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ORIGINAL PAPER

Comparing Performance Standards on the Retention of Words Read Correctly Per Minute

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Abstract To measure retention of oral reading fluency, three students attending a learning support classroom used a repeating reading strategy with two passages. Each student read one passage to a high performance standard and the other passage to a lower performance standard. Results show it took the students more practice to reach the higher performance standard in regards to both calendar days and practice trials. The retention measures revealed all students had comparable decrements with words read correctly per minute for both the high and low performance standards even though practice varied. During the last retention interval 3½ months after obtaining the performance standard, all students demonstrated the highest terminal frequency of words read correctly per minute in the high performance standard condition.

Keywords Retention · Performance standard · Behavioral fluency · Repeated reading · Precision teaching

Retention describes the relationship between two behavior frequencies over time when a person has not emitted the behavior (Binder 1996). A teacher can check a student's retention by measuring a behavioral frequency one day and then measuring the same behavior at a later time. The difference between the first

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frequency and the second frequency serves as an indicator of retention. A student who demonstrates retention exhibits a frequency similar to the previous frequency. Identifying educational procedures that produce high degrees of retention will help students, teachers, and the educational field (Kubina and Morrison 2000).

Studies of behavioral fluency (Binder 1996) have demonstrated a positive relationship between practicing to fluency and the promotion of long-term retention (e.g., Berens et al. 2003; Brown et al. 1996; Bucklin et al. 2000; Ivarie 1986; Peladeau et al 2003; Young et al. 1986). Typically, a student practices a selected behavior until he reaches a performance standard or fluency aim. The performance standard represents the frequency range associated with specific critical learning outcomes, retention representing one of the outcomes (Binder 1996; Kubina and Morrison 2000).

Berens et al. (2003) provide an example of behavioral fluency and retention. In their study, students attending a University affiliated tutoring center practiced basic computation facts, reducing fractions, and converting improper fractions to proper fractions presented on flashcards. The students practiced to a performance standard of 65 responses per minute. The results of the study show that after a 1-month retention interval, the participants who had behavioral frequencies closer to the performance standard showed greater degrees of retention than those with lower frequencies.

Performance standards used in the behavioral fluency literature symbolize a departure from other characterizations of mastery criteria. For instance, some researchers suggest using normative performance of students to serve as the performance standard. Citing Gronlund (1985), Hasbrouck and Tindal (1992) state the following, "Performance standards are typically derived from the scores of groups of students who take the same test" (p. 42). Binder (1990), however, questions the ultimate utility of classroom norms. Specifically, if a classroom has a group of students performing below the mastery level, the subsequent performance standard will not signify a true fluency criterion.

Therefore, establishing performance standards leading to critical learning outcomes such as long-term retention could greatly enhance the ultimate success and robustness of fluency interventions. For example, in the area of reading an intervention technique called repeated reading has received research validation as a way to increase oral reading fluency for students with and without disabilities (Chard et al. 2002; Kuhn and Stahl 2003; Mastropieri and Scruggs 1997; National Reading Panel 2000; Therrien 2004). Of the many models of repeated reading (c.f., Chard et al. 2002) very few have studied the impact of performance standards and their subsequent effect on reading performance.

For example, one of the original models of repeated reading described by Samuels (1979) has students reading a selected passage until meeting a fluency criterion or performance standard. In his research Samuels states that the student read to a criterion of 85 words per minute. Samuels also indicated that as the student continued repeated readings with new passages, progressively higher decoding frequencies occurred during the first readings of text and it took less time to achieve the fluency criterion.

Since Samuel's preliminary report on repeated reading, numerous studies have attempted to replicate his findings, some without success. Perhaps the lack of a performance criterion affected the unsuccessful replication attempts (e.g., Homan et al. 1993; Rashotte and Torgensen 1985)? Many repeated reading models have students reread passages a set number of times. Rereading passages for a set number of times may have affected the potential impact of the intervention when compared to repeated reading models that use a performance criterion. Namely, Therrien's (2004) meta-analysis on repeated reading reported that studies using a performance criterion, instead of a set number of readings, had effect sizes more than four times greater (i.e., Mean effect size of 1.70 for studies using a performance criteria compared to 0.38 for studies using a set number of readings).

Although Therrien clarified the importance of including a performance criterion, his review did not determine an optimal performance criterion based on the studies he reviewed. This study attempted to address this question by exploring the differential retention effects of performance standards with the repeated reading method. Specifically, what effects will a high fluency aim (i.e., a performance standard derived from the behavioral fluency literature) have when compared to a low fluency aim (i.e., a performance standard derived from the reading literature).

Method

Participants and Settings

Three students attending a resource room in a central Pennsylvania elementary school served as participants. Mark and Anna had specific learning disabilities in reading. Anna also received speech and language services. Connor received special education services for an emotional and behavioral disorder. All three 9-year-old participants attended most of their classes in the general education third grade classroom but spent part of their day in the resource room. The teacher nominated the students as participants because they needed extra practice with reading. All sessions occurred in the resource room at a desk in the back of the room. The students worked with the experimenter individually during a study period.

Materials and Response Measurement

Materials included photocopies of two passages taken from the *Reading Mastery V* textbook (Engelmann et al. 1995). Passage one and two, respectively, came from lesson two and three stories. A Fry readability (Fry 1977) formula showed that each passage had a third grade reading level. The experimenter used a digital timer to begin and end timing intervals. The number of correct words read per minute (CWPM) served as the response measure. The experimenter had a copy of the passage and followed along with the student. If the student made an omission, mispronunciation, insertion, or received a prompt (i.e., the teacher said the correct word if the student hesitated for more than 5 s), the response counted as an

incorrect. For student errors, the experimenter circled omitted words, marked an X for mispronounced and prompted words, and wrote any inserted words. The total number of errors subtracted from the total number of words read providing the CWPM count.

Procedure and Experimental Condition

The repeating reading method requires a student to repeatedly read a passage until reaching a predetermined criterion (Samuels 1979). The predetermined fluency criterion used in this study came from two suggested reading frequencies, one a performance standard of 200+ correct words per minute (Beck et al. 1995; Freeman and Haughton 1993) and a lower performance standard of 123+ correct words per minute (Hasbrouck and Tindal 1992). While other sources exist for reading performance standards (e.g., Dynamic indicators of basic early literacy skills) we choose the 200+ and 123+ criteria as they differed from one another significantly (i.e., a difference of 77 words per minute).

Each day the experimenter greeted the student and began the session with the same prompt, "Please read this passage as fast as you can. Ready? Please begin." The timer, set for 1-minute, began and the student read until hearing the timer beep with the experimenter simultaneously saying, "Please stop."

An alternating treatments design (Cooper et al. 2007) called for a daily counter balanced presentation of reading passages and the subsequent measurement of the effects of each reading condition. Students read each passage two to three times per session. At the end of the reading the experimenter provided verbal praise and corrective feedback for errors. Students engaged in repeated reading of each passage until they met the target performance standard for two consecutive days.

After attaining the performance standard for passage one, the experimenter assessed retention on that passage at 2, 8, and 14 weeks. Similarly, after attaining the performance standard for passage two, the experimenter assessed retention on that passage at 2, 8 and 14 weeks. In other words, retention checks occurred 2 weeks, 2 months, and finally 3½ months after meeting the goal for each passage. To measure retention the experimenter gave the same prompt as before and allowed the student to read the passage once. The students did not receive corrective feedback during retention checks.

Inter-observer Reliability and Procedural Integrity

The experimenter obtained interobserver agreement data for 28% of the sessions. The experimenter, working with the student and an independent observer, recorded the correct and incorrect reading behavior for each student. The total number of CWPM agreed upon divided by number of CWPM of agreements plus disagreements multiplied by 100 equaled interobserver agreements. The results of the calculation revealed 98% agreement between the two observers with a range of 89–100%.

The first author independently checked procedural integrity with the other experimenters using the checklist specifying the procedural methods described above for 20% of the experimental sessions. The experimenter recorded the number of steps followed correctly during baseline and intervention. The percentage of procedural integrity came to 100% for all conditions.

Results

Table 1 displays (1) the calendar days and number of trials required to reach the performance standards, (2) the beginning frequencies when the intervention started, (3) the ending frequencies or exit criteria for the termination of the repeated reading procedure, (4) the last retention frequencies taken 3½ months after the end of the repeated reading procedure, and (5) the change factors calculated by dividing the performance standard frequency of correct words per minute by the entry level or beginning frequency of correct words per minute.

The number of practice trials and calendar days needed to reach each criterion shows uniformity among the students. All three required more practice and calendar days to achieve the high performance standard for passage one than they did for the lower performance standard used with passage two. For Anna it took 3.6 times more practice trials to reach the performance standard in passage one when compared to passage two. Connor requires 2.4 times more practice trials for passage one. Mark's practice trials showed a difference of 2.7 times more practice to reach 200+ CWPM when compared to the 123+ CWPM performance standard.

Also shown in Table 1, the change factors provide a quantitative measure depicting the overall frequency change one must complete to meet a goal. In this study all three students displayed different change factors. For reading one, Anna had the lowest change factor, ×2.3. Connor had a change factor of ×3.1 and Mike had the highest, ×4.6. For reading two Anna again displayed the lowest change

Table 1 Number of calendar days, trials, ending frequency, last retention measure, and change factors for passage one and two

Student	Calendar days	Number of trials	Beginning frequency (before intervention) (CWPM)	Ending frequency (last day of intervention) (CWPM)	Last retention measure (3½ months) (CWPM)	Change factor
High performance standard 200+ CWPM (Passage one)						
Anna	26	58	86	196[a]	172	×2.3
Connor	17	34	64	212	153	×3.1
Mark	25	54	45	206	122	×4.6
Low performance standard 123+ CWPM (Passage two)						
Anna	8	16	83	152	143	×1.8
Connor	7	14	72	147	112	×2.0
Mark	7	20	42	132	82	×3.1

[a] Student could not meet 200 per minute due to speech impediment

factor, ×1.8, while Connor's change factor came in at ×2.0 and Mike had the highest change factor of ×3.1. Anna's low change factors indicated she had the least amount of change needed to reach her performance goals, while Mark's change factor meant he would have to exhibit the most change.

Figure 1 displays three Standard Celeration Charts (SCC) (Pennypacker et al. 2003) showing the ending frequency and subsequent retention checks for each reading at 2-week, 6-week, and 14-week intervals. The experimenters used SCC because they linearize behavioral data and show trend changes with straight lines.

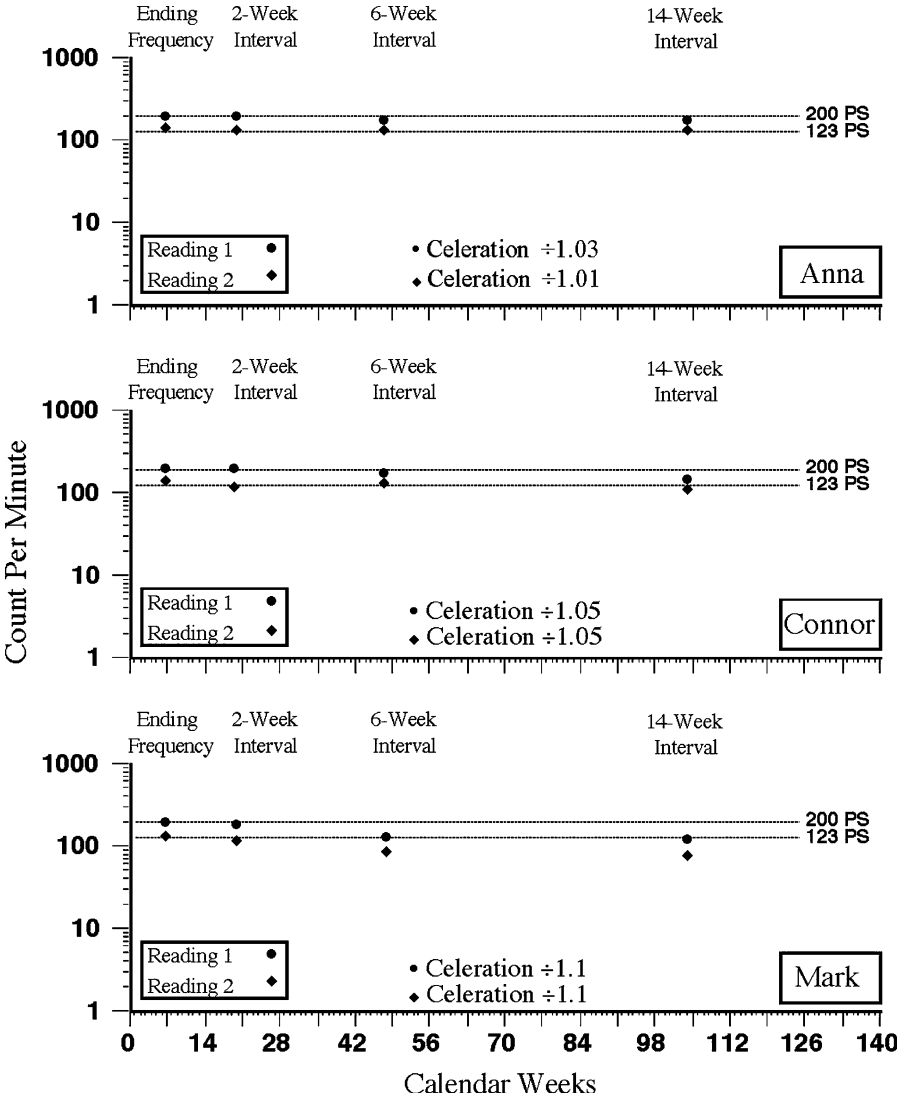

Fig. 1 The overall celerations showing retention of oral reading fluency for a high performance standard and a performance standard at 2, 6, and 14-week intervals

On a SCC, the slope or trend of the line, called a "celeration line," depicts the weekly change as a factor of multiplying (i.e., acceleration) or dividing (i.e., deceleration). A celeration line of $\times 2.0$ refers to a slope with a weekly doubling of learning. Interested readers may consult the following sources for more information regarding the SCC (Graf and Lindsley 2002; Pennypacker et al. 2003; West et al. 1990).

All three SCC in Fig. 1 have four dots and four diamonds depicting the frequency scores of reading one and two in real, calendar time. Dashed lines corresponding with the high performance standard of 200+ CWPM, labeled 200 PS, and the low performance standard of 123+ CWPM or 123 PS, graphically portray reading frequencies and their subsequent fluency aim criteria. The SCCs also include the celerations for each reading.

In the top SCC, for Anna, reading one the high performance standard and reading two the low performance standard, have an overall deceleration of $\div 1.03$ and $\div 1.01$, respectively. In other words, the amount of decrement from Anna's ending reading frequencies to the last reading frequencies 3½ months later changed very little decelerating by factors close to $\div 1.0$, which would mean no change. The second SCC in Fig. 1 has the reading frequencies for Connor who displayed celerations of $\div 1.05$, again very small decelerations in his frequencies of correct words per minute. The last SCCs have Mike's celerations, with an overall deceleration across 3 months occurring at $\div 1.1$ for both the high and low performance standard passages.

Discussion

This study examined the retention of words CWPM for passages read to two different performance standards. Students engaged in repeated reading until they met the specified performance standard for each condition. The first difference between the two performance standards comes into view when considering the amount of practice it took the students to reach the respective goals. It took all of the students anywhere from two to three times more practice to achieve the high performance standard when compared to the other one. And because the readings came from the same story series, each reading passage overlapped in regards to words (i.e., 19% of the words in passage one overlapped with passage two). Therefore, the observed differences suggest an absence of a potentially confounding variable, disproportionate passage difficulty. Additionally, Table 1 shows the beginning frequencies each student exhibited on the first day of the repeated reading intervention. The comparison between the frequencies for reading one and two demonstrates a consistency in the initial CWPM scores (e.g., Anna-86 CWPM for reading one, 83 CWPM for reading two) further supporting a correspondence of equality in passage difficulty between reading the readings.

Figure 1 shows the decrement, as measured by celeration, in the frequency of CWPM for reading one and two for each student. The CWPM frequencies show very similar decelerations when comparing each student's retention scores. For all three students the same general pattern emerges, even though they all engaged in

more practice to obtain the higher performance standard, every student showed comparable decrement for each reading. Stated differently, the rate at which the students retention changed appeared the same for two students and very similar for the other. These results differ from a meta-analysis on overlearning and retention which showed a significant relationship between how much overlearning occurred and the subsequent retention; the more overlearning trials one engages in the greater degree of retention (Driskell et al. 1992). According to Driskell and colleagues' results, one would suspect the extra practice for the higher performance to produce a lower deceleration (i.e., change of retention over time) than the passage practiced to a lesser degree. Such a result suggests that the performance standard, or the level of fluency, attained may affect retention as much as other variables like amount of practice.

We also introduce change factors as a possible metric to help further describe/explain differences in retention changes. Table 1 shows the change factors for all three students for both passages. Anna had the smallest change factors (i.e., $\times 2.3$ for passage one and $\times 1.8$ for passage two) suggesting she had the most developed oral reading decoding skill for the selected passages. Mark had the largest change factors (i.e., $\times 4.6$ for passage one and $\times 3.1$ for passage two) indicating he had the lowest oral reading decoding skill among the three students while Connor's change factors put him in the middle. The change factors for oral reading fluency performance show an ordinal correspondence to the decelerations. Specifically, Anna had the lowest deceleration, followed by Connor, and then Mark who had the highest deceleration. For the students the change factors correlate with retention. Interestingly, the change factor did not show a relation to the amount of practice necessary to attain the performance standard. Anna, who had the smallest change factor, needed 58 trials to reach her goal for passage one while Mark, who had the highest change factor, required 54 trials of practice to reach his aim for passage one.

The results from this study also suggest potential benefits for performance standards based on critical learning outcomes (e.g., retention) as opposed to normative standards. Namely, a performance standard represents a benchmark for fluency while a normative sampling may or may not correspond to a true fluency. For all three students the behavioral fluency performance standard of 200+ CWPM engendered higher terminal reading frequencies than the lower performance standard of 123+ CWPM during the last retention interval.

In terms of repeated reading the results of this study support propositions of the causal mechanisms associated with successful outcomes. Namely, refinements in stimulus control represent a behavioral theory accounting for improved reading following repeated reading interventions (e.g., Ardoin et al. 2007; Daly et al. 1999; Martens et al. 2007). For example, Ardoin et al. (2007) found repeated reading resulted in better generalization to new passage when compared to a multiple exemplar intervention. Ardoin et al. (2007) suggested the practice associated with repeated reading may have resulted better stimulus control. The performance standards in the present study also resulted in enhanced stimulus control. Three and 1/2 months after ending the intervention with the high performance standard results in post intervention gains (the difference from the students first read and last read at 3½ months) came to 89 words for Anna and Connor and 77 words for Mark. Even

in the low performance standard Anna, Connor and Mark had post intervention gains of, respectively, 60, 40, and 42 CWPM compared to their initial read. It would appear stimulus control proceeds from the degree of quality and quantity of practice.

Limitations

All three students exceeded the lower performance standard with frequencies above 123+ while two of the three surpassed the 200+ CMPM aim (Anna stropped at 194 due to a speech impediment). Because the phase condition goal called for two days reading above performance standard, the extra day allowed the students to exceed the target goal except in the case of Anna with the high performance standard. Therefore the interpretations of the retention changes may have differed if the students stop practicing immediately upon attaining the performance standards. The farther the frequencies lie beyond the performance standard the more difficulty one has in interpreting the exact retention effects for each condition.

Multiple treatment interference or interaction effects can sometimes occurs with multiple treatments designs (Kennedy 2005). Exposure to the practice in either condition or even reading in the students classroom could have effected performance in subsequent conditions. However, this limitation seems tempered by the fact that all students attended the same classroom and all received equal amount of instruction within their reading groups. Also, the passages had low word overlap therefore reducing the likelihood of interaction effects but nevertheless not completely eliminating interaction effects. Further, the comparison of two passages provides limited generality. Future studies could enhance the generality of this study by directly or systematically replicating this study and including additional instructional level passages.

Implications for Practice

The results from the present study have implications for practicing teachers. First, the performance standard of 200 CWPM could serve as benchmark for decoding fluency. In other words, if the performance standard of 200 CWPM produces long term retention of the decoding skill teachers who uses such a standard can reasonably assume salutary retention benefits for students meeting the fluency aim.

Second, when conducting screening for decoding fluency in a classroom setting the 200 CWPM performance standard will help teacher quickly see who needs additional decoding fluency assistance. Kubina and Starlin (2003) also offered performance guidelines used for placement and decision making with decoding fluency; 0–75 CWPM = challenging reading, 50–150 CWPM = instructional level reading; 150–250 CWPM = fluent reading.

And third, students decoding at higher frequencies may experience improvements in comprehension. The relationship between decoding fluency and comprehension follows the logic statement of "necessary but not sufficient." Reading fluency serves as a gateway to comprehension by allowing readers to shift their attention from decoding text to comprehending its meaning (Kuhn and Stahl

2003). If a high performance standard of 200 CWPM engenders longer term retention of decoding it stands to reason students may also benefit from enhanced comprehension across time. However, the link between decoding fluency and comprehension does not mean *all* readers will automatically comprehend better if they can decode text fluently. For instance a reader who does not understand the English language well may decode text at a high frequency but would still have comprehension problems if she did not understand key vocabulary.

Conclusion

Three students attending a learning support classroom used a repeating reading strategy with two passages. Students read one passage to a performance standard of 200+ CWPM and another passage to a 123+ CWPM performance standard. Results show students more practice to reach the of 200+ CWPM performance standard in regards to calendar days and practice trials. The retention measures show students had similar decrements with retention for CWPM for both performance standards even though practice varied. A metric called a change factor, a ratio or initial performance and the terminal aim, corresponded to the rate at which students retained CWPM. Students with smaller change factors retained CWPM better than students with large change factors. During the last retention interval for the 2 passage, a 3½ month retention interval, all students demonstrated the highest terminal frequency of CWPM in the 200+ performance standard condition.

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