting, and the individual providing the instruction (Cooper et al., 2007). Training with multiple response exemplars is designed to increase behaviors that have the same function as the target behavior (Cooper et al., 2007). For example, practitioners targeting verbal behavior such as initiating conversation might train individuals to use a variety of greetings instead of just one. Stokes and Baer (1977) said that the "diversity of exemplars seems to be the rule to follow in pursuit of maximum generalization" (p. 357).

Training with sufficient exemplars has been found to improve generalization of oral reading fluency (ORF) and early literacy skills. Silber and Martens (2010) tested the effects of multiple exemplar (ME) training on generalization of ORF in first and second grade students and compared the ME intervention to a listening passage preview/repeated readings intervention (LPP/RR) and the absence of intervention (control group). Students in the LPP/RR group listened to the experimenter read the entire passage while following along, and then read the passage three times. Students in the ME group practiced four selected sentences from the passage that each contained a target word. This intervention utilized the same LPP/RR procedures as the

LPP/RR group on four sentences alone. The generalization passage consisted of 16 sentences that included the same target words, but used different words to compose the sentences. Students in the ME condition exhibited greater ORF gains on generalization passages than controls, while the difference between the LPP/RR group and controls on the generalization passage was not statistically significant. Learning rates per minute of training time in both groups were also compared, and students in the ME group demonstrated the highest learning rates for both the generalization passage and the intervention passage. This study suggested that a ME intervention using selected sentences from a passages might be a better use of instructional time than a LPP/RR intervention that rehearsed the entire passage.

Ardoin, Eckert, and Cole (2008) compared second and fourth grade students' generalization of ORF on passages with high and medium word overlap after receiving either a RR intervention or a ME intervention. In the RR condition, the interventionist modeled fluent reading of a passage, instructed students to read the passage three times, and provided error correction after each reading. The ME intervention utilized three different passages that contained the same content but different organization of words and sentences. Selected words were also replaced with antonyms and synonyms. After fluent reading of the first passage was modeled, the students read each passage once, and error correction was provided after each reading. After intervention, students in each condition read a high-word overlap generalization passage that included 85-95% of the words used in the intervention passage, and a medium-word overlap passage that included 55-56% of the words in the intervention passage. Intervention and generalization passages had equivalent readability levels. Examination of ORF rates on high-word overlap generalization passages revealed no statistically significant differences between intervention groups. However, students in the ME condition demonstrated significantly greater ORF improvements on medium-word overlap passages.

Ardoin, McCall, and Klubnik (2007) compared the effects of a RR intervention and a ME intervention on six third grade students' generalization of ORF and found somewhat different

results. Students in the RR condition practiced the same passage four times, and students in the ME condition read two passages that contained a high percentage of the same words twice each. LPP and error correction were provided in both conditions. Students participated in each intervention condition, and read a generalization passage before and after intervention. While both interventions resulted in ORF improvements on the generalization passages, the RR intervention resulted in superior ORF gains on the generalization passage for three students. The authors posited that while they originally expected the ME intervention to result in greater generalization than the RR intervention, this effect may not have been observed due to insufficient stimulus control developed at the individual word level in the ME intervention. Results indicated the ME intervention resulted in ORF increases for all students, even though the RR resulted in greater increases for a selection of participants.

Duhon et al. (2010) used ME training to increase the generalization of early literacy skills. Three first grade students received a letter sound fluency intervention, and generalization to nonsense word fluency (letter sound blending) was assessed using a nonsense word probe after students reached a specified fluency criterion. If generalization was not seen, a ME generalization intervention was delivered. In the ME intervention, modeling, practice opportunities, and error correction were implemented with seven to ten nonsense words, exposing the student to multiple examples of blending. Improvements in letter sound fluency after intervention did not generalize to improvements in letter sound blending fluency for one student until the ME intervention was employed.

Fluency building. While not specifically listed in Stokes and Baer's (1977) generalization promoting techniques, fluency building (FB) is another technique that has been successfully used to promote generalization. Baer (1999) stated, "Sometimes behavior changes that seem to need generalization may only need better teaching. Try making the students fluent, and see if they still need further support" (p. 17). Cooper et al. (2007) described FB as teaching a behavior to standards demanded by natural contingencies and emphasized that practitioners

should take into account expected performance levels in non-treatment settings when designing interventions. Chandler, Lubeck, and Fowler (1992) reviewed 51 studies targeting preschool children's social skills, and found that specifying a fluency criterion was one of the most successful strategies utilized. FB has also been used to promote generalization of academic skills.

Several studies have reported improvements in ORF on generalization passages following FB interventions (Ardoin et al., 2007; Ardoin et al., 2008; Klubnik & Ardoin, 2010; Silber & Martens, 2010). The impact of training subjects to a specific fluency criterion on generalization has also been demonstrated in some studies. Bonfiglio, Daly, Martens, Lin, and Corsaut (2004) compared the effects of three ORF interventions on generalization across time (maintenance) and improvements across six across passages. A third grade student's ORF rates increased and were maintained on all passages regardless of the intervention employed, and a fascinating generalization effect was noted. Generalization across passages increased after the subject reached an ORF rate of about 100 correct words per minute, suggesting that "generalization across passages may occur partially as a function of a fluency threshold" (Bonfiglio et al., 2004, p. 114). Dowhower (1987) trained second grade students to read the first half of a passage at a criterion of 100 words correct per minute and then asked students to read the second half of the passage to assess generalization. After meeting the fluency criterion, students demonstrated increases in ORF rates on the second half of all five passages. Duhon et al. (2010) found that teaching letter sound fluency to a criterion of 52 letters sounds per minute resulted in generalized improvements in letter sound blending for two of three students.

These studies suggest that FB interventions can result in generalization of ORF and early literacy skills. While FB is not always conceptualized as a generalization strategy in studies examining academic behavior, it is a frequently used component in academic interventions, and the relationship between generalization and fluency is apparent in the skill-progression model referred to as the instructional hierarchy (IH) (Haring & Eaton, 1978).

Instructional Hierarchy

The IH developed by Haring and Eaton (1978) provides a model of academic skill development designed to help educators optimize learning through appropriately sequencing antecedent prompts and contingencies. The IH consists of four learning stages that require unique instructional strategies to optimize mastery of that particular skill: Acquisition, fluency, generalization, and adaptation.

Acquisition, the first stage in the hierarchy, refers to the period between initially demonstrating a target behavior and learning to perform that behavior at a sufficient accuracy level. Strategies to increase accuracy include modeling, immediate feedback, and error correction (Ardoin & Daly, 2007). For example, Nist and Joseph (2008) taught students to read individual sight words by correctly pronouncing each target word, asking the student to repeat the word, praising the student for accurate reading, and correctly pronouncing the word if the student made an error. While students must initially learn to generate correct responses to appropriate stimuli, accurate responding alone will produce few practical benefits in novel contexts if students do not also develop fluency, generalization, and adaptation skills (Codding & Poncy, 2010). To become a competent reader, for example, students must be able to quickly identify words in context in order to derive meaning from text, which is the ultimate goal of reading (Lyon & Moats, 1997). According to the IH, after performance is consistently accurate, educators should begin to teach fluent responding.

Fluency is the second stage in the IH, and students who are fluent in a skill can perform the skill accurately and quickly (Daly, Lentz, & Boyer, 1996). Strategies to promote fluency include providing multiple opportunities to respond, timed practice, and performance feedback (Ardoin & Daly, 2007). For example, to increase first and second grade students' reading fluency, Silber and Martens (2010) had students read a passage three times, timed the first and third reading and encouraged students to beat their previous scores, and provided error correction by modeling the word and asking students to repeat the word three times. Educators should set

goals for fluency rates based upon the expected performance levels of the particular target skill (Daly et al., 1996).

The final steps in the IH are generalization and adaptation. Generalization occurs when students perform the new behavior in numerous settings, or in the apposite context (e.g., reading newly acquired words in a variety of passages). Generalization can be promoted by utilizing techniques desired by Stokes and Baer (1977), and/or by teaching students perform the target behavior at sufficient accuracy and fluency levels (Daly et al., 1996). Adaptation consists of altering acquired behaviors when needed to meet changing environmental requirements. This skill can also be conceptualized as the ability to problem solve, and can be promoted through giving the learner several practice opportunities in new contexts (Haring & Eaton, 1978).

The optimal order of skill development in the IH has long been discussed amongst educators and researchers. Students who are accurate and fluent in a skill are more likely to generalize (Ardoin & Daly, 2007). Learning does not always progress in such clearly defined stages however, and additional research is needed to determine the extent to which early skills must be mastered before higher skills can be acquired (Martens & Eckert, 2006). Skinner and Daly (2010) encouraged researchers to view the IH as a "conceptual heuristic…and to avoid isolating phases of skill development and treating them as discrete stages" (p. 113). They also stressed the need for future research to examine the requisite ordering of skills because increased knowledge of the IH will help educators improve the effectiveness and efficiency of academic interventions.

Generalization of Isolated Word Training to Connected Text

Skills possessed by competent readers can be divided into three categories: decoding, fluency, and comprehension. Decoding refers to applying an understanding of letter-sound correspondence to read written words, fluency is reading correctly and speedily, and comprehension is the ability to understand what was read (Rathvon, 2008). Reading interventions often target a specific skill, but improvements in one skill can potentially impact

other skills (Rathvon, 2004). This review will examine accuracy, fluency, and comprehension building interventions that examined the generalization of words taught in isolation to connected text. Accuracy interventions trained correct responding, fluency interventions required quick responding (between 1.5-2 seconds), and comprehension interventions included a semantic component in training. Generalization strategies used, the subjects' degree of generalization after intervention, components shared by generalization-producing interventions, and methodological differences between studies will be discussed.

Accuracy interventions. Nist and Joseph (2008) compared the effects of three flashcard interventions on first grade students' maintenance of accuracy in isolation and generalization to connected text while examining intervention efficiency. All three interventions utilized modeling, opportunities to respond, praise for correct responses, and error correction, but differed in the ratio of known to unknown words used in training. All conditions trained six unknown words per session. The traditional drill and practice (TDP) condition trained six unknown words only, the interspersal training (IST) condition trained six unknown words and three known words, and the incremental rehearsal (IR) condition trained six unknown words and nine known words. The IR intervention took the longest to administer.

Retention was defined as words read correctly in isolation on a probe administered the day after the each intervention session. Maintenance of words read correctly in isolation on the retention probes was assessed five days after interventions terminated. Generalization was assessed the on the day after the maintained was assessed using a probe that presented maintained target words in sentences. Generalization of words that were read accurately in isolation on retention probes but inaccurately on maintenance probes was not assessed.

Results of this study by Nist and Joseph (2008) indicated that students in the IR condition read the highest amount of words correctly on retention and maintenance probes. An examination of instruction efficiency, however, revealed that students in the TDP condition read more words correctly on retention probes per minute of training time. Students in the IR

condition read a greater percentage of words accurately on the generalization probe than students in the IST and TDP conditions. The average accuracy percentage on the generalization probe for students in the IR condition was 94% compared to 87% for students in the IST condition and 82% for students in the TDP condition. This study suggests that interventions targeting isolated words can result in spontaneous generalization to connected text. While slight differences in performance on generalization probes were observed across conditions, all interventions resulted in some degree of generalization without employing a generalization strategy.

Schmidgall and Joseph (2007) compared the effectiveness of three sight word interventions on maintenance and generalization. Subjects included six first grade students. In the phonic analysis (PA) intervention, the experimenter emphasized the individual letter sounds of each word before reading the whole word, and asked students to point to the individual sounds as they slowly read the word. In the interspersal training (IST) condition, six unknown words and three known words were reviewed each session using flashcards. In the traditional drill and practice (TDP) condition, six unknown words were practiced each session. Modeling, opportunities to respond, feedback, and error correction were utilized in all interventions.

Maintenance of words read correctly during intervention sessions was assessed using flashcards. Results demonstrated that all three interventions produced moderate to high percentages of maintenance; mean percentages of words maintained ranged from 72%-92%. Generalization of a random selection of maintained words was measured by a probe that presented the target words in sentences. Mean percentages of words generalized ranged from 85%-90%. Students in the PA condition maintained and generalized a slightly higher percentage of words than students in the other two conditions, but differences between groups on maintenance and generalization measures were not statistically significant. Several ANOVA assumptions were not met, however, so statistical analysis should be interpreted with caution. Results of this study also suggest that accuracy interventions that target individual words can produce a substantial degree of spontaneous generalization to connect text.

Fluency interventions. Levy et al. (1997) conducted two studies to examine the effects of individual word fluency training on the accuracy and fluency of target words read in the context of a story (generalization). In the first experiment, 72 words selected from a third grade level story were practiced six times each per session. Fourth grade students identified as poor readers read each word as quickly as possible (within two seconds of presentation) during four training sessions. After intervention, the subjects read one story that included the trained words and one story that did not include any of the trained words, and accuracy, fluency, and story comprehension were assessed. During the last trial of the last intervention session, students read target words with 99% accuracy and named words within approximately 1.5 seconds on average. These data indicated that interventions produced that accurate and fluent responding. Results revealed that students demonstrated significantly higher accuracy and fluency performance on stories with the trained words than on stories with untrained words, demonstrating generalization of improved performance in isolation to context. The percentage of target words read correctly in isolation during the last intervention session and the percentage of training words read correctly in the story were equivalent (99%).

In the second experiment by Levy et al. (1997), training targeted every word in the selected story (instead of approximately 80% of words in the previous study), and subjects were required to read each word within 1.5 seconds. Students read all 90 target words five times each during four intervention sessions. After training, the percentage of words read accurately was approximately 99%, and students read each word in under one second on average. Results indicated that students read stories with the trained words with significantly higher accuracy and fluency levels than stories with untrained words. It is important to note that in both studies, students read 75-90% of target words accurately on the first trial prior to repeated practice. These studies showed that an intervention that trained fluent reading of individual words (between 1-1.5 seconds) resulted accuracy and fluency improvements in an untrained context (connected text).

Fleisher et al. (1979) conduced two experiments examining the effects on fluency training of individual words on generalization to connected text. Subjects were fourth and fifth grade students classified as either good readers or poor readers. In the first study, poor readers practiced all words from a selected passage using flashcards until they could read each word within approximately one second. All students were exposed to a control condition during which they read words in isolation and in a passage but received no training on the words in isolation. After intervention, poor readers read a word list containing the target words until they reached a criterion of 90 words correct per minute (WCPM). If the criterion was not met, student received additional flashcard training before reading a differently ordered word list. Students then read the passage containing the words and answered comprehension questions.

Results of the first study by Fleisher et al. (1979) study revealed that poor readers demonstrated statistically significantly higher accuracy and fluency rates on the passage containing trained words than on the control passage. Additionally, after training, poor readers did not differ from good readers on accuracy of words read in isolation or in context. These data indicated that fluency training of individual words resulted in generalization of accuracy and fluency skills for students classified as poor readers.

The second study by Fleisher et al. (1979) added a phrase training condition and increased the fluency criterion for word lists. Poor readers were assigned to either intervention conditions or the control condition, and good readers were assigned to the control condition. Poor readers in the single word condition received training on the individual words until they read two word lists at a rate of 95 WCPM. Poor readers in the phrase training condition read a list of phrases extracted from the passage until a criterion of 160 words per minute without errors was reached. Students in both conditions read a word list and a passage after training.

Results of the second Fleisher et al. (1979) study indicated that students in the training conditions read more words per minute in isolation that controls. Unlike the first study, however, trained readers in the second study did not differ from controls on fluency of words read

in connected text. While fluency differences were not observed between treatment and control groups, poor readers in both training conditions read more words context than in isolation, indicating that generalization to connected text did occur. These two studies indicated that isolated word fluency training resulted in generalization of accuracy and fluency skills to connected text for poor readers.

Therrien and Kubina (2007) compared the effects of contextual and acontextual word training on generalization to novel passages that contained around 55% of the target words. Subjects were third, fourth, and fifth students reading below grade level. In the contextual condition, students repeatedly read a passage until reaching a fluency criterion of 93 WCPM or until six passage readings were completed. Error correction was provided after the first reading. The acontextual condition utilized the same procedures as the contextual condition, but the words read were the same words used in the contextual passage presented horizontally in random order. Before reading either the contextual or acontextual words, students repeatedly read a first grade passage to criterion (either 93 WCPM or six readings). All students in the contextual condition reached the fluency criterion before reading the generalization passage, while less than half of the students in the acontextual group met the fluency criterion during training.

Results of the study by Therrien and Kubina (2007) revealed that while students in the contextual condition read the generalization passages at an average rate of 6.74 WCPM faster than students in the acontextual condition, this difference was not statistically significant. No difference was seen between conditions for mean errors read on the generalization passages. Errors averaged between 1.25 and 1.75 on the generalization passages, indicated high degrees of generalization resulting from both acontextual and contextual training. The observed generalization could potentially be attributed to the use a fluency building component in both intervention conditions.

Tan and Nicholson (1997) compared the effects of two interventions, single word training (SWT) and phrase training (PT) to a control group. In-context reading accuracy and

comprehension of 7-10 year old poor readers served as the dependent variables. Students in the SWT condition were taught individual words using flashcards. If a student made an error, the experimenter presented the target word in a two-word phrase to give semantic clues. In the PT condition, the target words were presented in multiple word phrases or sentences, and the student was instructed to focus on the target word. Training in both conditions would terminate after fluent responding was developed (reading each word within one second of presentation), or after 20 minutes. Students in the control group discussed the meaning of the target words with the experimenter for 20 minutes, but did not see the words in writing. After all sessions, students were instructed to quickly read the target words from a word list. Students also read a passage, which contained around 8% of the target words, and completed comprehension questions.

Results indicated that students in both intervention conditions performed significantly better on comprehension measures than students in the control group. No differences in reading fluency between the three conditions were seen, which could have been due to the low percentage of trained words in the passages. Differences in accuracy on the generalization passage between the intervention and control conditions revealed that the intervention groups who had received fluency training read a statistically significantly higher amount of words correctly in the passages (in-context) that they read correctly on the lists (out-of-context). The finding that students in the control group missed a missed a greater amount of words in context that they had previously read correctly in isolation, suggests that the fluency component in the SWT and PT intervention resulted in a higher degree of generalization (Tan & Nicholson, 1997).

Shapiro and McCurdy (1989) used a taped-words intervention with six high school students with social and emotional problems, three of which were learning disabled. Students listened to a recording of 80 target words read at a rate of 80 words per minute while reading silently from a word list and then read the lists aloud while the experimenter recorded the time. The experimenter did not provide feedback or error correction during intervention. After intervention, the students read a passage that contained the target words. Data indicated accuracy

improvements in reading words lists, but accuracy gains on reading in context was not observed for the majority of students. This study suggests that a taped-words intervention may not produce significant generalization in mildly disabled high school students. This intervention, however, did not include feedback or a generalization promoting technique, which may have impacted its effectiveness.

Martin-Chang and Levy (2005) studied the relative impact of context training and isolated word training on words read correctly in context in two studies. Subjects in the first study included good and poor fourth grade readers who participated in both intervention conditions that were conducted a week apart from each other. Two different sets of flashcards containing 85 words were utilized, and two stories were created that included the target words from each flashcard set twice. In the isolated word training condition, all target words were presented on a computer screen three times each day for four days. If the student made an error or did not name the word within 1.5 seconds, the experimenter read the word and presented the next word. In the context training condition, students practiced the previously unknown target words in the context of the story. The student read only the highlighted target words, and the experimenter read the other words. Both interventions provided the same amount of exposure to the target words. The day after the last intervention session, students read two passages. One passage contained the target words used during intervention (generalization passage), and the other passage contained untrained words (control passage).

Results of this study showed that both good and poor readers who received isolated word training demonstrated higher fluency rates on the generalization passage than on the control passage. Good readers in the isolated word training condition demonstrated higher fluency rates on the generalization passage than poor readers in this condition. Good readers who received isolated training displayed equivalent accuracy levels on both passages, while poor readers achieved higher accuracy rates on the generalization passage than on the control passage. The same findings related to fluency and accuracy differences on both passages were found for

students who received in-context training. When both reader types were compared based on training condition, students receiving the context training demonstrated higher fluency rates on the generalization passage than students in the isolated training condition.

The second study by Martin-Chang and Levy (2005) utilized similar procedures as the first study with average second grade readers. All students received both isolated word training and context training during separate weeks, and read a generalization and control passage after intervention. Each target word was presented 12 times per session during three training sessions. As in the first study, the generalization passage read after each intervention condition contained the words that had been trained in that condition.

Results in the second study by Martin-Chang and Levy (2005) were the same as the first in regards to fluency. Target words trained in context were read significantly faster on the generalization passage, and target words trained in isolation were read significantly faster on the generalization passage than on the control passage. In the second study however, students who received context training read a significantly higher amount of words correctly on the generalization passage than students who received isolated word training. Words trained in isolation were read more accurately in a novel context than untrained words. These two studies showed that while both training methods resulted in greater generalization of accuracy and fluency than no training, accuracy and fluency on generalization passages was greater following context training. The greater degree of generalization after context training in these studies could be explained by the use of the generalization promoting strategy, programming common stimuli, described by Stokes and Baer (1977). While not conceptualized as such in the study, the common stimulus presented in both the training conditions and the generalization probe was connected text surrounding the target words.

Martin-Chang et al. (2007) conducted two addition experiments to examine the effects of single word training and context training on accuracy of words read in and out of context. In the first experiment, average second grade readers received both interventions. Two sets of

flashcards containing 85 different words were utilized, and two stories were created that included each target word from each flashcard set twice. A pretest passage was administered, and students only received training on words read incorrectly in context. Students receiving isolated word training reviewed previously unknown words four times per day for three days. If the students made an error or did not name the word within 1.5 seconds, the interventionist read the word and presented the next word. Maintenance of words read in isolation was assessed eight days after intervention. Generalization was assessed using the pretest passage that contained the target words. In the context training condition, students practiced the previously unknown target words in the context of the story. The students only read highlighted target words; the experimenter read the other words in the passage. Maintenance was assessed using the training passage, and the interventionist did not read any words in the generalization passage.

Results from the first experiment conducted by Martin-Chang et al. (2007) showed that target words were maintained in both conditions. Accuracy percentages of target words decreased for students in both conditions on the generalization passage. Accuracy levels of students in the isolated training condition declined by over 25% on the generalization passage opposed to a 14% decline in accuracy levels of students who received context training.

Martin-Chang et al. (2007) replicated their first study with two added components: a control group that received no training, and a second generalization measure that presented words out of context. It was hypothesized that subjects receiving isolated word training would perform better on a generalization task that contained isolated words due the similarity between intervention and generalization conditions. Similar to experiment one, students in both conditions maintained the target words over the eight-day period. Accuracy percentages declined again in both conditions on the generalization passage. In experiment two however, students in the isolated word training condition demonstrated higher accuracy percentages on the generalization passage than students in the context condition. Both studies indicated that making the

generalization and training tasks similar to each other (programming common stimuli) promoted generalization.

Comprehension interventions. Petersen-Brown and Burns (2011) studied the effect of teaching word definitions on the maintenance and generalization of individually trained words. First and second grade students were randomly assigned to an incremental rehearsal (IR) with no vocabulary component group, or to an IR with a vocabulary component group. The IR intervention consisted of systematically folding in eight known words with each review of an unknown word, and seven unknown words were practiced each session. In the IR without the vocabulary component, the interventionist modeled correct reading, asked students to repeat the word and to use the word in a sentence, and provided feedback/error correction. In the IR with vocabulary condition, the interventionist read and defined the word, and students repeated both the word and the definition before using the word in a sentence. If the student used the word incorrectly in the sentence, the interventionist would provide an example of a sentence in which the word was used correctly. The procedure of asking the student say a sentence containing the word could be conceptualized as ME strategy because the student practiced saying the word individually and in context.

Retention of words read in isolation and generalization (target words read correctly in sentences) were assessed one week after intervention. Results showed that students in the IR with vocabulary training condition retained and generalized a significantly higher percentage of words than students who did not receive vocabulary training. Students in the IR with vocabulary condition read an average of 94% of words accurately on the generalization probe compared to students in the no vocabulary group who read an average of 84% of words accurately. This study suggests that IR interventions containing semantic and ME components can produce retention of words read in isolation in addition to generalization to connected text (Petersen-Brown & Burns, 2011).

Alberto, Waugh, and Fredrick (2010) used a sight word intervention that included semantic instruction and a ME generalization strategy to increase reading of connected text in students with moderate intellectual disabilities. Each student participated in nine training phases that consisted of teaching nouns, adjectives, verbs, and prepositions individually and in combination. For example, nouns were taught first, adjectives were taught second, and two word phrases containing a noun with an adjective were taught third. The last training phase included a combination of all types of trained words. The interventionist modeled fluent reading and asked students to repeat the word and point to an object that depicted the word while providing praise for correct responses and error correction. This intervention utilized MEs of each word (alone and in combination with different words) and included a comprehension component (pointing to a representative object).

Generalization was assessed by instructing students to read a story (leisure context) that contained the training words and execute the behavior described in the story or by instructing students to read the connected text in a natural setting (environmental context) and demonstrate the behavior. Results indicated high levels of generalization of words read and comprehended in leisure and environmental contexts. This study by Alberto et al. (2010) suggests that a incorporating a ME strategy when training sight words to moderately intellectually disabled individuals can promote generalization to connected text.

Components shared by generalization-producing interventions. Data from the majority of studies in the previous review indicated that moderate to high levels of generalization occurred after all interventions. Many of the effective interventions incorporated similar procedures including: modeling, error correction, and praise for correct responding. While these procedures have not been described as generalization strategies, their use during intervention appeared to result in improved accuracy and fluency. Development of accuracy and fluency can increase likelihood of generalization (e.g., Haring and Eaton, 1978).

All but one of the studies (Shapiro & McCurdy, 1989) included an error correction procedure after inaccurate or absent responses. It is interesting to note that this is the only study that reported a lack of generalization after intervention. Three of the studies included a modeling component during which the interventionist (or tape) displayed accurate and/or fluent reading before the subjects were asked to respond (Nist & Joseph, 2008; Schmidgall & Joseph, 2011; Shapiro & McCurdy, 1989). Interventionists delivered praise for accurate responding in three of the studies (Peterson-Brown & Burns, 2011; Nist & Joseph, 2008; Schmidgall & Joseph, 2011).

Generalization strategies utilized by effective interventions included FB, programming common stimuli, ME, and train and hope. Six studies set a fluency criterion of between 1-2 seconds for responding (Fleisher et al., 1979; Levy et al., 1997; Tan and Nicholson, 1989; Martin-Chang & Levy, 2005; Martin-Chang et al., 2006; Therrien & Kubina, 2007). Shapiro & McCurdy (1989) used a recording that modeled fluent reading, but did not require students to meet a fluency criterion during training. Results showed that students did not develop fluency on word lists during intervention, which could have resulted in the lack of observed generalization.

Two studies used the generalization strategy of programming common stimuli by training target words in a similar context as the generalization passage (Martin-Chang & Levy, 2005; Martin-Chang et al., 2007). A ME strategy was employed by two studies. Petersen-Brown and Burns (2011) had students read a target word and then say the target word in the context of a sentence, and Alberto et al. (2010) gave students opportunities to practice multiple combinations of target words. Nist and Joseph (2008) and Schmidgall and Joseph (2010) did not include a specific generalization strategy (i.e., utilized train and hope), but results indicated that generalization did occur. These two studies were the only two that delivered praise for correct responses in addition to modeling and error correction during intervention sessions. In summary, the majority of studies that produced substantial generalization incorporated similar intervention components and utilized a generalization strategy.

Methodological differences between studies. The studies discussed in the previous review all assessed generalization of individual words to connected text but varied in terms of the following: number of words reviewed during sessions, use of previously known versus unknown target words, and subject demographics (specifically related to reading ability and presence or absence of disability). The number of words trained in isolation per session differed significantly between studies. Four studies taught between four and seven target words per session (Alberto et al., 2010; Nist & Joseph, 2008; Petersen-Brown & Burns, 2011; Schmidgall & Joseph 2010). Tan and Nicholson (1997) taught 10-15 target words per session, and the remainder of the studies reviewed between 75-139 words per session. While not all studies listed the percentage of target words unknown prior to intervention, four studies reported using only previously unknown words during intervention (Nist & Joseph, 2008; Petersen-Brown & Burns, 2011; Schmidgall & Joseph 2010; Tan & Nicholson, 1997). The remainder of the studies taught a pre-established set of words to all students regardless of whether they were known or unknown.

Studies also differed according to subject demographics. Alberto et al. (2010) and Shapiro and McCurdy (1989) used subjects with learning, social/emotional, and cognitive disabilities. Petersen-Brown and Burns (2011) and Martin-Chang et al. (2007) used average readers, and the rest of the studies examined struggling readers (based on either teacher identification or reading assessments).

An examination of intervention and methodological components of the two studies that did not contain a generalization (train and hope) strategy produced interesting findings. Interventions in both studies taught a relatively small number of known words per session and provided modeling, error correction, and praise for correct responding (Nist & Joseph, 2008; Schmidgall & Joseph, 2010). Future research should examine the role of these components on spontaneous generalization.

Pretest-Posttest Design

Behavioral researchers frequently use pretest-posttest designs to compare the differences between groups and/or to examine effects of a treatment. A primary purpose of pretest is to increase power of the test by decreasing error variance (Dimotriv & Rumill, 2003). Power refers to the likelihood of identifying differences between groups when the null hypothesis is false (Keppel & Wickens, 2004). Awareness of threats to internal and external validity in pretest-posttest designs is crucial. Internal validity refers to extent to which the treatment is responsible for observed changes. External validity refers to the extent to which the effect of the treatment can be "generalized across populations, settings, treatment variables, and measurement instruments" (Dimitrov & Rumrill, 2003, p. 159). One commonly used pretest-posttest design is the randomized control-group pretest-posttest design.

Randomized control-group pretest-posttest design. In this design, the experimental group receives a treatment, and the control receives no treatment. Two or more assessments are given to all subjects, usually before and after treatment and at a later follow-up. Obtaining pre-test data when possible is important because it should not be assumed that groups are equivalent before intervention (Sheeber, Sorensen, & Howe, 1996). Internal validity threats to this design are history and maturation, and an external validity threat to this design is the interaction of pretesting and treatment (Dimitrov & Rumrill, 2003). This design if often referred to as a mixed design because it examines both between-group differences and within-subject differences (Keppel & Wickens, 2004).

ANOVA. A one-way analysis of variance (ANOVA) is an appropriate method of analyzing performance differences between groups on a single dependent variable (Cardinal & Aitken, 2006). In the current study, only the posttest scores were analyzed because pretest scores were equivalent across conditions (i.e., 0%). Two one-way ANOVAs were utilized to examine differences across conditions on accuracy of words read in context on the first posttests in addition to accuracy of words read in isolation during the last intervention session.

Several assumptions should be tested before ANOVA results can be interpreted with confidence. The first assumption is independence among observations (i.e., responses in each condition are made independently of responses in other conditions). Random assignments to groups typically fulfills this assumption. The second assumption is homogeneity of error variance in each group. The third assumption is that error is normally distributed within each group (Cardinal & Aitken, 2006).

Rationale

The ability to identify words in context is a prerequisite to reading comprehension, which is the ultimate goal of reading (Lyon & Moats, 1997). While use of the TH strategy is sometimes effective in producing generalization, practitioners should not assume that generalization will spontaneously occur after a new behavior is trained (Stokes & Baer, 1977). Several different methods have been used to successfully promote generalization of words trained in isolation to connected text that include: FB, programming common stimuli, and ME instruction. The majority of studies utilizing generalization strategies have compared the use of a strategy to the absence of a strategy (control). Additional research is needed to compare the relative effectiveness of generalization strategies to determine which interventions achieve "the most generalized effects in the least intrusive manner while subjecting the endeavor to a rigorous scientific process" (Osnes & Leiblein, 2003, p. 372).

Research Questions

Research Question 1: *Does implementation of a TH generalization strategy result in spontaneous generalization to connected text?*

It was hypothesized that students in the TH condition would demonstrate a greater degree of spontaneous generalization to connected text than students in the control condition who received no intervention.

Research Question 2: *Does degree of generalization to connected text differ based on generalization strategy utilized?*

It was hypothesized that the ME and FB generalization strategies would result in a greater degree of generalization to connected text (i.e., higher percentage of words read accurately on posttest one) than the TH strategy due to the inclusion of specific generalization programming techniques utilized in the FB and ME intervention procedures. While some previous research has indicated that spontaneous generalization to connected text sometimes occurs after accuracy training of words in isolation, other studies have documented the absence of adequate generalization when specific programming techniques were not utilized.

It was hypothesized that students in the ME condition would read a greater percentage of words accurately in connected text than students in the FB condition because students in the ME condition practiced reading the target words in context. Previous research has shown that training words in context produces greater generalization than training words in isolation (e.g., Martin-Chang & Levy, 2005).

Research Question 3: *Does accuracy of words read in isolation during the last intervention session differ across conditions?*

It was hypothesized that students in all treatment conditions would demonstrate adequate accuracy performance during the last trial of the last intervention session. Students in the ME and FB conditions were expected to respond accurately to a slightly higher percentage of words than students in the TH condition due to the additional practice opportunities provided in the ME and FB conditions.

Research Question 4: *Does retention of accuracy performance in connected text differ across conditions?*

It was hypothesized that students in the ME and FB conditions would read more words correctly on the retention probe (i.e., posttest two) than students in the TH condition. Additionally, students in the ME and FB conditions were expected to retain more words that were previously read correctly on posttest one than students in the TH condition (i.e., show less decay over time).

CHAPTER III

METHODOLOGY

Participants and Setting

Participants were 48 second grade students between the ages of seven and nine from three public schools in the north central sector of a Midwestern state. Fifty-six percent (n = 27) of participants were female, 60% (n = 29) were White, 19% (n = 9) were Native American, 6% (n = 3) were Black, 2% (n = 1) were Hispanic, and 13% (n = 6) were multiracial. Four percent (n = 2) of students were receiving English as a Second Language (ESL) services, and 14% (n = 7) were receiving special education services. School psychology graduate students who received training in intervention delivery conducted intervention sessions with students in quiet areas. The length of each intervention session was not recorded. After the study ended, delivery of each intervention was timed, and each intervention took between three to four minutes to complete.

Materials

Score sheets that listed each student's target words were used to document accuracy and fluency of target words read on each trial during intervention sessions. Target words trained in the standard flashcard (SF) intervention that was utilized across treatment conditions were individually presented in black font on white flashcards. Flashcards utilized in the multiple exemplar (ME) intervention were double sided. The front of the flashcard contained the target word in isolation; the back of the flashcard contained the target word in the context of two short sentences. Word lists in the fluency building (FB) intervention presented each student's 10 target words five times each in columns on 8.5x11 inch pages. A stopwatch was used to measure words

correct read per minute (WCPM) in the FB condition. Students in all conditions received a sticker after each intervention session.

Pretest. The pretest consisted of 48 sentences each containing one pre-identified target word. This assessment was designed to identify 10 target words that students read incorrectly in the context of a sentence. Forty-eight target sentences were constructed to ensure that students at different reading performance levels would make at least 10 errors. The majority of the target words were words with irregular spellings, and the majority of non-target words in the sentences were high frequency words. The target words in the sentences were presented in bold font on the score sheets; no words were presented in bold font on the copy read by the students. Students were instructed to start at the first sentence and read aloud until instructed to stop. Sentences in which the target word was read inaccurately and all non-target words were read accurately were documented, and students were instructed to discontinue reading after 12 sentences meeting these criteria were identified. The first 10 target words in the identified sentences were the target words practiced during intervention sessions and assessed on the posttests. Each participant had a different list of target words as errors on the pretest varied across students.

Posttests. Each student completed two posttests that consisted of the 10 sentences from the pretest that contained the student's target words. Generalization was said to occur when target words were read accurately after intervention in the untrained context of a sentence. The first posttest was administered two days after the last intervention session, and the second posttest was administered two weeks after the last intervention session.

Experimental Design and Analysis

The dependent variable of primary interest was the percentage of target words read accurately in context on the posttests. The accuracy of words read in isolation during the last trial of the last intervention session was the secondary dependent variable. The independent variables were the generalization strategies utilized in the TH, FB, and ME conditions. The TH

generalization strategy was utilized by training accurate responding to target words in isolation and hoping that generalization to connected text would occur in the absence of specific programming. The FB and ME generalization strategies were employed by the use of interventions that included procedures designed to elicit generalization.

A randomized control-group pretest-posttest design was used to evaluate differences in accuracy performance in context between treatment conditions. All participants completed a pretest assessment and two posttest assessments. Two one-way ANOVAs were utilized to examine differences across conditions on accuracy of words read in context on the first posttest in addition to accuracy of words read in isolation during the last intervention session.

Procedures

Students who had not met second grade level reading expectations as evidenced by performance on a sight word assessment were referred for participation by the reading specialists at each school site. The majority of participants had received additional reading supports in addition to classroom instruction during the 2012-2013 school year. Consent forms were sent to the parents of the referred students. Upon receiving parent consent, child assent to participate in the study was obtained. Participants were placed into either the control, TH, FB, or ME condition (n = 12 per condition) using a stratified, random sampling procedure across schools.

Intervention and assessment schedule. A five-day intervention schedule that began on Monday and ended on Friday was utilized. Students in the ME and FB conditions received the SF intervention on days one and two and the intervention containing the respective generalization strategy on days three, four, and five. Students in the TH condition received no intervention during first three days, and received the SF intervention on days four and five. Only two sessions of the SF intervention were conducted in the TH condition because the goal of the SF intervention was to build target word accuracy only. Delivering three additional SF intervention sessions to students in the TH condition would have likely developed target word fluency, making a comparison between the TH and FB conditions difficult. Students in the control group did not

receive any intervention. Students took the pretest on the Friday prior to the Monday on which the five-day intervention schedule commenced. The first posttest was administered two days after the last intervention session. The second posttest was administered two weeks after the last intervention session. The intervention schedule is displayed in Table 1.

Table 1.

Intervention Schedule

Group:	Day 1	Day 2	Day 3	Day 4	Day 5
Control	--	--	--	--	--
TH	--	--	--	SF	SF
FB	SF	SF	FB	FB	FB
ME	SF	SF	ME	ME	ME

Standard flashcard intervention. The SF intervention was designed to build accuracy of target words in insolation and did not include procedures specifically designed to promote generalization. Students in the TH, FB, and ME conditions received two days of the SF intervention. Students in the TH condition received the SF intervention only. The SF intervention contained a modeling procedure and a feedback procedure. During the modeling procedure, the experimenter read word, asked the student to repeat each word, and gave feedback by providing either verbal praise or error correction. Words read independently within five seconds were considered accurate, and the experimenter said, "Good job" after words read accurately. If a student read a word inaccurately, the experimenter read the word, asked the student to repeat the word, and praised the student for accurate responding. Each target word was reviewed five times per session, and flashcards were shuffled after each trial. The feedback procedure consisting of verbal praise for correct words and error correction for incorrect words was also used during the ME and FB intervention sessions.

Generalization strategies. The generalization strategies utilized during isolated word training in the three treatment conditions were TH, FB, and ME. Table 2 displays the intervention components utilized in each of the conditions.

Table 2.

Intervention Components Utilized in Each Condition

Condition	Intervention Components
Control	None
TH	SF Intervention + Hope
ME	SF + ME Intervention
FB	SF + FB Intervention

Train and hope. The TH procedures consisted of training accurate responding to words in isolation using the SF intervention and hoping that generalization to connected text would occur. Students in the TH condition received two sessions of SF intervention only. No intervention procedures specifically designed to promote generalization were utilized.

Fluency building. The FB generalization strategy was employed during isolated word training by training accurate and rapid responding to target words. After receiving two days of the SF intervention, students in the FB condition were trained to read each of the target words from a list as quickly as possible using a procedure similar to that described by Tan and Nicholson (1997). Each list had six columns of words, and each column contained all 10 target words in randomized order. The experimenter followed a protocol that is similar to the standard repeated reading procedure used by Silber and Martens (2010). Students were instructed to read the words in each column as quickly as possible and to go to the next column after finishing the current one until the experimenter said, "Stop." Students had one minute to read as many words as possible. After the first reading, the experimenter told the student the number of WCPM and

provided error correction. Students read the words lists two additional times and were encouraged to beat their previous scores. The experimenter delivered verbal praise if the student read more WCPM on the subsequent trials. Experimenters documented each student's accuracy and fluency on each of the three trials.

Multiple exemplar. The ME generalization strategy was employed during isolated word training by practicing the target words in different contexts (individually and in sentences). Students in the ME condition received two sessions of the SF intervention on days one and two of the five-day intervention schedule. In the three subsequent sessions, students received training on target words presented in isolation and in short sentences. Two sentences were developed for each target word. The words immediately before and after the target word in the ME intervention sentences had 0% overlap with the words before and after the target word in the posttests. The majority of non-target words in the sentences were one to four letter high frequency words that were easily decodable. The experimenter instructed the students to read each word and each sentence aloud without assistance while providing verbal praise for correct words and error correction for incorrect words. Experimenters reviewed each word and corresponding sentences three times per session, resulting in 9 total exposures to each target word per session. Target word accuracy on each trial was documented.

Procedural Integrity and Interscorer Agreement.

An independent observer collected procedural integrity (PI) data for 23% of the intervention sessions. A checklist detailing the steps of each intervention was developed, and the observer checked off each intervention step after the experimenter completed it. PI was calculated by dividing number of steps completed by number of steps possible. PI for intervention sessions was 99%. A review of students' score sheets indicated that students in all three treatment conditions received 100% of prescribed intervention sessions.

All pretests were audio recorded, and an independent scorer rescored the pretests by listing to the recordings. Interscorer agreement (IA) was calculated by dividing number of actual

agreements on target word errors by total number of possible agreements on target word errors. IA on the pretests was 95%. If scorers disagreed on a target word error, that target word was discarded and replaced with a target word that was identified as an error by both scorers. Therefore, IA for target words utilized in interventions was 100%. An independent scorer completed PI on 35% of the pretests to ensure that the experimenter followed the specified procedures when identifying the sentences with target words that met the inclusion criteria (i.e., target word was read inaccurately and non-target words were read accurately). PI on the pretests was 100%. Posttest assessment sessions were also audio recorded, and 47% posttests were rescored. Interscorer agreement (IA) was calculated by dividing number of actual agreements on posttests items (target words) by total number of possible agreements. IA on the posttests was 99%.

CHAPTER IV

RESULTS

The purpose of this study was to compare the effects of three generalization strategies utilized during isolated word training on accuracy of target words read in connected text. The train and hope (TH) generalization strategy was utilized by training accurate responding to target words in isolation and hoping that generalization to connected text would occur in the absence of specific programming. The fluency building (FB) generalization strategy was employed during isolated word training by training accurate and rapid responding to target words. The multiple exemplar (ME) generalization strategy was utilized during isolated word training by practicing the target words in different contexts (individually and in sentences).

Generalization was said to occur when target words trained in isolation were read accurately in the untrained context of a sentence. Generalization was assessed by having students read the 10 sentences from the pretest in which target words were read incorrectly two days after intervention terminated (posttest one). The retention of target words read accurately in context was assessed two weeks after posttest one by administering the same 10 sentences again (posttest two). Additionally, the percentage of words read accurately during the last trial of the last intervention session was examined to assess the extent to which the three interventions built accuracy in isolation.

Two one-way ANOVAs were utilized to examine differences across the conditions on accuracy of words read in context on the first posttest in addition to accuracy of words read in

during the last trial of the last intervention session. Before conducting analyses, the data were examined for outliers and normality of distributions. An examination of a boxplot depicting posttest one data indicated there were two extreme outliers in the FB condition and one extreme outlier in the TH condition. The boxplot for last trial data indicated that there was one extreme outlier in the FB condition. All extreme outliers were deleted prior to conducting the ANOVAs. An examination of posttest one and last trial data revealed that data all treatment conditions were negatively skewed. There was homogeneity of variances for posttest one data, as assessed by Levine's Test of Homogeneity of Variance ($p = .173$). Homogeneity of variances was violated for last trial data ($p = .000$). Interpretation limitations related to the violations of the aforementioned assumptions are mentioned in the discussion section.

Research Question 1

Does implementation of a TH generalization strategy result in spontaneous generalization to connected text?

To assess whether students in the TH condition displayed spontaneous generalization to connected text, pretest and posttest one scores of students in the TH condition were compared to scores of students in the control condition. Students in both conditions had equivalent scores on the pretests (0%). A one-way ANOVA, $F(3, 44) = 279.574$, $p = .000$, demonstrated a statistically significant main effect for condition on posttest one. A Tukey *post-hoc* analysis indicated that accuracy performance of students in the TH condition ($M = 79\%$, $SD = 7.0$) was statistically significantly higher ($p = .000$) than accuracy performance of students in the control group ($M = 15\%$, $SD = 10.9$). The effect size, calculated using Cohen's *d*, was 7.0. Results indicated that spontaneous generalization to connected text occurred after implementation of the TH generalization strategy. Descriptive statistics for accuracy of words read on posttest one are presented in Table 3.

Table 3.

Means and Standard Deviations for Groups on Percentage of Words Read Accurately

Percentage of Words Read Accurately									
	Last Trial			Posttest I			Posttest II		
Group	n	*M*	SD	n	*M*	SD	N	*M*	SD
Control	--	--	--	12	15%	10.9	12	25%	10
TH	12	91%	13.1	11	79%	7	11	74%	13.6
FB	11	98%	2.6	10	98%	6.3	10	91%	16
ME	12	100%	0	12	97%	6.5	12	97%	4.9

Research Question 2

Does degree of generalization to connected text differ based on generalization strategy utilized?

To answer this question, mean scores on posttest one of students in the TH, FB, and ME conditions were compared. A one-way ANOVA demonstrated a statistically significant main effect for condition on posttest one $F(3, 44) = 279.574$, $p = .000$. Students in the FB and ME conditions scored higher on posttest one than students in the TH condition (M = 98%, SD = 6.3; M = 97%, SD = 6.5; M = 79%, SD = 7, respectively). A Tukey *post-hoc* test showed that mean scores of students in the FB condition was statically significantly higher than scores of students in the TH condition ($p = .000$). The effect size, calculated using Cohen's *d*, was 2.9. Scores of students in the ME condition were also statically significantly higher than scores of students in the TH condition ($p = .000$). The effect size, calculated using Cohen's *d*, was 2.7. The difference in mean scores between students in the FB and ME conditions was not statistically significant. Descriptive statistics for accuracy of words read on posttest one are presented in Table 3.

Research Question 3

Does accuracy of words read in isolation during the last intervention session differ across conditions?

Differences in words read accurately in isolation were evaluated by examining performance during the last trial of the TH, FB, and ME interventions. A visual examination indicated that the TH, FB, and ME interventions all resulted in a high percentage of words read accurately in isolation (M = 91%, M = 98% and M = 100%, respectively). A one-way ANOVA showed a statistically significant main effect for condition on the mean percentage of words read accurately in isolation during the last intervention trial $F(2, 34) = 4.650$, $p = .017$. A Games-Howell *post-hoc* test which was utilized due to the violation of homogeneity of variance, showed that differences between conditions were not statically significant. Descriptive statistics for accuracy of words read in isolation on the last trial are presented in Table 3.

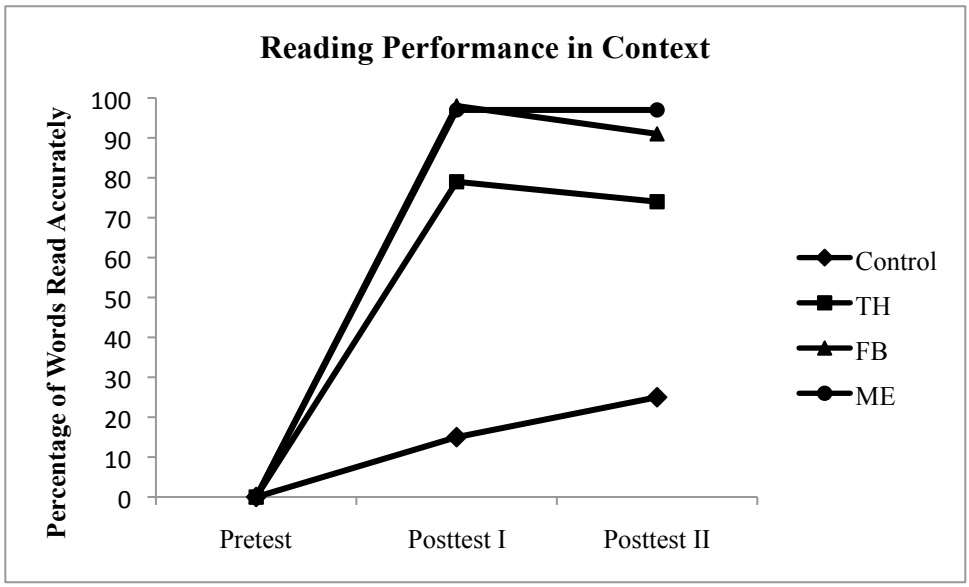
Research Question 4

Does retention of accuracy performance in connected text differ across conditions?

Retention was assessed by subtracting posttest two scores from posttest one scores to assess whether performance declined over time. Results indicated that performance between posttests was relatively stable across conditions. Scores for students in the ME condition remained the same. Scores for students in the FB condition declined by seven percent, and scores for students in the TH condition declined by five percent. Figure 1 displays the percentages of words read accurately on posttest one and posttest two.

Figure 1.

Observed Group Means in Reading Performance in Context from Pretest to Posttest Two



CHAPTER V

DISCUSSION

The purpose of this study was to compare the effects of three generalization strategies utilized during isolated word training on accuracy of target words read in connected text. The train and hope (TH) generalization strategy was utilized by training accurate responding to target words in isolation and hoping that generalization to connected text would occur in the absence of specific programming. The fluency building (FB) generalization strategy was employed during isolated word training by training accurate and rapid responding to target words. The multiple exemplar (ME) generalization strategy was utilized during isolated word training by practicing the target words in different contexts (individually and in sentences).

Generalization was said to occur when target words trained in isolation were read accurately in the untrained context of a sentence. Accuracy performance of students in the control, TH, FB, and ME conditions was compared by examining percentage of words read accurately in context on two posttests. Additionally, performance across treatment conditions during the last trial of the last intervention session was examined to compare the percentage of words read accurately in isolation. Results of the current study answer the research questions regarding the relative effectiveness of the generalization strategies utilized in the TH, FB, and ME conditions on students' degree of generalization, accuracy performance in isolation, and retention of generalization.

Research Question 1

The first research question examined the extent to which utilization of the TH generalization strategy resulted in spontaneous generalization. Spontaneous generalization refers to performance improvements in a novel context after receiving an intervention that does not include procedures specifically designed to promote generalization (Stokes & Baer, 1977). Mean score differences between students in the TH condition and control condition were statistically significant; students in the TH condition read an average of 79% of words accurately on posttest one compared to students in the control condition who read an average of 15% of words accurately. Results indicated that use of the generalization strategy TH resulted in a high degree of spontaneous generalization to connected text.

Results of the current study are similar to previous research that reported generalization to connected text after words were taught in isolation. Nist and Joseph (2008) found that students who received a traditional drill and practice (TDP) flashcard intervention generalized 82% of words that were maintained in isolation to connected text. Schmidgall and Joseph (2007) reported that students generalized an average of 89% of words after a TDP intervention. Results of an incremental rehearsal (IR) flashcard intervention examined by Peterson-Brown and Burns (2011) indicated that students read 82% of words taught in isolation correctly in sentences.

The average scores representing words read in context reported in the three aforementioned studies were approximately 10% higher than the mean score on the generalization probe in the current study. In two of the previous studies, students only read words on the generalization probe that had been maintained in isolation (Nist & Joseph, 2008; Peterson-Brown &Burns, 2011); in the current study, all words trained in isolation were assessed in context. The study by Peterson-Brown and Burns (2011) contained an additional practice component not utilized in the current study during which students were asked to verbally state the target word in

the context of a sentence. Intervention procedures shared by the current study and the previous studies included modeling, error correction, and praise for accurate responding.

Research Question 2

The second research question compared the degree of generalization produced by the TH, FB, and ME generalization strategies utilized during isolated word training. Results indicated that students in the FB and ME conditions had statistically significantly higher mean scores on posttest one than students in the TH condition. Therefore, the FB and ME strategies employed using intervention procedures that were designed to elicit generalization were more effective in producing generalization than the strategy of TH.

Results of the current study are similar to a study conducted by Peterson-Brown and Burns (2011) that compared an IR flashcard intervention that relied on a TH strategy to a flashcard intervention with additional procedures that could be described as use of a ME strategy. In addition to practicing the word in isolation, students in ME condition received feedback and error correction while practicing the definition of the target word and using it in a sentence. Results indicated that students in the ME condition read a greater percentage of words on the generalization probe than students in the TH condition who received the flashcard intervention alone. Previous studies have not specifically compared use of a FB strategy to use of a TH strategy.

Utilization of both the FB and ME generalization strategies resulted in a high degree of generalization to connected text; the difference in mean scores between these conditions was not significant. Previous research has not compared utilization of FB and ME generalization strategies during isolated word training on reading performance in context. Several studies, however, have demonstrated that building isolated word fluency resulted in significant accuracy improvements when words were read in connected text (e.g., Fleisher et al., 1979; Levy et al., 1997; Martin-Chang & Levy, 2005; Martin-Chang et al., 2007; Tan & Nicholson, 1997; Therrien & Kubina, 2007).

Research Question 3

The third research question examined accuracy of words read in isolation on the last trial of the last intervention session across treatment conditions. A review of these data was conducted to assess if differences in generalization across conditions could be attributed to differences in the percentage of target words learned during intervention. A visual examination of the percentage of words read accurately on the last trial indicated that the interventions utilized in the TH, FB, and ME conditions all resulted in a high percentage of words read accurately (91%, 98% and 100%, respectively). Differences in mean scores were not statistically significant. Therefore, it is unlikely that performance differences in context were primarily due to differences in percentage of target words learned in isolation during intervention.

Research Question 4

The fourth research question examined the retention of performance gains in connected text across intervention conditions. A comparison of posttest one and posttest two performance indicated that scores for students in the ME condition remained the same. Scores for students in the FB condition declined by seven percent and scores for students in the TH condition declined by five percent. Previous research has not specifically examined retention of words read accurately in an untrained context.

Implications

Results of the current study provide several implications for isolated word training. Osnes and Leiblen (2003) stated the importance of identifying instructional techniques that produce the "most generalized effects in the least intrusive manner" (p. 372). Intrusiveness of generalization strategies used in the current study can be compared by examining the time required for preparation of intervention materials, number of steps in intervention protocols, and session lengths. Time required to complete the interventions utilized during implementation of the TH, FB, and ME generalization strategies did not differ significantly. The SF intervention utilized as the sole training component during implementation of the TH strategy required the

least amount of materials and steps because the SF intervention did not include additional procedures designed to promote generalization. The spontaneous generalization observed after implementation of the TH strategy indicates that teaching accurate responding in isolation can result in performance improvements in context. These results suggest that students needing sight word instruction should initially receive an accuracy building flashcard intervention that utilizes modeling and corrective feedback. Educators should be cautioned, however, to not assume that in-context reading performance will automatically improve after training words in isolation. Students should be assessed in context to ensure that newly acquired words are read accurately in multiple contexts.

Results of the current study indicated that percentage of words read in context was significantly higher for students in the FB and ME conditions. While interventions utilized in these conditions contained more steps and required more time for material preparation than the SF intervention, they required minimal time to administer. If students demonstrate insufficient in-context generalization on reading assessments after receiving interventions that do not contain procedures specifically designed to promote generalization (e.g.., SF intervention), FB and ME interventions should be considered.

Limitations and Future Directions

Several limitations of the current should be considered when interpreting results. An examination of students' words read correct per minute (WCPM) on a reading fluency probe administered before the study commenced indicated that fluency performance varied across subjects. When compared to national norms, approximately 15% (n = 7) of subjects performed below the 10th percentile, 15% (n = 7) performed between 10^{th} and 20^{th} percentiles, 47% (n = 22) performed between 20^{th} and 50^{th} percentiles, 13 (n = 6) performed between 50^{th} and 75^{th} percentiles, 4% (n = 2) performed between 75^{th} and 90^{th} percentiles, and 6% (n = 3) performed above the 90^{th} percentile. A review of posttest performance for students who scored below the

10th percentile indicated that interventions might have produced differentiated effects for these low performing students. Future research should examine the effects of interventions with and without generalization strategies on the performance of students with low ORF scores. Another limitation related to the sample involves the use of a relatively small number of subjects per condition (i.e., 10-12). Future research should utilize larger samples to increase power.

Another limiting factor of the current study is that words on the pretest and posttests were examined in context only and not in isolation. As a result, the percentage of words read accurately in isolation after intervention could not be compared to the percentage of words read correctly in context. It is recommended that future studies use target words that were previously read incorrectly in isolation and in context and examine post-intervention reading ability of words read in isolation and in context.

Difficulty level of previously unknown words utilized in the current study was not formally assessed due to the lack of a universal standard that identifies individual word difficulty. Because each student had a different set of target words, it is possible that differences in target word difficulty existed across conditions. It is recommended that future studies examining sight word interventions formulate a method for comparing the relative difficulty of target words and/or teach the same unknown words to all students to equate difficulty.

Another limitation of the current study is that students in the TH condition received two intervention sessions while students in the ME and FB conditions received five intervention sessions. Therefore, it is possible that fewer opportunities to practice the target words in the TH condition was partially responsible for the lower average performance in context observed in that condition. Only two sessions of the SF intervention were conducted in the TH condition because the goal of the SF intervention was to build target word accuracy only. Delivering three additional SF intervention sessions to students in the TH condition would have likely developed target word fluency, making a comparison between the TH and FB conditions difficult. It should be noted, however, that students in the TH condition read an average of 91% of target words

accurately on the last intervention trial, indicating that high levels of accuracy were developed after only two intervention sessions. Future research comparing interventions should equate opportunities to respond to target words across conditions. Additionally, future research should examine if a certain number of opportunities to respond is a better predictor of performance in an untrained context than the use of a specific generalization strategy.

Finally, results of the current study should be interpreted with caution due to the violation of certain ANOVA assumptions. The homogeneity of variance assumption was violated for the accuracy of words read in isolation during the last trial of the last intervention session. All students in the ME condition demonstrated 100% accuracy of words in isolation; students in the TH condition demonstrated the greatest performance variances. Additionally, data in each condition for posttest one and last trial accuracy were negatively skewed. This could have been due to the fact that only 10 previously unknown words were trained in each condition. Future research should utilize a larger set size of unknown words with a greater number of participants.

Summary

Knowledge of best instructional practices "can enhance the capacity of teachers to meet student needs and the capacity of students to respond to instruction" (Rathvon, 2008, p. 4). This study compared the relative effectiveness of three generalization strategies utilized during isolated word training: TH, FB, and ME. Results indicated that all generalization strategies resulted in increased accuracy of words read in isolation and in context. Students in the TH condition demonstrated a degree of spontaneous generalization to connected text, indicating that implementing a flashcard intervention which utilizes modeling and feedback can produce performance improvements in context.

While significant performance differences between the FB and ME conditions were not observed, implementation of the FB and ME generalization strategies during instruction resulted

in a greater degree of generalization connected text than use of the TH strategy. This finding suggests that utilizing generalization strategies during isolated word training that include procedures specifically designed to elicit generalization may be the most effective way to promote generalization to connected text. Future research is needed to compare both the relative effectiveness and efficiency of generalization strategies used during isolated word training while examining reading performance in context.

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APPENDICES

Appendix A: IRB Approval

Oklahoma State University Institutional Review Board

Date:	Friday, December 07, 2012
IRB Application No	ED12126
Proposal Title:	Generalization of Isolated Word Training to Connected Text: A Comparison of Sight Word Interventions
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved Protocol Expires: 12/6/2013

Principal Investigator(s):

Kimberly Vogel
312 1/2 Jefferson Street
Stillwater, OK 74074

Gary J Duhon
423 Willard
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI, advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Shelia M. Kennison

Shelia Kennison, Chair
Institutional Review Board

Appendix B: Pretest Instructions

Pretest Instructions:

1) Record each pretest individually and write down the audio file number.
2) Read the directions.
3) If student takes longer than 3 seconds to read any word, instruct him/her to "go to the next word."
4) Do not correct errors or give feedback regarding whether words are correct or incorrect.
5) Mark all incorrect words with a slash (target and non-target words).
6) Circle sentences that meet the criteria listed below.
7) Tell students to stop reading after 12 sentences have meet criteria.

Criteria for Target Sentences:

1) Student made error on word in bold (self-corrections are not considered errors).
2) Student made no other errors in sentence (self-corrections are not considered errors).

Obtain for each student:

1) Assent
2) Pretest
3) Fluency Measure

Appendix C: Pretest

Name:	**School:**
Date:	**Interventionist:**
Test:	

Directions: When I say begin, please read these sentences until I tell you to stop. Be sure to do your best reading. If you come to a word you do not know, I may tell you to skip it.

1. The cat had a very good **idea**.
2. She **thought** it is fun to play.
3. He is the best **student** in the class.
4. The game was not **fair**.
5. How much **doubt** do you have?
6. The boy had to **obey** her.
7. What **type** of ball do you see?
8. I want to go to a new **country**.
9. The hen had not **laid** one egg.
10. I told my friend about the **secret** plan.
11. His mom said, "Come to my **office**."
12. The fat pig likes to drink **juice**.
13. The man is **afraid** of the big bug.
14. I want to go on a trip to an **island**.
15. Did you hear the song on the **radio**?
16. One day he saw a **strange** dog.
17. My legs **ache** when I walk up the hill.
18. It did not make any **sense** to me.
19. When will the man **return** home?
20. He did not know how to fix the **machine**.
21. The man said, "Please hold your **tongue**."
22. Give the best **answer** that you can.
23. The teacher will **inspire** the five kids.
24. I want to ride on a **yacht** when I go.
25. It was hard to **gauge** how tall he was.
26. The smart boy had a fun **scheme**.
27. It was a **typical** day at the park.
28. The small boy wants to walk **instead**.
29. There are **several** fun games to play.
30. He was happy when we went to the **museum**.
31. I want to run my own **business**.
32. The short **gnome** had green ears.
33. Cooking good food is not his **forte**.

34. He will **indict** the bad boy.
35. He can play because he has **rhythm.**
36. The blue waves were very **fierce**.
37. The movie was very **bizarre** to him.
38. They are very **envious** of his arm.
39. The king ended the long **rebellion**.
40. The cow will **devour** his food for lunch.
41. The **enormous** pig won the prize.
42. He did not **purchase** the new book.
43. They will **rehearse** for the play.
44. The child wants to go to a **foreign** city.
45. When will you **debut** the song?
46. He is going to be an **astronaut** someday.
47. You need to get the new **vaccine**.
48. The boss will **critique** his work.

Appendix D: Example Posttest I

Name:	**Interventionist:**
Class:	**Date:**
Audio#:	

Directions: When I say begin, please read these sentences until I tell you to stop. Be sure to do your best reading. If you come to a word you do not know, I may tell you to skip it.

1. Give the best **answer** that you can.
2. Cooking good food is not his **forte**.
3. The short **gnome** had green ears.
4. The teacher will **inspire** the five kids.
5. He was happy when we went to the **museum**.
6. The boy had to **obey** her.
7. I told my friend about the **secret** plan.
8. There are **several** fun games to play.
9. It was a **typical** day at the park.
10. I want to ride on a **yacht** when I go.

Posttest One % Accurate:

Appendix E: Example Posttest II

Name:	**Interventionist:**
Class:	**Date:**
Audio#:	

1. Give the best **answer** that you can.
2. Cooking good food is not his **forte**.
3. The short **gnome** had green ears.
4. The teacher will **inspire** the five kids.
5. He was happy when we went to the **museum**.
6. The boy had to **obey** her.
7. I told my friend about the **secret** plan.
8. There are **several** fun games to play.
9. It was a **typical** day at the park.
10. I want to ride on a **yacht** when I go.

Posttest Two % Accurate:

1. Does she know the **answer**?
2. Is art her only **forte**?
3. Was that a **gnome** that you saw?
4. The song did not **inspire** them.
5. Tell me about the big **museum**.
6. Who will **obey** this time?
7. Do not write the **secret** word.
8. **Several** people do not have time.
9. Most people are very **typical**.
10. Put the **yacht** in the water.

Generalization Posttest % Accurate:

Appendix F: Standard Flashcard Intervention Script

Materials needed: Stopwatch, flashcards, and data recording sheet.

1. Introduction: **"I am going to ask you to read words from these flashcards. We will read each word five times."**
2. Present each flashcard and say, **"This word is (read word.) What is this word?"**
    a. If student correctly reads word within 3 seconds, say, **"Good job!"**
    b. If student is incorrect or takes over 3 seconds to respond, say, **"This word is (read word). What is this word?**
    c. Repeat prompt until student accurately reads the word within 3 seconds, and then say, **"Good job."**
3. Review each word using the above procedures five times per session.
4. Document words correct/errors on the data recording sheet.
5. When finished, praise student for effort and allow student to select a sticker.

Appendix G: Multiple Exemplar Intervention Script

Materials needed: Stopwatch, flashcards, and data recording sheet.

1. Introduction: **"I am going to ask you to read words and sentences from these flashcards. We will read each word and sentence 3 times."**
2. Present each flashcard and ask, **"What is this word?"**
    a. If student correctly reads word within 3 seconds, praise student.
    b. If student is incorrect or takes over 3 seconds to respond, say, **"This word is (read word). What is this word?**
    c. Repeat prompt until student accurately reads the word, and praise student.
3. After the student correctly identifies the word, turn flashcard over and present the sentence containing the word just read in isolation. Run finger across phrase and ask, **"What does this say?"**
    a. If correct, say, **"Good job!"**
    b. If incorrect, say, **"This says (read sentence). What does this say?"**
    c. Repeat prompt until student accurately reads the sentence, and praise student.
4. Review each word/sentence using the above procedures 3 times per session.
5. Document words correct/errors on the data recording sheet.
6. When finished, praise student for effort and allow student to select a sticker.

Appendix H: Fluency Intervention Script

Materials needed: Stopwatch, word list, and data recording sheet.

1. Introduction: **"I am going to ask you to read as many words as you can from this list in a minute. You will read the list three times."**

2. *(First Reading)* **"When I say begin, start here (point) and read these words until I say, "Stop." When you get to the bottom of the list, go to the top of the next list (point). If you come to word you don't know, I will tell it to you. Be sure to do your best reading. You will have one minute."**
3. If student makes an error, **immediately** say correct word and encourage student to continue reading.
4. Record errors/words read correctly on data recording sheet and say, **"Good job! You read (say number) words correctly.**
    a. If student made any errors, say, **"Now we will review the words you missed."**
    b. Point to each incorrectly read word and say, **"This word is (read word.) What is this word?"**
    c. When student correctly reads word within 3 seconds, say, **"Good job!"**

5. *(Second Reading)* Say, **"When I say begin, read these words again, and try to beat your score."**
6. Draw bracket around last word read on student's sheet.
7. If student makes an error, **immediately** say correct word and encourage student to continue reading.
8.
9. (*Third Reading*) If student beats previous score, say, **"You beat your first score; Good job! You have one more reading. Let's see if you can read even faster.**
10. Draw bracket around last word read.
11. If student did not beat previous score, praise student for effort and say, "**You have one more reading. Let's see if you can beat your first score this time."**
12. If student makes an error, **immediately** say correct word and encourage student to continue reading.

13. Praise student for beating score/for effort, and allow student to select a sticker.
14. Document errors and amount of time (in seconds) student takes on each reading.

VITA

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