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The Effects of Preprinted versus Handwritten SAFMEDS on Fluency

Samantha Fodrocy
Western Michigan University, fodro1sj@cmich.edu

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Samantha J. Fodrocy, Jessica E. Frieder and Shawn Quigley

Western Michigan University

Abstract

Precision Teaching is an instructional evaluation technique used by educators to ensure that targeted skills are being achieved by learners (Moran & Malott, 2004). Say all fast a minute each day shuffled (SAFMEDS) is a specific PT influenced instructional strategy intended to develop fluency within timed trials (Eshleman, 2000). However, there is little empirical research related to the proposed effects of SAFMEDS. A recent study by Meindl and colleagues (in press) demonstrated the position of the text on SAFMEDS affected fluency. Results of this study suggest extraneous variables affect responding indicating a possible stimulus control issue. However, there were methodological concerns with the study that limit its interpretation. As such, the current article will focus on replication and extension of this study. Specifically, does the text type (i.e., handwritten versus printed) on the SAFMEDS cards affect fluency?

Keywords: SAFMEDS, Precision Teaching, fluency

The Effects of Preprinted Versus Handwritten SAFMEDS on Fluency

According to Moran and Malott (2004), Precision Teaching (PT) is an instructional evaluation procedure that employs many of the tenets of effective instruction to evaluate that adequate student progress is being made. Some of these tenets include practicing skills daily, measuring these skills, and then plotting them on a graph. First, a behavior should be targeted for intervention. An operational definition should be developed along with a system of measurement for that behavior. Then, data should be recorded on that behavior. Finally, data should then be charted so that it may be visually inspected by teachers so that trends in data can be monitored. PT specifically focuses on fluency, which is defined as accuracy and speed of responding (Binder, 1996). For example, when looking at a child's reading abilities, a measure of fluency would look at the number of words read correctly per unit of time (e.g., one minute). The fluency measure is then plotted on a Standard Celeration Chart, a semi logarithmic graph that depicts celerations or trends in the data and accurately predicts future performance (see Calkin, 2005 for a further review). PT follows the motto that 'the learner is always right.' This means that PT is guided not by what the teacher is doing, but by how the learner responds. For example, if a learner is not 'learning', as suggested by a flat or decelerating trend in the data on a Standard Celeration Chart, a teacher must analyze which component of instruction is not working, lack of prerequisite skills, or other factors (Moran & Malott, 2004).

For proponents of PT methods, the importance of fluency as an educational measure cannot be understated. As previously mentioned, fluency is a measure of accuracy and speed of responding. This is different from the traditional classroom in the United States, in that most teachers focus solely on measures of accuracy with their learners. For example, a measure of accuracy a teacher might use would be how many subtraction problems out of twenty a student answered correctly. Though it is clearly very important to having learners responding correctly, it is also very important to focus on speed of responding as well. To become proficient in complex skills, learners need to be able to complete the tool skills that they build upon at a high rate. For example, even if a learner can correctly answer every multiplication and subtraction problem given to them, if they cannot do it quickly, learning a skill such as long division which uses both multiplication and subtraction will be much more difficult. As such fluency must be a focus for teachers and other practitioners. However, they must be sure to choose a speed of responding that is appropriate for the skill at hand, which is known as a fluency aim.

The results of PT are often effective in improving “desirable” behaviors and decreasing “undesirable” behaviors for a variety of learners across an array of settings. According to Cihon (2007), a number of studies have successfully increased interverbal repertoires in a variety of different skill sets (Lovitt et al., 1985; Spaulding et al., 1995; Sweeney, et al., 2001; Killu et al., 2011). Beck and Clement (1991) summarized the findings of the Precision Teaching Project, which was a group of studies done based on the use of PT methods by teachers in Great Falls Public Schools. Originally the project was only intended to be completed in special education classrooms, but because of the efficacy of the program with special education students, teachers eventually implemented 1-minute timings with students in both special education and mainstream classrooms to increase fluency in reading, spelling and math. The use of PT methods in these studies has shown great effects in as little as 30 minutes a day of use in the classroom. In a 1975 study, researchers were interested in seeing the effects of a combination of PT methods on general test performance of mildly handicapped students in elementary classrooms over the course of a year. The independent variable was a group of PT methods including the use of daily 1-minute timings with basic skills with high fluency aims and daily charting. These tools were implemented daily over the course of a one year period. The dependent variable was tests given to the individuals. The results showed that 79% of experimental groups performed better than their counterparts in the control groups at the end of the one year period. Based on the results of the study completed with the special education population, the study was replicated with regular education students. This study showed increases of 20-40% over control groups by students in regular education classrooms. These gains are extremely important because for some struggling students, these PT methods may mean the difference between a special education and a regular education classroom. Also, in normal students, these gains are still very beneficial since it helps them increase their abilities in areas of weakness, such as tool skills and fluency.

Other studies outside of the Precision Teaching Project have evidenced similar results in settings within and outside of the academic settings. One example is McDowell and Keenan (2001), in which a fluency-based strategy was used in a 9-year-old with attention deficit hyperactivity disorder. The independent variable of the study was the implementation of two 1-minute timings with cards displaying letters of the alphabet. The dependent variables of the study were number of sounds correctly pronounced per minute and on-task behavior. In the baseline condition, the participant was given a set of cards which contained a letter in both lower and uppercase, a word that started with that letter and a picture of an object that started with that letter. In the intervention, the participant was given the same cards and practiced the sounds. The cards were spread on the floor, and the participant was to practice sounding out the sounds of the letters on the cards in front of him. He was given prompts and feedback from the teacher when needed. Data was not recorded during this part of the intervention. After practice, the student began a 1-minute trial. He was required to do at least two 1-minute trials per session, but was allowed to complete as many as he wanted to. Though the study had positive effects on correct responding and on-task behavior, there was a lack of experimental control because researchers used an ABAB design on a behavior that is irreversible. A different design approach such as multiple baseline across participants would ameliorate this problem and show better experimental control.

Another study that supports the use of fluency-based instruction is Miller, Hall and Heward (1995). Miller, Hall, and Heward conducted one-minute time trials with and without inter-trial feedback and self-correction to increase fluency with math facts in first grade students. The intervention was carried out in both regular and special education classrooms. Students were exposed to two conditions within a multiple treatment reversal design. The baseline consisted of a 10-minute work period in which students did not receive feedback until the next day. During this condition, students were instructed to answer as many problems as possible during the time period, but were told that they would likely not finish them all. Students individually completed the problems in order starting on the first page and continued working on them until the teacher signaled the end of the 10-minute time period. The first treatment condition was a series of 1-minute timed trials which had next day feedback as well. Students would answer as many questions from a one-page worksheet as they could during the 1-minute time period, and then would rest for 20 seconds, followed by another 1-minute timing. This pattern was repeated until 7 trials had been completed, for a total of ten minutes. The second condition consisted of two one-minute trials followed immediately by feedback. This consisted of group choral responding as well as self-correction and feedback from the teacher. In both the conditions of seven 1-minute timings and two 1-minute timings with choral responding and self-correction, teachers encouraged students to “go fast” through the problems. The dependent variables of the study were correct rate of responding, accuracy and on-task behavior. The measure of rate is different from fluency measures in that it does not take into account whether or not the response was correct, just how many responses overall were completed within a given amount of time. Results of the first grade classroom found that the lowest rate of correct responding occurred during baseline, in which students correctly answered 4.8 questions per minute. In the 1-minute time trial condition, students answered an average of 7.3 questions correctly per minute. The two timed trials plus feedback produced the highest rates of correct responding with 12.0 correct responses per minute. Overall accuracy also increased in the seven 1-minute time trials and two 1-minute timed trials with feedback conditions from 82.5% in baseline to 90% in the following conditions. A final dependent variable that was targeted was on-task behavior. To measure on-task behavior, researchers had the teachers involved select three students who had high rates of off-task behavior. These students' on-task behavior was observed. Baseline produced the lowest measure of on-task behavior at 55.9% of the time. A higher rate of on-task behavior was produced by 1-minute time trials with an average of 80.1%. Two 1-minute time trials plus feedback produced the highest rate of on-task behavior at an average of 90.3%.

The special education classroom had results similar to the general education classroom. However, their students were split into groups by how many days a week they participated, as some students participated only 3 days a week and others participated 5 days a week. The lowest rate of correct responding in the classroom was again observed in baseline with a rate of 8.4 correct answers per minute. The rates of correct responding in the seven 1-minute timed trials without feedback and the two 1-minute timed trials with feedback were 13.2 and 17.3 correct responses per minute respectively. Students who participated 5 days a week had higher rates of responding than those who only participated 3 days a week, but both groups had similar trends in their data. Accuracy rates were 86.5% for baseline, 88.5% for the one minute timed trials and

91.7 % for the one minute timed trials plus feedback. Finally, on-task behavior showed higher rates during the one-minute timed trial condition than baseline and also showed less variability.

There were some concerns with regards to this study. First, the experimental design used was weak. An ABAB design was used, but there were no reversals completed. The implementation of a second condition, so it was ABC, not just AB, strengthens the design somewhat but not completely. Future replications should involve reversals such as an ABCACB design. If there was a relationship demonstrated between the two variables, another problem is that it is not clear which variable was the mechanism of action. Since there were changes in both length of time and feedback given, we cannot be sure which change functioned as the mechanism of action, or whether a combination of both was responsible for the results. Future replications should look at each variable in isolation to ensure which variable is the mechanism of action in these findings.

A specific PT strategy is say all fast a minute each day shuffled (SAFMEDS: Eshleman, 2000). SAFMEDS is considered a PT strategy because it also requires that those implementing the procedure pinpoint, count and chart behavior. The behavior to be increased is typically fluency with concepts or facts (Moran & Malott, 2004). With SAFMEDS, learners are either given or make a deck of flash cards with a stimulus on one side (e.g. a definition, concept, problem) and a desired response to that stimuli (e.g. a term, an answer) on the reverse side of the card. Learners shuffle the cards and then complete a 1-minute timing in which they flip through the cards as fast as they can, stating out loud the answer while simultaneously sorting them into correct and incorrect piles. Correct cards are considered those for which the learner vocally said exactly what was on the back of the card. Incorrect cards are those that the learner either skipped or said something that did not exactly match what was on the back of the card. After the minute period is up, the learner must count the number of correct and incorrect cards and plot them on a Standard Celeration Chart. This same procedure is to be completed at least once per day. Before and after every use of the SAFMEDS cards, learners are also required to shuffle the cards in order to prevent serial learning, in which the order of the cards inadvertently evokes the response rather than the information on the front of the card.

The method described above is the typical standard procedure but, according to Eshleman (2000) there are some variations of the procedure that may be implemented. First, there may be three piles of cards rather than two piles. The cards would be separated into correct cards, incorrect cards and skipped cards. The main difference between this variation and the standard procedure is that the skipped cards are included in the incorrect cards pile in the standard procedure. Second, a learner may also complete more than one timing per day. The other trials completed are considered practice trials and are not graphed. The final timing is still graphed with this variation. Another variation involves which cards are being used. It is possible to begin with only a portion of all the SAFMEDS cards to be used and gradually add cards to the deck. Cards can be systematically added either at certain points in time (e.g., every two weeks) or once a specific fluency aim has been met (e.g., 40 cards correct per minute and 2 cards incorrect per minute). The length of the timing may also be altered. Also, instead of going through the cards for a certain length of time, learners may go through the entire deck once, and divide the number of cards correct and incorrect by that length of time to obtain a fluency measure (Eshleman, 2000).

To date, only a few studies have been completed demonstrating the effectiveness of SAFMEDS and similar procedures on a variety of different skills (Stockwell & Eshleman, 2010; Kubina, Ward & Mozzoni, 2000; Kim, Carr & Templeton, 2001). In Stockwell & Eshleman, the

SAFMEDS procedure was used with a graduate student to increase fluency in the use of terms related to verbal behavior. The dependent variables in the study were the number of correct and incorrect responses emitted during a one-minute timed trial. Before beginning the timed trial, the student studied the cards without being timed for a variable amount of time. Most timed trials occurred at the student's residence or in an office without being in the presence of any other individuals. The learner engaged in a variable number of practice timings each day that she completed the SAFMEDS activity. The number of practice timings ranged between one and six timings and always preceded the recorded timing. For the recorded timing, the student responded vocally to the item on the front of each card with what was written on the back of the card without seeing it. She would go through as many cards as possible during the 1-minute timing, sorting the cards into correct and incorrect piles based upon her responses. After implementing the SAFMEDS procedure, fluency increased from 16 correct per minute to 44 correct per minute. The number of incorrect cards decreased steadily from 4 to 0. Four follow-up timings were also completed which demonstrated a high level of maintenance. The four follow-up timings occurred at variable intervals between 3 and 11 weeks after the completion of the intervention. The lowest score during these follow-up timings was 32 correct and 1 incorrect on week 5.

Though the study shows a clear increasing trend in correct responses and decreasing trend in incorrect responses, there are a number of weaknesses to the study. First and foremost, there was no experimental design. Because there was no experimental design, it cannot be assumed that the implementation of the independent variable was the cause of the changes in the dependent variable. Also the student completed the timings in varying locations and implemented a varying number of practice trials. As such, it is possible that these factors affected the dependent variable in some way. Also, there was no IOA data taken to ensure that the cards were correctly separated. The student completed all timings besides the follow-up timings without being in the presence of another individual. There were also no measures of treatment integrity to ensure that the intervention was implemented with fidelity each time. Because we do not have these measures, we cannot assume that the intervention was implemented and the behaviors were recorded with fidelity. Future studies should be completed within an experimental design with strict requirements for location, treatment integrity and interobserver agreement.

In Kubina, Ward & Mozzoni (2000), a case study was conducted in which SAFMEDS were used with an individual who had sustained a traumatic brain injury to increase fluency in knowledge or orienting information (e.g. Will I be staying here tonight? Where do I go next?). The participant was a 44-year-old man who had suffered a traumatic brain injury. Because of the nature of his injury, he suffered from both retrograde and anterograde amnesia (i.e., inability or difficulty to learn things after the amnesia's onset and no longer being able to remember the past, respectively). As such, the participant was unable to form memories or remember anything about his past, leading to an increased number of questions asked daily. A form of SAFMEDS was used with the participant with orienting information, to help decrease the number of orienting questions he asked staff. The main differences from the typical SAFMEDS procedure were that during the procedure someone else manipulated the cards for him because of physical restrictions, and a 5-second latency criterion was put in place for each card because of his condition. Baseline included staff measuring the frequency with which the participant asked other orienting questions without changing the regular conditions. To implement the procedure, the therapist manipulated a deck of 40 cards for the individual. The participant was required to say what was on the back of the card for the trial to be considered correct. If the participant said an incorrect answer or did not begin answering within 5 seconds, the card was counted as incorrect. The intervention resulted in celeration of x1.1, or 10% increase, in the number of correct responses to SAFMEDS cards. The number of incorrect responses decreased by a celeration of ÷1.1, or decreasing by 10%. Orienting questions decreased from 315 questions during baseline to 31 questions during intervention. This was a deceleration of ÷1.2. A strength of this study is the applied nature of the use of SAFMEDS cards in this instance. One strength of this study is that it shows that SAFMEDS can be used in a nonacademic, applied setting. However, there are several limitations to the study. There was no experimental design. Though there was baseline data taken, we cannot assume it was considered an ABAB design as the study says nothing about why they implemented the intervention at that point in time. As such we cannot say with certainty that the independent variable was the cause of the changes in the dependent variable. There was also no information about IOA or treatment integrity, so we cannot ensure that over the course of the study that data taken was the same each time or that the intervention was implemented with fidelity. Future studies of this nature should be conducted in a similar applied setting but within a single-subject research design. Procedures should be implemented to obtain interobserver agreement ratings as well as treatment integrity data.

In Kim, Carr & Templeton (2001), researchers assessed the effects of SAFMEDS on endurance in participants in both distracting and non-distracting settings. In this study, the dependent variable was correct and incorrect responses per minute on SAFMEDS cards. Participants were exposed to a set of SAFMEDS cards. The set was split into 3, and participants completed 1-minute timings with each subset and combinations of the subsets. They moved to the next subset when they achieved 90-100 correct answers per minute. During these phases, researchers conducted endurance with distraction probes. Once the phases of skill acquisition, were completed, participants were exposed to two other phases: endurance over a 20-minute timing and endurance with distraction over a 20-minute timing. In endurance over a 20-minute timing, participants completed the timing without fatigue, and continued responding at levels between 90-100 correct answers per minute. Participants also maintained high levels of responding during the endurance with distraction phase. Researchers implemented both the endurance and endurance with distraction phases twice. Results show that completing SAFMEDS results in increased endurance when completing the activity with high levels of fluency and in the face of distraction.

However, there were some limitations to the study. Though there was a strong research design with multiple implementations of the two intervention phases, in the endurance and endurance with distraction phases, there was only one data point that was broken down into a minute-by-minute analysis. At least 3 data points within each phase would increase the strength of the design. Also, there may have been sequence effects since the endurance and endurance with distraction were always completed in the same order. Future replications should vary the order of these phases. Also, there were no control groups or participants who completed SAFMEDS who were not fluent to compare the participants to. Because there is no comparison, we cannot be sure that the individuals who do not perform fluently would not show similar unaffected performance during endurance over a 20-minute period. Also, the study did not test distraction conditions to ensure they were distracting, which may have been the reason for the probe results being inconclusive. Future studies should employ a control group and test distraction conditions prior to implementation.

According to Eshleman (2000), SAFMEDS activities, such as those previously mentioned, can be described as functioning as an interverbal repertoire. An intraverbal is one of

Skinner's verbal operants, which is a method of describing verbal behavior and the contingencies involved in it. In an intraverbal, a verbal stimulus evokes a verbal response that has no point-to-point correspondence with the antecedent verbal stimulus. For example, when one answer a question such as, "What is your name," the response would be considered an intraverbal, because the response will be a word different from the words that evoked that response. In the case of SAFMEDS, the text on the front of the card is the antecedent verbal stimulus for the response on the back of the card. SAFMEDS aims to increase fluency in the intraverbal repertoire, in which the stimulus on the front of the card consistently evokes what is on the back of the card. When this occurs, it is called stimulus control. Leslie and O'Reilly (2003) state that stimulus control is when in the presence of a discriminative stimulus you are more likely to respond than when you are not in the presence of that discriminative stimulus. SAFMEDS function correctly when the stimulus on the front of the card exerts stimulus control over the response on the back.

However, it is possible that other things on the card may exert stimulus control besides the intended stimulus. For example, a learner has a deck of cards in which the front of the card has a definition and the back has the corresponding term. One card out of the deck has a smudge on it, and every time the learner gets to that card, the stimulus that evokes their response, rather than the definition, is the smudge. So, the smudge, rather than the definition, has stimulus control over the response. In his directions on use of SAFMEDS, Eshleman (2000) controls for this by advising users to replace cards in the deck that have smudges, bent corners, etc. Another example Eshleman mentions is serial learning. The shuffling requirement embedded in the procedure prevents the position of the card relative to other cards from acquiring stimulus control.

It is possible, however, that in SAFMEDS features of the card that are even less salient may exert stimulus control over responding. Features such as text size, text location and text type may also exert stimulus control over responding. This topic was studied by Meindl, Ivy, Miller & Neef (in press). To test this, Meindl and colleagues conducted two studies in which they manipulated different characteristics of the SAFMEDS cards. In experiment one, the researchers manipulated the placement of the text of the card to examine if placement would have an effect on the fluency of responding

Six students participated in the study as part of a class at a university. There were two sets of cards, A and B, that each contained 45 cards. The only difference between the two sets of cards was the placement of the text on the cards. One set was centered on the card and single-spaced. The second set had definitions that were double-spaced, left justified, had shortened margins, and 1.5 spacing. Each set was split into three smaller sets of 15: A1, A2 and A3; B1, B2, and B3. Each subset in set A corresponded with another subset from set B. For example, A1 corresponded with B1, A2 with B2, and so on. They counterbalanced the three subsets of cards across the three training periods. Students received training cards on the first, fourth and seventh days, and testing occurred on the third, sixth and ninth day.

On training days, students used the cards for a total of 15 minutes consisting of individual review and timings, paired review and timings, and timings with the researcher, for a total of six timings. During individual timings, students timed themselves for 30 seconds and counted how many cards they completed after the timer went off. Partner timings were also 30 seconds in length. Timings with the researcher did not have a timer that counted down, but rather one that counted up. The students finished the deck as quickly as they could, and the time was recorded at the end of the test.

On testing days, students were timed twice by the researcher. The first timing used the cards from training days, while the second timing used the generalization set with the different formatting. Once the student got through the deck, the researcher would count the number of cards in each in pile and record them and would also record the amount of time the student took to complete the deck.

To measure changes in fluency from the first timing to the second, researchers subtracted the second timing from the first yielding either a positive or negative number which would mean that there was either an increase or decrease in fluency respectively. On training days, students were more fluent on the second timing than the first, with an increase of between 0.22 to 2.1 words per minute. Generalization tests 1 and 2 showed decreases in fluent responding of -2.87 and -0.4 words per minute respectively, while generalization test 3 showed a small increase at +0.6 words per minute. This suggests that changes in formatting do affect fluency, and thus formatting does have some stimulus control over responding.

Though the study had overall positive results, there were some issues. The biggest problem with the study was the experimental design implemented. Researchers implemented an ABC design in which there were no reversals. Implementing reversals would strengthen the experimental design. Also, there were generalization effects over the course of the study in which eventually participants did not show negative decreases in fluency to the independent variable. A multiple baseline across participants with an embedded reversal would strengthen the findings by repeating these findings across multiple participants at different times.

Though the Meindl and colleagues (in press) study had a few design flaws, the results support the idea that other variables besides the definition itself in a SAFMEDS card may affect responding. However, few other variables outside of text position have been systematically assessed in a similar way to see whether or not they too may have an effect on stimulus control. One of these important variables is the function of the type of text that is used on the cards.

Specifically, another variable that may impact responding, both in terms of accuracy as well as fluency, is whether the SAFMEDS cards are preprinted in a standard font or are handwritten. It is important to know whether or not this factor alters stimulus control in any manner, so it can be determined whether learners should be required to have all of one kind of SAFMEDS cards (e.g. preprinted), be allowed to mix the cards (e.g. preprinted mixed with handwritten) or whether one type (e.g. preprinted versus handwritten) enhances responding or increases generalization to different formats to increase stimulus control of the correct stimuli. The current study aims to replicate the findings of Meindl and colleagues (in press) and extend the findings beyond formatting to text type. The current study will look at the effects of SAFMEDS text type (e.g., handwritten versus preprinted) on fluency in six college students at a Midwestern university.

Method

Participants

A total of six participants will be recruited for this study. Students must be undergraduate psychology students at Western Michigan University. They must not have previously taken Psychology 5170, to limit previous exposure to the terms used in the SAFMEDS procedure. Flyers with information about the study will be posted in Wood Hall to recruit participants for the study. Undergraduate assistants will also recruit participants from psychology courses within the department. Students may be offered extra credit for relevant courses, which is decided by the instructor of their course.

Setting

The study will take place at a Midwestern university. A room that is 4x5 meters will be used. The room contains a large desk where the SAFMEDS timings will take place. In the room is also another desk with computers, file cabinets, and chairs. During the procedure, one to two researchers will be present with the participant. These researchers will be either one of the principal investigators, one of the undergraduate assistants or a combination of both, but will vary from session to session.

Materials

The main materials used will be 60 SAFMEDS cards created for a psychology course within the department (i.e., Psychology 5170, Psychology in the Schools). There will be two sets of cards which both contain all 60 cards, sets A and B. The differences between the two sets will be the type of text on the cards. Set A will contain cards with a preprinted text. The text on these cards will be times-new roman 14 pt. font printed using a laser printer. Set B will contain cards in which the text is handwritten. All cards will be handwritten by the principal investigator to ensure that the handwriting is the same on all cards. Text on both sets of cards will be centered on the middle of the cards. Additional materials will also include a stopwatch and data sheets to record responding.

Dependent Variable

The dependent variable of this study is the number of correct and incorrect responses per minute. A correct response will be defined as one in which the participant said exactly what was on the back of the card. A response will be marked as incorrect if the individual says something that is not exactly what is on the back of the card, says ‘skip’, or makes no response at all. Correct and incorrect responses will be recorded by researchers who will count and record both the number of correct cards and incorrect cards in each pile.

Measurement

The measurement used in this study is fluency, or the number of correct responses per unit of time (i.e., one minute). Both correct and incorrect responses will be recorded by researchers by counting the cards in both piles after each timing. Data for the study will be collected by the principal investigators as well as by undergraduate assistants. Two timings will take place during each session, a practice timing and a recorded timing. Only data from the second timing will be taken. The data will then be plotted on a Standard Celeration Chart.

Interobserver Agreement

Interobserver agreement data will be taken for a minimum of 30% of sessions. This will be completed by having a second observer present during the sessions. Interobserver agreement will be required to be above 80%. If interobserver agreement falls below 80%, the definitions for correct and incorrect responses will be reviewed, and observers will be retrained.

Independent Variable

The independent variable for this study is a variation in formatting of the cards, specifically whether the text on the cards is handwritten or preprinted text. Handwritten cards will have text handwritten by the same individual the same size as the 12 pt. font. Preprinted cards will have the text written in 12 pt. Times New Roman font printed by a laser printer. Both cards will have the same centered justification on the card.

Experimental Design

The experimental design for this study will be a reversal embedded within a multiple baseline across groups design. There will be counterbalancing of treatment conditions, with groups A and C beginning with set A (i.e., preprinted cards) and group B beginning with set B (i.e., handwritten cards).

Procedure

Training

Before beginning baseline, all participants will be introduced to the SAFMEDS procedure. Training will last for one session. Researchers will explain and show a model of the SAFMEDS procedure for the individual. To assess the rate at which the participant is able to flip the cards, researchers will give the participant 60 3x5 index cards with simple math facts to the procedure. Participants will be given a timer and allowed to individually practice the procedure. After being allowed to practice with the cards for 5 minutes, researchers will engage the participants in three 1-minute timings. During these timings, if the participants do not manipulate the cards at a rate of at least 50 cards per minute for at least one trial, they will be excluded from the study. Performance criteria for SAFMEDS was defined by Graf (2000), which states that individuals using SAFMEDS should be able to complete 50 cards or more per minute. If an individual cannot manipulate cards at this rate before beginning the SAFMEDS intervention, this may skew their results.

Baseline

SAFMEDS cards used during both baseline and intervention will consist of 60 term-definition pairs used in the psychology in the schools course. The terms are related to the content of the course. Sessions will occur 5 days a week, Monday through Friday. Participants will only be able to access the cards during these sessions. During baseline the six participants will be split into three equal groups of two participants each. This will be done randomly. During baseline, groups A and C will start with cards in set A, and group B will start with the cards in set B. Having three groups start with different sets and then switch to the other set of cards will more strongly support the idea that changing text type in general will affect responding, rather than one specific kind. If all participants only went from set A (preprinted) to set B (handwritten), we could not infer that the same results would occur when implementing the reverse (handwritten to preprinted). Participants will complete two timed trials per session. The second timing will be graphed and used to determine whether or not steady state responding has been achieved. All participants will continue in baseline until steady state responding is achieved in each participant. All participants will be required to meet a minimum of 35 correct cards per minute for 3 trials before the first group moves to the intervention phase.

Intervention

Once stable responding is achieved in all participants in baseline, the first group will begin the intervention with the next set of cards. They will again complete two timings with the second being graphed, however the new set of cards will contain the text type they were not exposed to in baseline. After stable responding is achieved again with the second set, the next participant will move to the intervention phase with the next set of cards. This pattern will continue with all participants. For this condition, stable responding will be reached when the individual has reached at least 35 correct cards per minute for 3 consecutive sessions.

There will also be embedded reversals in which, after reaching steady state responding, in the first phase of the intervention, individuals will return to the previous formatting and then to the second formatting again. For example, Group A will begin in baseline with the preprinted cards. Intervention will consist of the first condition with the handwritten cards, the second with the preprinted cards, and the third again with the handwritten cards.

Results

The results of this study should establish whether or not text type has stimulus control over responding in SAFMEDS activities. This will be beneficial in determining whether or not all students should be required to use one kind (preprinted vs. handwritten) or if they can mix their cards, and so that we can ensure that the correct stimuli are controlling responding.

It is expected that after becoming fluent with the first set of cards and moving to the second set in phase 2, that there will be a decrease in fluency and then fluency will begin to increase again. Latter phases are expected to show lesser decreases in fluency and possibly increases in fluency as a result of generalization effects. This will show that text type does have some stimulus control over responding in SAFMEDS, but that the more the individuals are exposed to these changes, the less stimulus control it will have. The reversal embedded within a multiple baseline across groups design allows for more confidence in the fact that the independent variable is responsible for changes in the dependent variable as each group moves to the next phase at different times after achieving steady state responding and the generalization effects across phases are repeated across participants.

There are limitations to the current study. The current study will only look at whether or not text type has stimulus control over responding. Though it will be valuable to know whether or not it does, the current study does not propose any situation to remedy this so that generalization will occur more readily from the use of the SAFMEDS cards to other settings. Future studies should look at ways to limit the control text type has over fluency, but also to replicate the findings of this study since it is the first to look at stimulus control of text type. Also, the current study has a rather small sample of six individuals. This may inhibit the inability to generalize the results to all college students. Future studies should attempt to include more participants. Another limitation is that students may choose to participate in the study for a number of different reasons, some of which include extra credit opportunities. This may affect the kind of student which participates in the study. Finally, similarly to Meindl and colleagues (in press), ceiling and floor effects may affect responding. Individuals who show the highest rates of responding may not be able to go much faster, but have a lot more to lose than those who respond more slowly. On the contrary, students who go slower may have much to gain, but also may not have much lose in terms of responding. Future studies should attempt to account for this in some way.

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