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The Effects of Reversing SAFMEDS Presentation on Learning and Generalization

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THE EFFECTS OF REVERSING SAFMEDS PRESENTATION ON LEARNING AND GENERALIZATION

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by

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We hereby approve the thesis of

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Dean of Graduate Studies

ABSTRACT

THE EFFECTS OF REVERSING SAFMEDS PRESENTATION ON LEARNING AND GENERALIZATION

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Say All Fast Minute Each Day (SAFMEDS) is a flashcard procedure that is effective in producing fluency, but not necessarily generalization of a content area. One possibility for the lack of generalization is the direction of the SAFMEDS training. Most learners are presented with a definition (the longer side) and have to say the term (the shorter side). Elements of single-case and between-groups designs were used to examine the effects of reversing the direction of training on acquisition and fluency of SAFMEDS content, as well as generalization. Within this study, the control group was presented with a book or paper title (the longer side) and had to learn the last name of the corresponding author (shorter side). The experimental group was presented with the author side and had to learn the book or paper title. A posttest was conducted to examine which direction of the SAFMEDS training resulted in greater generalization of the content. The basic findings of this study suggest that learning SAFMEDS in the reverse learning channel, “see-title, say-author” may result in an increase in correct responding and generalization compared to the “see-author, say-title” learning channel. The results of this study suggest that Individuals who learn

SAFMEDS in the “see-definition, say-term” format may have a harder time generalizing the content they learned to future applications.

Keywords: SAFMEDS, generalization, fluency

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CHAPTER I

INTRODUCTION

When relevant behaviors occur under conditions that are different from those in which the behaviors were trained, generalization has occurred (Baer, Wolf, & Risley, 1968). The term "generalization" may refer to a variety of behavioral processes as well as outcomes of behavior change. "Setting/situation generalization", "response maintenance", and "response generalization" are three different types of generalization. Setting/situation generalization is the extent to which a learner emits a learned behavior in the presence of an event or environmental condition that differs from the one in which the learned behavior was trained (Cooper, Heron & Heward, 2007). Response maintenance is the extent to which a learner continues to perform the behavior after the intervention has ended (Cooper et al., 2007). Response generalization is the extent to which a learner emits a behavior that is different than the trained behavior, but is functionally equivalent (Cooper et al., 2007). Generalization is necessary when learning new skills because the conditions in the environments in which training occurs are often controlled and stagnant. In the natural environment, conditions are constantly changing and it is important that a learned behavior persists, despite those changing conditions.

Generalization is not a passive phenomenon and it does not occur just because a behavior has changed. It is important that generalization is actively programmed (Stokes & Baer, 1977). Stokes and Baer (1977) outline a variety of methods to promote and assess generalization. The most frequent method for

assessing generalization is the train and hope method. This method is where generalization is desired, but not actively pursued (Stokes & Baer, 1977).

Precision Teaching is a systematic and programmed instructional model that focuses on the development of high frequency response rates. Within Precision Teaching, "fluency" is a common goal in which a learner makes a high rate of correct responses within a short amount of time. An important component when developing fluency is frequent practice of the target skill (Johnson & Street, 2013). One procedure that provides learners with frequent practice is an adapted flashcard procedure called SAFMEDS, an acronym standing for "Say All Fast, a Minute Each Day, Shuffled" (Lindsley, 1996). SAFMEDS has been shown to teach a variety of learners like children with special needs (Nam & Spruill, 2005; Ragnarsdottier, 2007) or college students (Kim, Carr, & Templeton, 2001; Stockwell & Eshleman, 2010) multiple skills such as letters (Ragnarsdottir, 2007), statistics (Beverly, Hughes, & Hastings, 2009), or French (Polson, Grabavac, & Parsons, 1997).

While SAFMEDS has been shown to promote fluent responding and generalization across time (Stockwell & Eshleman, 2010), SAFMEDS has failed to promote setting/situation generalization (Meindl, Ivy, Miller, Neef, Williamson, 2013; Nam & Spruill, 2005). Meindl et al. (2013) hypothesized that this may be due to restricted stimulus control, meaning that irrelevant topographical features of the SAFMEDS control responding rather than the actual, functional content of the cards. When irrelevant topographical features of the cards control responding, responding will not generalize to different or novel

conditions when those features are not present (Meindl et al., 2013). Topographical features such as the font, the shape of the words on the car, or irregularities such as coffee stains may be controlling responding rather than the actual content of the cards.

SAFMEDS might also fail to facilitate generalization due to the order of the learning channel in which the terms and definitions are trained. Standard SAFMEDS training involves seeing a phrase, then saying the corresponding term. When presented with vocabulary in natural environments, learners are often expected to provide the phrase when presented with a term. The learners might also have to be able to generalize the phrases to multiple examples. If irrelevant topographical features of the cards are controlling responding, as hypothesized by Meindl et al. (2013), the learner will fail to respond with the correct definition. While high rates of fluent responding can be developed for "See-phrase, say-term" learning channel, it may be just as important to reverse the order to "see-term, say-phrase" to loosen stimulus control and facilitate generalization (Stockwell & Eshleman, 2010).

Therefore, the purpose of the present study was to compare the effects of the standard SAFMEDS learning channel "see-term, say-phrase" with the reverse learning channel "see-phrase, say-term" on correct responding and generalization. The following chapter details relevant research regarding SAFMEDS, learning channels, and generalization and how these concepts can be utilized within education.

CHAPTER II

LITERATURE REVIEW

Foundation of SAFMEDS

B.F. Skinner was a scientist who supported and developed the science of behavior, now referred to as behavior analysis. He proposed that all behaviors could be measured and accounted for by examining the environmental conditions that surround them. He supported the direct measurement of response-rates, or how often a behavior occurs within a given interval of time, as the basis for changing behavior (Binder, 1980). Another supporter of measuring response-rates was Dr. Ogden Lindsley. He developed a system that allows teachers to measure rate, or count per unit of time, of a student's academic performance (Lindsley, 1972). Coined Precision Teaching, this academic system is an instructional strategy in which teachers are able to make academic decisions based on a student's individual performance (Lindsley, 1972). For example, a teacher can measure how many addition facts a student completes in one minute on a worksheet. The teacher repeats the timings multiple times a session, and based off of the student's performance, the teacher is able to make decisions based on if the student is improving or not. Rather than teaching materials based on norm-referenced goals, a teacher pinpoints a goal for a student to reach, and provides individualized instruction to meet that student's goals. In other words, while other teaching methods may use norm-referenced goals, Precision Teaching uses student-based goals. Precision Teaching seeks to build the learner's rate of component skills to a mastery level, through the development of fluent

responding. Fluency was defined by Haughton (1972, 1980) as occurring once a learner's performance demonstrates "REA-PS", an acronym for retention, endurance, and application performance standards (Haughton, 1972, 1980). This acronym has been expanded upon by Johnson and Street (2013) to "Get the MESsAGe". This updated fluency acronym stands for maintenance, endurance, stability, application, and generativity (Johnson & Street, 2013).

A benefit of Precision Teaching is that allows for the integration of diverse instructional methods (Johnson & Street, 2013). One instructional method that integrates well into Precision Teaching is Response to Intervention (RTI). This model of education is based on concepts from multiple areas, including Precision Teaching and applied behavior analysis. RTI uses data-based measures to group students into tiers. Within Tier 1, instruction is an evidence-based curriculum that is applicable to all students, and serves as a preventive measure for academic failure. When the standard protocols of Tier 1 are not successful, students may be grouped together based on similar academic deficits. Tier 2 thus provides evidence-based instruction tailored to address those specific deficits. The final tier, Tier 3, is for students who do not successfully progress in Tier 2. This tier provides specialized instruction that is tailored specifically to an individual student (Johnson & Street, 2013). One type of instructional package that can be integrated into Precision Teaching and Tier 3 intervention packages is a flashcard procedure, SAFMEDS.

Say-All-Fast-Minute-Each-Day-Shuffled

SAFMEDS is an effective flashcard procedure that can result in fluent responding. As of April 2017, there have been 27 peer-reviewed publications in which the data suggest that this instructional strategy increases fluent responding that is stable across time (Quigley, Peterson, Frieder, & Peck, 2017).

Lindsley (1996) developed and coined the acronym SAFMEDS for instructional purposes in his graduate courses at the University of Kansas in 1975, and by 1978 he had incorporated SAFMEDS into all his graduate courses for vocabulary fluency (Lindsley, 1996). SAFMEDS stands for "say all fast a minute each day shuffled". This acronym was created to differentiate SAFMEDS from standard flashcard procedures as well as a way to promote its correct usage. Lindsley (1996) defined SAFMEDS as:

"Say" to prevent silent card viewing. "All" to prevent learning the 75-card deck 25 cards at a time. "Fast" to prevent the common error of starting slow and accurate and then later trying to build speed. "A minute" to prevent skipping weekend days and then trying to catch up with extra timings on Monday. "Shuffled" to prevent the common error of first trying to learn the cards in the same order, then after "knowing them," shuffling to try different orders. (p. 213)

When utilizing a flashcard procedure like SAFMEDS, a learner should have operant freedom. Free operant responding occurs when a learner is able to make more than one response in the presence of a discriminative stimulus (Lindsley, 1996). This is in comparison to controlled operants in which the learner can only respond once in the presence of the discriminative stimulus (Lindsley,

1996). There are four different types of operant freedoms that support the development of fluent responding: free to present stimuli, free to form responses, free to repeat responses, and free to speed. Free to present stimuli means that the learner is able to present the stimuli to themselves at their own pace (Lindsley, 1996). In relation to SAFMEDS, this means that the learner is able to hold their own deck and flip the cards at their own pace (Graf & Auman, 2005). Learners should also be free to form responses (Lindsley, 1996). Within a SAFMEDS procedure, this may involve a student selecting their own content for the SAFMEDS and creating them in a way which is appealing to them (e.g., typing vs. writing cards). Free to repeat responses means that a learner is able to correct themselves in practice if they catch an error (Lindsley, 1996). While SAFMEDS allows for only one response per card, learners should check their answers as they are responding, and future timings may allow for them to correct that error (Graf & Auman, 2005). When responding, there should be a freedom to speed. A learner's responding should not be limited by the number of responses available in a given period of time (Lindsley, 1996). Regarding SAFMEDS, the deck should have more cards than the learner is ever going to be able to respond to in a one minute timing.

Lindsley (1996), Eshlemans (2000), and Graf and Auman (2005) suggest multiple strategies when using SAFMEDS to promote fluent responding. Quigley et al. (2017) summarizes these suggested strategies into nine steps in which the learner

1. Holds the complete deck

2. Shuffles the cards

3. Starts the timer for 1 minute

4. As fast as possible, “Sees” front and out loud “Says” the information on the back of the card

5. Turns the card over and checks answer to determine answer correctness

6. Sorts correct and incorrect responses into piles

7. After the time expires, counts the number of responses per pile

8. Charts performance for review and instructional changes

9. Repeats daily (Quigley et al., 2017, pg. 3).

SAFMEDS is typically formatted so that the learner “sees” the stimulus on the front of the card, and “says” the appropriate response that is printed on the back. For instance, the learner will see the term “mountain” on the front and will then say, “a large steep hill” before flipping the card over to check for accuracy. This “see” then “say” response can be accounted for within a learning channel analysis.

Learning Channel Analysis

In academics, learners often have to master complex concepts. One way to teach complex concepts to a variety of learners is through a “learning channel”. A learning channel specifies a sensory mode (e.g., see, hear, touch) in which a learner can contact an antecedent event and the physical mode (e.g., say, write, touch) in which the learner will respond (Haughton, 1980; Johnson & Street, 2004). This method was developed due to criticisms of ambiguous terms such as “understands” or “knows” when discussing a learner's academic performance

(Haughton, 1980). For instance, stating a learner "knows the alphabet" does not precisely describe what the leaner is able to do regarding the alphabet. The learner may be able to say the letters in the alphabet, but cannot point to or write the correct letters. Learning channels were suggested by Lindsley (1996) to help create precise, informative definitions for outlining instructional objectives, goals, and progress monitoring. This analysis is a method of describing learning objectives based on a stimulus-response pair (Haughton, 1980). The stimulus may be visual (see), auditory (hear), tactile (touch), olfactory (smell), or gustatory (taste). The corresponding responses are based on similar physical movements such as say, write, type, do, or point (Johnson & Street, 2004).

Learning channels are organized using learning channel matrices. Created by Haughton (1980), these matrices provide the means for adding precision to an individual learner's academic objectives (Lin & Kubina, 2004). Learning channel matrices are comprised of an "in" channel represented vertically, and an "out" channel represented horizontally. Figure 1 depicts an example of a teacher made learning channel adapted from the Haughton Learning Center (Haughton, 1996). The in channel refers to the sensory mode of the antecedent stimulus and the out channel refers to the topography, or the form of the behavior, the response should be in.

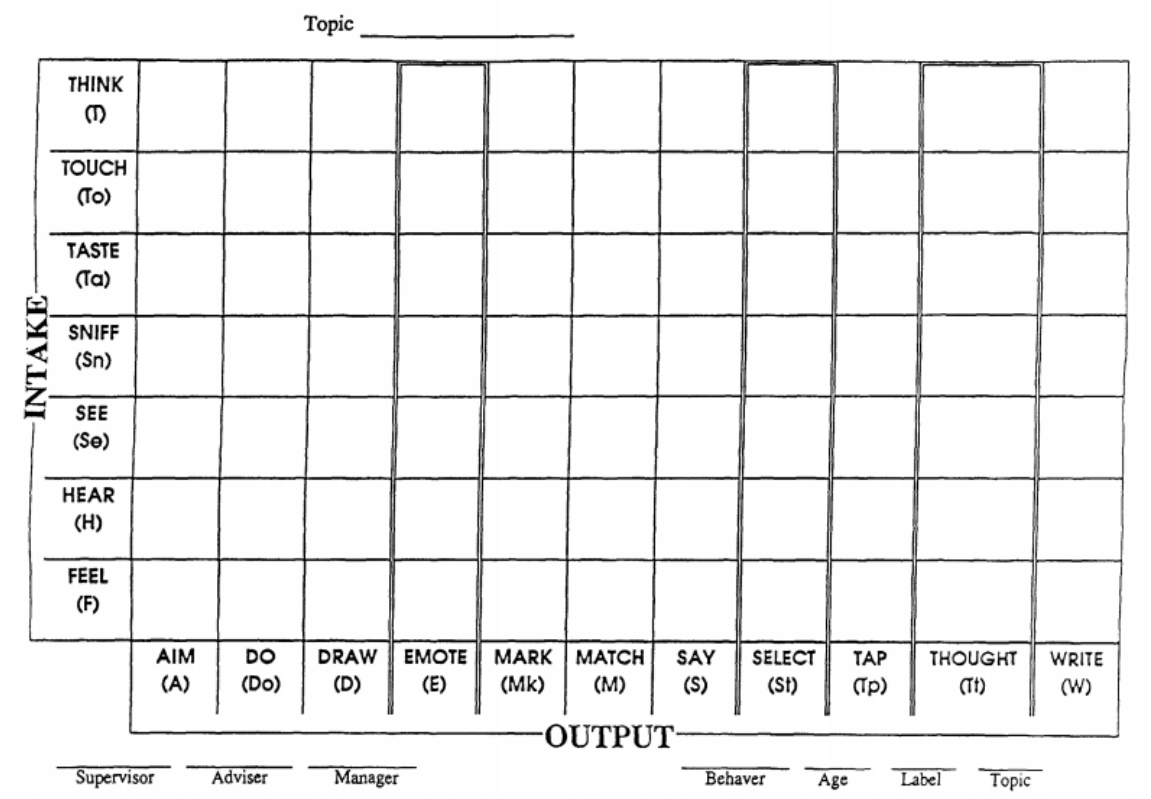

Figure 1. Haughton's academic [personal social matrix]. Adapted from Haughton Learning material, by E. Haughton 1996, Napa, CA: Haughton Learning Center. Copyright 1996 by Elizabeth Haughton.

Learning channels may facilitate "generic extension". Generic extension is a type of stimulus generalization that occurs when a learner who was trained to respond in the presence of a specific stimulus is able to respond in the presence of a novel stimulus that shares properties with the original stimulus. Responding therefore, is under the control of those shared properties (Skinner, 1957). For example, a young learner is trained to say "dog" in the presence of a small, spotted dog. Generic extension occurs when the learner says "dog" in the presence of a novel dog that is large and black. The shared properties (e.g., four legs, tail, furry) between the novel dog and trained dog control the learner's

response. Learning channels may facilitate generic extension by providing multiple examples through multiple channels (Lin & Kubina, 2004). Within a see/say learning channel, showing the learner pictures of different dogs and instructing them to say dog in the presence of those pictures facilitates generic extension through multiple examples. Through different learning channels, such as hear/select, the learner could be presented with a recording of a dog bark and instructed to point to an image of a dog in the presence of the bark sound. By utilizing multiple examples and multiple learning channels, the learner will come in contact with relevant properties of the item, therefore increasing the probability of generic extension (Lin & Kubina, 2004).

When developing fluency related to vocabulary, Johnson and Street (2013) identifed the see/say and see/write learning channels as being relevant to fluent vocabulary responding. In a recent review of SAFMEDS literature, Quigley et al. (2017) found that the majority of research (23 out of 27 articles) focused on see/say learning channels, but it is possible for SAFMEDS to incorporate other learning channels. For example, and as noted in the aforementioned Quigley et al. (2017) review, Polson et al. (1997) created a computer-based SAFMEDS procedure in which the researchers used see/type learning channels for French to English words, then reversed the order of the French/English stimuli and response items. Both accuracy and rate were considered within this study, and utilizing the see/type channels did allow for participants to reach 100% correct. However, they found that the reversal of the stimulus and response items resulted in a decrease in response rates and accuracy for most the participants (Polson et al., 1997).

SAFMEDS and Generalization

Generalized behavior change is when a behavior occurs in a novel condition that differs from the one in which it was trained (Stokes & Baer, 1977). Generalization is often a desired outcome of a behavior change program like SAFMEDS because an inability to demonstrate some learned behavior outside of the treatment setting renders training moot. Some studies do not even assess generalization (Cihon, Sturtz, & Eshleman, 2012; Casey, McLaughin, Weber, & Everson, 2003), while others use the train and hope method (Stockwell & Eshleman, 2012). Within the train and hope method, once an intervention has been implemented, any generalization that may occur is documented, but it is not actively pursued (Stokes & Baer, 1977). In order to maximize the likelihood that generalization occurs, generalization should be explicitly addressed and planned for. Few studies on SAFMEDS have actively sought to program for generalization. One such method of facilitating generalization is training sufficient exemplars. This method is where the learner is presented with repeated exemplars until they are able to generalize that behavior (Stokes & Baer, 1977).

Graf and Auman (2005) proposed that including multiple decks of SAFMEDS in practice may help allow facilitate generalization. Based on the methods outlined by Stokes and Baer (1977), training with multiple decks is training sufficient exemplars. Meindl et al. (2013) evaluated the effects of incorporating multiple decks of SAFMEDS with multiple examples of the same term on tests for generalization. The results showed that including multiple decks did support generalization, as proposed by Graf and Auman (2005).

Based on the Quigley et al. (2017) review, SAFMEDS procedures typically utilize one learning channel, the see/say channel. However, Nam and Spruill (2005) found that learners, especially those with learning disabilities, are often not able to transfer or generalize the skills learned in one context to novel settings. In one scenario, a student learned to respond correctly to a see/write channel, but was unable to respond to a hear/say prompt (Lin & Kubina, 2004). Nam and Spruill (2005) compared two learning channels and tested for generalization. Math facts in see/say and hear/say learning channels were trained, and the results showed that the see/say learning channel did not have an effect on a see/write generalization test. Although fluency-building instructional practices (e.g., SAFMEDS) is generally assumed to result in generalization across learning channels, the results of Nam and Spruill (2005) suggest the opposite.

Polson, Wong, Parson, and Grabavac (1991) examined generalization in which participants were first taught to type a term when they were presented with a definition (see definition/type term). After training, the participants took a test in which the task was reversed so the participants were given the term, and had to write the definitions (see term/write definition). The participants failed the generalization test, and further training resulted in few improvements in performance. The results of this study showed that even though the participants could correctly respond to the see definition/type term learning channel, the skill did not generalize when the participants were presented with the reverse task, the see term/write definition learning channel. Several variables were hypothesized to

have accounted for the poor results such as the response modes used, potential learning histories with the terms and definitions used, and stimulus sizes.

Polson, Grabavac, and Parsons (1997) sought to control for potential confounding variables in the previous study by controlling for the participants' learning histories. By only including participants who were naïve to French, and using English and French words that were similar in length, this study was able to also control for extraneous effects regarding stimulus size. The results of this study, like Polson et al. (1991), show when learning channels are reversed, there is a reduction in correct responding for most participants. The implications of these results suggest that teaching strategies should focus on the practice of unfamiliar responses. In relation to SAFMEDS, the learner should not just be practicing saying the words when presented with the definitions, but also have the occasion to practice saying the definition when presented with the words (Polson et al., 1997).

A similar conclusion was developed based on the results of a study in which graduate students were taught verbal behavior terminology (Stockwell & Eshleman, 2010). A see/say learning channel was used to teach term/definition pairs. The results of this study showed that SAFMEDS developed fluent responding, and follow-up data showed that performance was generalizable across time. The train and hope method for facilitating generalization was used in that generalization was desired, but not actively pursued outside the intervention. Response generalization and setting/situational generalization were not assessed, and the researchers questioned if changing certain characteristics of the cards

during tests for generalization would yield similar results. They suggest that even though response rates were high for the see term/say definition learning channel, it cannot be assumed that there would also be fluent responding for the reverse learning channel of see term/say definition. They hypothesized that the see term/say definition learning channel is just as important for use in the natural environment, if not more (Stockwell & Eshleman, 2010). Cihon, Sturtz, and Eshleman (2012) also suggest that it may be important to assess the differential effects of a see term/say definition learning channel when using SAFMEDS because students may have to provide definitions when presented with terms on assessments. Therefore, this reverse format may not only produce better results on academic assessments, but also facilitate generalization across learning channels.

Purpose and Hypothesis

The purpose of this study is to compare the effects of the standard SAFMEDS learning channel "see-phrase, say-term" with the reverse learning channel "see-term, say-phrase" on correct responding and generalization. Within this study, it is predicted that there will be higher posttest outcomes when the learning channels are reversed. It is also predicted that the participants in the experimental group will score higher scores on the posttest. When the participants learn to "see-author (term), say-journal article title (phrase)" rather than "see-title, say-author", they are attending to more relevant aspects of the SAFMEDS cards. Because the participants in the experimental group have learned more information, they will be able to generalize key components of the SAFMEDS when presented with novel stimuli.

CHAPTER III

METHODS

Participants and Setting

Nine teachers at Morningside Academy in Seattle, WA were recruited through email (Appendix F) and fliers (Appendix G). Participants were assigned to groups based on their order of participation. Group assignments alternated between each participant. A laboratory log was kept, listing participant numbers and groups assignments. Assigning alternating participants to groups helped to decrease potential systematic biases, and decreased the chance of differences amongst the participants that could affect the results. It also decreased the possibility that the difference in the results could be attributed to the experimental effects (Keppel & Wickens, 2003).

All sessions took place in a Morningside computer lab room. The room was contained multiple computers,. One participant and the primary investigator were present for each session. Sessions ran for approximately 20 minutes. Clearance for this study was approved by the Human Subject Review Council at Central Washington University.

Materials

Two sets of SAFMEDS were created for use in this study. One set contained the first author's name on the front with the journal article's title on the back. The second set contained the title on the front with the author's name on the back. Each set contained 16 author to title pairs that were the same for each deck (Appendix A). The SAFMEDS were created on the program Fluency FlashCards

developed by Vicci Tucci and Dr. Kent Johnson (2017). Appendix H contains sample screenshots of Fluency Flashcards.

Fluency Flashcards is a program in which users are able to create decks of SAFMEDS and use them to learn sets of information. This program tracks and charts the data from each session on a standard celeration chart. The standard celeration chart is a display tool that was created by Ogden Lindsley in 1967 to display fluency, or how accurately a learner can respond in a certain amount of time (Lindsley, 1972). An additional set of SAFMEDS, containing 16 children's authors to book title pairs were used as a tutorial deck (Appendix B). The SAFMEDS were presented to the participants via a desktop computer that was present in the university lab room. In the lab room, pencils were available to fill out the informed consent paper work and posttest assessment.

Experimental Design

Within this study, single-case and between-group designs were combined. This combination of designs was selected in order to prevent interference when measuring which order of presentation was most effective (Kazdin, 2011). If a single-case design was the only design used, the participant would be exposed to learning the content of the cards under each condition. Learning cannot be reversed, so spill over would occur between the two conditions, and it would become difficult to identify which condition was more effective. Using elements of between-group designs allowed for accurate measurement between two separate groups of participants who received different interventions (Kazdin, 2011). In addition, it was not possible to recruit enough participants to run a

between-group design that would be able to measure a significant difference between the two different SAFMEDS conditions. Therefore, the design used within this study used a control group who was exposed to the standard SAFMEDS procedure "see-definition, say-term" as outlined by Quigley et al. (2017) in which they were presented with the longer side (journal article title) and had to respond with the shorter side (author). The experimental group received similar SAFMEDS training, but the presentation of the stimuli was reversed so that they were presented with the shorter side (author), and had to respond with the longer side (journal article title). Similar to an alternating-treatment design without baseline, these two exposure conditions were measured and compared during three, 2 minute SAFMEDS timings followed by a posttest that measured for generalization across different learning channels.. This design was selected in order to identify which intervention between the two groups was most effective (Kazdin, 2011).

Independent and Dependent Variables

The independent variable was the order of the presented learning channels in which the titles and authors were trained using SAFMEDS. The control group was presented with the longer, title side of the SAFMEDs during training and had to respond with the correct corresponding author (see-title/say-author). The experimental group was presented with the shorter, author side of the SAFMEDS and had to respond with the correct corresponding title (see-author/say-title). The dependent variable was the participants' performance on the paper-and-pencil posttest.

Data Analysis

The posttest assessment from each participant was scored with a possible range of values from 0-16. The posttest a paper-and-pencil fill in the blanks test in which half of the questions required the participant to give the author when presented with a title and the other half of the questions required the participant to give the title when presented with the author. During scoring, spelling did not count and approximations to the correct word were accepted as correct as long as they were functionally equivalent (i.e. rft was accepted as reinforcement). Because the first eight questions required a higher response effort, only the nouns, adjectives, and adverbs of the title were scored for a total of one point per question. Prepositions and conjunctions were not scored. For the first eight questions, each answer was worth one point. Since the answers contained more than one word and the total word count varied per answer, if an error was made it was only counted as a partial mistake. Each word in the criterion answer was worth a fraction of one. So if the answer was “Precision Teaching”, “Precision” would be worth .5 points, and “Teaching” would be worth .5 points, for a total answer of one point, as each question was worth one point. This accounted for the participants getting only part of the questions correct.

Pre-Experiment Procedures and Posttest Assessments

Participants were able to enter to win a raffle worth $50 for their participation. Participants then reviewed and signed informed consent forms (Appendix C). Once the consent forms were completed, the participants were told that their task was to learn a set of 16 journal article titles to authors (first author

only) pairs. This content area was selected in order to be applicable for teachers working in the field of behavior analysis in which recognizing authors and their works is important. SAFMEDS containing similar content were utilized in a study in which the participant, a graduate student in special education, needed to know author names, publication dates, and a summary of information (Korinek & Wolking, 1984).

Participants were given a list of steps depending on their group assignment (Appendix D) that the primary investigator verbally went over with the participant. The primary investigator then presented a tutorial deck that did not share qualities with the decks used during training. The tutorial deck contained 16 pairs of children authors with their corresponding book titles. This deck was used to familiarize the participant with the SAFMEDS procedure and the computer program prior to training. Once the participant was allotted time to practice and familiarize themselves with the tutorial deck and the computer program (about 5 minutes), the practice phase began.

The point of the practice phase was to expose the participants to the content they would be learning during the timing sessions. The participants were allotted 5 minutes to learn the deck of the journal article titles and authors in a free format in which data was not collected. The instructions within the practice phase and the following timing sessions were the same.

Participants were instructed to look at the presented card and say its corresponding item out loud. If the participants did not know an answer, they were instructed to say, “I do not know”. After answering out loud, the participants

hit the space bar to present the correct corresponding item. If their verbal answer exactly matched the corresponding item, they hit the right arrow key for correct. If the verbal answer was wrong or the participant said, “I do not know”, they hit the left answer key for incorrect. Participants were instructed to follow the list of steps as closely as possible.

After the 5 minutes of practice, the participants completed three, 2 minute SAFMEDS timings. After completing the 5 minutes of practice and the three, 2 minute timing sessions, participants were allotted 3-5 minutes to complete the posttest. Each participant took about 20 minutes to complete the entire experiment.

The posttest (Appendix E) assessed the participants’ knowledge of the information within the SAFMEDS deck. The SAFMEDS required the participant to see the content then say the corresponding pair item. The posttest required the participant to see the content and write in the corresponding pair item. Half of the posttest contained questions in which the author was presented and the participant had to write in the title, and the other half contained questions in which the title was presented and the participant had to write in the author. Spelling errors within this portion of the posttest did not result in point reduction. This assessed if the participant was able to respond in a see/write channel after learning the content in a see/say channel in the order in which it was presented to them. It also tested for generalization in which the opposite item was presented than training.

CHAPTER IV

RESULTS

This study sought to to compare the effects of the standard SAFMEDS learning channel “see-term, say-phrase” with the reverse learning channel “see-phrase, say-term” on correct responding and generalization. Figure 2 and Figure 3 display the results from the three SAFMEDS timing sessions for each participant in each group. Names were changed to protect participant confidentiality.

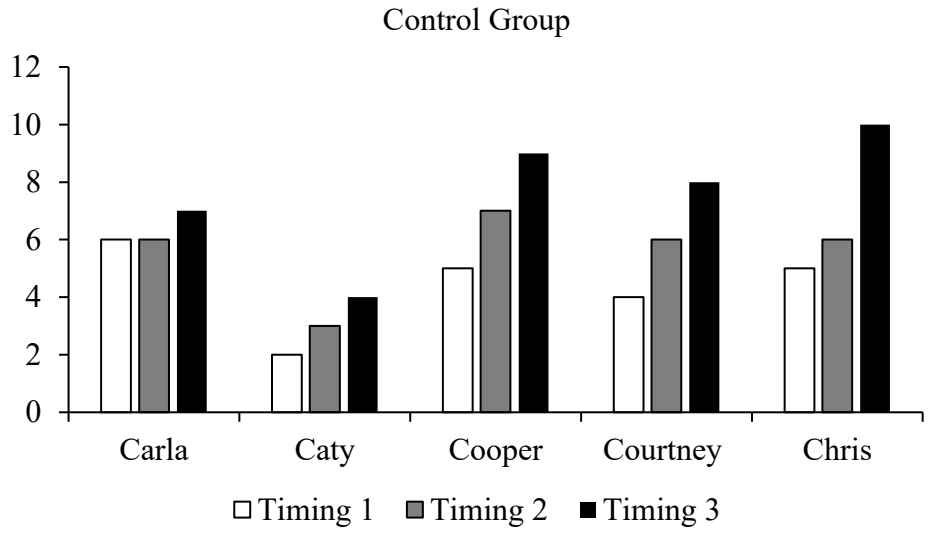

Figure 2. Correct responses during the three SAFMEDS timing sessions for each participant in the control group.

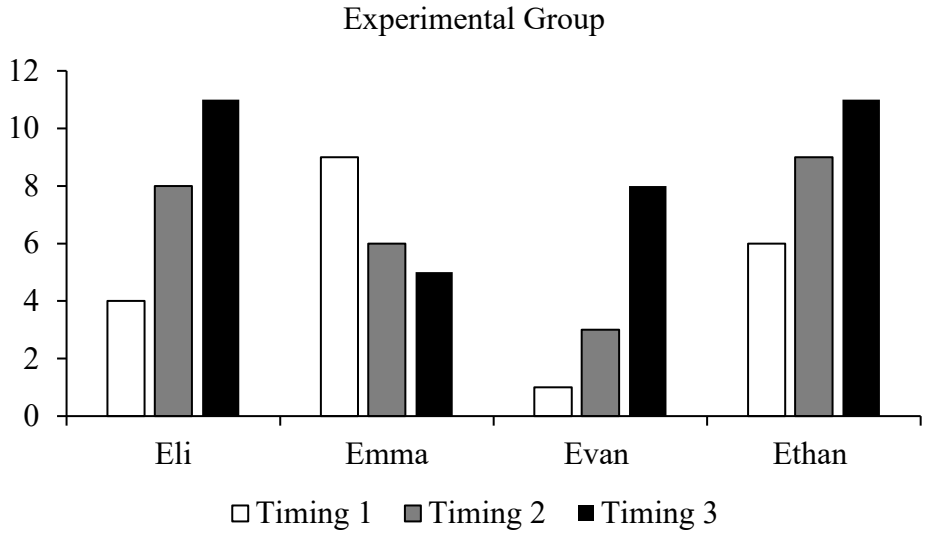

Figure 3. Correct responses during the three SAFMEDS timing sessions for each participant in the experimental group.

Figure 2 and Figure 3 show that for participants in both groups, except for Emma, scores increased across each successive timing. This suggests that the SAFMEDS procedures were working to help the participants learn the information. While actual conditions are unknown, Emma's decrease in performance may have been due to external factors such as a distracting environment or a decrease in motivation. On average, participants in the experimental group scored higher on each timing than the participants in the control group. Averages from the correct responses from the control group and the experimental group are displayed in Figure 4.

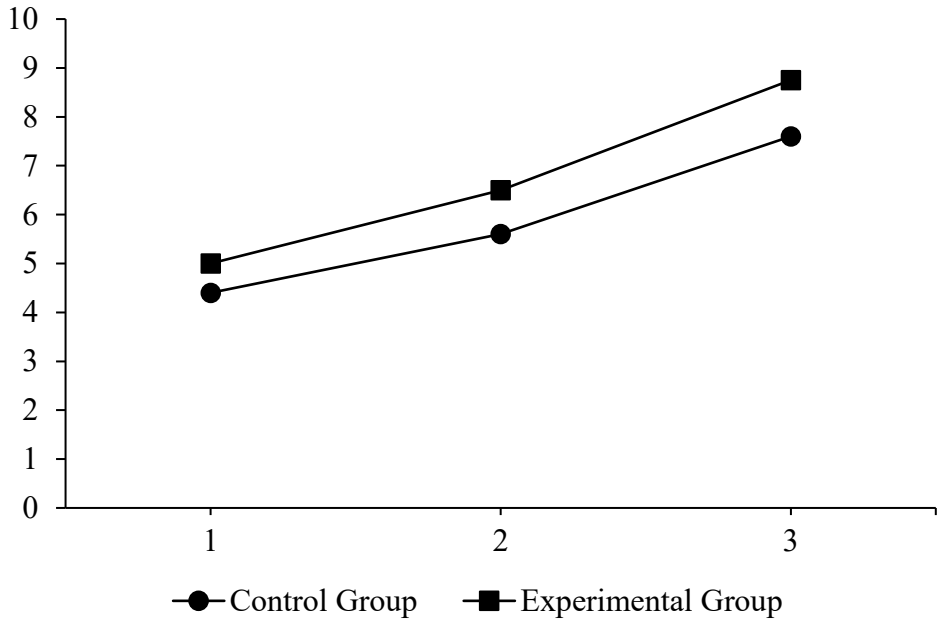

Figure 4. Average number of correct responses during the three SAFMEDS timings for both the control group and the experimental group.

Figure 4 shows that across the SAFMEDS timings, participants in the experimental group scored higher on average than the control group. After the 5 minutes of practice, participants in the experimental group correctly responded to five of the cards. The control group correctly responded to 4.4 cards. Using visual analysis, a systematic way of examining data within a graph, the trends of both data lines were assessed (Cooper et al., 2007). The trend is the direction a data path takes (Cooper et al., 2007). For both the experimental group and the control group, there is a gradually increasing stable trend, again suggesting that both groups were learning the content on the SAFMEDS. One possible explanation for why the experimental group was scoring slightly higher on each timing session may have been due to the 5 minutes of practice with the SAFMEDS prior to the timing sessions. During this practice, participants in the experimental group were

required to attend to the longer side of the SAFMEDS, just like in training. They were having to attend to more relevant features of the cards in order to get them correct.

After the three SAFMEDS timing sessions, the posttest was completed by each participant. The posttest tested for generalization and examined if the participants were able to respond in a see/write channel after learning the content in a see/say channel. The posttest also tested for generalization in which the opposite item (author or title) was presented to the participant than training. During training, the control group was required to see the title and say the author, and the experimental group was required to see the author and say the title. During the posttest, the control group was also required to see the author and say the title and the experimental group was also required to see the title and say the author, which was a novel presentation for both groups. Results from this analysis are displayed in Table 1.

Table 1

Average Scores Across Practice Sessions and Posttest

Group	Practice Sessions	Posttest Questions 1-8	Posttest Questions 9-16	Posttest Total
Control	5.87	1.09	4.4	5.49
Experimental	6.75	2.47	5.5	7.97
Combined	6.32	1.78	4.95	6.73

The scores from Table 3 were analyzed by obtaining the mean and standard deviation for both groups, which served as the descriptive statistics. (Keppel & Wickens, 2004). It was expected that the experimental group would

perform better on the posttest, than the control group. These expectations were correct and participants in the experimental group had higher post test scores (M = 7.97, SD = 3.73) than did those in the control group (M = 5.49, SD = 3.4). Because the posttest was measuring generalization across a different learning channel, these results suggest that learning the cards in the reverse order may facilitate more generalized responding.

Across both groups, participants scored an average of 6.6 correct out of 16, or 41% correct on the posttest. Within the control group, participants scored an average of 5.5 points out of 16 (34%), and participants in the experimental group scored 7.9 points out of 16 (50%). These results show that the experimental group performed better on the posttest with a difference of 2.4 points (16%). Figure 5 and Figure 6 display the results for each participant in both groups from the posttest.

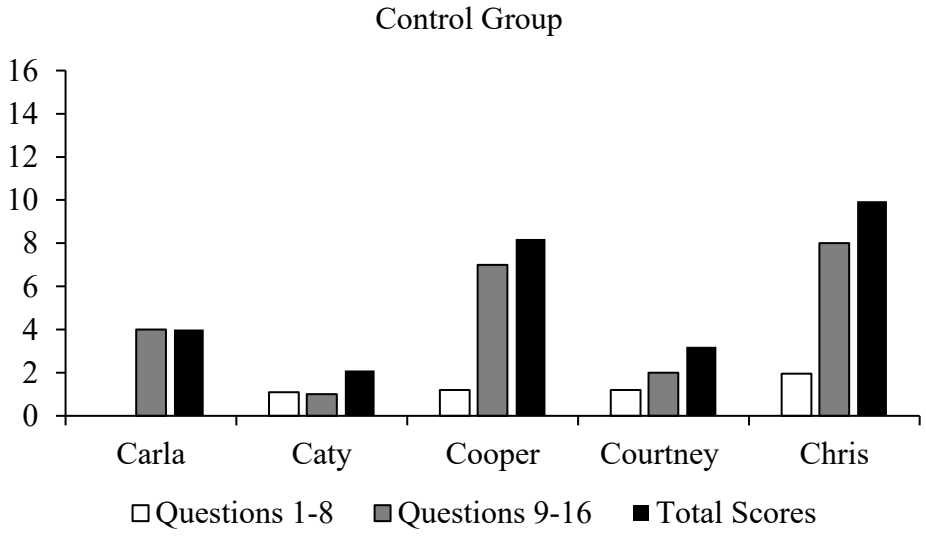

Figure 5. Correct responses for questions on the posttest for each participant in the control group out of 16 possible points.

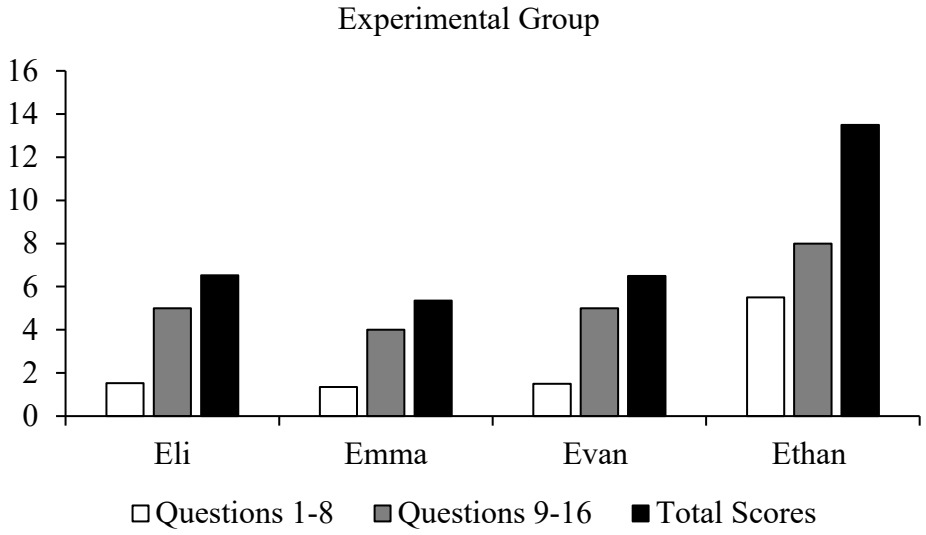

Figure 6. Correct responses for questions on the posttest for each participant in the experimental group out of 16 possible points.

The data displayed in Figure 5 and Figure 6 show that each participant scored higher on questions nine through 16 than they did on questions one through eight. This may have been due to the last eight questions requiring a shorter answer, therefore a lower response effort. For the experimental group, all participants got at least half of the questions correct on nine through 16. This suggests that they were able to generalize the information they learned in the "see-author, say-title" learning channel to a learning channel in which they had to "see-title, write-author". However, when presented with the reverse learning channel, "see-author, write-title", the control group control group did not demonstrate generalization like the experimental group did.

Again, the experimental group scored higher overall than the control group on the posttest. These results suggest that learning SAFMEDS in a "see-title, say-author", or "see-definition, say-term", format may make it more difficult

for individuals to generalize the content they have learned within the SAFMEDS procedure to real world tests. Therefore, if individuals use SAFMEDS in a "see-author, say-title" or "see-term, say-definition", learning channel, there may be quicker acquisition of academic topics and an increase in the likelihood of generalization.

CHAPTER V

DISCUSSION

The findings of this study suggest that learning SAFMEDS in the reverse learning channel, “see-author, say-title”, may result in a slight increase in correct responding and generalization compared to the “see-title, say-author” learning channel, but this difference is not statistically significant. Further, this data suggest it is important for learners to consider both presentation orders when they are practicing and learning using SAFMEDS.

The findings of this study differ slightly from the findings of Polson et al. (1997). In their study, they found that when the stimulus and response items were reversed, there was a decrease in accuracy and response rates for the majority of the participants. These results are similar to the current study in that the control group scored better on the posttest when the stimuli were in the same presentation order as the training sessions. When the stimuli and response items were reversed for the control group, their performance decreased. However, the results from the current study differed from Polson et al. (1997) in regard to the experimental group. When the stimulus and response items were reversed from the standard SAFMEDS procedures in the posttest, participants in the experimental group were able to correctly respond when the items were reversed. Possibly due to the response effort required, participants in the experimental group were able to correctly respond to more questions in the reverse learning channel than the control group.

Again, the findings from the current study both agree and disagree with the findings of previous research. Polson, Wong, Parson, and Grabavac (1991) also examined generalization with reverse presentations. The participants in Polson et al. (1991) failed the generalization tests. The results from their study showed that the skill did not generalize when the participants were presented with the reverse task on the test. The results from their study coincide with the results from the current study in regard to the control group only. When the task was reversed for the control group, they were only able to correctly respond to about one question on average. When presented with the reverse presentation on the posttest, the experimental group was able to get more than half of the questions correct on average. There are a variety of factors that may explain these results.

One factor that may explain the results of the current study is that the response effort for participants in the "see-author, say-title" or "see-author, write-title" learning channel was greater than the reverse learning channel. The experimental group learned the SAFMEDS in the "see author, say title" presentation order, but based on the posttest, it was more difficult for them to respond correctly to the "see-author, write-title" questions than the "see-title, write-author" questions. For the control group, this difference in response effort made it significantly harder to answer the first eight questions correctly, which resulted in an average of one correct answer for each participant.

There were a few limitations within this study. One limitation was that specific data related to procedural integrity were not collected. Procedural integrity is the extent to which the procedures are implemented as intended. The

primary investigator was the only individual running the experimental procedures. The procedures were created by the primary investigator and a document was created in which the steps of the procedures were written down (Appendix D). This document was accessible to both participants and the primary investigator throughout the entire experimental procedure. This document served as a visual self-checklist. However, data were not collected by an unbiased observing party due to barriers related to location and time. Collecting procedural integrity data may have benefited the results of the study by ensuring that each step of the procedure was implemented as intended and that each participant received the same exact instructions throughout the experiment. If procedural integrity were to be collected in future research of this kind, a data sheet would be collected that would allow for the unbiased observer to check that the primary investigator was running the procedures as intended.

Another limitation was that social validity was not collected. Social validity is the extent to which a procedure is liked by the participants and the extent to which they may use the procedures again in the future. Social validity data were not collected due to the location and the participants involved. *Flashcard Fluency*, the program used, and SAFMEDS are procedures that the participants already used in their daily work as teachers at Morningside Academy. Because social validity measures the extent to which a procedure is liked and the likelihood of the participants using again, these data were not collected.

While social validity was not included within this study, future research could incorporate it by creating a survey for participants to fill out at the end of

the experiment. This survey could collect data on how the participants liked the program, the content, and if they are likely to use these procedures and programs with their learners in the future.

Another limitation of this study was the time spent learning the decks. Part of the acronym, SAFMEDS, is to practice the decks daily (Lindsley, 1996). The participants in this study were not able to learn the decks to a fluent level of responding due to the study only taking place across one day. If the participants were able to practice each day until fluent, the results may have shown which direction of training would result in a quicker rate of acquisition.

There were also a limitations related to the participants having to recall information learned during the SAFMEDS timing sessions to take the posttest. One of these limitations was that the tutorial deck contained children's authors and their corresponding book titles. This content was very similar to the content used during training and the timing sessions (authors and titles). These stimuli may have been too similar, which may have resulted in some errors when the participants were required to respond. In addition, the use of the author's names may have been too arbitrary of stimuli to use within this study. This is because the participants may have unaccounted for histories with the names of the authors (i.e. Johnson), or the names may be so obscure that they were harder to recall (i.e. Andronis).

Another limitation of the posttest used within this study was that order effects were not accounted for. Order effects occur as the result of the presentation order of questions on the posttest. Due to fatigue or boredom,

participants may have performed differently as a result of the order of the questions asked in which the harder, longer questions were presented at first and all at once. The likelihood of order effects like this increase when questions on posttests like the one used within this study are repetitive, uninteresting, or too difficult (Shaughnessy, Zechmeister, & Zechmeister, 2006). This could be addressed in future research by shortening the posttest and systematically varying the order of the questions so that the questions that require more response effort do not all occur at the same time (Shaughnessy et al., 2006).

Based on the stated limitations, future research should look into increasing the number of participants as well as the days and trials participants are able to practice until they are fluent with the decks. Another suggestion for future research is to look at measuring generalization across learning channels using SAFMEDS decks with similar stimulus size on both sides to equalize the response effort.

SAFMEDS is a useful tool for learning information quickly and accurately compared to other notecard procedures. Different SAFMEDS procedures may affect the rate by which learners acquire new information and generalize to novel learning channels. While the limitations of this study make it difficult to prove which learning channel presentation is most effective for correct responding and generalization, individuals looking to utilize SAFMEDS should consider changing the order in which they are presenting the cards from the standard format of "see-definition, say-term" to "see-term, say-definition" as it may result in quicker acquisition of content and increase the likelihood of generalization.

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Appendix A

SAFMEDS Training Sets

	First Author	Journal Article Title
1.	Andronis	Contingency Adduction of Symbolic Aggression by Pigeons
2.	Binder	Behavioral Fluency
3.	Deno	Developments in Curriculum-Based Measurement
4.	Eshleman	Quantitative Trends in the History of Verbal Behavior Research
5.	Graf	SAFMEDS: A Tool to Build Fluency
6.	Greer	The Evolution of Verbal Behavior in Children
7.	Haughton	Great Gains from Small Starts
8.	Iwata	On the Distinction Between Positive and Negative Reinforcement
9.	Johnson	Contributions of Precision Teaching
10.	Kubina	Behavior Analytic Contributions to the Study of Creativity
11.	Lindsley	Is Fluency Free-Operant Response-Response Chaining?
12.	Michael	Two Kinds of Verbal Behavior Plus a Possible Third
13.	Mullins	Systematic Desensitization with Children and Adolescents
14.	Sidman	Equivalence Relations and the Reinforcement Contingency
15.	Skinner	A Case History in Scientific Method
16.	Stokes	An Implicit Technology of Generalization

Appendix B

SAFMEDS Practice Set

	Author's Last Name	Book Title
1.	Allsburg	Jumanji
2.	Blume	Freckle Juice
3.	Brett	Annie and the Wild Animals
4.	Brown	Goodnight Moon
5.	Carle	The Very Hungry Caterpillar
6.	Cleary	Ramona Quimby, Age 8
7.	Dahl	Charlie and the Chocolate Factory
8.	Lewis	The Chronicles of Narnia
9.	Martin	Chicka Chicka Boom Boom
10.	Paterson	Bridge to Terabithia
11.	Potter	Peter Rabbit
12.	Rowling	Harry Potter
13.	Sendak	Where the Wild Things Are
14.	Seuss	The Cat in the Hat
15.	Tolkien	The Hobbit
16.	White	Charlotte's Web

Appendix C

Informed Consent

RESEARCH PARTICIPANT INFORMED CONSENT

Study Title: The Effects of Reversing SAFMEDS Presentation on Learning and Generalization

Principal Investigator: Emily Nordlund, Graduate Student

Faculty Sponsor: Dr. Richard Marsicano, Assistant Professor of Psychology, RMarsicano@cwu.edu

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1. What you should know about this study:

- You are being asked to join a research study.
- This consent form explains the research study and your part in the study.
- Please read it carefully and take as much time as you need.
- Ask questions about anything you do not understand now, or when you think of them later.
- You are a volunteer. If you do join the study and change your mind later, you may quit at any time during or right after testing without fear of penalty or loss of benefits.

2. Why is this research being done?

This research is being done to compare the effects of a standard SAFMEDS (a type of flashcard) procedure with a reversed SAFMEDS. This study is designed to discover which procedure produces the best learning outcomes.

3. Who can take part in this study?

Employees at Morningside Academy without significant visual impairments are eligible to participate in this study. Approximately 66 participants are expected to participate in this study.

4. What will happen if you join this study?

If you agree to be in this study, we will ask you to do the following things:

Pre-Procedures

- Once you sign the informed consent, you will be assigned to groups based on your order of participation. There are two groups in this study and group assignments are alternated between participants.
- This study only requires your participation for one session. Sessions will last approximately 20 minutes.

Tutorial

- The primary investigator will give you directions on how to use a computer program in which you will learn a tutorial deck of flashcards. You will be instructed to look at a set of electronic flashcards and learn their corresponding pairs and familiarize yourself with the computer program.

Training

- During training, you will use the same program as you learned during the tutorial. You will be instructed to learn a new set of electronic flashcards. You will have five minutes to study the deck before completing three, 2 minute timings in which you will respond to the given flashcards.

Results

- The paper pencil posttest will consist of 16 fill in the blank questions that will measure your responses after training.

5. What are the risks or discomforts of the study?

There are no foreseeable physiological risks/discomforts, psychological, emotional, financial, social, and legal risks. You may experience minor boredom or academic strain. You may request breaks between timings and will be allotted to do so. There may be side effects and discomforts that are not yet known.

6. Are there benefits to being in the study?

By participating in this study, you may learn a new flashcard procedure that you may find useful in your academic studies.

If you take part in this study, you may help others in the future utilize an effective flashcard procedure when learning new academic content.

7. What are your options if you do not want to be in the study?

You do not have to join this study. If you do not join, it will not affect your jobs status in or any of your privileges as a Morningside Academy employee.

8. Will you be paid if you join this study?

You will not be paid to participate in this study. However, you may enter your name for a raffle drawing for a $50 gift card. You may decline to participate in the raffle.

9. Can you leave the study early?

You can agree to be in the study now and change your mind later. If you wish to stop at any time, please tell us right away. Leaving this study early will not affect

your standing at Morningside Academy in any way. If you leave the study early, the investigator may use information already collected from you.

10. What information about you will be kept private and what information may be given out?

Participants will be assigned a number upon participating in the study. This number will be used to record all data. No client identifiers will be used in this study. Data will be cleared from the flashcard program at the end of this study.

11. What other things should you know about this research study?

a. What is the Institutional Review Board (IRB) and how does it protect you?

This study has been reviewed by the CWU Human Subject Review Council. HSRC is made up of faculty from many different departments, ethicists, nurses, scientists, non-scientists and people from the local community. The HSRC's purpose is to review human research studies and to protect the rights and welfare of the people participating in those studies. You may contact the HSRC if you have questions about your rights as a participant or if you think you have not been treated fairly. The HSRC office number is (509) 963-3115.

b. What do you do if you have questions about the study?

Email the principal investigator, Emily Nordlund at nordlunde@cwu.edu or the faculty sponsor, Dr. Richard Marsicano at RMarsicano@cwu.edu.

12. What does your signature on this consent form mean?

By signing this consent form, you are not giving up any legal rights. Your signature means that you understand the study plan, have been able to ask

questions about the information given to you in this form, and you are willing to participate under the conditions we have described.

A copy of the form will be given to you.

Participant's Name (print): _____

Participant's Signature: _____ Date: _____

Signature of Investigator: _____ Date: _____

Appendix D

Participant Instructions

Follow the instructions below.

1. The research assistant will start the timings for you. When you begin, these are the keys to use.

a. When you see the card, say the corresponding pair item **OUT LOUD**

b. After you say the corresponding pair item out loud, press the **SPACEBAR** to display the item.

c. If you do not know the answer, say **"I DO NOT KNOW"**

d. If your answer was **CORRECT** press the **RIGHT ARROW KEY**

e. If your answer was **INCORRECT** or **"I DO NOT KNOW"** press the **LEFT ARROW KEY**

2. First, you will practice with the research assistant using a practice deck containing a set of children's authors and their corresponding book titles.

3. After you complete the practice deck, you will begin with the training decks. You will complete 5 minutes of untimed practice, then three 2 minute timings. Your job is to learn a set of authors and their corresponding journal article titles.

Appendix E

Posttest

To be filled out by

Research Assistant

Participant Number:____

Group:_____

Please fill in the blanks with the corresponding author or article title.

1. Binder _____
2. Eshleman _____
3. Iwata _____
4. Kubina _____
5. Michael _____
6. Greer _____
7. Sidman _____
8. Stokes _____
9. _____ Contributions of Precision Teaching
10. _____ Systematic Desensitization with Children and Adolescents
11. _____ SAFMEDS: A Tool to Build Fluency
12. _____ Is Fluency Free-Operant Response-Response Chaining?
13. _____ Great Gains from Small Starts
14. _____ Developments in Curriculum-Based Measurement
15. _____ Contingency Adduction of Symbolic Aggression by Pigeons
16. _____ A Case History in Scientific Method

Appendix F

Sample Recruiting Email

Hello Morningside Faculty & Staff,

I am emailing you to request your participation in my thesis study titled *The Effects of Reversing SAFMEDS Presentation on Learning and Generalization.* This study will use Dr. Kent Johnson and Vicci Tucci's Flashcard Fluency Program to assess the effects of reversing the order of presentation of SAFMEDS. Your participation will take roughly 15-20 minutes, and can be scheduled to your convenience. If you would like to sign up to participate or have any questions, feel free to email me.

Thank you for your consideration,

Emily Nordlund

Appendix G

Sample Flyer

RESEARCH PARTICIPANTS WANTED

ARE YOU INTERESTED IN LEARNING NEW AND EFFECTIVE FLASHCARD PROCEDURES?

I am requesting participants for my thesis study, *The Effects of Reversing SAFMEDS Presentation on Learning and Generalization.* This study will use Dr. Kent Johnson and Vicci Tucci's Flashcard Fluency Program to assess the effects of reversing the order of presentation of SAFMEDS (Say All Fast a Minute Each Day Shuffled). Your participation will take roughly 15-20 minutes, and can be scheduled to your convenience. By participating, you can enter a raffle for a $50 gift card!

Sign up by contacting the primary investigator, Emily Nordlund for more information.

Appendix H

Sample of Fluency Flashcards

In order, these images represent what the participant during the experimental phase.

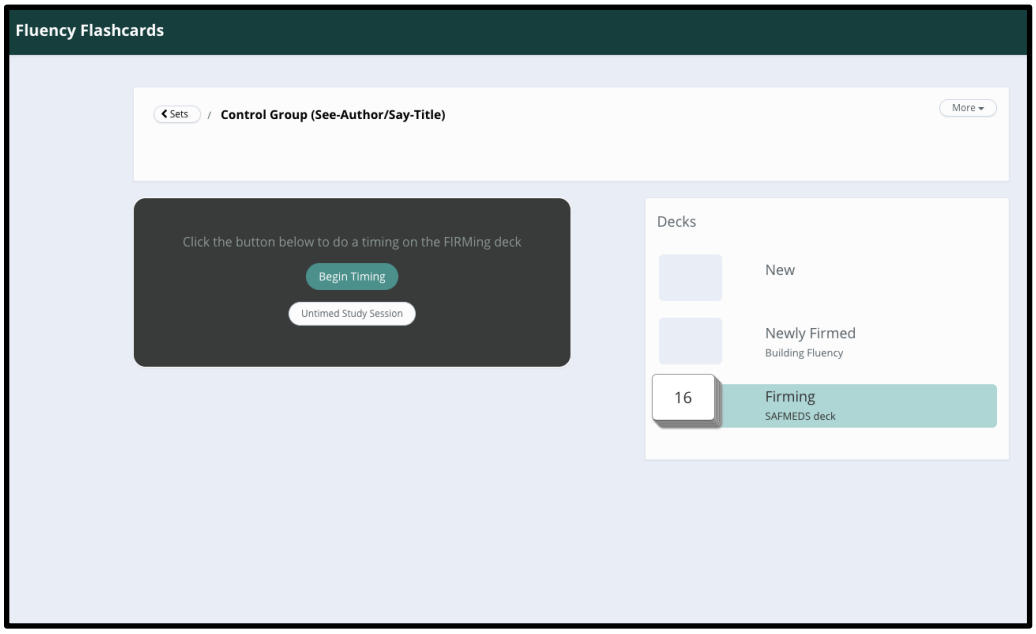

Figure 1.

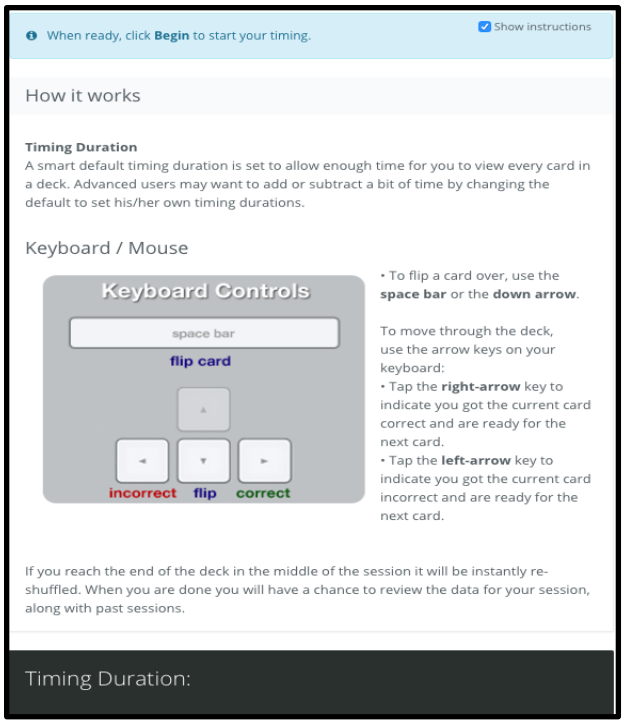

Figure 2.

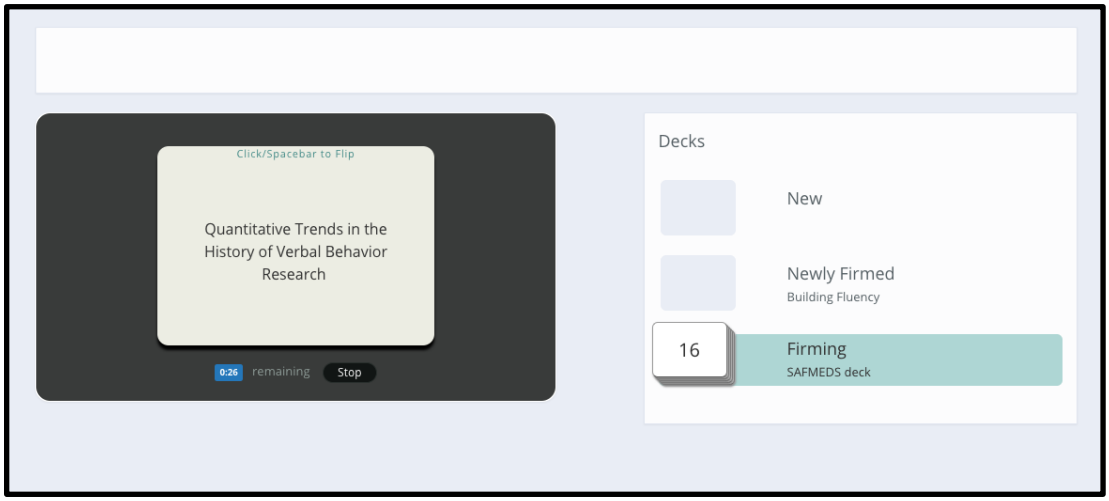

Figure 3.

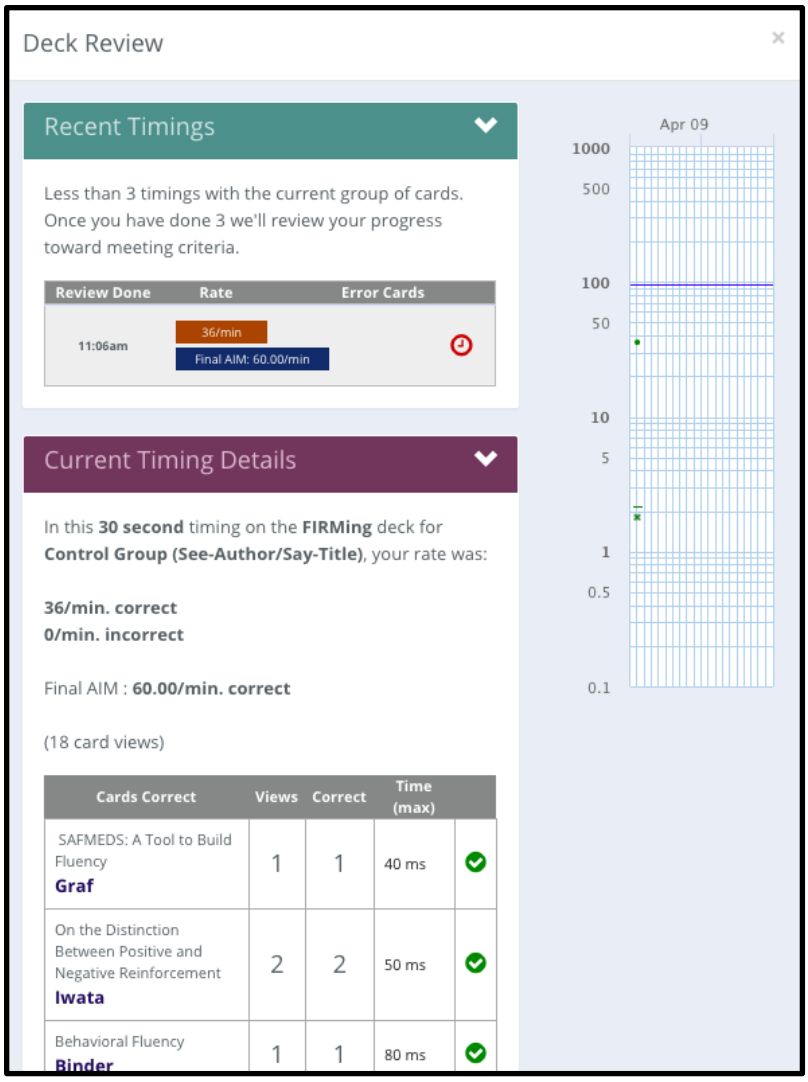
Deck Review
Recent Timings
Less than 3 timings with the current group of cards. Once you have done 3 we'll review your progress toward meeting criteria.
Review Done
Rate
Error Cards
11:06am
36/min
Final AIM: 60.00/min
Current Timing Details
In this 30 second timing on the FIRMing deck for Control Group (See-Author/Say-Title), your rate was:
36/min. correct
0/min. incorrect
Final AIM : 60.00/min. correct
(18 card views)
Cards Correct
Views
Correct
Time (max)
SAFMEDS: A Tool to Build Fluency
Graf
1
1
40 ms
On the Distinction Between Positive and Negative Reinforcement
Iwata
2
2
50 ms
Behavioral Fluency
Binder
1
1
80 ms
Apr 09
1000
500
100
50
10
5
1
0.5
0.1

Figure 4.