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Using Precision Teaching with Direct Instruction in a Summer School Program

Abstract: This study examined the effects of a Direct Instruction (DI) reading program combined with Precision Teaching during a public school's summer program. Students received instruction from *Reading Mastery* programs for a six-week period. Students also practiced specific reading skills including letter-sound identification, sounding out words, and passage decoding, and they displayed their data on Standard Celeration Charts. Results showed that DI combined with Precision Teaching produced statistically significant gains as measured by informal and formal tests of reading. The results also indicated small to moderate effect sizes for the reading measures.

The climate for research-based, or evidence-based, approaches for reading has changed. The No Child Left Behind Act of 2001 (NCLB) mandated evidence-based criteria as a standard for judging which programs will receive federal education funding. Evidence-based programs have undergone scientific testing and have yielded reliable and valid results. By incorporating evidence-based programs, the educational outcomes of students across the nation will improve (Whitehurst, 2002). Indeed, without the use of research-based practices as a guide, true reform efforts in education are unlikely to occur (National Research Council, 1998).

In recent years, a number of evidence-based programs have been developed and tested to put the educational reform effort into action. For example, DI reading programs, developed by Engelmann and colleagues, have consistently and reliably shown significant success with diverse groups of learners (Adams & Engelmann, 1996; Carnine, Silbert, Kame'enui, & Tarver, 2004; Hempenstall, 2004; Kinder, Kubina, & Marchand-Martella, 2005; Marchand-Martella, Slocum, & Martella, 2004). The range of learners extends from students in special education to those in gifted programs (Adams & Engelmann). These developmental reading programs include *Horizons*, *Journeys*, *Reading Mastery Classic*, and *Reading Mastery Plus*, whereas remedial programs consist of *Corrective Reading—Decoding* and *Comprehension*. DI reading programs form a comprehensive curriculum with teacher presentation manuals, student books, and other materials.

DI also has some activities built into the programs to gauge student progress. Some of these progress mechanisms include skills-profile folders and mastery test checkouts. However, DI programs may further benefit from an additional standard graphic display system and a standard set of graphing conventions for student progress. One such classroom-based procedure that helps to

Journal of Direct Instruction, Vol. 9, No. 1, pp. 1-12. Address correspondence to Richard Kubina at rmk11@psu.edu.

measure student behavior with standard charts and conventions and facilitates curricular decisions, Precision Teaching, may further augment the educational outcomes produced by DI.

Lindsley (1997) defined Precision Teaching as a set of tactics and strategies that assist with the analysis and interpretation of behavior. Precision Teaching uses a Standard Celeration Chart to display data in a formative manner. Teachers have used Precision Teaching in both public- and private-school classrooms as well as with a variety of learners spanning various ages, genders, and disabilities (Johnson & Layng, 1992; Kubina & Morrison, 2000; Lindsley, 1990, 1997; Mercer, Mercer, & Evans, 1982; West & Young, 1992). Precision Teaching, like DI, meets the criteria for an evidence-based approach to education.

However, unlike DI, Precision Teaching does not specify what or how to teach. It offers a method to measure behavior, display the data on the Standard Celeration Charts, and facilitate decision-making for a teacher. Precision Teaching has four important guidelines that influence its use: (a) a focus on directly observable behavior, (b) the use of frequency as a standard unit of measurement, (c) data displayed on a Standard Celeration Chart, and (d) the belief that the "learner knows best" or the practice of embracing data as a reflection of the current environmental effects influencing a behavior (Kubina, Ward, & Mozzoni, 2000; White, 1986, 2005).

As shown by previous research, teachers who formatively assess students and use graphs make more responsive decisions than teachers who do not (Fuchs & Fuchs, 1986). The specialized Standard Celeration Chart and systematic practice procedures used in Precision Teaching have facilitated improved outcomes in both public and private schools (Beck & Clement, 1991; Johnson & Layng, 1992, 1994; Maloney, 1998). As a public school example, Sacajawea Elementary in Great Falls, MT, implemented Precision Teaching throughout the school. The intervention consisted of teachers adding approximately 20 to 30 minutes of daily practice, Standard Celeration charting, and subsequent decision-making. Aggregated achievement test scores increased an average of 20 to 40 percentile points from the previous level after 3 years of the Precision Teaching intervention (Beck & Clement, 1991; Binder & Watkins, 1989). By combining Precision Teaching and DI, teachers and students may experience additional benefits. As Binder and Watkins (1990) put it, "Precision Teaching and Direct Instruction are mature and extremely powerful instructional technologies that are fully capable of erasing America's 'basic skills crisis' if widely adopted" (p. 93).

Further research exists supporting the proposition that DI reading programs show positive results when combined with Precision Teaching techniques (Blackwell, Stookey, & McLaughlin, 1996; Edmonson, Peck, & McLaughlin, 1996; Haring & Krug, 1975; Holz, Peck, McLaughlin, & Stookey, 1996; Johnson & Layng, 1992; Johnson & Street, 2004; Maloney, 1998; Morrell, Morrell, & Kubina, 1995; Neely, 1995; Stenseth & McLaughlin, 1996). For instance, Morrell et al. examined the effects of practicing sight words from *Reading Mastery I* with three second-grade students who had specific learning disabilities in reading. An instructional day consisted of following the *Reading Mastery I* curriculum as well as supplementing 5 to 10 minutes of systematic practice and Standard Celeration charting of the data. The intervention helped students to proceed through the lessons rapidly and improved their reading of targeted words within sentences. The students began the intervention of *Reading Mastery* and Precision Teaching toward the end of the school year and could fluently read more than 40 sight words from *Reading Mastery I* within 2 months. Prior to the DI and Precision Teaching intervention, the students could not read any words.

By adding Precision Teaching to DI programs, teachers have a powerful combination of carefully designed instruction and a "sophisticated set of measurement practices" and "productive practice exercises" capable of producing substantial academic gains (Desjardins & Slocum, 1993, p. 20). Considering the critical need for producing competent readers, combining DI reading programs with Precision Teaching may have a positive synergistic effect. To date, published articles describing large-scale combinations of Precision Teaching and DI in a public school do not exist. Therefore, in this study we examined the effects of a public school district's summer school program that combined the DI reading program *Reading Mastery* with Precision Teaching.

Method

Participants and Setting

The participants came from an urban district located in central Pennsylvania. There were 203 students, including 89 girls (43.8%) and 114 boys (56.2%), from five elementary schools attending the summer school program. Selection criteria for summer school included scoring at the 25th percentile or lower on the *Pennsylvania System of School Assessment* (Pennsylvania Department of Education) and performing below grade level in reading. There were 61 first graders (30.0%), 53 second graders (26.1%), 49 third graders (24.1%), and 40 fourth graders (19.7 %).

Of the student population for summer school, 36 (18%) were identified, using standardized methods, as "Limited English Proficient, LEP," and 26 (13%) of the students had an Individualized Education Program. All of the eligible students in each participating classroom participated in the study. The students attended summer school, which ran 4 days a week for 6 weeks. Class size ranged from 10 to 14 students per class. Each class had a teacher and a paraprofessional.

Materials

Reading Mastery Rainbow Editions I, II, and *III* were used (Engelmann & Bruner, 1995a; Engelmann & Bruner, 1995b; Engelmann & Hanner, 1995). Each *Reading Mastery* program contained a teacher presentation book, student reading books, and student workbooks. To display daily reading practice measures, Standard Celeration Charts were used. Other materials included practice sheets, pieces of Mylar, dry-erase pens, and paper towels. All students used a data sheet to record practice scores before displaying them on Standard Celeration Charts.

Response Measurement

The difference between each student's pretest and posttest measure served as the method to evaluate the results of *Reading Mastery*, the selected skills practiced to fluency, and the Standard Celeration charting methods from Precision Teaching. During the first week of summer school, before students received instruction, a team of principals, school psychologists, and teachers administered the pretest measures. During the last week of summer school, the same team administered the posttest measures to the students. The assessors gave three informal and three formal measures of reading.

Informal measures of reading. Classroom teachers and paraprofessionals implemented the informal measures (these assessments are available from the first author upon request). For all three informal measures, assessors gave directions, modeled the performance, and asked if the student understood. When students did not understand a direction, the assessors repeated the direction, modeled the performance, and led the students to the correct response. During each informal reading measure, the assessors scored correct and incorrect answers out of the students' view. If students made mistakes, they did not receive feedback on their errors. Additionally, if students hesitated for more than five seconds on any part of

the informal measures, the assessors told the students the correct response, marked it as incorrect, and told the students to keep going. At the end of each informal measure, the assessors made positive comments and thanked the students for participating.

Letter sound fluency measure. The first informal measure of reading required students to point to and say as many letter sounds as they could in 1 minute. The letter-sound sequence came from the *Reading Mastery I* teachers' guide (Engelmann & Bruner, 1995c). A sheet set in landscape view had the first 40 letter sounds in random order and then repeated the order two more times for a total of 120 letters. Macrons were used to show the long sounds. The assessor gave the student instructions and then modeled how to point to a letter, say its sound, and move across the page in a left-to-right fashion. After asking if the student had any questions, the assessor told the student to begin and started the timer, which was set for 1 minute. At the end of the timing, the student left and the assessor scored and recorded the student's performance.

Orally decoding words fluency measure. The second informal measure required students to sound out words and then say them fast. All words came from *Reading Mastery I, II,* and *III* sight-word lists and were taken from advanced parts of each program. It was possible that some students in advanced *Reading Mastery* lessons (e.g., *RM III*) had already been taught some of the words (e.g., *RM I*). The regular words had a mixture of word types (e.g., C = Consonant; V = Vowel: CV, VC, CVC, CVCC, CCVCC) and words beginning with continuous and quick sounds. Each sheet had a total of 60 words. The assessors provided directions and modeled how to sound out words and then say them fast. To record correct and incorrect answers, a separate sheet was used to follow along with the students. The assessors awarded the students one point for each correctly identified letter sound and one point for saying the word fast. For instance, the word "run" had a potential score of four with one correct point for each letter sound and one point for saying the word fast.

Oral reading fluency measure. The third informal test measured how many correct words per minute the students read. Assessors used a story taken from a lesson at the end of the storybook, depending on which *Reading Mastery* program each student tested into. For example, if a student placed into *Reading Mastery II,* she read a passage from Lesson 60 during both the pretest and posttest. The passage was selected from a lesson that the students would not read before summer school ended. For each of the informal measures, students could have encountered sounds and words not yet instructed.

Formal measures of reading. Three subtests from the *Woodcock Reading Mastery Test-Revised-NU* (Woodcock, 1998) served as formal measures of reading. The subtests, "Word Attack" and "Word Identification," provided formal measures of the students' skills in correctly pronouncing words and employing analytic decoding strategies. The other subtest, "Passage Comprehension," gave information regarding the students' skills in comprehending what they read. Only three assessors (i.e., one principal and two school psychologists), who were trained to administer the subtests from the *Woodcock Reading Mastery Test-Revised-NU,* assessed the students. The assessors administered Form G for the pretest and Form H, which had parallel test items, for the posttest.

Research Design

To examine the effects of the combination of *Reading Mastery* and Precision Teaching, the investigators used a pre-experimental, one-group pretest-posttest design (Fraenkel & Wallen, 1996). The one-group pretest-posttest design, however, contains a number of threats to internal validity. As Fraenkel and Wallen point out, any of the nine identified threats to internal validity could explain the results of the posttest. Therefore we recom-

mend that readers interpret the subsequent results cautiously.

Procedure

Each classroom had a teacher who taught *Reading Mastery* lessons to homogeneously grouped students. All teachers had previously taught *Reading Mastery* for a minimum of 1 year. The teachers also attended a district training aimed at providing additional instruction for the summer school. At the district training, both teachers and paraprofessionals learned to implement certain aspects of Precision Teaching for the summer school program. Specifically, they learned how to use the Standard Celeration Chart and how to set up practice-to-fluency activities for letter sounds, oral decoding of words, and passage reading (Kubina, 2005). The initial training, conducted by the first author, spanned two days and occurred prior to summer school. Throughout the six weeks of summer school, the teachers received periodic coaching sessions. Coaching sessions involved checking data on the Standard Celeration Chart, reviewing instructional decisions, and answering any teacher questions. During summer school, teachers who used *Reading Mastery* continued to use the program as they were trained and did not change any formats or instructional delivery techniques.

Letter sounds. A sheet with letter sounds was used to practice saying letter sounds fluently. Five sheets of letter sounds were used depending on the students' current level of instruction in *Reading Mastery*. Sheet A consisted of the first 8 letter sounds from the *Reading Mastery* letter-sound sequence placed in random order on 8 x 11 in. landscape-view paper. The letters filled the page and appeared in equal proportion. Therefore, if a letter sound sheet had 120 total sounds, each separate letter sound appeared 15 times. Sheets B, C, D, and E each added another 8 sounds, so that B had 16 letter sounds from the *Reading Mastery* sequence, and C, D, and E contained 24, 32, and 40 letter sounds respectively. All letter sounds followed the previously mentioned instructional design of using an 8 x 11 in. landscape view of 120 letters per page.

Each day, students practiced saying their letter sounds with a partner who was also a student. The students engaged in practice as a group. The teacher started a countdown timer and told the students when to begin and when to stop. Students were taught how to record correct and incorrect answers on a sheet and then to provide feedback to the partner. After providing feedback to the partner, students switched roles so that all students had an opportunity to practice each day. The Precision Teaching fluency aim for letter sounds was 100 to 120 letter sounds per minute (Freeman & Haughton, 1993). First-grade students practiced for 20 seconds instead of 1 minute and had a goal or fluency aim of 33 to 40 letter sounds per 20 seconds. The goal of 33 to 40 letter sounds was calculated by dividing 60 seconds or 1 minute by three because there are three, 20-second intervals per minute. The second through fourth graders had to reach the fluency aim of 100 to 120 letter sounds per minute. If students struggled with reaching their aim, the teacher could lower the counting time to 30 seconds (i.e., aim would then equal 50 to 60 letter sounds per 30 seconds) or to 20 seconds. Reducing the time interval of practice was an attempt to help the students build endurance, or the ability to perform stably for a given period of time (Binder, 1996). If students were fluent with letter sounds, evidenced by meeting the fluency aim, they did not engage in the practice procedure.

It should be noted that students did not practice letter sounds without first receiving instruction. Because all students were in small groups and received the same instruction, practice did not begin until after the lesson that contained the last letter sound of a sheet. For example, in *Reading Mastery I* the eighth letter sound /i/ was introduced in Lesson 34.

Students practiced sheet A only after passing Lesson 34. Practice continued until a student met the fluency aim. Sheet B was introduced after Lesson 64. Students who mastered letter-sound sheet A before the next letter sheet was introduced were helpers who counted corrects and incorrects or provided help or encouragement directed by the classroom teacher.

Orally decoding words. As described in the second informal measure, students practiced sounding out words and saying them fast. The words came from the word list used in their current *Reading Mastery* program and not from the words used in the informal measure, thus avoiding an overlap. A student on Lesson 20 of *Reading Mastery II* practiced words made up of letter sounds previously instructed. Each sheet had more words than the students could sound out and say fast in a minute. Each *Reading Mastery* program (*I, II,* and *III*) included five different sheets made up of words from 20 lessons, and some words were repeated on the sheet.

Students were taught how to record correct and incorrect answers on the word-list sheet that their partners were using. Partners started from a different place on the word list each time to avoid repeating what the other partner had previously sounded out and then said fast. Because the Precision Teaching published literature did not include fluency aims for orally decoding words, the first author sampled a group of young adults who were considered fluent (Kubina, 2003). The sampling procedure followed the guidelines from Binder (1996) and Koorland, Keel, and Ueberhorst (1990). The fluency aim for second through fourth graders was 80 to 100 letters sounded out and words said quickly per minute. First-grade students used a 20-second counting time with a fluency aim of 27 to 33 letters sounded out and words said correctly. The first-grade students' counting time was calculated by dividing three (i.e., three 20-second intervals in one minute) into the 80 to 100 fluency aim. As an intervention and at the discretion of the teacher, teachers used 20- and 30-second counting times with the second-though fourth-grade students (i.e., fluency aim of 40 to 50 for 30-second counting time) when students did not make adequate progress with the 1-minute counting time. Students' Standard Celeration Charts, consulted by the teacher, helped guide the decision whether to make a change in timing length.

Passage fluency. Students practiced repeated readings of a passage they had read in the *Reading Mastery* program. The students in third and fourth grade practiced reading a passage until they met the Precision Teaching fluency aim of 200 words correct per minute (Beck, Conrad, & Anderson, 1995; Freeman & Haughton, 1993; Kubina, Amato, Schwilk, & Therrien, 2008). After a student met the fluency aim, he or she started to read a new passage and would do so again until reaching the aim. Students in second grade used a 30-second counting time and had an aim of 100 words. Students in first grade performed the repeated reading of the passage until they met an aim of 66 words in 20 seconds. If students could not read a minimum of 10 words in 30 seconds they did not engage in repeated reading.

The teacher selected stories for repeated reading. Passages came from a *Reading Mastery* passage that the students had already read. To implement the procedure, the teacher put the students into pairs with one student as the reader and the other as the scorer. Each student had a copy of the passage. The scorer placed a Mylar sheet over the passage. Once the teacher started the timer, students started to read while their partners used a dry-erase marker to write Xs by words the readers omitted or said incorrectly. At the end of the timing, the scorers shared feedback with the readers, wrote the scores on a separate datasheet, and then switched roles.

Each reader engaged in a repeated reading of the passage two to three times at the teachers' discretion. The teachers made their decision for the third extra practice trial based on the

trend of the data displayed on the Standard Celeration Charts. Teachers' decisions were influenced by flat or slowly growing trends in the data (cf. Figure 1). The teachers systematically checked partners' scoring accuracy by moving from student to student during each timing and varying their checking procedure each day to ensure they had an opportunity to observe all students.

Standard Celeration charting. Each teacher taught her class of students how to use the Standard Celeration Chart using a modified version of procedures described by Cancio and Maloney (1994). The Standard Celeration Chart procedures were found in a script that sequentially taught students to find day lines and counting lines and to display dots and Xs for correct and incorrect data. In first grade, approximately half of the students did not learn how to chart. Those students had either a classmate or paraprofessional help them. The teacher observed the charted frequencies and made decisions if a change to the particular practice procedure was warranted. Students could also participate in asking for a change or using a procedure they suggested (e.g., beating a set score for the day).

Results

Over the period of the six-week summer intervention program, both the celerations of students' learning and the standardized tests significantly increased (we report only the latter). Students showed statistically significant improvement from the pretest to posttest assessments for the informal and formal reading measures at the end of the six-week summer school program. Students who attended fewer than 25% of the summer school sessions were not included in the data analysis.

Informal measures

The changes in student learning are shown by a pretest and posttest for each measure using SPSS version 12 repeated measures analysis of variance (ANOVA) program, as indicated in Table 1. The first informal measure is the

Figure 1

The Decision Rules Chart Used By Teachers

Standard Celeration Chart data	Action
Meets aim for two out of three days	Make a change
Four to five days of flat data	Make a change
Minimum celeration less than x1.25 (for acceleration aims)	Make a change
Acceleration data decelerating	Make a change
Deceleration data accelerating	Make a change
Data fall below projected celeration aim line	Make a change
Teacher Prerogative (Teacher has information pertinent to improving the learner's performance)	Make a change

Adapted from Cancio & Maloney (1994) and other sources

number of *Reading Mastery* letter sounds said by a student in 1 minute. The frequency scores (n = 165) had a pretest mean of 42.4 (SD = 15.8) and a posttest mean of 64.2 (SD = 24.98). The improvement of 21.8 letter sounds per minute was statistically significant, F (1,164) = 173.035, p < .0005 and ? = .513, a moderate effect size (Vasquez, Gangstead, & Henson, 2000).

The second informal measure recorded one point for each correctly identified letter sound and for each word correctly read the fast way (n = 162). There was a statistically significant improvement from the pretest mean of 58.38 (SD = 24.26) to the posttest mean of 103.47 (SD = 42.86), a difference of 45.09 letters sounded out and words read per minute, F(1,161) = 241.207, p < .0005, ? = 0.60 (moderate effect size). The gain of 45 letters sounded out translates into an average gain of 9 to 11 more words orally decoded on a word list.

The third informal measure was the number of words read correctly (n = 148). There was also a statistically significant improvement from the pretest mean of 69.31 (SD = 32.29) to the posttest mean of 86.15 (SD = 40.96), an increase of 16.84, F(1,147) = 98.368, p < .0005, ? = 0.401 (moderate effect size). Students showed an average gain of 17 words per minute for their oral reading fluency.

Table 2 shows there were also statistically significant improvements on the selected standardized subtests of the *Woodcock Reading Mastery Test-Revised-NU* (Woodcock, 1998) for Word Identification (n = 97). The pretest mean was 89.04 (SD = 12.55) and the posttest mean was 94.00 (SD = 12.74). The difference between the means = 4.96, which was found to be a statistically significant improvement, F(1,96) = 20.741, p < .0005, with a small effect size of ? =.178.

In the second formal measure, Word Attack (n = 97), there was a pretest mean of 92.63 (SD = 18.28) and a posttest mean of 101.53 (SD = 14.94). The resulting difference between the means was 8.9, a statistically significant improvement, F(1,96) = 17.972, p < .0005, and a small effect size (? = 0.158).

Passage Comprehension (n = 93) was the final formal measure. Again, the difference between the pretest mean of 88.11 (SD = 14.11) and

Table 1

Pretest and Posttest Informal Measures of Reading Fluency

Informal reading measure	*n*	Pretest fluency mean	Posttest fluency mean	F	Effect size
Letter sound (identification) fluency	165	42.40 (SD = 15.80)	64.20 (SD = 24.98)	173.035**	0.513
Orally decoding words fluency	162	58.38 (SD = 24.26)	103.47 (SD = 42.86)	241.207**	0.6
Passage fluency	148	69.31 (SD = 32.29)	86.15 (SD = 40.96)	98.368**	0.401

** p < .0005

the posttest mean of 94.63 (SD = 12.37), a difference of 6.52, was statistically significant, $F(1, 92) = 30.220$, $p < .0005$, with a small effect size of ? = 0.247. Because of the moderate rather than large sample size and resulting empty cells, we did not separate the data according to the levels of *Reading Mastery* used for instruction. A larger sample size would have allowed the pretest-to-posttest changes in reading fluency to be evaluated in relationship to "in-program" *Reading Mastery* reading fluency goals.

Discussion

The combination of the DI program *Reading Mastery* and Precision Teaching implemented over the six-week summer school program resulted in statistically and educationally significant improvements in students' informal and formal measures of reading. In this intervention, summer school students received instruction from *Reading Mastery* programs and spent time practicing letter sounds, sounding out and saying words fast, and repeatedly reading passages to Precision Teaching fluency aims. The data are encouraging because they show that even over a short six-week summer school period, the reading skills of students greatly improved after being exposed to the combination of *Reading Mastery* and Precision Teaching.

This study supports the notion that Precision Teaching, combined with other curricula, produces positive outcomes (Lindsley, 1992). During the summer school implementation, teachers who used *Reading Mastery* continued to use the program as designed and did not change any formats or instructional delivery techniques. The addition of Precision Teaching required students to practice skills to fluency and to display data on a Standard Celeration Chart. The skills selected for the students to practice and monitor (letter sounds, sounding out words and saying them fast, and passage reading) were chosen because they are pivotal decoding skills. The scope and sequence for *Reading Mastery I, II,* and *III* all show that the selected skills used in this study play critical roles not only for decoding but also for comprehension. For example, oral reading fluency strongly reflects a student's overall reading competence (Fuchs, Fuchs, Hosp, & Jenkins, 2001).

Table 2

Pretest and Posttest Formal Measures of Reading Fluency

Formal reading measure	*n*	Pretest standard score mean	Posttest standard score mean	F	Effect size
Word Identification	97	89.04 (SD = 12.55)	94.00 (SD = 12.74)	20.741**	0.178
Word Attack	97	92.63 (SD = 18.28)	101.53 (SD = 14.94)	17.972**	0.158
Passage Comprehension	93	88.11 (SD = 14.11)	94.63 (SD = 12.37)	30.220**	0.247

** $p < .0005$

By facilitating fluency with pivotal decoding skills, beyond what the *Reading Mastery* program calls for, the use of Precision Teaching (i.e., practice methods, monitoring data on Standard Celeration Charts) may have produced a critical learning outcome associated with fluency called "application." Application refers to the process where component skills, when fluent, quickly apply or combine to form a composite skill (Binder, 1996; Haughton, 1972; Kubina & Morrison, 2000; Kubina, Young, & Kilwein, 2004). Some students, for instance, received instruction on letter-sound identification through *Reading Mastery I*. Letter-sound identification is a component skill of sounding out words. Students who could fluently identify letter sounds may have more readily applied the component skill to the composite behavior of sounding out a word more quickly than students who could not fluently say letter sounds. For example, students who could identify letter sounds at 100% accuracy but did so at a rate of 5 letter sounds per 10 seconds demonstrated a different performance sounding out words than students who identified 16 letter sounds per 10 seconds. Additionally, students who could sound out words fluently (i.e., 80 letters and words said fast per minute) may have applied this skill to the composite behavior of reading words in a passage more readily than students who orally decoded words at a rate of 30 letter sounds and words said fast per minute.

Because the teachers used Standard Celeration Charts to make instructional decisions, one would expect larger effect sizes for informal reading measures (i.e., directly practiced pivotal reading skills) than for formal measures (i.e., not directly practiced reading skills). The data show a larger effect size for the charted behaviors. The teachers looked at the fluency data on a daily basis and made instructional decisions following decision rules adapted from Cancio and Maloney (1994) and other sources (Figure 1). One decision rule—"If four to five days of flat data, make a change"—promoted active involvement and individualized and responsive changes implemented by the teacher. For instance, if a student did not make progress for three days for her letter sounds, the teacher analyzed the charted data, implemented an intervention, and then examined the results of the intervention in the coming days. Examples of interventions consisted of reducing the counting time or practice interval, having the student set goals, and selecting a school supply reward for obtaining an improvement goal (e.g., receiving a pencil after reading 15 more words correctly in 30 seconds).

The conclusions of this study present positive results, but there are several limitations that suggest alternative explanations. The methodology is also limited due to the one-group pretest-posttest design, but this method also allows for the investigation of the subject matter, which might otherwise not be feasible. In addition, the one-group pretest-posttest design includes variables such as history and maturation that can affect internal validity. Despite these limitations, readers are encouraged not to discount the findings of this study but instead to carefully interpret them.

This investigation cannot fully conclude that Precision Teaching augmented and improved the use of the DI program *Reading Mastery*. However, it can suggest that the effects of the combination of DI and Precision Teaching are positive for those students involved. Due to the lack of a control group and the study design, a cause-effect conclusion cannot be made, but the evidence does show a positive effect when using Precision Teaching with *Reading Mastery.*

Future Research

We hope to replicate the findings of the present study but with two additional control groups. Participants in the first control group would be pretested and posttested but would not participate in the intervention. Rather, they would receive alternative instruction that

did not include DI. This would allow us to see if the change in scores was due to our intervention rather than just an effect of going to summer school. A second control group would have a DI-only intervention, permitting an appraisal as to the effects of adding Precision Teaching to DI and using DI alone. Examining the separate effects for various interventions in the future holds value. For instance, do the Precision Teaching fluency aims for a particular skill enhance the progress students make in a specific strand (e.g., orally decoding words)? Also, additional research should be conducted to further confirm and establish the fluency aims (e.g., orally decoding words). Another suggestion for future research entails the analysis of disaggregated data by separate grades and reading levels. Many other future research questions may arise, and if the present study serves as an indication for prospective research, future students will benefit from the use of DI and Precision Teaching.

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