

Flashcard Interventions to Teach Sight Words and Math Facts

Lindsey Loflin¹, Kristina K. Vargo², and Melanie Plaster³

Therapy and Beyond¹

Sam Houston State University²

Conroe Independent School District³

Authors' Note

Dr. Kristina Vargo is an Associate Professor of Special Education at Sam Houston State University. Dr. Vargo is also a Board-Certified Behavior Analyst-Doctoral (BCBA-D) and a Licensed Behavior Analyst in the state of Texas. She earned her M.S. in Behavior Analysis and Therapy, and her Ph.D. in Rehabilitation, both from Southern Illinois University-Carbondale. Dr. Vargo teaches courses primarily in the Low Incidence Disabilities and Autism program. Her research interests focus on the application of behavior analysis in educational settings. Kristina K. Vargo  <https://orcid.org/0000-0001-7868-0550>

Lindsey Loflin is now at Therapy and Beyond.

Melanie Plaster is now at Conroe Independent School District.

Correspondence concerning this article should be addressed to Dr. Kristina K. Vargo, School of Teaching and Learning, Sam Houston State University, Huntsville, TX 77340, United States. Email: kkv003@shsu.edu

Abstract

Many elementary students struggle with the acquisition of sight words which can hinder development of complex reading skills. Additionally, students who lack fluency with computation of basic math facts may struggle with higher-order math concepts. In this study, we compared the efficacy of two flashcard interventions for teaching sight words and math facts to 4 elementary students. The results showed that Strategic Incremental Rehearsal (SIR) was generally superior to Incremental Rehearsal (IR) in that more targets were mastered. We assessed student preference for the flashcard interventions and found that 2 students showed preference for each of the flashcard interventions. In addition, we evaluated social validity of the flashcard procedures with 6 teachers from the students' school, and all rated both interventions favorably.

Keywords: flashcard interventions, incremental rehearsal, interspersal techniques, preferences, sight words

An Evaluation of and Preference for Two Flashcard Interventions

Students who struggle with reading are more likely to struggle in school and have a higher risk of dropping out (Stewart et al., 1997). While learning phonics is a vital skill needed for reading (National Reading Panel, 2000), many words (e.g., “come,” “said,” and “once”) do not follow typical phonics patterns making them difficult to decode and sound out. Sight words are “high-frequency, irregularly spelled words,” and acquisition of sight words enables students to recognize the words immediately upon seeing them (National Reading Panel, 2000). Many teachers and researchers have effectively utilized flashcard interventions to teach students to memorize and recall words (Nist, & Joseph 2008; Phillips, & Feng 2012).

One commonly used flashcard intervention is known as incremental rehearsal (IR). IR consists of teaching new words by interspersing known (e.g., mastered) and unknown (e.g., novel) words (MacQuarrie et al., 2002). A teaching session begins when the teacher presents the first unknown word, followed by a known word. The teacher then presents the unknown word again, followed by the previously-presented known word and an additional known word. The sequence of adding an additional known word continues until the designated number (e.g., nine) of known words has been exhausted. The teacher then removes one known word from the rotation and moves the previously unknown word to the first known item position. The teacher then presents a second unknown word while sequentially adding each known word one at a time. The teacher follows this sequence until the all unknown words (e.g., three) have been presented within a single session (MacQuarrie et al., 2002). Throughout the teaching session, when the student reads aloud a word correctly (within 3 s), the teacher provides praise and proceeds to the next word. Failure to correctly read aloud the word correctly results in corrective feedback and error correction from the teacher.

IR has been shown to be effective at teaching sight words (e.g., MacQuarrie et al., 2002; Nist & Joseph, 2008), but may not be the most efficient procedure for classroom use. Kupzyk et al. (2011) discussed potential limitations of IR, including “an artificial constraint on the number of unknown words that can be presented in an instructional session” (p. 783), arbitrary standards regarding when a word moves from an unknown to known classification, and a lack of prompting strategies. As a result, Kupzyk et al. (2011) developed a revised version of IR known as strategic incremental rehearsal (SIR) and compared its effectiveness to IR.

SIR is similar to IR except that the teacher only presents unknown words during a teaching session. Additionally, when each unknown word is presented for the first time, the teacher simultaneously models the correct response and requires the student to repeat it (e.g., antecedent prompt; Kupzyk et al., 2011). During the first instructional session of SIR, the teacher presents two unknown words individually, models the correct responses, and requires the student to repeat the correct responses. The teacher then presents each word again (with a simultaneous prompt). During the third presentation of the words, the teacher inserts a 3-s prompt delay to allow for independent responding. Errors result in corrective feedback and correct responses result in presentation of the next word. Once students respond correctly (and independently) to the first two words, the teacher introduces a third word (that is unknown) with an immediate prompt. Subsequent erred presentations of the words result in error-correction and corrective feedback. The order of word presentation is randomized (cards shuffled) and words are presented until the student responds correctly to each word during a given rotation. Additional unknown words are added sequentially until the targeted number (e.g., 10) of words is reached, or until the allotted session time expires.

IR and SIR vary in their specific procedures, but are similar in that they are categorized as interspersal techniques used to teach sight word acquisition. Despite numerous studies demonstrating the effectiveness of interspersal techniques (Burns et al., 2004; Joseph, 2006; Neef et al., 1977; Neef et al., 1980; Peterson et al., 2014), only two studies (January et al., 2017; Kupzyk et al., 2011) have directly compared the outcomes of IR and SIR. Kupzyk et al. (2011) compared the effects of IR and SIR with four first-grade students attending a public elementary school using an ABAB reversal design. The researchers found that both IR and SIR were effective in teaching new words to the participants, but that SIR resulted in an overall higher number of correctly read words and better maintenance of the skills. Though these results suggest the superiority of SIR over IR (e.g., additional response opportunities, inclusion of new words based on prior student responding, and greater maintenance), Kupzyk et al. (2011) did not evaluate and compare the efficiency of the procedures, a crucial element for teachers.

January et al. (2017) compared the effectiveness and efficiency of IR and SIR on sight word acquisition with four general education elementary students using an alternating treatments design. The experimenters assessed efficiency through the average length of sessions and students' learning rates. Similar to Kupzyk et al. (2011), results of January et al. (2017) showed that IR and SIR were both effective in teaching sight words to elementary school students enrolled in general education classes. Furthermore, SIR was more efficient at teaching sight words for three of the four participants.

Taken together, the results of Kupzyk et al. (2011) and January et al. (2017) suggest that SIR is an effective and efficient procedure for teaching sight words to young children. However, additional factors may need to be considered when teachers choose which interspersal procedure to use with students. For example, the generality of SIR on acquisition of skills other than sight

words (e.g., math facts; Burns, 2005) is yet to be determined. Moreover, previous studies have found only slight advantages with SIR compared to IR, which suggests that additional variables, such as student preference and teacher acceptability, may help determine which intervention to implement. The purpose of this study was to extend the findings of the Kupzyk et al. (2011) and January et al. (2017) studies that compared the efficacy of IR and SIR on sight word acquisition. Specifically, we compared the efficacy of IR and SIR procedures on sight word and math fact acquisition. We also evaluated preference of each student and assessed the social validity of the procedures and goals from teachers at the students' school.

Method

Participants and Setting

Four children who attended a public elementary school participated in this study. All students were referred for participation by their primary classroom teachers due to low scores on their most recent reading or math assessments. Informed consent was obtained from all students' guardians.

Patrick was an 8-year-old boy diagnosed with Intellectual Disability. According to his teacher, Patrick had 37 known sight words in his repertoire and was reading on level A on the Fountas and Pinnell Reading Benchmark Assessment System. These assessments suggested that Patrick was reading at a kindergarten level, well below his second-grade grade level. Hudson was an 8-year-old boy diagnosed with Autism Spectrum Disorder and a language impairment. He was assessed as a non-reader on the Fountas and Pinnell Reading Benchmark Assessment System, and had 49 sight words in his repertoire. These assessments suggested Hudson was reading at an end of Kindergarten level, below his second-grade grade level. Steven was a 9-year-old boy in fourth grade who was diagnosed with a specific learning disability in reading.

According to his teacher, he was unable to recall basic addition and subtraction math facts with automaticity, which resulted in poor grades related to the fourth-grade math curriculum. Patrick, Hudson, and Steven were each enrolled in general education classrooms in their respective grade level, and received special education services through both in-class support, and pull-out support provided by a special education teacher. Natasha was an 8-year-old girl enrolled in general education third grade classes. Natasha did not have a documented disability, but was referred by her teacher because of difficulties mastering basic first and second grade math addition facts.

Sessions were conducted individually in the first author's private office located at the students' elementary campus. The office was 10 m by 7 m with one window. For each session, the student was seated at a trapezoid table across from the instructor. Each session was video recorded to allow for data collection by a second, independent observer. The first author served as the instructor for all sessions, and no one else was present during sessions.

Materials

The high-frequency sight words used for the study were taken from the Pre-primer, Primer, 1st Grade, and 2nd Grade Dolch word lists that were retrieved from the developer's website (www.dolchsightwords.org). Each word used for the screening was printed using Arial black, Comic Sans, and Lucida Handwriting (cursive) size 48 fonts on white Avery Shipping labels (5 cm x 10 cm) with black ink. The addition and subtraction math facts for all combinations from zero through twenty were typed horizontally on the Avery shipping labels, using the Arial black size 48 font for each number sentence. Each math fact was displayed horizontally and vertically on separate labels. The labels for the sight words and math facts were each individually placed on white un-ruled index cards (8 cm x 13 cm).

Design

A single-case experimental research design (i.e., ABAB reversal design; Horner et al., 2005) was used to compare the effectiveness of IR and SIR on sight word and math fact acquisition. We counterbalanced the order of the interventions across students. Each phase included five instructional sessions and five assessment sessions. Each phase was experienced twice by each student, for a total of 20 instructional sessions and 20 assessment sessions. Instructional sessions were conducted three to five days per week, and each session lasted no longer than 15 min. All sight words and math facts were assessed during an assessment session conducted approximately 24 hours after the instructional session. If assessment and instructional sessions were conducted on the same day, the instructor first assessed the previous day's targets then conducted an instructional session.

Data Collection and Response Definitions

The primary dependent variable was the total number of words read or math facts answered correctly during each assessment session. We focused on responses during assessment sessions, as opposed to instruction sessions, because the assessment sessions provided a better indication of whether the students learned and maintained the skills. Correct responses were defined as the student reading the word or math fact answer aloud and independently within 3 s of the instructor's presentation. An incorrect response was defined as the student vocalizing a different word or math fact answer from the item presented, an incorrect pronunciation of the word, or no vocal response within 3 s. During the preference assessments, we recorded selection responses to a color card that was paired with each intervention. Selection responses were defined as the participant touching or handing a color card to the instructor within 5 s of the instruction (i.e., "Pick one.")

Inter-Observer Agreement (IOA) and Procedural Integrity

All sessions were videotaped to assess IOA and procedural integrity. A second, independent observer watched approximately 30% of the sessions for each student across conditions. IOA was calculated using trial-by-trial agreement (number of agreements per session divided by the total number of agreements plus disagreements, multiplied by 100%). An agreement between observers was defined as both observers recording a correct or incorrect response. A disagreement was defined as both observers recording a different response for the same trial. Prior to beginning observations, the data collectors reached 90% agreement.

Mean IOA scores for Patrick were 99% (*range*, 98-99%) for IR, 99% (*range*, 98-100%) for SIR, and 98% (*range*, 89-100%) for assessment sessions. For Hudson, mean IOA scores were 98% (*range*, 97-99%) for IR, 98% (*range*, 97-99%) for SIR, and 99% (*range*, 92-100%) for assessment sessions. For Steven, mean IOA scores were 97% (*range*, 93-100%) for IR, 98% (*range*, 97-99%) for SIR, and 97% (*range*, 93-100%) for assessment sessions. For Natasha, mean IOA scores were 98% (*range*, 96-100%) for IR, 93% (*range*, 92-95%) for SIR, and 99% (*range*, 93-100%) for assessment sessions.

Procedural integrity data were collected to ensure the instructor implemented the procedures with fidelity. During approximately 30% of sessions (across conditions) for each participant, a second, independent observer scored the percentage of procedural steps correctly implemented by the instructor, based on a task analysis. The task analysis detailed the steps for both the IR and SIR procedures and was similar to the information shown in Appendices A and B. To calculate procedural integrity, the instructor divided the number of steps implemented correctly by the total number of steps for each procedure. Correct steps were defined as the instructor implementing the procedures as described on the task analysis. Incorrect responses were defined as the instructor not completing a step as described or eliminating a step. Mean

procedural integrity scores were 99% (*range*, 99-100%) for Patrick, 99% (*range*, 98-100%) for Hudson, 99% (*range*, 99-100%) for Steven, and 99% (*range*, 98-100%) for Natasha. On 30% of sessions where procedural integrity data were collected, another independent observer recorded data to assess IOA of procedural integrity. Mean agreement for procedural integrity scores across students and conditions was 99% (*range*, 99-100%).

Social Validity

To assess the acceptability of the goals and procedures of the study, six teachers from the students' school completed a brief questionnaire developed by the authors. Each teacher had at least two years of teaching experience and currently taught elementary school. Prior to completing the questionnaire, each teacher met individually with the instructor to watch at least two video-recorded sessions of each flashcard intervention. After watching the videos, each teacher independently and privately completed a 10-item questionnaire with nine Likert-type questions and one multiple choice question.

Procedures

Screening. Screening sessions were conducted with each student individually to identify non-mastered targets to include in the intervention conditions. During the screening sessions, the instructor presented targets to the student one at a time and asked him or her to state the answer. The instructor provided no performance feedback; however, intermittent praise for on-task behavior was provided. Targets that evoked correct responses within 3 s were identified as *known targets*. If a student erred, the target was presented again during a second session. Targets that were answered incorrectly two times were designated as *unknown targets*.

Instructional Sessions. Instructional sessions for both IR and SIR conditions followed the procedures outlined by Kupzyk et al. (2011) and are shown in Appendices A and B. The

purpose of the instructional sessions was to teach unknown targets to the students. It should be noted that a color card was paired with each flashcard intervention and was present during each instructional session to aide in discrimination of interventions.

Incremental Rehearsal. Prior to beginning the IR instructional sessions with each student, the instructor reviewed the screening results and selected three unknown targets and nine known targets. Each IR session began with the instructor presenting the first unknown target (U1) followed by a known target (K1). The unknown (U1) and known (K1) targets were then presented again, followed by an additional known target (K2). Next, U1, K1, and K2 were presented followed by another known target (K3). The instructor continued to present the unknown target followed by an increasing number of known targets (U1, K1, K2, K3, K4, etc) until all nine known targets had been presented with the unknown target. The instructor then removed one of the known targets (K9) from the sequence and moved the previously unknown target (U1) to the K1 position so that a new unknown target (U2) could be introduced and subsequently presented with nine known targets. This pattern continued until all three unknown targets had each been presented with nine known targets. Throughout the IR sessions, correct responses within 3 s resulted in praise (e.g., “Good!”) from the instructor. Errors resulted in corrective feedback (e.g., “No, the word is —.”), followed by a prompt to state the correct response.

Strategic Incremental Rehearsal. Prior to beginning the SIR instructional sessions with each student, the instructor reviewed the screening results and selected ten unknown targets (and no known targets). Each SIR session began with the instructor simultaneously presenting the first unknown target (U1) and the correct response (“The word is --.”), followed by a prompt for the student to state the correct response. Following the student’s response, the instructor presented a

second unknown target (U2) with the same prompting procedure. The instructor then presented both U1 and U2 a second time with a simultaneous prompt and required the correct response from the student. During subsequent presentations of U1 and U2, the instructor inserted a 3 s prompt delay to allow for independent responding. Correct responses resulted in progression to the next target and errors resulted in corrective feedback. Once the student responded correctly to both U1 and U2 independently, a third unknown target (U3) was introduced. U1 and U2 were presented in random order and during the first presentation of U3, a simultaneous prompt was provided. Subsequent presentations of U3 included a 3 s prompt delay. The instructor shuffled the cards prior to each set of presentations to increase the likelihood that the student attended to the relevant stimulus and did not simply memorize the order of the targets. Additional unknown targets were added sequentially when the student responded to all targets correctly and independently. Targets were added until the session time expired or until all 10 targets were presented.

Assessments. Assessment sessions were conducted throughout the study to evaluate whether students learned and maintained the unknown targets from the previous instructional sessions. Each assessment session lasted no more than 3 min. Assessment sessions were conducted similar to screening sessions in that the instructor gave no performance feedback. If a student responded incorrectly to a target, it maintained its designation as an unknown target. The instructor conducted an assessment session approximately 24 hours after the students had been exposed to new targets during the previous day's instructional session. If an assessment session was unable to be conducted due to an expected absence or school event (e.g., assembly), the instructional session was not conducted on the previous day to ensure that all assessment sessions were conducted at approximately equal intervals following instruction. On days during

which both assessment and instructional sessions were conducted, the assessment session was conducted first; the instructional session followed after a brief 2-min break.

Preference Assessment. Following 20 assessment sessions (10 sessions of each flashcard intervention), we evaluated preference for the flashcard interventions by allowing students to select which intervention the teacher implemented during that day's session. Each preference assessment session began with the instructor placing color cards that had previously been paired with IR and SIR interventions on the table in front of the student. The instructor told the student to "Pick the color for the game you want to play today." Following the student's color card selection, the instructor immediately implemented the corresponding instructional procedure. The preference assessment continued until a student selected the same color card for four consecutive trials, or until 10 trials occurred (Hanley, 2010).

Results

Figure 1 shows the results of assessment sessions across the IR and SIR conditions. Patrick and Hudson were taught sight words and Steven and Natasha were taught math facts. For two of the students, clear conclusions were evident with replication across phases for Hudson and Natasha. That is, visual analysis showed that the SIR condition was more effective than the IR condition, demonstrated by a greater number of words (Hudson) or math facts (Natasha) answered correctly during SIR assessment sessions. For Patrick and Steven, the results were less clear using visual analysis. That is, neither flashcard intervention appeared to be consistently superior to the other flashcard intervention. Therefore, to further analyze the data, we compared the number of new (unknown) targets acquired during IR and SIR interventions for each student (see Figure 2). For three of four students, the SIR intervention resulted in a greater number of new targets acquired. Patrick's data differ in that slightly more words were acquired during the

IR intervention (28 words) compared to the SIR intervention (25 words). One potential explanation for why Patrick acquired more words in the IR condition may be an unintentional difference in level of difficulty across conditions. We attempted to control for difficulty of words across sessions by equating the number of letters and syllables assigned to each condition. However, there is a chance that more difficult words were assigned to Patrick's SIR condition. For example, during the second phase of SIR phase, Patrick continuously erred on the words "could" and "round," which limited the number of new words that could be introduced.

Figure 3 shows the results of the preference assessment for all four students. Interestingly, two students preferred the IR condition and two students preferred the SIR condition. Patrick and Steven, whose efficacy results were less clear, exclusively selected the color card associated with the SIR condition, indicating a preference for SIR over IR. This preference for SIR was further supported by anecdotal statements. For example, Patrick often made statements indicative of aversion for IR such as "No repeating today, right?" or "I don't like when they repeat." Similarly, Steven only selected the color card associated with SIR for four consecutive sessions, indicative of a preference for SIR as well. Hudson and Natasha selected the color cards associated with the IR condition despite greater efficacy with the SIR condition. These results highlight the need to collect efficacy data and utilize procedures that are more effective.

The results from the social validity questionnaire are shown in Table 1. Of the six teachers who completed the questionnaire, all agreed that sight word and math fact acquisition were important skills to target with the students. The results of the questionnaire also indicated that the teachers felt that both flashcard interventions were efficient, could easily be implemented in their classrooms, and could be taught to parents for use at home. Additionally, when asked

which method was most efficient and easiest to implement, four teachers (66%) chose SIR and two teachers (33%) chose IR. These results support the use of flashcard interventions to teach sight words and math facts in school settings.

Discussion

In this study, we compared the effectiveness of two flashcard interventions to increase sight word and math fact acquisition in struggling learners, three of which had documented disabilities. The results indicate that all four students were able to acquire unknown targets using both the IR and SIR interventions. However, the SIR intervention resulted in greater acquisition of unknown targets for three of the four participants, suggesting that it may be a more effective method for sight word and math fact acquisition for some students.

The results of this study replicate the findings of Kupzyk et al. (2011) and January et al. (2017) by demonstrating that SIR was more effective than IR for three of four participants. In addition, this study extended previous research by showing that SIR was more effective than IR at teaching math facts in addition to sight words. For two of the four participants, visual analysis did not yield clear conclusions regarding which intervention was more effective, which led to preference evaluations. Two students demonstrated preference for each flashcard intervention, suggesting that student preference may be another variable for teachers to evaluate when determining which intervention to utilize. Future research could assess the variables that make SIR more preferable so they can be incorporated into other instructional flashcard procedures.

In addition to being the first study to assess the effectiveness of SIR on math fact acquisition, this study also collected social validity data on IR and SIR interventions. The social validity data obtained from teachers who watched instructional sessions support the inclusion of IR and SIR procedures in the classroom as both were viewed as easy and efficient procedures.

Additionally, more teachers viewed SIR as more efficient and easier compared to IR, suggesting that it may be more likely to be implemented by teachers in the classroom. Future research could train teachers to implement the flashcard procedures with students and evaluate which is more effective, efficient, and preferred under naturalistic conditions.

For students who learned to read aloud sight words, we did not assess their knowledge of sight words in the context of books or standardized reading passages. That is, even though students could read the word aloud, it is unknown whether they could use the word in various contexts outside of the educational setting. Despite this limitation, the students' teachers reported improvements in sight word reading and both students showed gains in their end of the school year reading benchmark. Specifically, Patrick, who was a level A(1) at the beginning of the study moved to a level D(3) by the end of the school year and conclusion of the study. Hudson's initial reading benchmark yielded a score as a nonreader (unable to read the level A(1) book at the beginning of the study); by the end of the school year and conclusion of the study, he was at a level E(6). Though it is not clear how much of the benchmark gains can be attributed to participation in this study, future research could assess generalization of sight word reading to standardized assessments, books, and other grade-level reading materials.

There were some additional limitations in this study that could be addressed with future research. First, we did not evaluate the amount of time required to implement both IR and SIR to identify whether one flashcard intervention was more efficient than the other. January et al. (2017) found that SIR was more efficient than IR when teaching sight words, yet efficiency of the procedures is unknown with other targets (e.g., math facts). Future research should continue to compare the effectiveness and efficiency of IR and SIR interventions with various target skills. Second, we implemented IR and SIR under contrived one-on-one settings with an

instructor, which may limit the external validity of the findings. Future research could explore ways to use these flashcard interventions during small or large group instruction within the typical classroom setting. Third, the preference assessment did not include a control condition, which may have affected selection responses. That is, participants only selected from two color cards representing IR and SIR. As a result, it is unknown whether these interspersal procedures are preferable to a non-interspersal procedure. Future research could replicate the current study using three or more initial links and inclusion of a control condition. Fourth, though we designed the study to include an ABAB reversal design, experimental control was not clearly demonstrated for all participants. Future research may evaluate the procedures using a different experimental design. Finally, we maintained the same response time requirement of 3 s throughout the study and across targets. However, the authors noted several instances during which the participant stated the answer at the same time as the instructor or expressed frustration that he or she did not have enough time to “do it on my own.” Future studies could determine if lengthening the response time to 5 s or 7 s might result in increases in correct responding, especially with math facts.

Recommendations for Practice

Based on the results of this study and related research, the following recommendations may be beneficial for teachers and educators when utilizing flashcard interventions in the classroom.

1. *Utilize effective interventions.* Select the flashcard intervention (or other teaching procedure) that is most effective with *your* students. The effectiveness of instructional procedures may vary depending on several factors (e.g., content application, age,

diagnosis, or grade level). Teachers should collect data on individual students' behavior and utilize the procedure(s) that results in the greatest positive outcome.

2. *Formally collect data and analyze the data often.* Whether the flashcard intervention is being used individually or within group settings, it is important to collect data on individual performance so that improvements and skill acquisition can be recognized and rewarded. Data should be analyzed following each teaching session so that changes to the teaching protocol can be made quickly, if necessary.
3. *Utilize reinforcement freely and often.* Positive reinforcement is defined as the delivery of a stimulus (e.g., item, activity, praise) that results in an increase of the behavior it follows (Cooper, Heron, & Heward, 2007). For example, if a student responds correctly when presented with a sight word, the teacher may provide praise, a token, or access to another reward to maintain and improve the student's performance over time. Embedding a variety of reinforcers within flashcard intervention sessions may result in faster acquisition. Failure to include reinforcement may result in slow or delayed acquisition of skills.
4. *Assess student preference for interventions.* If two or more interventions are similarly effective with a student, or if it is unclear whether one intervention is more effective than another, the teacher may assess the student's preferences. Teachers can evaluate preference by having students vote for their favorite intervention or context, rank order different procedures, or by directly assessing selection responses.
5. *Monitor a variety of behaviors.* When selecting and implementing flashcard interventions, a primary concern should be the efficacy of the intervention on acquiring

the target skill. However, teachers may also want to track other behaviors that may interfere with learning, such as off-task behavior, talking out, or avoidant behaviors.

6. *Evaluate parents' and teachers' acceptability of interventions.* Teachers and parents are often responsible for implementing flashcard interventions. It is important to ensure that teachers and parents find the procedures and goals associated with flashcard interventions valuable to ensure continued and accurate implementation. If a teacher or parent does not find a particular intervention acceptable, he or she may choose not to implement it, thus resulting in less acquisition for the student.

Conclusion

The results of this study demonstrate that both IR and SIR interventions were effective for increasing sight word and math fact acquisition in struggling learners. Furthermore, three of the four participants acquired more unknown targets using the SIR intervention compared to the IR intervention. Though these are preliminary data and additional studies comparing the efficacy of IR and SIR are warranted, these data provide additional support for the SIR intervention as an effective teaching method for sight word and math fact acquisition for some students. Teachers, clinicians, and parents are encouraged to formally evaluate the efficacy of interventions used with their students and focus on individualized instruction.

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Table 1
Results from Social Validity Questionnaire

Question	% Selected Response				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I feel that sight word acquisition is an important skill that my students need help with.	50%	50%	0%	0%	0%
I feel that math fact acquisition is an important skill that my students need help with.	66%	33%	0%	0%	0%
I feel that the components of the flash card rehearsal methods could easily be implemented in my classroom.	50%	50%	0%	0%	0%
I feel that these flash card rehearsal methods could be taught to parents and easily implemented at home.	83%	17%	0%	0%	0%
Overall, I believe the flash card rehearsal methods are an effective way to increase sight word/math fact skills acquisition of students.	83%	17%	0%	0%	0%
I feel that the IR method is easy to implement, and efficient.	50%	50%	0%	0%	0%
I feel confident that I could implement the IR flash card method in my classroom.	50%	50%	0%	0%	0%
I feel that the SIR method is easy to implement, and efficient.	66%	33%	0%	0%	0%
I feel confident that I could implement the SIR flash card method in my classroom.	66%	33%	0%	0%	0%
The method that is most efficient and easiest to implement is	Incremental Rehearsal				33%
	Strategic Incremental Rehearsal				66%

Note. Six teachers completed the questionnaire.

Figure 1

Correct Responses in IR and SIR Assessment Sessions

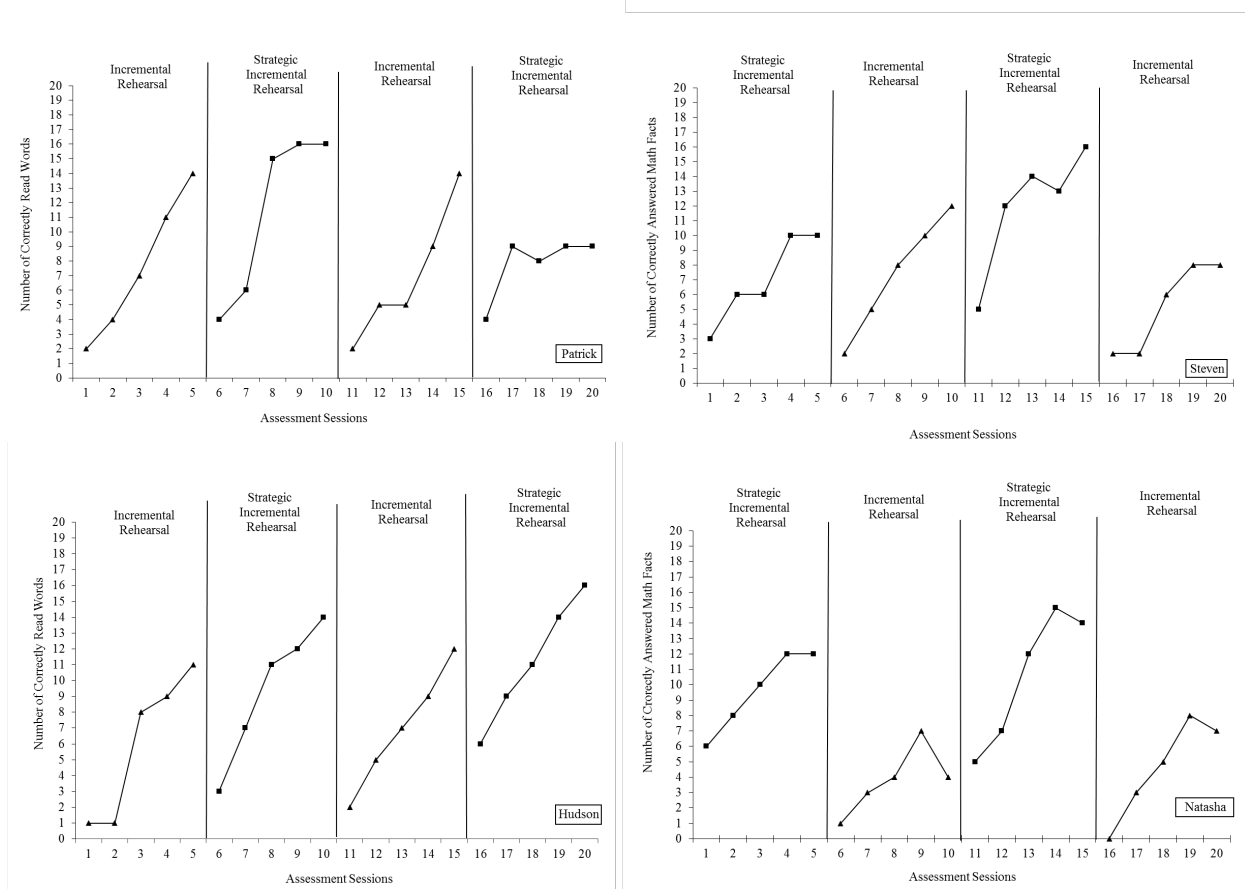
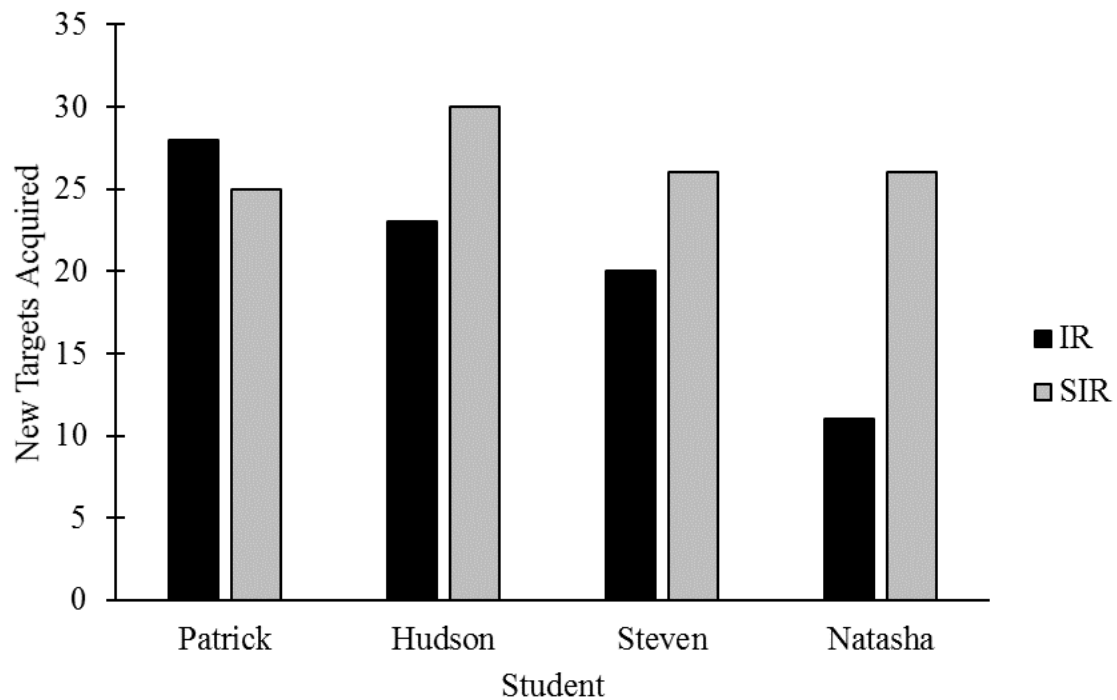


Figure 2

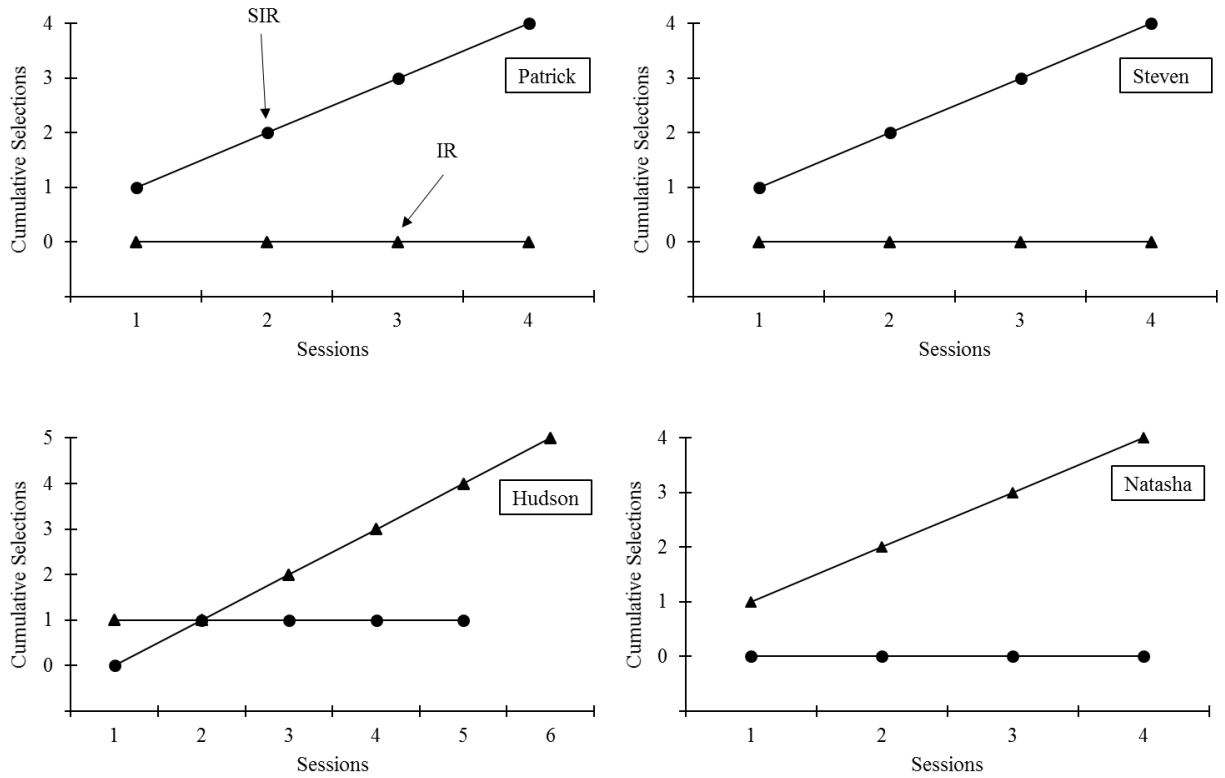
New (unknown) Targets Acquired during IR and SIR Interventions



Note. A target was considered acquired when a student responded correctly during the assessment session.

Figure 3

Cumulative Selections of Color Cards



Appendix A

Item Presentation Order during Incremental Rehearsal (IR) Sessions

	Order of Presentation									
	1	2	3	4	5	6	7	8	9	10
Trial 1	U1	K1								
Trial 2	U1	K1	K2							
Trial 3	U1	K1	K2	K3						
Trial 4	U1	K1	K2	K3	K4					
Trial 5	U1	K1	K2	K3	K4	K5				
Trial 6	U1	K1	K2	K3	K4	K5	K6			
Trial 7	U1	K1	K2	K3	K4	K5	K6	K7		
Trial 8	U1	K1	K2	K3	K4	K5	K6	K7	K8	
Trial 9	U1	K1	K2	K3	K4	K5	K6	K7	K8	K9
Trial 10	U2	U1								
Trial 11	U2	U1	K1							
Trial 12	U2	U1	K1	K2						
Trial 13	U2	U1	K1	K2	K3					
Trial 14	U2	U1	K1	K2	K3	K4				
Trial 15	U2	U1	K1	K2	K3	K4	K5			
Trial 16	U2	U1	K1	K2	K3	K4	K5	K6		
Trial 17	U2	U1	K1	K2	K3	K4	K5	K6	K7	
Trial 18	U2	U1	K1	K2	K3	K4	K5	K6	K7	K8
Trial 19	U3	U2								
Trial 20	U3	U2	U1							
Trial 21	U3	U2	U1	K1						
Trial 22	U3	U2	U1	K1	K2					
Trial 23	U3	U2	U1	K1	K2	K3				
Trial 24	U3	U2	U1	K1	K2	K3	K4			
Trial 25	U3	U2	U1	K1	K2	K3	K4	K5		
Trial 26	U3	U2	U1	K1	K2	K3	K4	K5	K6	
Trial 27	U3	U2	U1	K1	K2	K3	K4	K5	K6	K7

Note. U = Unknown and K = Known. The session ends after Trial 27.

Appendix B

Item Presentation Order during Strategic Incremental Rehearsal (SIR) Sessions

Step	Instructions
1	· Present U1 with SP
2	· Present U2 with SP
3	· Repeat steps 1 and 2
4	· Present U1 and U2 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
5	· Present U1 and U2 in random order (no prompt). · Present U3 with SP.
6	· Present U1, U2, and U3 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
7	· Present U1, U2, and U3 in random order (no prompt). · Present U4 with SP.
8	· Present U1, U2, U3, and U4 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
9	· Present U1, U2, U3, and U4 in random order (no prompt). · Present U5 with SP.
10	· Present U1, U2, U3, U4, and U5 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
11	· Present U1, U2, U3, U4, and U5 in random order (no prompt). · Present U6 with SP.
12	· Present U1, U2, U3, U4, U5, and U6 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
13	· Present U1, U2, U3, U4, U5, and U6 in random order (no prompt). · Present U7 with SP.
14	· Present U1, U2, U3, U4, U5, U6, and U7 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
15	· Present U1, U2, U3, U4, U5, U6, and U7 in random order (no prompt). · Present U8 with SP.
16	· Present U1, U2, U3, U4, U5, U6, U7, and U8 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, move to the next step.
17	· Present U1, U2, U3, U4, U5, U6, U7, and U8 in random order (no prompt). · Present U9 with SP.
18	· Present U1, U2, U3, U4, U5, U6, U7, U8, and U9 in random order with a 3 s prompt delay. · If student errors, provide error correction and repeat step. · When student responds correctly to all stimuli, end session.

Note. U = Unknown, K = Known, and SP = Simultaneous Prompt. The session ends when step 18 is complete, or if session time has expired.