Reading with Precision

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This article looks at the area of reading through the lens of Precision Teaching and its Standard Celeration Chart. Precision Teaching grows from the science of human behavior and is distinguished by its use of standard measurement units, procedures and display systems in studying human behavior. Precision Teaching benefits the study and practice of reading instruction by applying concepts of behavior analysis.

Teaching reading remains a controversial subject in American education. In 1955 Flesh published "Why Johhny can't read" and called into question the "look-say method." In 1967 Chall wrote "Learning to read: The great debate" which reviewed the reading literature and concluded that phonics instruction was critical to success in beginning reading. Adams published "Beginning to read: Thinking and learning about print" in 1990 and drew attention to "phonological awareness." Each of these books focused national attention on reading instruction. These three high profile books are among thousands of publications that have addressed the teaching of reading over the last 50 years. Yet intense disagreements continue over how best to teach reading. Many arguments in the reading literature stem from an anti-science basis. Some "reading/education experts" are not instructed in research methodologies while others refuse to accept scientific data. "Education experts routinely make decisions in subjective fashion, eschewing quantitative measures and ignoring research findings" (Carnine 2000, p. 9).

The United States government has emphasized the need to integrate research-based results and methods into education. The U. S. Congress commissioned a panel of reading experts to review the reading research to find reliable and valid studies showing effective methods of teaching early reading (National Reading Panel, 2000). The National Reading Panel documented that research-based evidence exists which supports specific methods for helping students become better decoders, increase comprehension, and become more fluent in reading text. In 2002 the U. S. congress passed legislation requiring reading practices to be based on research/scientifically based evidence (No Child Left Behind, 2002). These initiatives provide hope that the climate is right in the U.S. for the establishment of scientific practices in the teaching of reading. However, it is important that we follow the lead of other scientific disciplines and *standardize* our measurement units, procedures and display systems. Carnine (1995) dubbed the status of education "preprofessional." He suggested that the failure of education to develop powerful generalizations based on scientific evidence contrasts markedly with mature professions such as health and engineering. The fact that meta-analysis is such a common practice in summarizing educational research underscores the non-standard nature of the systems for measuring and reporting research results. Standard measurement systems within a dis-

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cipline enable scientists to communicate efficiently and effectively research findings which facilitates the accumulation of knowledge. The Precision Teaching system grew from the science of human behavior. (Lindsley, 1972, 1991, 1997) and provides such a standard system for measuring and displaying human behavior such as reading or what Skinner (1957) called textual behavior. The founder of Precision Teaching, Lindsley, points out that the use of a standard unit of performance measurement, frequency, and a standard display of visual data, the cumulative response recorder, are legacies from Skinner and provided the foundation for the precise scientific behavior monitoring system of Precision Teaching (Lindsley, 1991). While Precision Teaching can be used with any curriculum area (Lindsley, 1992), we focus on how Precision Teaching can contribute to improving reading behavior.

Reading

Literacy research documents that reading is a complex subject leading some professionals, like the American Federation of Teachers, to proclaim "Teaching reading is rocket science" (Moats, 1999). Reading has two large skill areas: decoding and comprehension (Carnine, Silbert, & Kameenui, 1997). Gough and Tunmer (1986) expressed reading as an equation "Reading = Decoding x Comprehension." Under the decoding and comprehension umbrella a multitude of behaviors exist. For example under decoding, a skilled reader uses phonic, structural and contextual analysis skills to decode words (Carnine et al., 1997). Exploring all of the skills involved in decoding and comprehension falls beyond the scope of this paper. We focus on how Precision Teaching supports improvement of skills in decoding. Note: Our usage of the term *teacher* refers to any person who teaches a new skill: general education teachers, special education teachers, para-professionals, behavior analysts, speech and language clinicians, parents.

Decoding

Decoding, also called "phonological recoding," refers to the process of translating written alphabetic letters into sounds, and matching the sounds with the pronunciation of a word the student has learned (Daneman, 1991). The reader changes the print representation into a spoken word format (Shanker & Ekwall, 1998). Research has shown that oral reading fluency, or ORF, serves as one of the best measures of basic reading competence. Fuchs, Fuchs and Hosp (2001) conducted a literature review and found ORF predicted comprehension better than direct measures of reading comprehension such as questioning, retelling, and cloze. ORF measures involve recording the number of words read aloud correctly and incorrectly per minute. While oral reading fluency has received considerable attention in the reading literature, Precision Teaching further enhances its use by including "performance standards."

Performance standards for oral reading fluency

Precision Teaching defines performance standards as performance frequencies empirically associated with retention, endurance, and application (Binder, 1996; Haughton, 1984). In other words, a response that occurs within a certain frequency range will display retention, endurance and application. When contemplating performance standards Haughton (1984) made the following statement: "...in the final analysis we owe it to each behaver to determine levels that will ensure Retention, Endurance, and Application..." (p. 96).

The acronym REAPS concisely captures the relationship between behavior and associated learning outcomes. REAPS stands for *R*etention, *E*ndurance, *A*pplication *P*erformance *S*tandards (Binder, 1996; Haughton, 1981). *Retention* addresses "the relation between two behavior frequencies at two points in time, between which the individual has had no opportunity to emit the behavior" (Binder, 1996, p. 164). If a person reaches the fluency aim or performance standard long term retention can occur even though practice has not taken place (Johnson & Layng, 1996). *Endurance* describes the ability to perform a behavior over significant periods in the face of environmental distraction without performance decrement (Binder, 1996). *Application* refers to element or component behaviors that combine or become integrated into a compound or com-

posite behavior (Barrett, 1979; Bucklin, Dickinson, & Brethower, 2000; Haughton, 1972, 1980).

For more than 25 years Precision Teaching has worked on establishing academic performance standards (Maloney, 1998). Beck, Conrad, and Anderson, (1996) document performance standards obtained through the performances of thousands of students in the Great Falls Montana Project (Beck & Clement, 1991). Freeman and Haughton (1993a, 1993b) offer fluency aims for reading and handwriting based on a variety of learners. Mercer, Mercer, and Evans (1982) provide performance standards based on large-scale Precision Teaching projects conducted at multiple sites with a wide breadth of learners and over long periods of time.

Table 1 contains a listing of the recommended goals and objectives for ORF. Central to these goals and objectives are the performance standards for oral reading fluency, 150 - 250 words read correctly per minute. The fluency criteria of 150 - 250 words per minute indicates the level at which a person achieves REAPS (Haughton, 1981; Mercer, Mercer, & Evans, 1982; Starlin, 1979). These criteria are used regardless of the native language, complexity of the material or age or grade levels (Haughton, 1982; Starlin, 1979). The performance standard defines when a student demonstrates accurate and fluent recognition of the words they are reading.

Oral reading fluency (ORF) as a reading domain measure. When students achieve decoding fluency some researchers suggest more "attention" is available for comprehension (Kuhn & Stahl, 2003; Nathan & Stanovich, 1991). Fluent decoding allows a student to concentrate on the meaning of the words rather than on the code or the words in the passage. Oral reading fluency serves as a

Table 1. A list of Reading Goals and Objectives

General Reading Goal: To read accurately and fluently orally and then silently 10,000 - 60,000 printed words in common reading materials such as newspapers, magazines, and novels under typical circumstances.
Functional Reading Goal: (1) The student will read orally two randomly selected articles in a local newspaper on two separate days at 150-250 words/minute with only 0 - 2 errors, by a specific targeted date. (2) The student will read silently two randomly selected articles in a local newspaper on two separate days at 350-900 words/minute by a specific targeted date.
Metric: Words read orally correctly/minute (action to count/time); Words read orally incorrectly/minute.
Proficiency Standard: 150-250 words correct/minute with only 0 - 2 errors.
Developmental Objectives:
1. The student will read orally a randomly selected passage from two different "level one" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
2. The student will read orally a randomly selected passage from two different "level two" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
3. The student will read orally a randomly selected passage from two different "level three" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
4. The student will read orally a randomly selected passage from two different "level four" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
5. The student will read orally a randomly selected passage from two different "level five" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
6. The student will read orally a randomly selected passage from two different "level six" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
7. The student will read orally a randomly selected passage from two different "level seven" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
8. The student will read orally a randomly selected passage from two different "level eight" materials on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.
9. The student will read orally a randomly selected passage from two different secondary content textbooks on two separate days at 150-250 words/minute with only 0 - 2 errors by a specific targeted date.

general measure for decoding and comprehension. As Fuchs et al., state: "...as an individual translates text into spoken language, he or she quickly coordinates these skills in an obligatory and seemingly effortless manner, and because oral reading fluency reflects this complex orchestration, it can be used in an elegant and reliable way to characterize reading expertise" (2001, p. 240).

Teachers should be aware of a number of reading comprehension instructional tactics that are essential to oral reading fluency. For example, expanding a student's reading vocabulary contributes to her decoding and comprehension. Additonally, teaching students to read with expression helps a student better understand the content in the passage (Carnine, et al, 1997). Such comprehension skills, however, need not always be directly measured due to the strong reltionship between ORF and comprehension (Fuchs et al, 2001).

Instructional Placement

Given a sensitive domain measure for reading, ORF, and performance standards based on retention, endurance and application, REAPS, teachers are in a position to begin instruction and have confidence they can monitor instructional effectiveness. Ideally in determining instructional placement, a teacher would select a number of materials such as grade level text, estimated instructional text, or newspapers, and sample performance for a week to determine in which material the student is *learning* the most and moving rapidly from non-fluent to fluent performance. Learning (or celeration) in the Precision Teaching system is defined as the change in frequency per week (Graf & Lindsley, 2002). Each data point is a "performance" frequency. When multiple performances are displayed on a Standard Celeration Chart the celeration (e.g. the ac*celeration* target = correct, the de*celeration* target = incorrect) represents "learning" (West & Young, 1992).

Table 2 presents a frequency-based instructional placement guide that can provide guidance if time prohibits a celeration-based instructional placement system. Fluent performance indicates mastery of the skills/knowledge and ability to move up to new skills. It indicates effortless responding that is automatic. Fluent performance in lower level skills also enable students to use them as a foundation for higher level skills. Table 2 presents a modified version of reading levels. Levels of reading are the (1) "independent or free level" where the student can read without the assistance of a teacher; (2) "instructional level" where the student needs some teacher guidance but can experience growth; and (3) the "frustration level" where the student cannot function without teacher assistance (Shanker & Ekwall, 1998).

Table 2 states and defines the various levels of performance frequency. The "fluency level" replaces the "independent or free level" to emphasize the student has reached a fluent performance standard indicative of retention, endurance, and application. The "instructional level" refers to content appropriate for instruction and daily practice. The "frustration level" changes to the "challenge level" to suggest a level where no or limited learning is occurring and the student is challenged by the content. At the challenge level the task should be made simpler by focusing on

Table 2. A list of Performance Guidelines for Instructional Placement in Oral Passage Reading

PERFORMANCE GUIDES FOR INSTRUCTIONAL PLACEMENT IN ORAL PASSAGE READING		
LEVEL	**DECISION CRITERIA**	**ACTION**
FLUENT	150-250 WORDS READ CORRECTLY PER MINUTE	**MOVE UP** (TO NEW SKILLS)
INSTRUCTIONAL	50-150 WORDS READ CORRECTLY PER MINUTE	**STAY** (AT THIS LEVEL FOR INSTRUCTION)
CHALLENGE	0-75 WORDS READ CORRECTLY PER MINUTE	**DROP BACK** (TO PREREQUISITE OR FEWER SKILLS)

prerequisite skills or a smaller set of the skill domain.

Decision Process. When a student produces a frequency by reading selected material the teacher will make a decision based on the data. The teacher would compare the student's reading performance against the challenge level first. If correct performance falls into this range the teacher will "drop back" to instructional material likely to produce learning. Because Precision Teaching is not a curriculum, but meant to be used concomitantly with a curriculum (Lindsley, 1992), the instructional materials or methods the teacher would select would be dictated by the scope and sequence of the curriculum. If student's correct performance does not fall within the challenge range, then the teacher would check the performance against the instructional level. If correct performance falls into the instructional level range the teacher would make the decision to allow the student to "stay" with the selected reading materials.

After reviewing automaticity in the reading literature Logan (1997) suggested that consistent practice facilitated fluent word reading skills. As students practice decoding and experience success the higher the probability the student will become fluent with the particular patterns in the words (Share & Stanovich, 1995). Therefore, practice at the instructional level allows the student to make meaningful growth with the selected material.

If a student's correct reading performance does not fall into the instructional range the student is fluent and the teacher should decide to "move up" to new reading materials. Students who read at the fluency level have achieved their goal for the selected reading. A student who can read second grade level text will not show growth when reading because he is already at the fluency aim. By moving the student up to 3rd or 4th grade level materials, a technique called "slicing of the curriculum" occurs (Starlin, 1979). Student reading at the fluency level will slice forward while students reading at the challenge level will slice back. The overlap between the challenge level and instructional level performance frequency ranges emphasizes that these are guides intended to inform our judgment not to dictate our decisions.

A recommended coding system to use in tracking oral reading performance is presented in Table 3. Analyzing reading errors in a curriculum, albeit an "informal measure," provides teachers with valuable information about why a student may have a particular mistake (Carnine et al., 1997). The teacher can then provide instruction or additional practice procedures to remedy the student reading errors.

Table 3. Coding System for Recording Oral Reading Performance

PERFORMANCE	CODING
TOTAL WORDS	Place slash, start and finish
CORRECT PERFORMANCE (Words Read Correctly)	Leave unmarked
INCORRECT PERFORMANCE ● Mispronunciations (write in mispronunciation) ● Words **S**kipped (**S**) ● Words **G**iven (3 second hesitation) (**G**)	Screening: Place check mark (●) over word. Assessment: Use coding (diagnostic)
NON-FLUENT (BUT NOT INCORRECT) PERFORMANCE ● Words Inserted (^, write in word) ● Words **R**epeated (**R**) ● **S**elf **C**orrections (**SC**) ● Words **S**ounded-**O**ut (**SO**)	Screening: Leave unmarked Assessment: Use coding (diagnostic)

Practicing to Fluency

Once a teacher has established a point of instructional placement she can begin instruction and monitor learning. Monitoring learning involves taking periodic oral reading measures from the point of instructional placement to the numeric performance standard or fluency aim of 150 - 250 wpm. Figure 1 shows an example of an elementary student's learning based on reading practice with a university student in a tutoring setting.

Some Practice Tactics

Direct Repeated Practice. It would appear that one of the most powerful tactics for promoting fluency is direct repeated practice of the skill (Bloom, 1986; National Reading Panel, 2000). Studies have shown that some students do not have many "opportunities to respond" during classroom instruction. Greenwood, Hart, Walker and Risley (1994) found a difference in the amount of exposure to instruction and the amount of engagement in instruction when comparing low and high SES children. Cumulatively low SES children receive less instruction and practice than high SES children. By directly practicing a skill and allocating time for students to practice oral reading, teachers ensure their students will have the opportunity to produce numerous responses. With skillful instructional placement teachers place students at levels where few errors exist, reducing the need for extensive error correction/remedial procedures, making direct repeated practice the intervention of greatest return.

Endurance building. In the early stages of learning a new skill, such as reading, performing the behavior for long periods of time even for 1-minute can be taxing. Endurance building (Bourie,

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Figure 1. Josh's reading

1980; Desjardins, 1981) means reducing the counting-time to smaller units such as 10, 20 or 30-seconds. Figure 2 shows a chart from another elementary student working with a university student in a tutoring setting. The student began with a 15-second counting time. After the student read three different passages and achieved fluent performance for all passages, the student began practicing a new passage for 30 seconds. After developing fluency with the passages over 15 seconds the student transitioned to a 30-second counting time. With endurance building students practice for shorter periods of time making the task easier as well as providing opportunities for more rapid growth as evidenced by the celeration.

Graphic Feedback. Graphs provide powerful tools for analyzing applied and experimental data. For the teacher who measures student performance, the data play an extremely important role in decision making. Johnston and Pennypacker (1993) described the primary function of data as: "stimuli that influence the behavior of those who view them" (p 110). Data presented in a visual display allow an individual a method for analyzing data in a fashion more easily interpreted than by viewing the quantitative data alone (Tufte, 1983). Thus, graphic displays of data influence the interpretive behavior of the graph reader by depicting performance data in a visual format (Johnson & Pennypacker, 1993). Evidence suggests that teachers who incorporate graphical displays of data and review it formatively produce significantly better achievement outcomes than those teachers who do not (Fuchs & Fuchs, 1986).

Teachers who view daily student behavior on a Standard Celeration Chart (SCC) can engage in sound formative evaluation procedures and make decisions based on visual representations of students' performances. Additionally, data on a SCC provide a standard visual display of the data per-

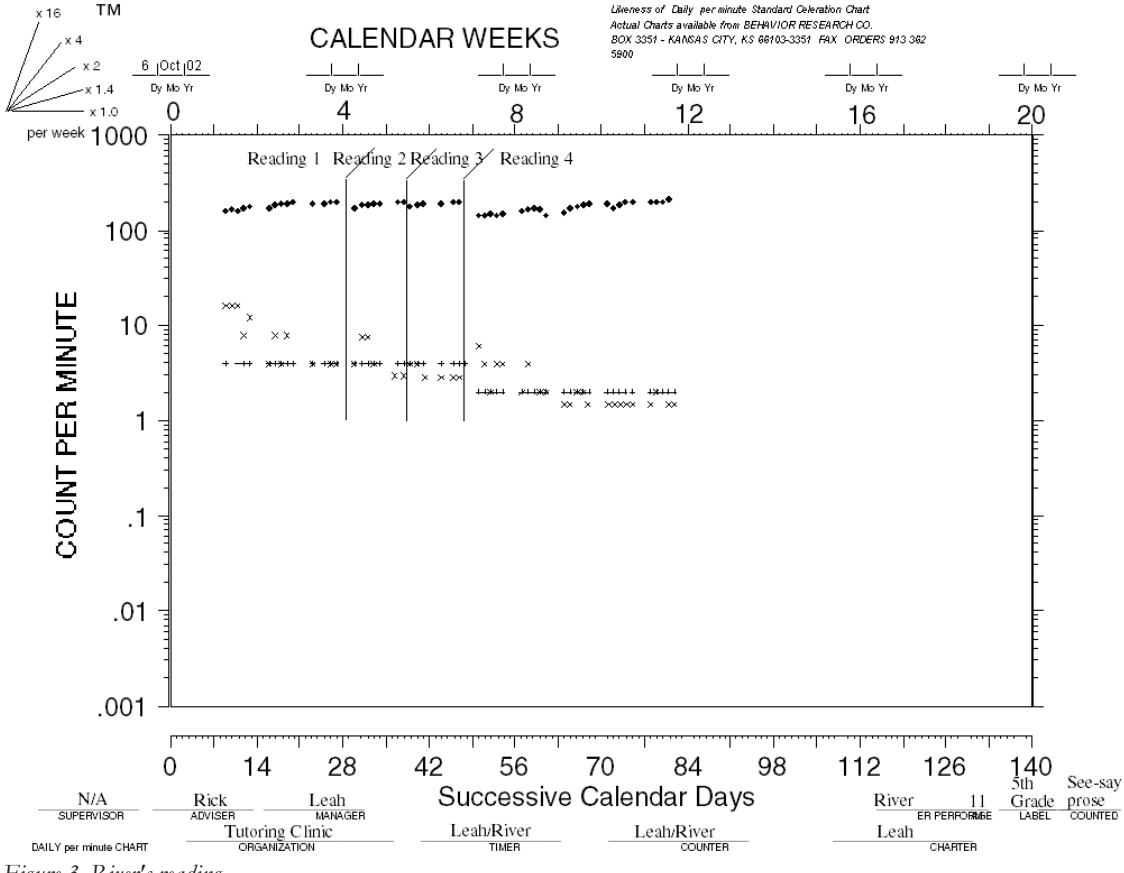

Figure 3. River's reading

mitting consistency and ease of interpretations for the chart readers. In Figure 2 the celeration (i.e., the numeric degree of weekly learning) shows a student's oral reading performance accelerating by x 1.2 while his incorrects decelerating by ÷1.4. The student's correct performance accelerates until he reached his fluency aim of 150 words read correctly per minute. As can be seen by the student's SCC, the teacher made a decision to give the student extra practice to help him accelerate more rapidly to the performance standard. While explaining the Standard Celeration chart in more detail falls beyond the scope of this paper, interested readers may consult texts by Graf and Lindsley (2002) and Pennypacker, Gutierrez, and Lindsley (2003).

Conclusion

Reading is generally considered to be the most critical skill to success in school. As the National Research Council (1998) put it: "Reading is essential to success in our society" (p. 1). The good news from the research community is that the critical knowledge exists regarding how to teach children to read well. Precision Teaching aids teachers to define and measure reading behavior. This is critical to good teaching and to increasing student success in school and in life.

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