

Journal of Precision Teaching

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**A Publication of
The Standard Celeration
Society**

The *Journal of Precision Teaching* (ISSN 0271-8200) is a multidisciplinary journal that is dedicated to a science of human behavior which includes direct, continuous and standard measurement. This measurement includes a standard unit of behavior, **frequency**; a standard scale on which successive frequencies are displayed, the **Standard Celeration Chart**; a standard measure of behavior change between two frequencies, **frequency multiplier**, and a standard, straight-line measure of behavior change across seven or more frequencies, **celeration**. Frequencies, frequency multipliers, and celerations displayed on the Standard Celeration Chart form the basis for Chart-based decision-making and for evaluating the effects of independent variables.

The purpose of the *Journal of Precision Teaching* is to accelerate the sharing of scientific and practical information among its readers. To this end, both formal manuscripts and informal, Chart-sharing articles are to be considered for publication. Materials submitted for publication should meet the following criteria:

- * be written in plain English
- * contain a narrative that is brief, to the point, and easy to read
- * use the *Journal of Precision Teaching* Standard Glossary and Charting Conventions (See Volume X, Number 2, Spring, 1993, pp. 79 - 82.)
- * format references according to the *Publication Manual of the American Psychological Association*
- * contain data displayed or displayable on the Standard Celeration Chart to justify conclusions made
- * direct data points may be submitted, so the Charting Macro program (Slocum, 1990) may produce an electronic version of the Chart
- * original charts may also be submitted.

Articles which are not data-based and do not include data displayed on Standard Celeration Charts may be included. These articles should substantially contribute to the development or dissemination of Precision Teaching/Learning. "About PT" is a column for shorter notes.

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A Publication of
 The Standard Celeration Society

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Editor's Comments

Claudia E. McDade

This issue of the *Journal of Precision Teaching* is a reprint of the special issue on Precision Teaching produced by The Council for Exceptional Children in its Spring, 1990 *Teaching Exceptional Children*. John Cooper suggested this reprint project at the May, 1995 meeting of the Board of Consulting Editors. While many educators and practitioners of standard celeration refer to this issue of *TEC* as a succinct introduction to the discipline, it is no longer available from the Council. We are deeply indebted to Fred Spooner, who co-edited the *TEC* special issue with guest consulting editors Richard West and Richard Young, and to Virginia Miller, Copyright Administrator for The Council for Exceptional Children for their assistance in obtaining permission to reprint. Additional copies of this reprint issue will be available through the *Journal of Precision Teaching's* editorial office in the Center for Individualized Instruction at Jacksonville State University.

The Twelfth International Precision Teaching Conference will be held in Seattle, WA in Spring, 1996. A team of planners, coordinated by Owen White, is meeting in Seattle in September, 1995 to plan the conference, so look for an announcement and call for papers in the Volume XIII, Number 1 issue of the *Journal of Precision Teaching* in Fall, 1995. Your attendance and participation is vital to the Conference's success and the growth of the Standard Celeration Society.

Precision Teaching: An Introduction

Richard P. West, K. Richard Young, and Fred Spooner

Eliza is a fourth-grade student at the Valley Dale School. For a few minutes during her various academic periods each day, Eliza works with a classmate on exercises in reading, mathematics, and spelling. For the first few minutes, she reads aloud, answers arithmetic problems, and spells words dictated to her as her peer tutor times her work. After each exercise, the two students look at Eliza's work, correct it, count the number of correct and incorrect responses, and enter the scores into a computer. Then, they practice the academic skills together. A few minutes later, Eliza and her classmate exchange roles; Eliza now becomes the tutor and her classmate the learner.

Each exercise the students complete is designed to help them develop fluency, or *automaticity*, in the performance of important academic skills. They use the computer to analyze their daily performance and suggest practice, instructional, and motivation strategies that should help them perform fluently. Fluent performance is accurate as well as relatively effortless.

Eliza and her classmates have found that developing fluency helps them learn quickly and retain their learning much longer. The exercises they complete provide them with many opportunities to respond, be corrected, and help one another. They all have learned a great deal during this year of school.

Eliza has a severe language disorder, is bilingual, and was seriously behind her expected grade level at the beginning of the year. Now, at the end of the year, Eliza is performing near grade level in reading, spelling, mathematics, and language skills. She has accomplished nearly 2 years of growth, and her percentile score on the California Test of Basic Skills (CTBS) (1978) has improved by 21 points. Her classmate-tutor, Jorge, also

improved by nearly two grade levels. He was performing nearly 2 years below his expected grade level at the outset and his percentile score improved by 23 points on the CTBS.

Similar achievements were accomplished by the other class members. The average improvement in percentile rank was more than 17 points (de Ayora, 1988; West, Young, & de Ayora, 1988). However, since students who previously have scored well below the norm on this test are likely to make more improvement in percentile rank, the percentile scores were converted to normal curve equivalents or NCEs (Tallmadge & Wood, 1980). The average improvement in NCEs for Eliza's classmates (18 points) was even greater than their improvement in percentile rank (West, Young, & de Ayora, 1988).

Eliza and her classmates used the AC-CEL Computer Program (West, Young, West, Johnson, & Freston, 1985) to evaluate their own academic progress, which saved teacher time and involved the students in the learning process. This curriculum-based assessment system was used by the fourth-grade students at Valley Dale every day to enter and display their scores and every sixth day to analyze the scores. Based on this analysis, AC-CEL recommended strategies the students could employ during their peer tutoring sessions throughout the next 6 days. Every 6 days, the students conducted another analysis and adjusted their tutoring according to the recommendations of the software. Using this system, students learned effective peer tutoring techniques that significantly improved the learning of their partners.

Overview of Precision Teaching

The experimental approach used by Eliza's teacher at the Valley Dale School was built

largely upon the principles of Precision Teaching, a method of measuring student performance regularly and frequently and using an analysis of the measurements to suggest instructional and motivational strategies capable of correcting failures to learn. Using Precision Teaching procedures, educators become students "of the pupil's behavior, carefully analyzing how the behavior changes from day to day and adjusting the instructional plan as necessary to facilitate continued learning" (White, 1986, p. 522). Precision Teaching is not so much a method of instruction as it is a precise and systematic method of evaluating instructional tactics and curricula. In naming this approach, Ogden Lindsley, its originator, noted that "what was really new in [the] procedure was precision, [so] we decided to use that as an adjective in front of whatever it was one was doing; hence in our case, 'Precision Teaching' " (Lindsley, 1972, p. 9).

Lindsley, a former student of B. F. Skinner, built Precision Teaching around a framework of operant conditioning and the methods of experimental analysis of behavior developed by Skinner. This framework consisted of the following seven basic elements:

1. The principle that the student knows best, or in other words, the student's behavior can tell us better than anything else whether or not instruction has been effective.
2. An emphasis on the direct measurement of behavior and continuous monitoring (daily performance assessment).
3. The use of rate of response (e.g., number of correct answers per minute) as a universal measure of behavior.
4. A standard chart format or visual display that can be used to study performance patterns.
5. The use of descriptive and functional definitions of behavior and processes.
6. Ongoing analytical investigations of the impact of environmental influences (teaching tactics) on individual behavior (student learning).
7. An emphasis on building appropriate and useful behavior, rather than focusing exclusively on eliminating undesired or inappropriate behavior.

Precision Teaching is effective in providing information to teachers that can help them help students learn, even if their past learning history has been unspectacular. It provides a great number of response opportunities because it promotes fluency (increasing responses per unit of time). Greenwood, Delquadri, and Hall (1984) have concluded that the number of opportunities to respond is consistently associated with gains in academic achievement. Other researchers have found that fluency produces greater retention and generalization (Chomsky, 1978; Howell & Morehead, 1987; Jenkins, Barksdale, & Clinton, 1978; Young, West, Howard, & Whitney, 1986).

Applications

The articles in this special issue of *TEACHING Exceptional Children* describe various applications of Precision Teaching. Each application transforms the fundamental principles of Precision Teaching into practice.

Be Aware of the Relationship Between Teaching and Learning

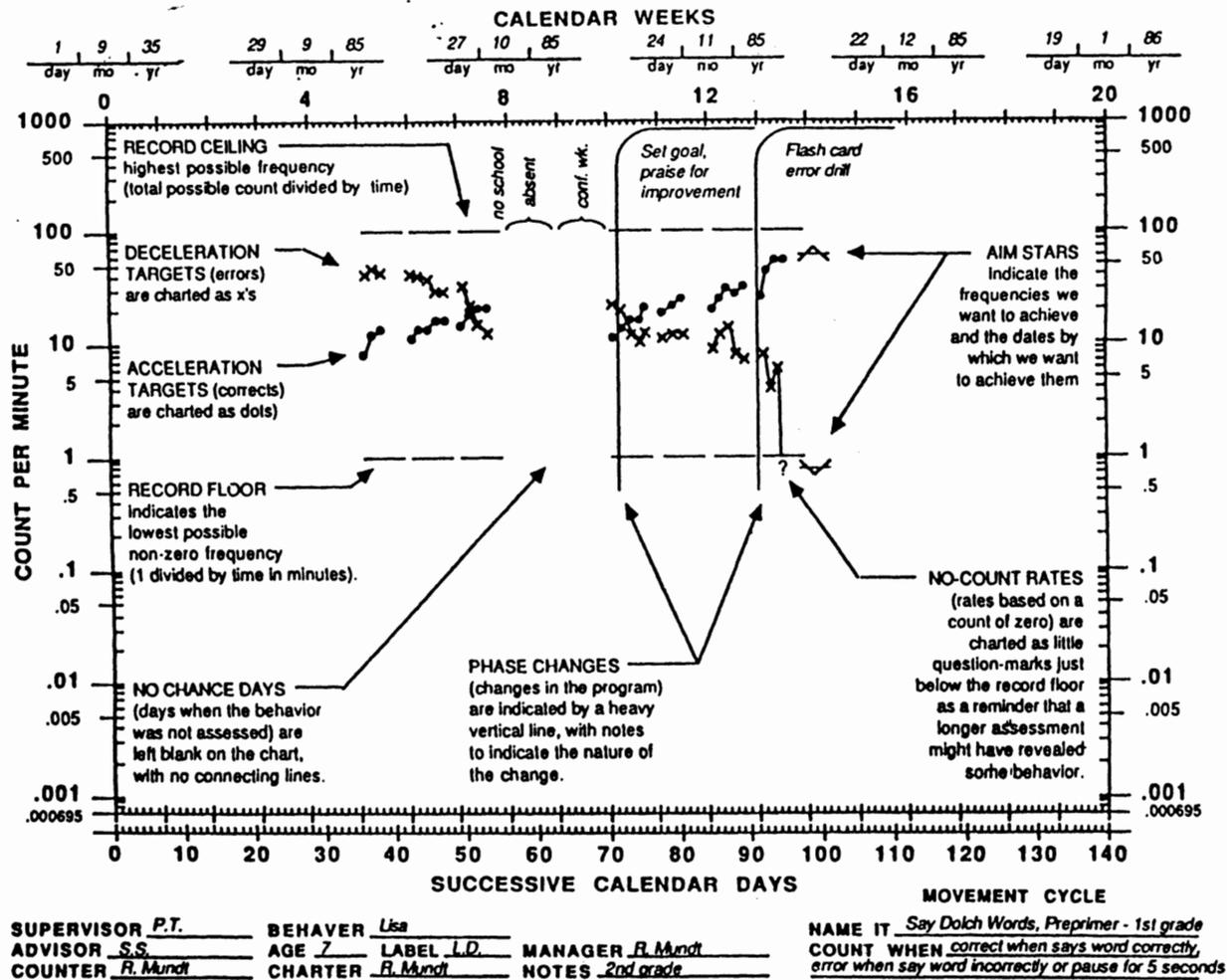
Learning is the objective of teaching, or at least that seems to be a logical proposition. However, teachers sometime neglect to determine whether or not their teaching has had any effect on the learning of their students. Teachers who are truly interested in ensuring that teaching has had the intended effect will certainly be interested in precise measurements of learning. More important, however, they will want to adjust their teaching practices when the measurements indicate that prior instruction has failed to accomplish its objective. Therefore, measuring learning is one of the most important of all instructional acts.

Measure Frequently

The first thing that must be decided in order to measure learning is what the phenomenon is that is to be quantified. What is learning? Are learning and knowing the same? Coming to an agreement on the definition of these terms is prerequisite to a discussion of how learning ought to be quantified. While they are not the same, learning and knowing are certainly related: *Learning* is the process of acquiring

Figure 1

STANDARD CELEBRATION CHART AND CHARTING CONVENTIONS



From "Precision Teaching—Precision Learning" by O. R. White, 1986, *Exceptional Children*, 52, p. 529. Copyright 1986 by The Council for Exceptional Children. Reprinted by permission.

knowledge; *knowing* is the condition that results from the process of learning.

Learning is a continuous process; it can be compared to a motion picture that gives a continuous study of an event or series of events. Assessing a student's performance is like taking a single frame from the motion picture. At that particular point in time, the student "did this" or "knew X." Knowledge, in this sense, is a static property, something that is inferred from the student's performance on a particular occasion, under particular circumstances. Learning, on the other hand, requires more than a single instance of measurement. In fact, the more instances of measurement we have to inspect, the more accurate and representative will be our interpretation of learning. If we can study many frames from the motion picture, we will have a much better idea of the continuous process the motion picture represents .

One frame in a motion picture differs little from frames that are adjacent to it. Similarly, we do not need to measure "knowing" constantly in order to detect significant changes in what is known. However, just as it is difficult to determine the story reflected in a motion picture if we see only the first and last frames, measurement must be frequent enough to permit an inspection of the process of "coming to know" or learning. Therefore, measured learning should be frequent enough to detect changes in knowing, and it should relate to specific skills the instructor considers to be important, presumably those which are the objects of instruction. Generally speaking, each student's performance should be assessed at least once during each instructional session or class period. Changes in the student's performance from one assessment to the next may be thought of as learning.

Most academic skills can improve slightly in a single day's time. Therefore, timed observations of performance should be conducted each day or four to five times per week. The more frequently assessments are made, the more often decisions can be made about the effectiveness of instruction. A minimum of three data points (resulting from three assessments) is required before a picture

of learning emerges. If performance assessments were conducted only once a week, it would take 3 weeks or more to accumulate enough data to evaluate teaching effectiveness. Too much valuable instructional time is lost when assessments are as infrequent as this.

Each timing should (a) be essentially the same from day to day; (b) be free from constraints that inhibit responding; (c) provide sufficient opportunities to respond; and (d) provide time for repeated occurrences of the response. This consistent format reduces the possibility that a detected change in performance is the result of a change in the assessment environment rather than in the performance or ability of the student.

Use Rate of Response as a Way to Measure Performance

An adequate definition of learning specifies the units that should be used in the measurement. It may be clear that learning is a change in performance, but what dimension of the performance must change in order to say that learning has occurred? We say that learning occurs when something is done that could not or was not done before, under similar circumstances or that something can now be done better than it could be done before. But in what way is the performance better: accuracy, fluency, or a combination of accuracy and fluency?

Generally speaking, educators emphasize accuracy when they are concerned with learning; correctness of the response receives the most attention. At the beginning of the term, for example, Sally was able to answer correctly only 5 of the 25 questions on a quiz. Today, she answered 23 of the questions correctly. Obviously, her performance has improved, and she has learned something, but what has she learned, and how much has she learned? It may be said that Sally answered only 20% of the questions correctly at the beginning of the term and that she can now answer 92% correctly—an improvement of 72% in the accuracy of her performance.

Percent scores also mask the incorrect responses by treating everything that is not

scored as correct as an error (e.g. "skips," or those items not attempted). Accuracy (percent correct) is subtracted from the "total possible" (100%); everything that is left is treated the same even though the percent wrong consists of incorrect responses and skips. Any teacher knows that skips and incorrect responses (also known in Precision Teaching as "learning opportunities") are not the same. If a student responds incorrectly to an item on an exercise, the teacher has been given important information concerning the nature of the incorrect response (and any associated learning problem) and can help the student to correct his performance in the future. The error represents an "opportunity to learn" to perform the skill correctly. Skips, on the other hand, can be the result of carelessness, boredom, avoidance of punishment, or other factors. Additional information must be obtained for the teacher to adjust instruction. For these reasons, precision teachers record information on both corrects and errors (some even record "skips"), and make decisions about the impact of their instruction based upon a careful analysis of both characteristics of accuracy.

However, Sally has improved not only in accuracy but also in fluency, or rate of responding; her performance is much more efficient now than in the past. At the beginning of the term, she took 50 minutes to answer 5 questions correctly, a rate of .1 correct answer per minute (5 answers/50 minutes). At the close of the term, Sally took only 10 minutes to answer 23 questions correctly, a rate of 2.3 correct answers per minute. This is an improvement of 23 times (a "x23" or "times 23" improvement). Sally's performance at the end of the term is 23 times better than her performance at the beginning of the term. By combining measures of rate and accuracy, we have a more complete picture of learning than with either measure alone.

Rate of response may be the most important consideration in quantifying performance. Accuracy measures can only describe gross improvements in quality; they reveal nothing about quantity. Therefore, if teachers are interested in quantifying changes in performance of learning, they must use rate measures rather than accuracy measures.

Skinner (1972) contended that "rate of responding appears to be the only datum which varies significantly and in the expected direction under conditions which are relevant to the 'learning process' "(p. 75).

Use a Graphic Display

Changes in performance can be studied more easily when scores are plotted on a graph and inspected visually, especially when many performance scores are obtained for each of several students. Graphs enable teachers to inspect and compare many data points without having to sort through pages of tabularized data and raw performance scores. Use of a standard scale and format can help teachers avoid the potential misinterpretations that may result from using many different formats and permits them to make consistent and reliable interpretations of instructional effectiveness.

One scale that spans a wide range of performance values without requiring tremendous space is a ratio or logarithmic scale. Figure 1 is an example of a graph with a logarithmic scale on the y-axis. This graph is referred to as the *Standard Celeration Chart* because the logarithmic scale and other aspects of the chart are standardized. The logarithmic scale permits the display of performance values (recorded as number of responses per minute) ranging from 1 response per day (1÷1440 min. = .0007) to 1,000 responses per minute. The scale encompasses virtually all performance values of interest to educators (White, 1986).

The logarithmic scale is important for reasons other than its ability to display widely varying scores. When the Standard Celeration Chart is the medium through which the data will be charted, analyzed, and interpreted, attention is usually focused on both errors frequencies (# of errors/unit of time) and corrects frequencies (# of corrects/unit of time), concurrently. These frequencies are arranged in an accuracy pair (corrects and errors).

When correct and error scores are plotted on the Standard Celeration Chart, teachers have a picture of learning that is easy to interpret. When data are plotted on the Standard Celeration Chart, learning is generally

represented by a straight or nearly straight line. The value of the slope of the line that best fits the distribution of values plotted on the logarithmic scale is considered an index of learning. The steeper the slope, the faster the learning is; the flatter the slope, the slower the learning is.

Because learning (change in performance scores) appears to grow like compound interest, or by multiplying, it is analogous to acceleration. Change is measured in terms of the number of responses per minute per week. Theoretically, the change in performance scores can be either up or down, meaning that performance scores can either increase or decrease. With this method of measurement, *celeration*, the root of acceleration, has come to mean "learning," with *acceleration*, or *times (x) celeration*, representing "up learning," or an increase in performance scores, while *deceleration*, or *divide by (÷)*, celeration means that scores are declining in value.

The index of learning (celeration), which is represented by the slope of the line best fitting the performance scores, can be estimated with a simple calculation. Data are generally obtained from daily timings; therefore, the most representative scores from the week would probably be the median of the five daily scores. The celeration score (which is always 1.0 or greater) can be thought of as a factor by which the more representative score from the five scores in the first week is either multiplied or divided to obtain the most representative score in the second week. Thus, if the median of the scores in week 10 is 40 correct responses per minute and the median of the score in week 11 is 50 correct responses, the celeration score is 1.25, or 25% improvement, because $40 \times 1.25 = 50$ responses.

The logarithmic scale employed by the Standard Celeration Chart is also useful in studying the variability of scores, or relative change in the values, as opposed to absolute change. Equal distance on the logarithmic scale corresponds to equal ratios. In other words, the distance from a score of 10 per minute to a score of 20 is the same as the distance from 100 to 200 per minute. In these two cases, improvement from the first to the second score

would be "times x 2," meaning that performance had doubled in 1 week.

Adjust Instruction According to Analysis of Learning

An ambitious, conscientiously applied program of collecting and displaying performance scores cannot ensure effective instruction. This will not occur until the learning is inspected regularly and instruction is adjusted according to the analysis. A given instructional strategy is presumed to be effective if the learning slopes (or best-fitting lines) are steeper in the desired direction when the strategy is used than when the strategy is not used. When a learning slope is nearly flat or is going in the wrong direction, different teaching strategies must be tried until one is found that reverses the trend. An effective teaching strategy is retained until the student reaches a performance standard, or aim. The aim represents the teacher's fluency criterion for a particular skill. Decisions to change instruction are made for each student, thus individualizing each instructional program. The rate of a student's response is very sensitive to changes in instruction, so the effects of a new teaching strategy are immediately obvious.

Conclusion

Teachers are more effective if they clearly specify what they want to teach, provide opportunities for their students to learn, frequently measure the performance of critical skills, regularly analyze the performance data, and adjust instruction according to the analysis. The picture of learning that results from this type of program is convincing evidence of the teacher's commitment and dedication to a program of effective instruction (Beck, 1981; Beck, & Clement, 1976; Burney & Shores, 1979; de Ayora, 1988; West, Young & de Ayora, 1988).

The articles in this special issue represent theoretical discussions and descriptions of Precision Teaching applications. The first was written by Ogden Lindsley, who is considered the founder of precision teaching. He refers to the work of many teachers who helped him refine Precision Teaching practices. Next is an

article by Lovitt and his colleagues describing an application of Precision Teaching combined with learning strategies. There are three articles by Howell and Lorson-Howell; Binder, Haughton, and Van Eyk; and Downs and Morin that emphasize the importance of focusing on fluent, as well as accurate, performance. There are three articles by Scott, Stoutimore, Wolking, & Harris; Peterson, Scott, & Sroka; and Williams, White, Haring, Cohen, & Rudsit that describe Precision Teaching applications with students who have learning difficulties. The articles in the *TEC* Departments also focus on Precision Teaching issues (Koorland, Keel, & Ueberhorst — Research into Practice) and applications (Mounstevan— Teacher Idea Exchange and Liberty & Paeth—Teacher Notebook).

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Precision Teaching: By Teachers for Children

Ogden R. Lindsley

People often state that I developed Precision Teaching. This is incorrect. I did not develop it. It would be more accurate to say that I founded and coached it. Teachers developed it at my urging by following its founding policies. I still urge teachers to use the powerful methods of free-operant conditioning (often referred to as *behavioral psychology*) in their classrooms. This refers to a process of learning in which students are free to respond at their own pace without having restraints placed on them by the limits of the materials or the instructional procedures of the teachers. In following these procedures, teachers went beyond the use of teaching trials to develop the methods of Precision Teaching.

Founding Policies of Precision Teaching

I learned, adopted, and committed to the methods of free-operant conditioning as a student of B. F. Skinner at Harvard University during the 1950s. I successfully applied these methods to the study of psychotic behavior in adults and children at the Behavior Research Laboratory at Metropolitan State Hospital, Waltham, Massachusetts, under the supervision of Skinner and Harry C. Solomon, Massachusetts Commissioner of Mental Health. Visitors to the laboratory went back to their universities, agencies, and schools to apply our methods in their settings. But when they applied these methods to children in their classrooms, they typically neglected to use rate of response, self-recording, and standard recording—the hallmarks of free-operant conditioning. Instead, they adopted reward and token economy systems and continued to record the percentage correct of the children's academic work, the time-honored educational measure.

Unfortunately, percentage ignores speed and fluency. Sole attention to percentage correct often produces highly accurate, painfully slow learners who have very low tolerance for error-filled, courageous learning. When the primary type of feedback students receive is percentage correct, with accuracy usually falling between 60% and 90%, students often become fearful of making errors, which in turn can stifle creativity and exploration.

Policy 1: Monitor Frequency Daily

My laboratory research (Lindsley, 1960) has shown frequency to be 10 to 100 times more sensitive than percentage correct in recording the effects of drugs and different reinforcers on the behavior of psychotic and normal children and adults. However, no amount of urging from me would get visiting experts to standardize the use of frequency of response in their classrooms. I knew that the real power of learning enhanced by free-operant conditioning lay in frequency of responding (by allowing the student to be both accurate and fluent) and standard self-recording. When educators would not heed my caution and could not see my vision for dramatic learning opportunities, I decided the ethical thing to *do* was to close my hospital laboratory and devote myself to education.

As a professor in teacher training in a midwestern university, I began teaching teachers how to teach their pupils to efficiently self-record their own academic frequencies on standardized charts. When children's charts were collected, we summarized their learning and found that frequency and standard self-recording were far superior to traditional educational monitoring. This proved that the superior sensitivity of frequency found in my hospital laboratory experiences also held for

pupils in public school classrooms (Lindsley, 1971a).

Policy 2: Use Self-Recording

Students in Precision Teaching classrooms keep records of their own academic and nonacademic performance and use these records to guide their performance. Students might correct their own assignments and count the number of problems they have answered correctly or words they have read correctly, or count the number of times they praised the work of other students in the class. These records can indicate changes in performance over time as well as telling each student the level of today's performance. When a student charts these "counts" on the Standard Celeration Chart, performance changes, or learning can be seen readily. Using the Chart, the student has a visual display of past performance and can see how performance must be changed to meet current aims or standards. Many teachers have found that behavior changes are much greater when students take such an active role.

Policy 3: Use Standard Charts to Display Major Changes

Skinner often urged his graduate students to look for important variables that produced major changes in behavior. He cautioned against wasting time measuring unimportant, small changes in behavior. At the time, I was aware that our cumulative response recorders forced us to look at major changes in response frequency in our laboratories. However, it was not until 1969, after 4 years of charting on standard multiply scales, that I understood why. I noted that in all cases the cumulative response recorders were built to display *doublings* in frequency on their charts. This doubling forced laboratory researchers to search for powerful interventions that produced at least a doubling in response frequency.

In the Harvard Medical School Behavior Research Laboratory at Metropolitan State Hospital, the patients' response rates were automatically recorded on cumulative response recorders throughout each daily session. These cumulative response records displayed changes in their behavior frequencies within

experimental sessions. Changes in behavior frequencies between and across sessions from week to week and month to month were charted by hand on 8 1/2- by 11-inch, 10-squares-to-the-inch chart paper. This paper was limited in the number of changes it could record, and as behavior frequencies increased, we had to rechart two or three times.

However, it was not until I was training teachers at the University of Kansas Children's Rehabilitation Unit that I was compelled to have a custom chart printed. The teachers met once a week for a 3-hour class. I required that they improve a behavior of one of their pupils and also one of their own behaviors. The teachers shared their progress on these behavior change projects by showing charts in class each week. It took 20 to 30 minutes to share one behavior project because most of this time was spent describing each teacher's unique charting and recording system.

In desperation, I had a Standard Chart printed with the full range of behavior frequencies, from 1 per day to 1,000 per minute, on a multiply (or logarithmic) scale up from the left, or short side of the paper. The long side had 140 calendar days, or 20 weeks, which is about 1 school semester. This chart had several advantages.

First, by accommodating the full range of behavior frequencies on one Chart, a teacher could record any behavior of interest. Behaviors with low frequencies (e.g., a student getting into one or two fights per day) and those with high frequencies (e.g., a student reading several hundred words per minute) could be recorded on the same type of chart, eliminating the need for interpretation.

Second, student performance data from an entire semester could be recorded on one Chart.

Third, the logarithmic scale also made it possible to measure the rate of learning or celeration.

Fourth, later we learned that the Chart could be used to accurately predict future performance, which helped in making decisions. For example, if learning was slow and the

prediction was that several weeks would be required to master an objective, a teacher could try something else and accelerate learning.

In order to standardize the interpretation of rate of learning and accurate prediction and to promote major changes in student performance, I designed the Chart so that a line from the lower left corner to the upper right corner of the grid represented a doubling in frequency every week (celeration period). This angle of about 33 degrees was the most sensitive part of the slope of the Chart. If the central slope of the Chart was a doubling, it should prompt our teachers to produce doublings of their pupils' frequencies each week. In the same way that the doubling cumulative response recorder grids prompted the early laboratory free-operant conditioners to search for major variables, I hoped that the Standard Chart doubling would prompt our precision teachers to discover major classroom variables that would accelerate learning.

Because the Standard Celeration Chart forces us to look for at least doublings in pupil performance frequency, it blinds us to very small changes. For this reason many researchers avoid the Standard Celeration Chart because it makes the small changes they may have produced (e.g., changes from 11 to 13 responses per minute) look trivial. In fact, when changes from 11 to 100 responses per minute can be produced easily, a change from 11 to 13 is trivial and should be seen as such.

Policy 4: The Child Knows Best

When I was a graduate student, I trained a rat whose behavior did not extinguish exactly as the charts in Skinner's (1938) book had shown. My rat had at first responded much more rapidly when his responding was no longer reinforced. This rapid responding went on for about 30 minutes, at which time the rat stopped abruptly. I took the cumulative record of the rat's unusual extinction to Dr. Skinner and asked him how this happened. How could the rat do this when the book showed a very different gradual extinction curve? Skinner answered, "In this case, the book is wrong! The rat knows best! That's why we still have him in the experiment!"

Skinner's easy acceptance of possible error in his book's generalizations impressed me. Here was an empiricist at work! His charming way of admitting that the scientist did not know everything yet, that the rat knew rat behavior best, was the clearest way I had yet found to describe the inductive approach to behavioral research. For this reason I made "the child knows best" a policy and slogan for precision teachers to use in their discoveries (Lindsley, 1971b).

Often in workshops a teacher will ask, "Dr. Lindsley, what is the best way to help a child improve his oral reading to a frequency above 40 words per minute?" I always reply, "What is the child's name?" If the teacher replies, "Brent," I answer, "What did Brent suggest?" The teacher usually replies, "I didn't ask him!" And I answer, "Then please go back and ask him, because, after all, the child knows best."

Contributions of Precision Teachers

Applying these founding policies of Precision Teaching has enabled many teachers to discover effective teaching techniques. Some of these discoveries are mentioned here.

Academic performance can be accelerated by Chart display. In 1965, Lois Cox, supervised by Thomas Caldwell, found that pupil academic performance frequencies increased when pupils displayed their Charts. Lois also found that fourth-grade children enjoyed computing and charting their own daily performance frequencies.

Self-recording is simplified with wrist tally cards. In 1966, Jean Stables cut 3- by 5-inch blank cards in half and held the 2 1/2- by 3-inch card to her wrist with a watch strap. She used this wrist tally card to record six or seven different behaviors. At the end of the day, the tallies were counted and charted and the dated cards were filed in a card box.

Pupils can count academic and nonacademic behaviors and display their performance on the Standard Celeration Chart. In 1967, Carl Koenig, under my supervision, taught a special

class of six 9- to 11-year-old boys classified as emotionally disturbed. The pupils timed and counted their own arithmetic and both silent and oral reading frequencies. Each pupil also counted one nonacademic behavior (Koenig, 1967). Koenig's master's thesis at the U. of Kansas was the first to use the term *Precision Teaching* and the first to include Standard Celeration Charts. The chart was called six-cycle semilog graph paper at the time, and was later called the standard behavior chart (Pennypacker, Koenig, & Lindsley, 1972). Still later, the chart was correctly named *Standard Celeration Chart*, because what is standard on the chart is the angle of the celeration lines. A line from the lower left corner to the upper right corner represents a learning in which performance doubles every celeration period (i.e., times 2.0 per week, per month, per 6 months, or every 5 years, depending on the version of the chart that is employed). A line from the upper left corner to the lower right corner represents unlearning, or deceleration, in which performance halves each celeration period (i.e., divide by 2.0 per week, per month, per 6 months, or every 5 years).

Self-selected competencies are more effective than teacher-selected. In 1969, Karen A. Curtis, supervised by Tom Lovitt, found that higher academic response frequencies occurred when the pupils selected their own reward contingencies than when the teacher selected them (Lovitt & Curtis, 1969).

Pupils with orthopedic handicaps can chart their own behaviors. In 1969, Sally Slezak, under my supervision, taught two different classes of children with orthopedic handicaps. The first year she taught 8 primary pupils: 4 paraplegic cerebral palsied, 3 spina bifida, and 1 brain damaged. Of these, 4 were severe and 4 were mobile. The second year she taught 7 intermediate pupils: 3 paraplegic cerebral palsied, 2 spina bifida, 1 muscular dystrophy, and 1 chronic health disorder. Of these, 1 was severe and 6 were ambulatory. All the children used wrist counters, which they purchased with points they earned, to count their own nonacademic behaviors. Wrist tally boards were used to count up to six or seven behaviors on the same tally card. The daily tally cards were dated and kept by the children.

Sally discovered that they could use masking tape strips (better known as "stickies") to record behaviors. The best size was 1 inch wide cut 3 to 4 inches long. Each morning the children would tear off a piece of tape and write the date and the behavior they were recording on it. These stickies were placed on wheelchair arms, crutch legs, comb cases, shorts, or wrists. At the end of the day, the children placed their stickies under their names on the "stickie chart."

In 2 weeks or less, Sally taught her children to use the standard chart paper. She used the performance charts as report cards for parents. Hers was the first thesis to use the term *daily behavior chart* to report acceleration as movements per minute per week and to use an acceleration finder (Slezak, 1969).

Regular second graders can keep 19 academic charts each. In 1970, Elizabeth Freeman, supervised by Eric Haughton, taught an entire class of second graders at Whitaker School, Eugene, Oregon, to time, correct, count, and chart their own academic behaviors. The children posted their own charts on room dividers that were set up along the wall. The children and parents loved this demonstration of self-recording.

Young children can learn standard charting. In 1971, 5-year-old Stephanie Bates, supervised by her father, Douglas Bates, not only taught her kindergarten class to chart, but also taught her teacher. Stephanie's chart-teaching method was made into an 18-minute color slide presentation that dispelled the common educational fear that using semilogarithmic charts was difficult to learn (Bates & Bates, 1971).

Instructional procedures can be compared using Precision Teaching methods. In 1971, Nina Young, supervised by Nancy Johnson, found that inner city high school students successfully tutored elementary school pupils who were one to four grade levels behind in their reading. The pupils were tutored by the same tutor 45 minutes a day, 5 days a week. The project,

called Operation Upgrade, lasted several years during which several graded readers, several vocabulary lists, the local newspaper, and pupil written stories were used as curricula from which the pupils read aloud each day. No one curriculum produced the best learning for a majority of the pupils, once again proving "different strokes for different folks." If one had to pick a best, it was the newspaper.

For any given two-week period each pupil was reading from three different materials in three separate one-minute timings each day. For example, the SRA graded reader, *The Kansas City Star*, and the pupil written "our stories." If over that two-week period the pupil showed the steepest learning (not the highest performance) on *The Kansas City Star*, the *Star* would be kept as one of the three curricula for the next two-week practice period and the graded reader and our stories discarded and two other curricula tried in attempts to get even better learning producers. In this way, three different curricula can be tried at once. The worst can be discarded, and three more tried again.

More important for Precision Teaching methods was the discovery that if three different curricula are tried for 1 minute each day, the performances and learnings (frequencies and celerations) for each curriculum stay independent and projectable. This means that three different procedures can be compared at once in the same pupil with the same tutor in the same calendar time (Johnson, 1971).

Countoons are useful for self-recording. In 1972, Marilyn Cohen, supervised by Harold Kunzelmann, designed "countoons." These were cartoon-like drawings in sequenced frames that described a behavior pinpoint to accelerate and another to decelerate. Each time a pupil emitted one of these target behaviors, he or she made a tally under the picture on the countoon. These countoons were very effective in helping students record their own behavior frequencies.

Charting can help predict student performance. In 1974, Sally Macmillan, supervised by Donna Boykin and Ray Beck and teaching a regular first-grade classroom in Great Falls, Montana, had all the children writing numbers

in sequence. She found that a trendline through 2 weeks (10 daily scores) of student data plotted on Standard Celeration Charts could be used to predict performance 2 weeks into the future.

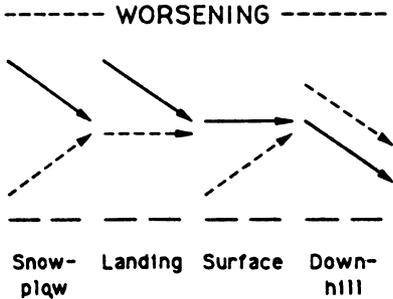
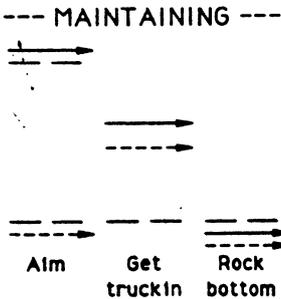
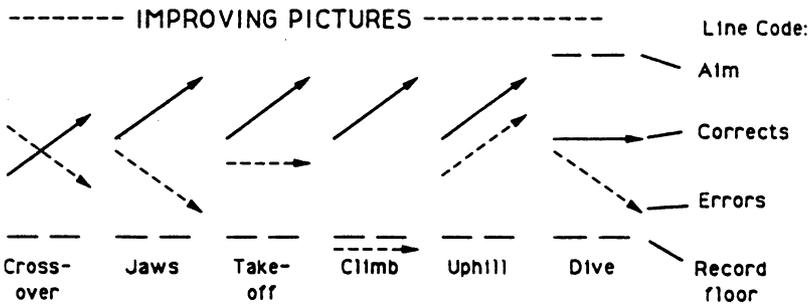
Naming their "learning pictures" can help students monitor progress. In 1977, Pat All, under my supervision, taught her regular seventh-grade students to count and chart the words they spelled correctly. She had them sort their charts according to the patterns of data, called *learning pictures*. She asked them to name the pictures by their patterns. Figure 1 illustrates the learning pictures named.

The code in Figure 1 shows the correct celeration or learning line as solid line with an arrow at its left end. It would have been drawn through the daily correct frequencies that had been charted. It is moving as on the Chart from left to right. It should be considered as a vector in motion, the arrow pointing to where the performance is going. The error learning line is short dashes with an arrow pointing in its direction. The record floor (the lowest frequency that can occur) is shown as two horizontal long dashes at the bottom of each picture. These floor lines indicate that each picture is about two weeks long. The floor lines also show how far the frequencies are above the Floor. Note that in the Aim picture the errors are below the floor, showing zero errors are being made.

The students named Jaws after the wide-open jaws of the shark famous in a thriller movie the prior summer. Snowplow, Uphill, and Downhill came from the positions of snow skis while skiing. In Climb, Takeoff and Landing the correct celeration line is the flight of an airplane and its related error line is the surface of the ground. In Surface and Dive the correct line is the surface of the sea, and the error line is the path of a submarine. Note that all the names describe motion, showing that the students knew their learning is dynamic and has direction and that their performance is almost always changing for better or for worse. These relationships are useful as memory aids in sharing these learning picture names with other students.

Figure 1

THIRTEEN LEARNING PICTURES



The students saw pictures with corrects maintaining and errors maintaining not as one picture, but as three very different pictures. One picture on which both frequencies were very low was known as the "Rock-Bottom." Another picture, with both frequencies in the middle of the Chart, was "Get-Truckin'." The last picture, with the corrects above the aim and the errors below the floor, became known as the "Aim." This showed the advantages of inductive over deductive development and also demonstrated that the child knows best (All, 1977).

Daily practice produces more learning than practicing every other day. In 1978, Suellen Gabriel, supervised by Dick Clement and Ray Beck, taught her 26 regular fourth-grade pupils to locate and abbreviate the names of the states on a blank United States map. She found that the learning from 1-minute practice sessions every day was greater than that from 2 minutes practice every other day. She learned that daily practice is more effective than alternate day practice when the same time is spent.

Using two channels at once can help students learn. In 1978, David Keller, supervised by Linda Haines, Dave Freschi, and Ann Duncan, taught boys who were diagnosed as emotionally disturbed and autistic at Spaulding Youth Center in Tilton, New Hampshire. He taught spatial relationships in more than one channel each day. (*Channels* refer to the pathways by which the student receives information and produces a response: for example, see and write, see and say, and hear and write.) David found not only that correct learning and error learning were independent, but also that the learning in one channel ("See the name"/"Point to the picture") was independent from the learning in another channel ("Hear the name"/ "Place your hand in the position"). Just as Young and Johnson had found that three curricula can be tried at once because their learning is independent, Keller found that two or more channels can be tried at once each day because their learning is also independent.

A leap-up in curriculum improves learning and motivation. In 1979, Marilyn Chappel, supervised by her principal, Gene Stromberg, taught her second-grade class at Garfield

School, Ottawa, Kansas, basic mathematics facts. Figure 2 is a copy of Hollie's mathematics chart for the fall semester. She looked at basic mathematics problems and wrote the answers on Precision Teaching practice sheets during 1-minute timings (see/write). The dots on the Chart represent her frequency of correct additions during her best timing each day. The small x's are her error frequencies per minute each day. Learning (celeration) lines are drawn through the dots and x's to show the slopes of the correct and error learning in each curriculum phase.

Note that the +5 and +6 addition problem phases produced correct learning, but little error learning. When +5 and +6 addition problems were mixed on the same practice sheet (the next two phases), error learning did not occur either. However, when all basic addition facts and all basic subtraction facts were mixed with basic multiplication facts and practiced *without* prior instruction (+, -, x) Hollie had both high correct (x1.6) and higher error (/10.0) learning!

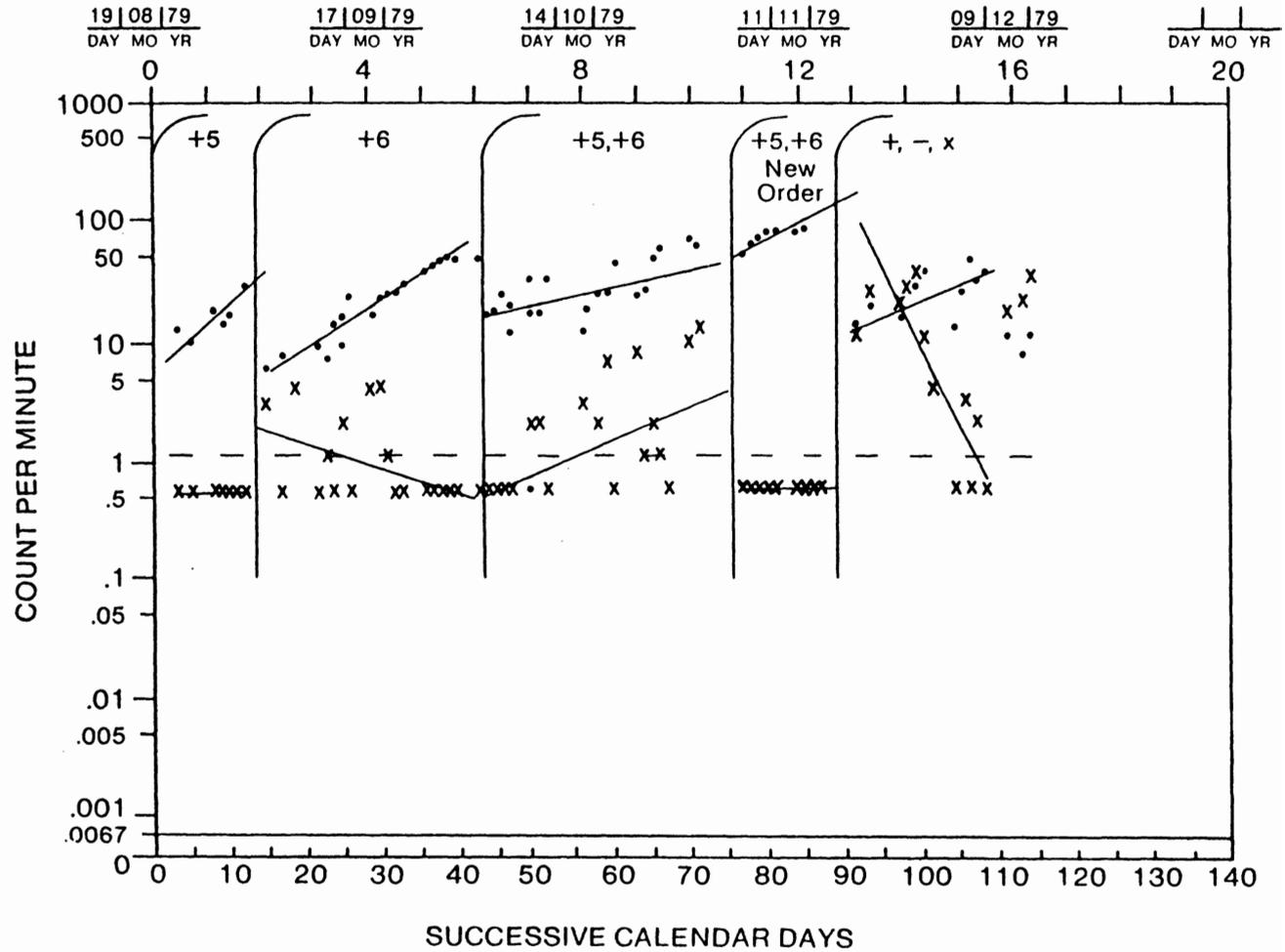
Essentially the same beneficial effect of the curriculum leap-up on Hollie's correct learning (advancing well ahead in the curriculum to a new instructional objective) was seen on all the other children's learning. Their median correct frequency jumped down from 120 to 4 per minute from the last day of "mixed +5 and +6" to the first day of "mixed add, subtract, and multiply facts." This showed that the leap-up was 30 times harder to do (120/4). Their median correct learning turned up from x1.60 to x1.90, with a range of x1.40 to x3.0 per week. This showed their correct learning had improved by x1.19 or 19% (1.90/1.60).

A similar beneficial effect similar to that of the curriculum leap-up on Hollie's error learning was seen on all the other children's error learning. Their median error frequency jumped up from 0 to 20 per minute. This showed that the leap-up produced over 20 times more errors. Their median error learning turned down from /1.00 to /2.50, with a range of /1.50 to /10.0 per week. This showed that their error learning was 2.5 times better.

Figure 2

HOLLIE'S MATHEMATICS CHART

CALENDAR WEEKS



In summary, the leap-up in the curriculum to mixed addition, subtraction, and multiplication facts *without instruction* made the pupils' basic mathematics 30 times harder to do with 20 times more errors, but over all their learning was doubled. After their leap-up, most of the students were in cross-over learning, with the error frequencies five times higher than their corrects. All the students enjoyed the challenging error-filled curriculum much more than their prior accuracy-addictive curriculum. With these challenges, the students made more improvement in less time in both correct and error performance than would have been expected using traditional curricular sequence steps.

The learning of most students is held back by traditional lockstep, slow-paced public school curricula. However, Marilyn's class results suggest that *all* students are capable of doubling their frequencies every week if given an appropriate and proper curriculum challenge. The results also show that the traditional instruction before-practice educational sequence may be unnecessary and therefore wastes valuable educational time. Even more important, Hollie and Marilyn's other pupils have shown that accuracy addiction, or perfectionism, and its desired opposite, curricular courage, are not properties of children. Rather, they are both clearly properties of the curriculum.

Conclusion

The list of bench-mark contributions to Precision Teaching presented here is not complete. Many more teacher supervisor teams have made significant contributions. However, the list demonstrates the nature of the contributions that practicing teachers have made to Precision Teaching. It should be clear by now that Precision Teaching was built by a large number of Practicing Teachers in their classrooms, not in an academic, grant, or administrative office. It was not deductive, not the classroom testing of academic hypotheses. Rather, it was inductive, coming from classroom discoveries, made by teachers in their daily efforts to improve the amount, quality, and precision of their pupils' learning.

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Using Precision Teaching Techniques: Translating Research

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Researchers and others have for some time complained about the dissemination gap—the time elapsed between discovery of an instructional technique and its implementation in classrooms (e.g., Goodlad, 1983). Depending on the research, its marketing, the locale, and many other factors, this gap could be from 1 to 10 years or longer. The obvious reason for lamenting this lag is that if researchers have come up with a more effective, more efficient way to teach something and teachers are not making use of that approach, then scores of youngsters are not being served as well as they might be.

The following are among the reasons advanced to account for this gap: (a) the topics that were investigated were not of particular interest to teachers; (b) the research was published in journals that neither teachers nor teacher educators commonly read; and (c) the steps for carrying out the new procedures were not adequately explained so that teachers could arrange them in their settings.

The intent of the project described in this article was to translate research of interest to teachers into practice for them. A related purpose was to encourage teachers to validate that research in their classrooms by carrying out experiments of their own and to provide a clear explanation of the procedures in a journal that would be read by a large number of special education teachers. In the research reported here, three strategies were presented to special education teachers and to classroom teachers who had students with mild handicaps in their classes. The three strategies were keywords, study guides, and graphic organizers.

Another intent of the project was to rely on principles of Precision Teaching (PT) to translate and further validate the selected

research. Following are seven principles of PT as expressed by Lindsley (1972):

1. Teachers learn best by studying the behaviors of their students.
2. Rate of response is the universal measure of behaviors.
3. Student performances are charted on a Standard Celeration Chart.
4. Direct and continuous monitoring is emphasized.
5. Behaviors and processes are described and functionally defined.
6. Building, rather than eliminating, behaviors is emphasized.
7. Impact of environmental influences on behaviors is analyzed.

Participants

Members of the Utah Learning Resource Center (ULRC) staff in Salt Lake City provided inservice training for the teachers in this project. The staff members are experienced special education teachers. Providing instruction to teachers of adolescents with mild handicaps in this project is only a part of their responsibilities. They offer staff development on numerous topics to teachers in 44 school districts and state-operated programs.

The teachers who received inservice instruction in this research were from eight Utah school districts. Of the 110 teachers who participated, 75 carried out research in their classrooms and returned data on 1,431 students to the ULRC. For keywords, 38 teachers returned data from 729 students; for graphic organizers, 25 teachers returned data on 477 students; and for study guides, data were returned from 12 teachers on 225 pupils.

Strategy Instruction

Strategy instruction was defined to include both teaching strategies and learning strategies. Teaching strategies are controlled and managed by teachers regarding decisions as to what information is presented to students and when and how it is presented. In this research, graphic organizers and study guides were considered teaching strategies for adapting materials.

Learning strategies are controlled and managed by students. They are intended to facilitate problem solving and independent learning. Use of keywords was the learning strategy involved in this investigation.

The teachers who participated in the project were given a six-step procedure for instructing students in the use of these strategies. Following are the steps as adapted from CEC's Academy for Effective Instruction (Archer, et al., 1986): (1) gain attention; (2) review; (3) communicate objective and provide rationale; (4) model the steps in the strategy; (5) prompt students to use the strategy; and (6) check students in performing the strategy. This procedure was selected in order to provide a consistent and effective instructional method across teachers and content areas.

Following are descriptions of the three strategies used, including explanations of how PT procedures were integrated with each as a measurement technique.

Keywords

Keywords are significant words in a statement or phrase that provide indexes to the content. Many keywords are nouns or verbs, but that depends on the context of the phrase. Keywords are often words that are italicized, set in bold print, or underlined. In the following sentence, the keywords from a passage in a history textbook are italicized: "*Woodrow Wilson*, from *New Jersey*, was president of the United States before and during the *First World War*." From a sentence in a science textbook, the keywords are italicized: "Humans and many other species are *vertebrates* of the class *Mammalia*."

The procedure used to teach students to identify keywords is RIMS, a mnemonic that prompts them to do the following: Read the statement; Identify important words using clues (e.g., important persons, places, things, words that are underlined, capitalized, boldfaced, italicized, or in quotes); Mark the important words; and Self-check by asking whether or not the words that were marked conveyed the important information. (For additional information on RIMS, contact personnel at ULRC, 801/2723431.)

This study investigated students' ability to identify keywords while taking PT timings and the effect on their performance in a number of content areas. It was postulated that if students could identify keywords in test items more efficiently, their test scores would improve. (For more information about keywords see Link, 1979.)

To evaluate the effects of the keyword strategy, a three-phase study was arranged: baseline, intervention, and retention. Throughout a 5-day baseline period, teachers either lectured the students or required them to read passages from their textbooks. Students were not instructed in the RIMS strategy at this time. Following the baseline, a 5-day intervention phase was scheduled. Throughout this period, teachers used the six steps from the Academy for Effective Instruction and students were instructed in the RIMS strategy. Several days after the intervention phase, a retention phase was scheduled, during which time data were gathered once a week for 4 weeks. In this phase, students were not instructed on the keyword strategy.

Following the lecture or reading in all sessions across phases, students were given a 20-item, 1-minute timing over the material (see and mark [S/M] keywords, see and write [S/W] answers). During this timing, the students' first task was to circle all the keywords in the question and then answer the question. Students were instructed to move on to the next question if they were unable to answer the question after circling the keywords. At the end of the timing, students put a slash where they finished. They were then instructed to finish the exercise untimed.

Data were obtained on the number of correct and incorrect answers to keywords circled and answers written during the timed period. Data were also obtained on the number of correct and incorrect answers marked during the untimed portion of the exercise. Data from the three phases were charted on the Standard Celeration Chart.

Graphic Organizers

Graphic organizers are spatial displays of information that are connected in a meaningful way. This study investigated the effectiveness of presenting lecture information through a graphic organizer, as measured by student performance on a PT timing (S/W answers). It was assumed that if teachers presented information using a graphic organizer as a visual aid, students would improve their performance on timings.

Graphic organizers were categorized into four formats: (1) top down/bottom up (to organize information that has a main idea followed by supporting details); (2) compare/contrast (to compare key attributes of various items or situations); (3) sequence (to depict a progression of events); and (4) diagram (to display information in the form of sketches, maps, and pictures).

Teachers who participated in the project were given the following four-step procedure for developing graphic organizers to accompany the material presented to their students:

Step 1. Select an appropriate scope of content material. A graphic organizer could cover enough information for 1 or 2 class periods.

Step 2. Determine the most important facts and concepts from the selected material.

Step 3. Arrange the facts and concepts on paper in a logical manner. Boxes, circles, lines, arrows, and other symbols could be used to display relationships among pieces of information. It is important to consider the teaching objective carefully and select an appropriate and efficient format.

Step 4. Prepare three different copies of the graphic organizer for students: completely blank and partially blank copies to use for lectures or quizzes and a completed organizer for review activities. (For more detail on

developing and implementing graphic organizers, see Horton & Lovitt, 1989.)

To evaluate the effects of graphic organizers, a two-phase study was arranged: baseline and intervention. Throughout a 5-day baseline, teachers either lectured or required students to read passages from their textbooks. During the 5-day intervention phase, teachers explained the use of graphic organizers and provided students with a rationale for their use. The new material was then presented using the six steps from the Academy for Effective Instruction and the four-step graphic organizer procedure. Following all sessions throughout the study, students were given a 50-item, 3 minute timing over the material that was presented. Data were entered on a Standard Celeration Chart.

Study Guides

Study guides are outlines, abstracts, or questions that emphasize important information in textbooks or lectures. They have taken a variety of forms, from straightforward listing of sentences to more involved outlines. This study examined the use of study guides as a teaching strategy for presenting information and a means of improving student performance on timings related to content materials.

The following four-step procedure was provided to teachers to help them develop study guides:

Step 1. Select an appropriate scope of content material. A study guide could cover enough material for 1 or 2 days of assignments.

Step 2. Determine the most important facts and concepts from the selected material.

Step 3. Arrange the facts and concepts logically and sequentially.

Step 4. Prepare copies of the guides for students. Write them at a level appropriate for students and consider the amount of information they are to complete. (For more information on developing and implementing study guides, see Lovitt & Horton, 1987.)

To evaluate the effects of study guides, baseline and intervention periods were scheduled. During a 5-day baseline phase,

teachers either lectured or required students to read passages from their textbooks. During the 5-day intervention phase, teachers provided a rationale for using study guides and used the six steps from the Academy for Effective Instruction and the four-step study guide procedure.

Following all sessions, students were given a 50-item, 3-minute timing (S/W answers) over the material that was presented. At the end of 3 minutes, the students made a mark and continued responding until they were finished with the exercise. Thus, two scores were calculated for the pupils: one for the timed and one for the untimed period. Data were plotted on the Standard Celeration Chart.

Workshops and Follow-Up

Each workshop was conducted by two members of the ULRC staff and ran for about 6 hours. For the first 3 hours the staff presented an overview of the strategy and explained procedures for implementing and integrating it with PT techniques. The presenters also offered a rationale for scheduling the strategy and summarized supporting research. Sample lessons were modeled to demonstrate the use of the strategy and how to collect and record data. Throughout the afternoon, teachers were assisted by ULRC trainers to develop the materials, including PT timing sheets, required to carry out the strategies in their classrooms. To facilitate this process, teachers brought their textbooks, class notes, and other instructional materials to the workshops.

After the teachers completed their research on one of the strategies, they responded to a follow-up survey. They were asked whether they thought the strategy assisted students, particularly low-achieving students; whether they would continue using the strategy; whether they received support from principals as they carried out the strategy, and whether they informed other teachers about the new approach. Students who participated in the research were also surveyed. They were asked whether they thought the strategies helped them learn more and whether they would continue using them.

Evaluation

The data from this project were analyzed in several ways. First, the overall data from each of the strategies were examined. For this, data were pooled from all districts, teachers, and students. For keywords and study guides there were two measures: one for circling keywords or completing study guides during timed periods and one for circling keywords or completing study guides and answering questions during untimed periods. For graphic organizers, data were from timed periods only.

The data, in Figure 1, indicated that the mean correct rates increased from baseline to intervention phases for all three strategies. Mean incorrect rates decreased from baseline to intervention phases for study guides and graphic organizers, and from baseline to retention phases for keywords.

In addition, net gains were calculated for all the districts and teachers for the three strategies. Those data, for the timed periods, showed that for keywords, graphic organizers, and study guides, all districts improved.

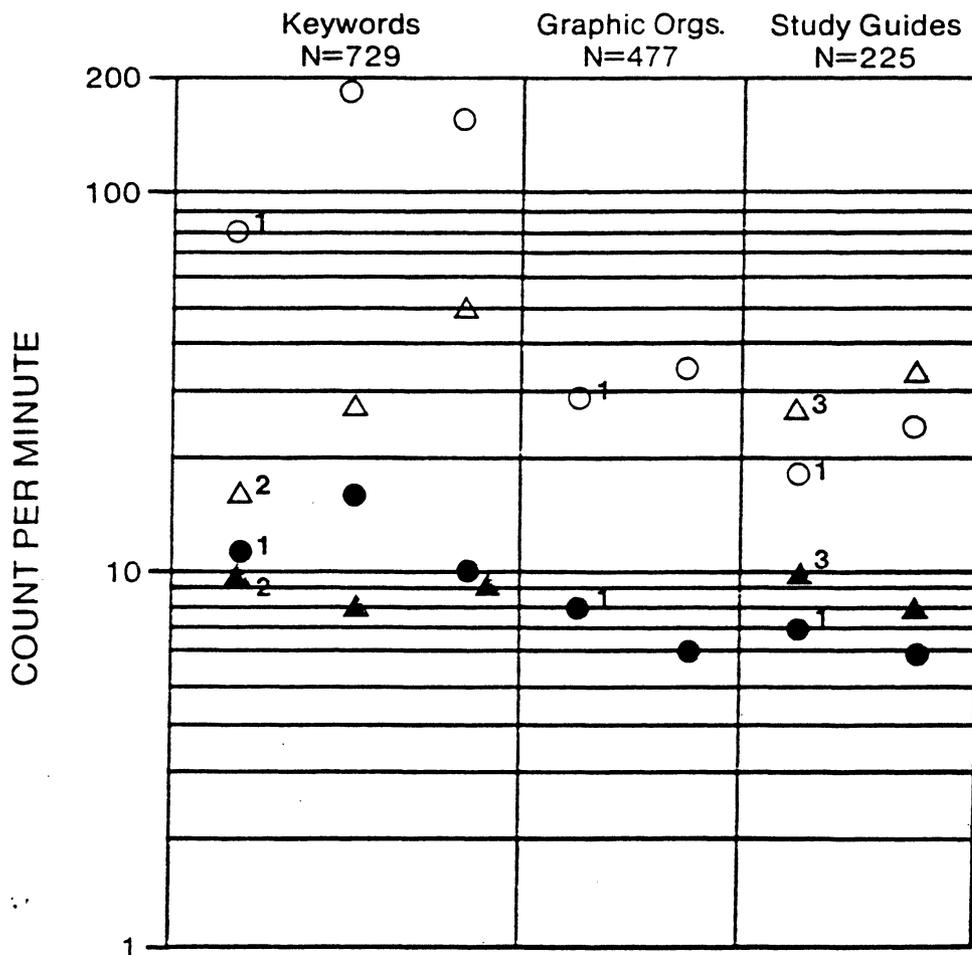
With respect to the net gains for teachers for the timed periods, data showed that for keywords, 30 of 38 teachers improved from baseline to intervention and 17 of 23 from baseline to retention. For graphic organizers, 21 of 25 teachers improved from baseline to intervention. and for study guides, 11 of 12 teachers showed improvement across those phases.

Data from the teachers' follow-up surveys showed that most of them thought the strategies helped low-achieving students and increased student achievement in general. The majority also indicated that they planned to incorporate the strategies and timing sheets into their teaching after the study, that many of their fellow teachers were interested in learning more about the strategies, and that building principals supported their efforts to try out the procedures.

Survey results from the students indicated that most of them believed that their grades would improve as a result of using graphic organizers

Figure 1

OVERALL RATES FOR THREE STRATEGIES



	B	I	R	B	I	B	I
○ Correct	81	183	158	28	34	18	24
● Incorrect	11	16	10	8	6	7	6
△ Correct	16	27	49	—	—	26	33
▲ Incorrect	10	8	9	—	—	10	8

- 1 Correct and incorrect rates during timed tests for keywords, graphic organizers, and study guides.
- 2 Correct and incorrect rates during untimed test for keywords.
- 3 Correct and incorrect rates during untimed test for study guides.

B=Baseline
 I=Intervention
 R=Retention

and study guides and that they planned to continue using them. They were not convinced that knowing about keywords would raise their grades, and they were not certain that they would continue using them.

Conclusion

This research yielded two recommendations for teachers. One is that teachers, particularly those at the secondary level, should make use of the teaching and learning strategies discussed here. Sufficient evidence exists to show that these strategies help youngsters gain more from lectures and textbooks.

The second recommendation deals with evaluation. We strongly support the use of PT techniques for assessing educational programs and procedures. The data from this project, gathered with PT techniques, were highly sensitive to various teachers' abilities to carry out programs and to various pupils' performances in their classes.

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What's the Hurry? Fluency in the Classroom

Kenneth W. Howell and Kathy A. Lorson-Howell

In Precision Teaching, frequent measurements taken with curriculum-based instruments are summarized to illustrate trends in student learning. One of the basic elements of Precision Teaching is the use of rate data (number of responses per minute) to illustrate the fluency of a student's work. (Fluency may also be indicated by latency, the time between task presentation and the beginning of work; and duration, the time required to finish the task.) The use of rate data offers certain advantages and disadvantages that must be understood if teachers are to make good use of the technique.

There are several reasons why teachers should be interested in the fluency of student response regardless of their interest in Precision Teaching. The first of these is that rate, like accuracy, indicates how well a student knows or can do a task. If two students work a set of multiplication problems and one misses 20% while the other does not miss any, it is clear that the first student has less skill at multiplication than the second. That is because the first student is less accurate. Now imagine that two other students work the same problems and neither of them make an error. It is still possible to recognize the differences between these students by noting the rate at which they complete the problems. The student who can do more problems in less time, while maintaining accuracy, is better at multiplication. Rate, therefore, is sensitive to differences between students—and between repeated measures of the same student—that accuracy data alone will not show. Accuracy is essential, but it does not describe all dimensions of skill and knowledge. A student who is fluent is both accurate and quick. By collecting the rate of correct answers *and* errors, teachers are able to examine both the accuracy and fluency of response.

A second argument for fluency is that it has functional implications. Some things must be done quickly.

Finally, fluency is thought to be related to the eventual generalization and maintenance of skills (Ivarie, 1986; Liberty, Haring, White, & Billingsley, 1988). Several explanations for this relationship can be found in the current literature, including the idea that high levels of fluency allow students to become "automatic" (Phye & Andre, 1986). When a person is automatic in the use of a skill, he or she is not aware of its use. An example of automatic use can be found in your own reading of this article. While the reading process requires you to employ various phonic, semantic, and syntax skills, you are doing so without awareness of that use. This automaticity frees your working memory to consider the meaning of the text.

Fluency and Learning

While it may be clear that a student should work certain tasks quickly, what the student should be taught in order to obtain the fluency desired is not always as clear. Often there are many different ways to complete a task. For example, one student might be able to solve addition fact problems by counting on fingers, while a second student might supply equally accurate answers by rote. These different ways of doing tasks are referred to as *strategies*; they are the procedures for task completion that teachers teach to students (Scott, 1988).

Not all strategies can be used to complete tasks fluently, including many of those with which special educators are most familiar. Since special educators work with students who have difficulty learning, they tend to emphasize rational and ordered strategies for task comple

tion. (For an example, see Archer, 1988.) This emphasis is understandable because such strategies are excellent for developing accurate performance, but insistence on their continued use may inhibit the shift from accuracy to fluency. For example, teaching a student to substitute colored blocks for numbers may help the student become accurate at addition, but because the blocks are not transportable or efficient they must eventually be replaced. This does not mean that it was wrong to initially promote a strategy of counting blocks. It does mean that use of the blocks must eventually be replaced by a new strategy. One way to decide whether or not a strategy can be used fluently is to find out whether successful students use it.

Fluency and Teaching

While fluency building should be a natural extension of the earlier acquisition stage of instruction, it is important to understand the demands it places on teachers and students. Because most special education teachers are more familiar with building accuracy than fluency, it is convenient to relate fluency instruction to acquisition.

When teaching a student to be accurate at addition, the teacher explains how to work accurately, provides the student with elaborate demonstrations of how to add, guides the student through early practice in adding, uses extensive correction procedures when errors occur, and praises the student for increases in accuracy. However, the teacher does not push fluency when the student cannot yet work the problems accurately. Similarly, when teaching a student to be fluent, techniques used to promote accuracy are not used. During fluency instruction, elaborate explanations and corrections are not needed; in fact, they might even slow the student down. Instead, the teacher talks about and rewards fluency. This means fluency becomes as much the focus as the addition content. The shift, then, is not in content (e.g., from addition to multiplication) but in what the student is supposed to do with the content.

It is important to remember that fluency involves doing something quickly as well as correctly and to make this point clear while teaching and testing. For example, when

giving daily tests or engaging in drill, teachers, should say, "I'm interested in seeing how quickly you can do these right," not "Go as fast as you can."

Fluency and Measurement

Two of the most common complaints about Precision Teaching are that it places too much emphasis on the use of drill and that it often targets isolated subskills. These complaints may arise from misconceptions promoted when observers (and, unfortunately, some precision teachers) confuse evaluation activities with instruction. The basic format of Precision Teaching is teach-measure-decide-teach-measure-decide (White, 1986; White & Haring, 1982). This process of frequent data collection and decision making has been shown to increase student achievement (Fuchs & Fuchs, 1986; Jones & Krouse, 1988). In a typical lesson a teacher might deliver instruction for 25 minutes and then follow the lesson with a 1- or 2-minute timing that directly samples the fluency of the skill being taught. If, over a period of sessions, these timings reveal a pattern of improved learning, the teacher decides to continue with the same instruction. If learning is not apparent, the teacher uses a set of data decision rules to modify the instruction (Eaton, 1978; Liberty, Haring, White, & Billingsley, 1988).

In order to focus the measurement used in this process, precision teachers often use tests that are different from the ones with which most teachers are familiar. These measures contain only the specific material being taught in the lesson (Howell, & Morehead, 1987). These very narrow tests (sometimes called *probes*) are given to measure, not to instruct.

Having students drill on timed worksheets is *not* Precision Teaching. The daily timings are not given to teach (although students often do learn from the experience). They are given to collect data on the effect of instruction. Precision Teaching specifies how the skill will be measured, how the learning will be summarized, how the instruction should be described, and how the instruction might be modified to improve its effectiveness. It does

not specify a type of instruction. Put more simply, advocates of Precision Teaching do not demand that all teachers teach the same way, but they do demand that teachers monitor what they are doing and change if necessary.

Teaching for Fluency

The first step in fluency instruction is deciding when to do it. If a teacher moves a student into fluency instruction while the student is inaccurate (as a general rule less than 85% [White, 1984]), the student may practice and become better at working incorrectly. However, if the student is accurate and the teacher does not begin fluency instruction, the student may get bored. While decision rules can help a teacher recognize when to shift from acquisition to fluency instruction, these risks can also be reduced by following the principles of effective instruction.

To clarify, it is a good idea to distinguish between *instruction* and *lesson*. Any lesson can include many different instruction actions. This means that a lesson designed to teach oral reading, for example, can include acquisition *and* fluency instruction, as well as generalization. The teacher effectiveness literature tells us that lessons should include components such as preview, explanation, guided practice, and independent practice (Rosenshine & Stevens, 1986). While fluency instruction typically involves rapid-paced independent practice, and practice is essential, it should only be one part of the lesson. Practice cannot replace the other elements of the lesson, and independent practice must always be preceded by adequate guided practice. The best way to ensure that fluency instruction is effective is to make sure that it is embedded within an adequate total lesson.

General Suggestions

First, be sure that all blocks to fluency, such as awkward materials, are removed. Second, remember that it is important to model, prompt, and praise fluency. Third, avoid competition among students. If the students want to race, have them try to beat their own previous score. Fourth, remember that fluency is built primarily through repetition, and that can be boring. Often, several short, intense sessions a day are

better than one long one. Fifth, use peers and paraprofessionals to make the instruction efficient. Finally, be sure the rate criteria are appropriate.

Establishing standards of performance (criteria) is important because different levels of fluency lead to different levels of competence. While various procedures for establishing criteria have been recommended (see pages 64-66 in this issue), we believe that the best practice is to develop standards from the performance of successful students working in the target setting. This means that the exit criteria for third grade are the performance levels required for success in fourth grade. Similarly, the exit criteria for special classes are those required in regular classes. However, because these levels differ from one school to another, the following discussion will include general recommended criterion statements. We have taken these statements from what we believe to be the best current sources, but not all authors agree. Remember, when we talk about teaching students to be fluent we are *not* talking about having them go as fast as is humanly possible. Students need to be accurate and fluent enough to be successful.

Considering how hard it is for educators to set fluency criteria, it is not surprising that students have trouble conceptualizing them. Students are used to accuracy feedback, which typically comes when the items they have worked are marked right or wrong. This allows them to see the mistakes they make. When a student is working on fluency, no items are wrong; they are just late. Because there are no errors to mark, the student can have trouble understanding what is expected. Simply telling a student to go faster is too intangible. Therefore, it is a good idea to illustrate the fluency target in some way. If a page of problems or words is going to be used, circle the target. If flashcards are used, put a red card in the deck to mark the target. Charting performance is an excellent way to illustrate progress and show how much more improvement is needed.

Content Suggestions

Reading fluency is built most effectively with passage reading, not drill on words or sounds in isolation. Target rates of 60 words per minute (wpm) for first graders, 110 wpm for second graders, and 145+ wpm for students in third grade and above (all with 90 to 95% accuracy) are commonly recommended (Carnine, Silbert, & Kameenui 1990). Reading rate can also be increased by providing more silent reading practice (this does not mean cutting back on oral reading) and by reducing the corrections the teacher delivers when the student is reading. (Remember, if many corrections are needed, independent practice is not indicated.) It is also a good idea to start oral reading exercises with the teacher reading the first few sentences aloud.

Another technique is to have students do repeated readings of the same material (Allington, 1983). Have the student read through a passage and note his or her rate. Then determine what 40% of that rate is and add the two numbers together. This 40% improvement level becomes the target for the day. The student then rereads the passage as many times as needed until the target is met. This continues until the day that the student's initial reading rate is at target.

Mathematics facts can be practiced from timed worksheets and flashcards. The rate of response for written and oral facts is the same, approximately 40 facts per minute with 100% accuracy (Howell & Morehead, 1987). It is a good idea to select larger problems, recognize the facts required to work them, and drill the student briefly on the facts prior to having the student work the larger problems.

Written communication criteria, based on a norm process, have been suggested by Tindal and Marston (1990). These standards vary by grade level and include spelling correct letter sequences (from dictation, in writing, and during a 2-minute timing) at a rate of about 45 letter sequences per minute in the fourth grade. The criterion for writing in 3 minutes, from a story starter, is about 16 words per minute at the fourth-grade level.

Written communication fluency can be increased by increasing the student's fluency in handwriting, spelling, and punctuation components. It can also be increased by presenting story starters, or topic sentences, and allowing the student time to plan before writing. Eaton (1984) has suggested having students do 1-minute timings during which they list words related to the topic before timing the story starter. Because transcribing and production are only one aspect of written communication (Bos, 1988) fluency in planning, reviewing, and revising also should be promoted.

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Increasing Endurance by Building Fluency: Precision Teaching Attention Span

Carl Binder, Elizabeth Haughton, and Denise Van Eyk

Precision Teaching (PT) uses timed and charted measures of students' performance on instructional and practice activities to support a curriculum-based decision-making process. Many precision teachers and their students use 1-minute timings when measuring and charting performance. This is a short but sufficient interval for measuring performance on many academic and simple nonacademic tasks. Moreover, by measuring for exactly 1 minute, teachers and students can avoid the need to calculate count-per-minute frequencies based on longer timings before recording results on a standard celeration chart, which is the basic PT decision-making tool.

However, it may be a good idea to measure performance for either more or less than 1 minute when dealing with the problem of attention span, a common concern among educators. How long can students maintain reasonable levels of performance on a given task? How can teachers increase students' ability to work productively over extended periods? How can educators deal with what are often called *attention deficits*? Precision teachers can provide answers to these questions by systematically varying practice and measurement durations.

By timing and charting students' performance across a range of different durations, educators can learn to deal more effectively with individual differences in attention span. This will also promote a better general understanding of the problem of attention (which precision teachers prefer to call endurance) in terms of the relationship between how long a student performs and his or her performance level.

The Mystery of Attention Span

The concept of attention span: often assumed an almost mystical quality in the thinking of educators. Teachers and clinicians have developed explanatory theories and a diagnostic language about so-called attentional deficits and the problems of inattentive students. Many professionals hypothesize various brain dysfunctions to account for students' inability to maintain focused activities for significant periods of time. Others, willing to assume a greater degree of responsibility for students' learning arrange positive consequences when students remain on task for increasing periods of time (Ferritor, Buckholdt, Hamblin, & Smith, 1972) or they vary instructional content (Krupski, 1979), situations (Wacker, Berg, & Moore, 1984), or level of difficulty (Krupski, 1985) in attempting to improve attention to task.

Precision Teaching offers an alternative way of understanding attention span. The key ingredients of this perspective are count-per-minute measures of performance (Lindsley, 1972); time-based aims, or mastery criteria (Haughton, 1972), and a definition of mastery as behavioral fluency—speed plus accuracy (Binder, 1988). The literature of cognitive psychology contains references to *automaticity* and its relationship to attention span (Bloom, 1986; LaBerge & Samuels, 1974), paralleling PT concern with behavioral fluency.

In general, data from PT classrooms suggest that, until students attain certain minimum levels of speed and accuracy on individual curriculum tasks, they typically lack the ability to maintain steady performance levels for extended periods of time. On the other hand,

when learners approach fluency—accurate, nonhesitant performance—they become able to work steadily for significant durations. Endurance, or attention span, thus follows, or is a byproduct of behavioral fluency. This notion of attention span is very different from the theories suggested by brain state theories or time-on-task definitions.

In addition, accurate but hesitant (nonfluent) performance, when carried on for extended periods, is often accompanied by increased error rates and negative emotional behaviors. This is particularly obvious in students with special needs, although just about anyone has experienced negative feelings when required to perform new skills that were not yet fluent for relatively long periods of time.

Finally, evidence suggests that requiring students to work for relatively long durations before they have attained minimum levels of speed and accuracy may actually depress learning rates.

Effects of Performance Duration on Performance Level

Some of our early observations about endurance were made during the late 1970s in prevocational programs for adolescents with severe developmental handicaps at the Behavior Prosthesis Laboratory of the Fernald State School in Waltham, Massachusetts. In one case, students practiced counting out quantities of small objects to match numerals printed on the outsides of containers. After several weeks of practice for 3 minutes at a time, the teacher changed to 15-minute practice durations. Students who had been counting out between 30 and 50 objects per minute for 3 minutes maintained approximately the same levels of performance for 15 minutes. However, students who performed at between 10 and 30 per minute for 3 minutes fell to below 10 per minute after the change. These observations caused us to look more carefully at the relationship between performance level and duration.

In a series of previously unpublished studies in the Hastings County, Ontario, schools, we attempted to clarify results reported in an article by Van Houten and Thompson (1976). These

researchers were measuring the effects on performance of telling students that they were being timed versus timing them covertly. Unfortunately, Van Houten and Thompson changed from explicit to covert timing at the same time as they changed the duration of timings, thereby precluding an unequivocal conclusion about the relationship of either variable to performance. In their study, second graders wrote answers to single-digit addition problems under two conditions. First, without explicit timing, they worked continuously for 30 minutes. Then the teacher broke the 30-minute intervals into as many separate 1-minute timings as would fit and told students they were being timed. The results were that, even though the total for the successive 1-minute timings was less than 30 minutes, students completed more than twice as many problems as when they worked continuously for 30 minutes.

We suspected that the change from continuous performance to brief intervals may have had a powerful effect on performance independent of whether or not students knew they were being timed. In other words, a series of 1-minute "sprints" caused them to complete many more problems than a single 30-minute "marathon."

In our research, teachers changed performance durations without altering any other conditions. In the study, 75 Hastings County students in kindergarten through eighth grade practiced writing the digits 0 through 9 as fast as they could. On different days they wrote digits for 15 seconds, 30 seconds, 1 minute, 2 minutes, 4 minutes, 8 minutes, or 16 minutes. Those who could write more than about 70 digits per minute for 15 seconds were very close to the same performance levels for up to 16 minutes. The performance of those who wrote more slowly for 15 seconds fell off rapidly as they worked for longer periods. In fact, some students who wrote at about 20 digits per minute for 15 seconds actually stopped writing before the end of 16 minutes. These results show that students who have not yet attained minimal levels of performance cannot be expected to continue working for longer than a brief interval without slowing down considerably or even stopping work.

Effects on Error Rates

When nonfluent performance is extended for longer durations, error rates sometimes increase. Figure 1 shows a Standard Celeration Chart from Nancy, a 7-year-old girl diagnosed as having severe retardation. She lived at home and attended a day-school program, and she was often, aggressive or noncompliant in demand situations. In the charted program, she grasped and released an object, with physical guidance as needed, for 1 minute practice intervals. The incorrect responses were occasions on which she pulled away from the teacher's guidance. After a change to 15-second practice intervals, she continued to improve her fine motor skill, without pulling away during the practice.

Roy, a 9-year-old boy in a day-school program who was diagnosed as having behavior disorders and severe mental retardation, was charted as he practiced putting pieces into a puzzle with prompts from the teacher (see Figure 2). When he worked for 1 minute at a time, there were many instances in which he either placed the puzzle piece incorrectly or threw the piece away from the table. The rate of correct responding was variable between 1 and 30 per minute, with no consistent pattern of progress. When the teacher shifted to working for only 15 seconds at a time, correct responding began to show less day-to-day variability, with errors and noncompliant responses virtually disappearing.

These cases are typical of what we see in many children for whom continuous activity of more than 15 or 30 seconds at a time can stretch endurance, resulting in variable and non-compliant behavior with high error rates. With such students, changing to very brief practice periods can improve performance, eliminate errors, and increase compliance.

Effects on Learning Rates

Another study shifted first-grade students writing to 20 by 2's (a premultiplication skill) from 2-minute timings to 10 minutes and back again. The general finding was a decrease in average performance with the longer duration, as well as a reduction in learning rate. There was a flattening of learning during the 2 weeks of 10-minute practices and an increase in

learning during weeks with 2-minute sessions. Thus, requiring lengthy performance before students achieve sufficient performance levels may actually retard learning. Unfortunately, long practice sessions are common in many classrooms, and they may well be a cause of many behaviors diagnosed as attention disorders.

Implications for Classroom Practice

The practical implication of these findings is that in order to build endurance, or attention span, teachers should first build fluency. Teachers need to be aware that changes in practice and measurement duration may affect students' performance levels, error frequencies, emotional dispositions, and learning rates. Likewise, students who lack fluency in a given skill or knowledge area will tend to have very short endurance in that area.

Teachers can try using timings longer or shorter than 1 minute and comparing performance levels across the different durations. Sometimes shifting to practice durations as short as 15 or 30 seconds can be effective when students are not progressing with other interventions. Practice periods can be increased systematically as students achieve fluency at each duration, thereby building their endurance.

Especially in the beginning of a student's work on a given skill, several brief timings may be more fruitful than one or two long ones. For example, when practicing writing alphabet letters, students can be asked to write *c*'s for 30 seconds, then *l*'s, then *m*'s, and so forth in successive intervals. When they need a rest, they can stop for 30 seconds before continuing on to the next letter. This routine gives students control over their overall practice duration while building fluency and endurance.

Students who lack fluency in prerequisite skills or knowledge are often diagnosed as having attention deficits. Instead of focusing on establishing on-task behavior, teachers should check these students' performance on such basics as grasping and releasing, writing numbers and letters, reading digits, and basic facts

Figure 1

STANDARD CELEATION CHART-NANCY

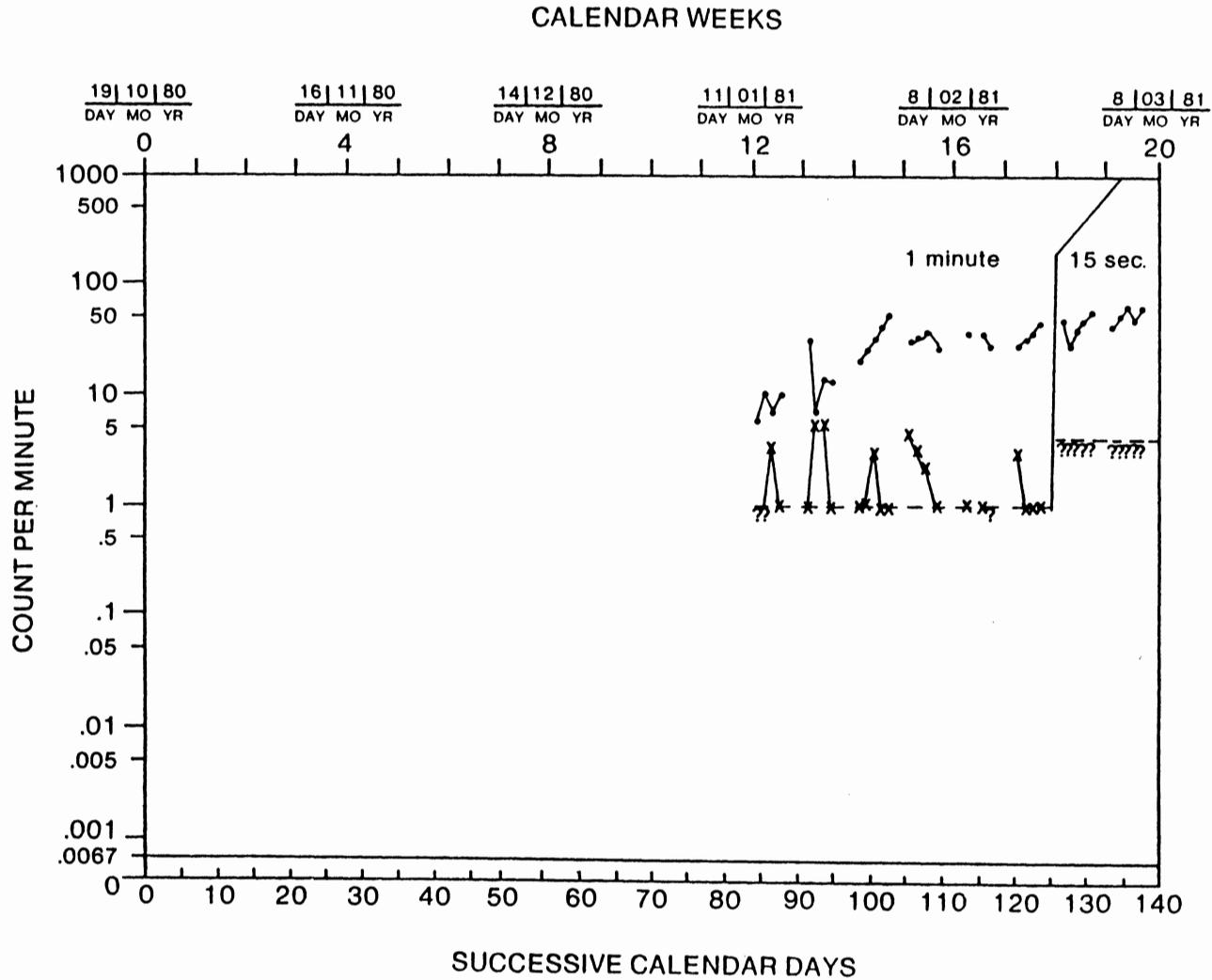
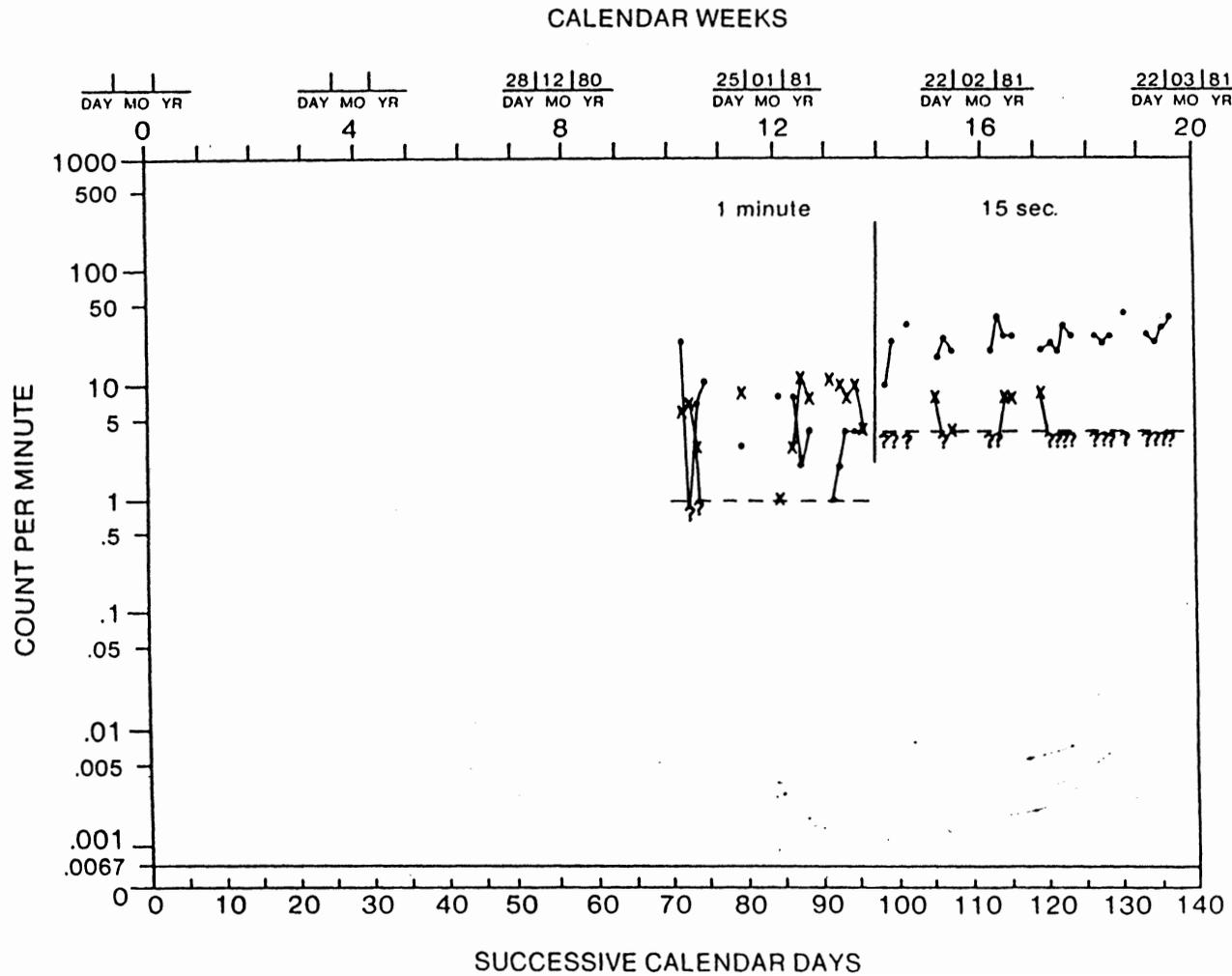


Figure 2

STANDARD CELEBRATION CHART - ROY



(Haughton, 1972). When these skills fall below fluency (e.g., below 50 to 70 facts correct per minute in basic arithmetic), students often have difficulty becoming fluent in, or attending to, more advanced skills. Often, practice on elementary skills to the point of fluency will do wonders for attention span on more advanced work.

Performance should always be evaluated at the duration that will be required in real life, whether in applying skills or knowledge to more advanced curriculum, performing on tests, or using skills and knowledge outside the classroom. If long durations cause problems, teachers can help students become fluent for shorter durations and gradually work up to the required endurance.

Duration changes also should be included among behavior management tools. Sometimes shifting to repeated shorter practice durations so that students can perform at their peak levels for brief intervals will keep them engaged while reducing problem behaviors. Practice durations are then increased as students achieve higher performance levels.

Conclusion

In the final analysis, the goal is to help students perform their best, for however long they are able, and then to provide support and practice that will enable them to maintain that performance for as long as they need to do so. Precision Teaching is a valuable tool for helping teachers achieve that goal.

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Using the Language Experience Approach with Precision

Susan K. Peterson, Jack Scott, and Karen Sroka

One method of reading instruction that is often employed by teachers of students experiencing academic difficulties is the whole-language approach (Heymsfeld, 1989). This approach focuses on the child's development of meaning from text, stresses the use of meaningful readings, favors a whole to part instructional format, and de-emphasizes subskill teaching. A potentially productive aspect of the whole-word orientation is the language experience approach (LEA) (Van Allen, 1976), in which learner generated stories serve as the reading material. These stories are meaningful to the child, contain familiar vocabulary, and offer the potential for increased motivation due to a greater sense of ownership of the story. Initially the student may need assistance in formulating good stories (Heller, 1988), but greater responsibility for creating the story can be shifted to the student gradually. The intuitive appeal of LEA has made it a popular reading tactic among mainstream and special education teachers attempting to individualize for students with poorly developed reading skills.

Although LEA is frequently used to supplement reading instruction. Its current usage has placed little demand on teachers for direct and frequent measurement of learner performance. Such measurement is desirable to document student achievement as it relates to individualized education programs. Therefore, it is important to explore methods for bridging the gap between the language experience approach and data-based techniques that directly and frequently monitor learner performance (e. g., Precision Teaching). The combination of LEA and Precision Teaching seems to offer great potential.

This article describes two interventions that were used with elementary students to improve their oral reading skills. Repeated readings

(O'Shea, Sindelar, & O'Shea, 1987; Samuels, 1979), combined with a simple error correction technique (Graham & Johnson, 1989; Sindelar, 1987), and precision teaching were included in both procedures. The only difference between the two interventions was that the first used LEA stories, while the second used passages from a basal reading program. Student progress was compared in terms of the rate of learning (celeration) and accuracy.

Implementation

The Students

The instructional procedures were implemented with two elementary school students attending a self-contained diagnostic classroom for students experiencing academic, behavioral, and/ or medical difficulties—Latasha, a 9 year-old third grader and June, an 8-year-old second grader. Intelligence scores were in the average to low average range, and both students were considered at risk for special education services. In spite of their intellectual ability, the girls were experiencing difficulties in reading, particularly their oral reading skills: Both girls needed to increase their reading rate.

Setting

The setting for this investigation was the Multidisciplinary Diagnostic and Training Program (MDTP) diagnostic classroom located at the University of Florida, which accepts referrals from 14 school districts and one laboratory school located in north-central Florida. School district personnel refer children who have diverse learning, behavioral, and medical problems. The students discussed in this article attended the diagnostic classroom instead of their home schools for 6 weeks. The purpose of their enrollment was to identify

data-based teaching techniques that would enable them to be more successful in their school experiences.

Materials

Materials included a stopwatch, standard celeration charts, student-generated reading passages, and reading passages taken from the Ginn Basal Reading Program. Individual file folders were used to store each student's reading passages and the standard celeration charts.

Procedures

Informal assessment data indicated that Latasha and June needed practice on oral reading skills. Both girls read slowly, so reading fluency and comprehension were a problem. Their teacher decided to use 1-minute repeated readings on a daily basis to help the girls increase their oral reading rates. Two interventions were implemented—LEA passages and Ginn passages. The students received both interventions concurrently on a daily basis. The order in which the passages were assigned was determined by a table of random numbers (Ary, Jacobs, & Razavieh, 1979). This allowed the teacher to monitor the girls' individual progress and determine which reading material was more effective for increasing reading rate.

Baseline data were collected for the girls on both the LEA and Ginn reading passages. To generate an LEA passage, each student dictated a story into a tape recorder. The teacher listened to the taped story, wrote it down, and later typed it on a blank sheet of paper. For several days, each student read aloud from her LEA and Ginn stories for 1 minute. Passage order was randomized. The teacher counted the number of correct words read per minute and the number of errors made. No feedback was provided to the students regarding their performance. The teacher plotted these baseline data on Standard Celeration Charts and initiated the treatment procedure (see Figure 1 for an example).

Intervention 1. The teacher set a stopwatch and cued the student to begin reading her LEA story orally. While the student was reading, the teacher noted any reading errors. To facilitate the notation of errors, the teacher made a copy

of each student's story and covered it with an acetate, marking the errors as the student read. At the end of 1 minute the stopwatch beeped, cueing the student to stop reading. The teacher then pointed to the first word the student missed, pronounced it correctly, and asked the student to repeat the word. Then the teacher read the word in its context (i.e., a phrase), and the student repeated the phrase while looking at it. This same correction procedure was used for all words missed. The student was then allowed to read the remainder of the passage untimed. If the student miscalled any additional words, the teacher simply said each word correctly and the student repeated it and continued reading. This oral reading practice continued for 9 days.

Intervention 2. The instructional procedures used in intervention 2 were identical to those used in intervention 1, but instead of the LEA story, the child was asked to read passages taken from the Ginn Basal Reading Program. Passage selection was based on student performance. The teacher had the students read several Ginn passages until an oral reading rate was obtained that was similar to the rates obtained on the student's LEA passage. Thus, the student's initial reading rate was similar for both the LEA and Ginn passages.

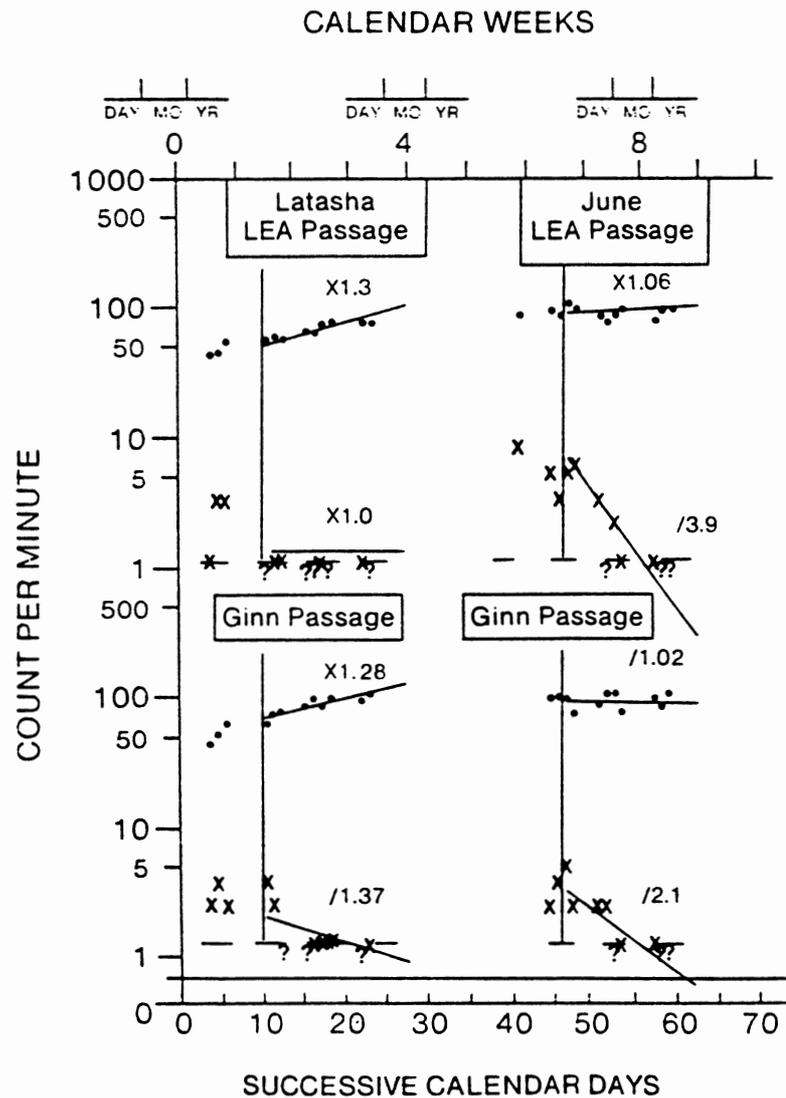
Reliability data. Reliability data were collected to ensure accurate scoring on both the LEA and Ginn timings. Interobserver agreement occurred with 100% accuracy on 2 separate days during the treatment period for both students.

Results

Intervention 1 and intervention 2 were equally effective with both girls. They improved their reading fluency (correct words per minute) and/or decreased their error rate. Latasha's initial LEA rate was 41 correct words per minute with 1 error. Her ending rate after 11 days of practice was 74 words per minute with 0 errors. Her celeration, or rate of learning for correct responding, was $\times 1.30$, or 30% improvement per week. Latasha's initial rate on the Ginn passage was 39 words per minute

Figure 1

LEARNER PERFORMANCE DATA



with 2 errors. Her ending rate was 93 words per minute with 1 error. The rate of learning on this task for correct responding was $\times 1.28$ or 28% improvement per week.

June's initial rate on the LEA passage was 89 correct words per minute with 8 errors. Her ending rate was 99 correct words per minute with 0 errors. While June's rate of correct responding increased with a score of $\times 1.06$ or 6% improvement per week, the decrease in errors was even more dramatic, a $/3.90$. On the Ginn passage, June showed minor improvement. She scored 86 correct words with 2 errors initially and ended with 92 correct words with 0 errors.

The initial accuracy values [i.e., corrects / (corrects + errors)] for both students were between 93% and 98%. This is the range teachers typically select for instructional reading materials. The ending accuracy for each student was 99% or better.

Discussion

Celeration and accuracy scores obtained from both the LEA and Ginn reading passages provided an equal opportunity for learning. The students' individual performance was consistent regardless of the reading material used for practice. These data show that if teachers were using repeated readings, error correction procedures, and precision teaching to improve reading fluency, either basal readers or LEA stories would work equally well.

An informal survey was taken at the end of 9 instructional days. Another teacher, who was not involved in the reading instruction, interviewed Latasha and June. Each girl was asked two questions: "Which timing did you like better?" and "What helped you the most to do well on these timings?" Both students said they liked their LEA timing better. The students had more difficulty answering the second question: Latasha and June said that going faster helped them the most.

When asked which timings she enjoyed more, the teacher who provided the instruction said, "The LEA, because the children were more excited about their own stories." When asked

whether or not any student resistance was noted on the timings, she reported that Latasha was a little resistant on the Ginn passage because she had already read the story prior to the use of the timing. According to the teacher, June seemed to like both timings equally well.

The final question answered by the teacher was, "What were the advantages and disadvantages of each intervention?" Advantages for the LEA intervention were greater student interest and increased familiarity with vocabulary. The disadvantage reported was the time involved in having the 1-minute timings served as additional reinforcement that could enhance their overall performance. The disadvantage of the Ginn intervention was the uncontrolled vocabulary: Words were included that may not have been in the students' own language repertoire.

Conclusion

For children who are resistant readers the personalized nature of LEA stories may provide needed motivation. The opportunity for a student to succeed on a text with personal meaning should be noted as a significant benefit. On the other hand, students who do not need the special motivational advantages of the LEA story may perform equally well on a standard piece of text. If the instructional goal is to increase reading rate, teachers can save the time it takes to have students generate their own stories as well as the time it takes to type the stories. In such cases, it may be more productive to incorporate storytelling into creative writing or composition instruction. Using basal readers may also bridge the gap between regular and special education classes.

The instructional strategies used by a teacher may be of more importance than the materials selected. Building reading fluency through the use of repeated readings, a direct instruction correction procedure, and daily monitoring of student performance through precision teaching is an effective combination of teaching strategies (Jenson, Sloane, & Young, 1988). Collection of student performance data is particularly important, and the precision

teaching format provides a viable method for doing this. Traditionally, LEA has been used without data collection. Unfortunately, this leaves the technique open to criticism and prevents the teacher from knowing when to change instructional tasks.

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Challenging Reading for Students with Mild Handicaps

Jack Scott, Bill Wolking, Jolenea Stoutimore, Carolyn Harris

Placing students with special needs in curriculum tasks that maximize both short- and long-term learning is a good idea, but one that is seldom practiced effectively. Placement on easy tasks seem to be preferred, regardless the effects of such placement on learning. Perhaps we expect easy tasks to be learned quickly and thus promote a sense of confidence in learners. Hard tasks, on the other hand, are expected to be learned slowly, or not at all, and may undermine learner confidence and motivation.

Special educators and school psychologists generally recommend placement of special education students in relatively easy tasks. In the field of reading, this practice is traceable to the work of Betts (1941, 1946), who suggested instructional placement at a level at which the learner could read with 95% to 98% accuracy. This placement tradition is still at work today. For example, according to Hargis (1982), reading at more than 8% initial errors constitutes "reading levels that induce frustration and failure, are nonproductive, and so should be avoided" (p. 107). Even more succinctly, Mercer and Mercer (1981) stated that "reading material at this level [10% errors] cannot be used for instruction" (p. 269). However, questions are beginning to be raised. Addressing the general issue of literacy, Cadenhead (1987) has asked whether we have not become too reliant on procedures that carefully control reading levels and place students in unchallenging materials. Powell (1984) has provided new placement criteria for informal reading inventories that have the effect of placing students in somewhat more challenging material.

Precision teachers have been aware of the problems associated with placement on easy tasks for some time. McGreevy (1978) epitomized the precision teaching approach to placement with a slogan: "Easy to do, hard to

learn; hard to do, easy to learn." Research published so far supports the outcome predicted by this slogan. The work of Johnson (1971), Neufeld and Lindsley (1980), and Gerent (1983) provides evidence that placement on more difficult tasks often results in improved rates of learning.

This article describes a method for placing students in challenging reading materials and also describes simple procedures for reducing errors and building oral reading fluency.

The Challenging Reading Method

The strategy for presentation of reading material at challenging placement levels consists of the following four steps: assessment, daily timings, error correction, and rate pacing. Reading passages may be developed from a variety of sources, including any standard basal reading series or high-interest material from books, newspapers, or magazines. Passages should be divided into segments of 185 to 200 words and ordered from easy to progressively more difficult reading material. We used passages from the Ginn Reading Series (1982-1984) (levels preprimer through 8) and Jamestown Publishers' Timed Reading Series (Spargo & Williston, 1980) (levels 9 through 12).

Although we transferred the passages to probe sheets (i.e., printed each segment on separate pages), passages may also be marked in the reading text. Probe sheets may take some time to prepare initially, but they are convenient and can be reused.

Words per minute (wpm) should be recorded for both correct and incorrect responding. Incorrect responses include omissions, substi

tutions, repetitions, and mispronunciations. Words read true to the text and quickly self-corrected responses are counted as correct. The frequencies for correct and error responding are charted on a Standard Celeration Chart.

The participants in this study were 16 elementary school children from the P. K. Yonge Laboratory School who were participants in an after-school tutoring program. The median age of the children was 8 years and 6 months, with a range of 7 to 10 years. The median grade level was second, with a range from first to fourth. None of the learners was in special education due to learning problems, although all had been recommended for the tutoring program due to their teachers' concerns about their failure to make adequate academic progress. School policy did not permit the use of traditional special education classifications; rather, it promoted the extensive use of regular class accommodations and after-school tutorial programs. These children would be seen as being at high risk for special education placement if they attended a public school in Florida.

Procedure

Assessment

Assessment was begun at each learner's current reading level and proceeded through passages of different grade levels until a challenging passage was determined. A challenging passage is defined as one in which fewer than 83% of the words are read correctly (more than one error for every six words read). In practice, we attempted to find passages that were as close as possible to the 83% criterion. Thus, passages in which 17% to 20% of the words were read incorrectly were selected for teaching.

Daily Timings

Once a challenging passage was found, daily timings were implemented. During the timing, the learner was asked to read the passage for 1 minute. All errors were recorded and the last word read was marked. A follow-along sheet was convenient, but any method indicating the last word read would do. Learners who had not completed the passage at the end of the

timing were asked to continue reading until the passage was completed.

Error Correction

Only errors recorded during the first minute were corrected during this phase, using a two-step procedure. First, the teacher pointed to each word read incorrectly (target word), said the word correctly, and had the learner imitate the teacher's model. This correction procedure was repeated before the learner moved to the next target word. Next, the teacher said the two words on either side of the target word, along with the target word, and then asked the learner to imitate this five-word phrase. As with the first step, the word-in-context procedure was repeated one time. No other error instruction was provided.

Repeated Reading and Rate Pacing

Upon completion of the error correction procedure, a repeated reading and rate pacing procedure was implemented (Chomsky, 1976; Samuels, 1979). The teacher prepared an audiotape on which the appropriate passage was read at a rate approximately 30 wpm faster than the learner's current performance level. Learners were instructed to keep their eyes on the text and read along with the tape, imitating both speed and inflection. It has been our experience using this procedure that some learners are unable or unwilling to read as fast as the tape, even with encouragement. However, the procedure should not be discontinued based on this phenomenon. We have found that the ability to keep up with the tape is not predictive of celeration values. That is, even learners who seem to have difficulty keeping up make significant gains in reading rates. Headphones may be used during the procedure to minimize distractions. However, it is more difficult to monitor correct implementation with headphones.

Materials

To use the procedure described here, teachers need a supply of audiotapes on which passages are prerecorded at a variety of reading rates. One is recommended for each passage. For example, a fifth-grade reading passage would

be recorded on five tapes at 50, 80, 110, 150, and 180 wpm. These five levels can accommodate very slow to moderately proficient readers. Although making the tapes may take some time, it is a sound investment. Once they are made they can be used by many learners. Color coding them by speed of presentation makes tape management easier.

Making the tapes is fairly simple with a little practice. For each rate level, the teacher marks the word in the passage to which he or she must read by 15 seconds (s), 30 s, and 1 minute. For example, with the 80 wpm tape the teacher would mark 15 s at 20 words, 30 s at 40 words, and 1 minute at 80 words. These points help the teacher establish a pace. Using a timer, the teacher practices reading the 15-second portion a few times, and when the pace is appropriate, turns on the tape. The procedure is to announce the story title and the reading rate and then begin reading. A stopwatch helps with pacing, or an assistant can help keep the teacher paced correctly. The entire passage is read as the teacher models proper inflection and pronunciation and reads under the control of all punctuation marks. However, it is difficult to model correct inflection at lower rates. Production of a full set of tapes could be a project undertaken by a volunteer, a talented parent, or a highly skilled student peer.

Classroom Use

Some teachers might conduct the assessment portion of this technique and then have their aides work with the students on a daily basis. These teachers could monitor the charted data quickly and make changes in instruction, motivation, or level of task difficulty efficiently. Other teachers might prefer to work intensively with one child over 2 or 3 weeks for a short period of time each day in an effort to achieve a dramatic increase in reading fluency. Many students have convinced themselves that they cannot read successfully and may require the carefully data-managed "boost" that these techniques can offer.

Effectiveness

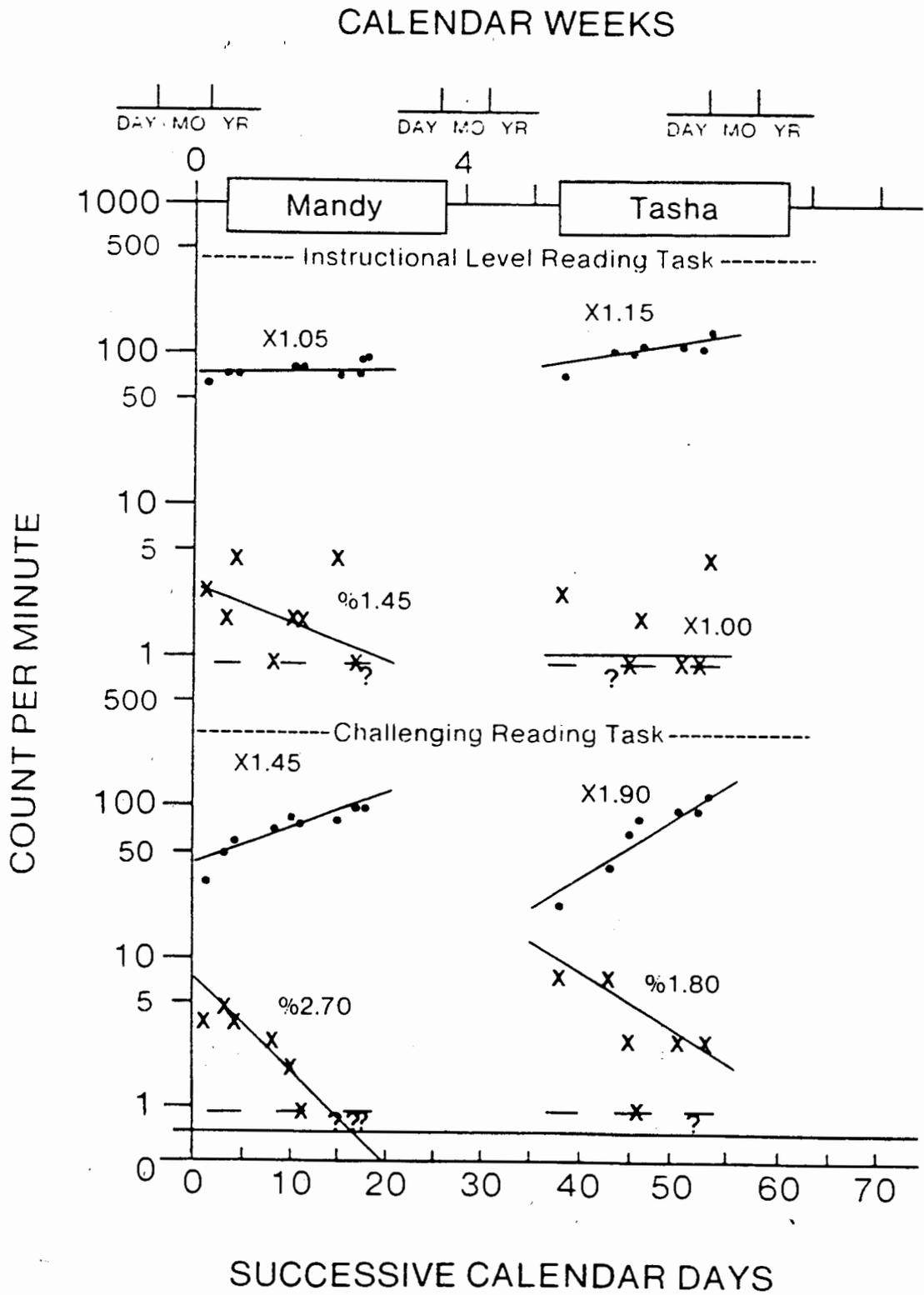
When these procedures were used to teach challenging reading passages, progress rates for both correct and error responses were high.

The teachers in this program used the Standard Celeration Chart and determined the rate of learning or *celeration* for correct responses and errors for each level of text difficulty. The data presented here are based on 32 comparisons of learners' performances on instructional and challenging reading tasks. Instructional tasks are those on which initial errors do not exceed 5%. Challenging tasks are those on which initial errors exceed 17% (1 error for every 6 responses). In our work all learners showed higher or equal celerations for correct responding. Error progress also favored the challenging readings in 23 comparisons. In only nine comparisons was the instructional-level task associated with a faster deceleration of errors. Median celeration values provided a conservative measure of typical performance for the entire group of learners. For the challenging readings the median celeration values were $\times 1.73$ for correct responses and $+2.00$ for error responses. By comparison, the median celerations for the instructional level passages were $\times 1.35$ for correct responses and $+1.60$ for error responses. While the students started with a higher number of words read correctly per minute in the instructional reading level, they made greater gains (or, in precision teaching terms, had higher celeration values) with the challenging reading tasks.

Figure 1 presents the charted data or learning pictures for two students whose performances under the instructional-level and challenging conditions were representative. Mandy, an 8-year-old second grader, was referred for tutoring due to extreme restlessness and a short attention span. Her data, shown in the first panel, are fairly typical of reading instruction guided by traditional placement criteria. The celeration for corrects is flat, and a $+1.45$ reduction in errors (a reduction from 3 to 0 errors over 17 days) was obtained. For Mandy the instructional task was at the preprimer level and the challenging task was second-grade-level text. The overall learning rate for this plan was a modest $\times 1.52$. Performance on the challenging passage, by comparison, was better. Correct responding increased at $\times 1.45$ while error responding decreased at $+2.7$, for an overall learning rate of $\times 3.92$.

Figure 1

LEARNER PERFORMANCE ON INSTRUCTIONAL LEVEL AND CHALLENGING TASKS



Tasha, 10 years old and in the fourth grade, showed another pattern with a similar overall rate of learning (panel two). Her teachers were concerned about increasing episodes of daydreaming and withdrawn behavior linked with a decrease in her academic performance. Correct responding increased at $\times 1.15$, while error responding, having started at 3 per minute, failed to decelerate. The overall learning rate was $\times 1.15$. Tasha's performance on the challenging passage is a picture of successful data-managed instruction, with a celeration of $\times 1.90$ for correct responding and $\div 1.8$ for error responding. The relative difficulty levels of the instructional material and the challenging material can be seen in the fact that Tasha said 34 words correctly for each error on the instructional-level material versus only 3 words correct for each error on the challenging passage.

The techniques that produced these gains are relatively simple, and the necessary materials and equipment can be found or produced in any resource room or regular classroom. While these teachers were making a special attempt with each child in an effort to compare reading progress at two different levels, there is no reason to believe that the same kinds of gains could not be made by other students with mild learning problems.

Conclusion

For children who can progress rapidly under either level of difficulty, there are several advantages to using challenging reading material. These include reading more interesting and age-appropriate content, gaining confidence in their reading abilities, becoming more motivated to read, increasing their fund of knowledge, and developing flexible reading skills that are useful in the general community. It may be that educators have been unduly influenced by grade and difficulty levels and the criteria traditionally used to place students in these materials. Our experience and that of others cited in this article suggests that even students with handicaps are being underchallenged. When provided with a data-managed individualized reading program, children with learning problems can make rapid progress. Using the procedures described

here, we have found that most learners can make more rapid progress in material that is considerably more challenging than the material traditionally assigned.

However, when students are placed in challenging materials effective error-reduction and fluency building instructional procedures must be used. In our experience, some students will lack confidence or actually resist placement on tasks in which initial error rates are high. They have been conditioned to expect that they cannot succeed on materials on which they make many errors or on those with grade-level labels that communicate that the material is too difficult to attempt, learn, master, or enjoy.

Some learners will need a face-saving rationale for the errors they make, and all will need solid instructional support from the teacher, including effective prompting, error correction, and other procedures that are direct, intensive, and closely monitored on Standard Celeration Charts.

In our experience the period of insecurity on the part of the learner is typically brief; it is often followed by newfound confidence and motivation that show in higher energy levels, enthusiasm for the task, acceptance of instruction, willingness to practice, and positive statements about the task and about the learner's performance.

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Improving Reading Fluency with Precision Teaching

John Downs and Suzann Morin

Are you bothered by the repetitions, hesitations, word miscalls, laborious attempts to decode words, and the painfully slow reading rate of many of your students? Not surprisingly, most remedial reading instructors and teachers of students with mild handicaps answer yes and report that the same students who have reading fluency problems also have problems comprehending what they struggle to read. But where should teachers begin? Should they attempt to improve students' ability to read fluently (i.e., to decode words rapidly), or should the focus be on improving their ability to understand what is being read? Where is precious instructional time best spent, and how can teachers be sure their instructional strategies and materials are having an impact on students' reading fluency and understanding? This article describes a set of procedures that has provided some answers to these difficult questions.

The research literature cites numerous studies linking reading fluency and comprehension (Deno, Mirkin, & Chiang, 1982; Fleisher, Jenkins, & Pany, 1979; Fuchs & Deno, 1981; LaBerge & Samuels, 1974). For example, Harris (1970) has noted that slow readers do poorly in comprehension due to the fact that their many repetitions and hesitations break up the continuity of thought. Smith (1971) noted more specifically that "a reader is unlikely to comprehend while reading slower than 200 words a minute because a lesser rate would imply that words were being read as isolated units rather than as meaningful sequences" (p. 38). Starlin (1979) also supported a view that links fluent decoding and comprehension:

Very few students who have word pronunciation proficiencies in specific reading material will have difficulty in comprehending this material. The vast majority of students who are referred

for "reading" comprehension problems do not understand what they read because they lack fluency and/or accuracy in word pronunciation skills. (p. 9)

Additional literature has cited several strategies for improving reading fluency while simultaneously having a positive effect on reading comprehension (Dowhower, 1987; Henk, Helfeldt, & Platt, 1986; Kann, 1983; Samuels, 1979). Two of the most widely used strategies for improving reading fluency have included the method of repeated readings (Samuels, 1979) and the neurological impress method (Heckelman, 1969; Heckelman, 1986; Kann, 1983).

Repeated Readings

The method of repeated readings involves having students orally reread a passage until a satisfactory level of fluency is reached (Dowhower, 1987; Moyer, 1983; Samuels, 1979). The purpose of repeated readings is to provide the practice necessary to make decoding automatic, thus enabling the reader to concentrate on comprehension. The oral reading can include sections of text containing words that occur frequently in written English or it may include sections of text from the book or basal reader currently assigned. Reading occurs at each session (2-3 rereadings) and is repeated daily until a predetermined fluency standard is reached. Text passages generally range from 50 to 200 words in length.

Neurological Impress

The neurological impress method (NIM), like the repeated readings method, attempts to increase fluency in slow and hesitant readers. With NIM, however, students traditionally read

new passages each session. These passages are read aloud, simultaneously with the teacher, covering as much material as possible in 10 minutes. Initially, the student sits slightly in front and to one side of the teacher, and they read in unison as the teacher moves a finger beneath the words. The teacher maintains a brisk pace (150-200 words per minute) and prevents the student from slowing down or repeating words. The teacher reads louder than the student at first, but quickly fades his or her volume as the student becomes less hesitant and more fluent.

Precision Teaching

Precision teaching provides teachers with a set of measurement procedures for (a) recording of student performance frequencies, (b) observation of change in performance over time, and (c) frequency measures by which to determine a student's level of fluency. Student performance is measured during a specified time interval, often 1 minute for academic tasks such as reading and mathematics. Timing each reading while using a repeated readings procedure and charting the student's best daily performance provides feedback to the student and the teacher as well as establishing an incentive system. Students compete with themselves by trying to improve their correct reading rate while decreasing their error rate. Daily charting provides visible evidence of improvement over time and a means by which teachers know when to make instructional decisions (White & Haring, 1976).

Program Procedures

The procedures outlined here are modifications of the NIM and repeated readings methods. They have been used successfully with students who have demonstrated reading problems related to poor reading fluency.

Step 1. Identify students needing reading fluency improvement through direct observation and measurement of the students' oral reading. The following criteria are used for student selection:

1. Slow reading (i.e., less than 80 wpm).
2. Frequent repetitions, hesitations, and/or miscalls.
3. Reading level far below grade placement.

4. Reading too fast *and* ignoring punctuation (run-on phrases and sentences).
5. Lack of expression and inflection in voice tone (monotone).
6. Unwillingness to take risks in reading (i.e., refuses or resists reading orally in individual sessions).

Step 2. Meet with and explain the procedure and its benefits to each student. Obtain an agreement from each student to participate. Model the process with the students, explaining the pauses necessary at commas and ending punctuation. Explain the need to continue reading if they do not know a word. Confirm their commitment.

Step 3. Meet with each student the next day. Have the student bring the assigned reading text and have your own copy handy. Meet at a table or desk away from other students so as not to distract them. Sit on the student's right side and give the following instructions and encouragement:

1. Say to the student, "We are going to read this page, and I want you to follow along with my finger and read with me. Try to keep up. If you don't know all the words, that's OK. Say the words you know and follow along with my finger."
2. Provide reassurance if the student hesitates, pauses, or in any way has difficulty keeping up (e.g., "Now remember to read along." "Do your best.").
3. Provide praise for close approximation in keeping pace (e.g., "You're doing well." "You're really trying." "Nice reading!"). (Pauses for reassurance or statements of praise should be made at the end of sentences and at the end of the page.)

Step 4. For very hesitant students (those who read only one out of every three words), go back and repeat a paragraph by saying, "Let's try that again." "I'll read this paragraph and you listen, and then we'll read it together." The primary purpose in rereading at this point is to have the student experience success. After rereading the paragraph, say, "Now we are going to read this together. Are you ready? Remember to follow my finger and try to read

with me." When the rereading is completed, praise the student.

Step 5. The next part of the process is a timed 1-minute measure without your auditory input. During this phase, continue to use your finger to guide the reading while the student reads exactly the same material just read using the NIM method. Observe the following procedures:

1. Begin the timed measure by saying, "Please begin."
2. If a student hesitates on any words, wait 3 seconds and then provide the word.
3. If a word is miscalled *and* the student hesitates, correct the error.
4. If a word is miscalled and the student does *not* pause or hesitate, do not interrupt the process.

Step 6. At the end of 1 minute, thank the student and ask him or her to stop. Praise the student immediately ("Look how many words you read!"). Help the student count the words read during the 1-minute measure.

The next step is to point out the learning opportunities the student has by identifying any errors the student made, including any miscalls and words skipped. Identify errors as follows:

1. Say, "Let's look at the learning opportunities you had."
2. Point out the words to the student and write them on a tablet. Tell the student each word and ask him or her to read it.
3. Have the student subtract the "learning opportunities" from the total words read to obtain a count of corrects and errors.

Step 7. Chart the data (corrects/errors per minute) on a Standard Celeration Chart as shown on page 4 of this issue.

Step 8. Repeat the process in the same fashion the next day. The next day's reading will be done on a different page in the text (a page the student has read or will be reading that day). The process repeats itself daily until the data indicate the NIM method can be dropped.

The data gathered are critical to the success of this process. When charted on the Standard Celeration Chart, the data will provide:

1. A measure of learning and an indication as to whether or not a change should be made so that learning can be improved.
2. Motivation and feedback for both the student and the teacher.
3. A record of when reading fluency was first reached and what changes in fluency occur as the procedures are gradually phased out.

Conclusion

We have included in this process several instructional procedures and methodologies that maximize learning over a short period of time including: (a) modeling and practicing the desired behavior, (b) blocking interfering responses such as repetitions, (c) moving to fluency rapidly, and (d) frequent and specific reinforcement and feedback for the learner.

The process works! It has been used with readers from elementary grades through high school, all of whom demonstrated rapid improvement in reading fluency and a renewed confidence in their abilities as readers and as learners.

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Early Identification and Remediation of Learning Problems: The PIRL Project

Gregory J. Williams, Norris G. Haring, Owen R. White,
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Simple Precision Teaching-based probes were used in a regular kindergarten class to identify pupils who might be at risk for demonstrating potentially serious learning problems. Two, one-minute probes were completed with each pupil to assess their performances in six basic skill areas targeted for instruction in the kindergarten curriculum and listed on the kindergarten report card: see-say letter names from ordered and random lists, see-say letter sounds from ordered and random lists, see-write (copy) numbers from a random list, and see-say colors. The probe on see/say letter sounds from a random list proved to discriminate most easily among students who had already mastered the skill and those who had not yet mastered it, so it was selected as the instructional target for a special remedial program. The nine lowest performing students on that skill were provided 15 minutes of small group direct instruction for three days each week over an eleven week period. During the course of the remedial program, six of the students mastered the skill, but three did not. Those students were therefore considered at risk of potentially serious learning problems, and in need of more highly individualized instructional attention. Implications for practice and the continued development of procedures for identifying children in need of more individualized instruction are discussed.

If they are identified as having learning difficulties early in their school years, students might be helped before their problems multiply (Epstein, Kauffman, & Cullinan, 1985; Wallace & Larsen, 1986). The Precise Identification and Remediation for Learning (PIRL) project was established to accomplish this goal of early identification using

procedures that could be implemented easily in a regular education kindergarten.

The PIRL project was conducted in a regular education kindergarten class with 21 students in a suburban school district. The project involved the following seven steps: (1) identification of meaningful assessment targets; (2) development of simple assessment materials for each target skill; (3) initial assessment of pupil performance on each target skill; (4) identification of children with performance deficits on one or more skills; (5) implementation of small-group remedial programs for children displaying initial performance deficits; (6) identification of children failing to benefit from the small-group remedial program; and (7) development and implementation of more individualized programs to promote learning with children who failed to benefit from the small-group remedial program.

Target Skill Identification

Target skills were selected through an examination of the established kindergarten curriculum and the skills listed on the kindergarten report card. Choosing skills that were listed on both of those documents provided assurances that the skills were valued by the school, would be the target of formal instruction, and would be formally assessed.

Six skills were eventually selected to represent a variety of tasks, ranging from those that typically would be mastered before kindergarten (or very early in the year) to those that might not be mastered until rather late in the kindergarten year: see/say letter names from ordered and random lists, see/say letter sounds from ordered and random lists, see/write

(copy) numbers from a random list, and see/say colors.

Assessment Materials

For each target skill, a simple probe was constructed consisting of a single sheet of paper with the appropriate items (i.e., numbers, letters, or color patches) arranged in the proper sequence (randomly or ordered). Space was provided at the top of each sheet for recording the pupil's name, the date, the number of minutes allowed for working on the probe, and the number of correct and incorrect responses made by the pupil during the assessment. An example of one probe is shown in Figure 1.

Initial Assessments

Initial assessments consisted of two 1-minute probes on each of the target skills. Probes were conducted with individual pupils in a room separate from the main classroom. All of a pupil's assessments were completed during a single session, with brief periods of rest between probes. Sessions lasted approximately 15 minutes for each pupil, and they were completed in approximately 5 hours for the entire class.

Identification of Children with Performance Deficits

The best of the two probe results for each pupil on each of the target skills was used in the evaluation of results. The scores for the entire class on any given probe were plotted on a Standard Celeration Chart to determine whether or not any individuals were clearly below the performances of their peers.

One or more pupils did fall noticeably below the rest of the class on each of the target skills. However, variation across class members on the skill of saying letter sounds when presented in random order was much greater than with any of the other skills probed. Some pupils were already fluent, saying their sounds correctly at a rate of more than 50 per minute, while others were still clearly in the acquisition phase of learning, with frequencies of fewer than 20 sounds per minute and equally high error frequencies. It was decided, therefore, to focus attention on that skill.

Specifically, pupils were considered to have a performance deficit if they failed to achieve a minimally fluent performance of 20 correct sounds per minute with 5 or fewer errors on the randomly ordered letter sounds probe. Those criteria were based on suggestions made by White and Haring (1980) regarding the most common transition point between the acquisition and fluency-building phases of learning.

Nine pupils met the performance deficit criteria, with correct frequencies ranging from 1 to 19 and error frequencies ranging as high as 20 per minute on the randomly ordered letter sounds probe. The median correct performance for those nine children was 13.4 per minute, while the median correct performance for the rest of the class was 35.5 per minute. All of the pupils scoring below 20 correct responses per minute on this probe also ranked low on the other probes, with five of the nine pupils consistently at the bottom of the class.

Small-Group Remedial Instruction

A special small-group direct instruction program was established to teach letter sounds to the nine children identified as having a performance deficit in that skill. Two groups were formed, and the following instructional procedures were used:

1. *Modeling.* Each letter was presented visually, combined with a model of the appropriate letter sound. The letter was written on a blackboard, and the instructor pointed to it and its correct phonetic pronunciation. For vowels, the long sound was used.
2. *Guided performance.* Each student tried to pronounce the letter sound while the instructor monitored to ensure correct performance. The instructor would use verbal prompts when necessary to ensure correct pronunciation.
3. *Independent performance.* Students would pronounce the letter sound without prompting from the instructor. This was performed initially as a choral response by the group as a whole and then individually by each student.
4. *Probe.* Following each instructional session, each student was probed individually on the letters that were taught. Probe results

Figure 1

SAMPLE PROBE

Name _____ Date _____

Letter Sounds
Random Probe Sheet

Time _____ C _____ E _____

B	D	G	N	C	T	Q	R
Z	W	O	A	M	Y	X	V
E	F	H	K	I	P	L	U
J	T	L	D	A	S	J	F
X	N	C	E	W	Q	G	I
Z	B	Y	H	U	M	O	V
S	K	P	R	L	K	P	U
M	H	X	W	F	D	I	T
C	W	A	Q	F	G	B	D
H	K	J					

were then plotted on the Standard Celeration Chart to evaluate performance and progress.

The letters of the alphabet were divided into three separate groups for instruction. The first set included B, E, C, V, F, W, H, J, and I, the second included Q, K, L, M, P, R, S, and T; and the third included N, G, D, Y, Z, A, U, X, and O. Instructional phases were sequenced in the following manner: (1) the first group of letters was taught; (2) the second group of letters was taught; (3) the first and second group of letters were combined and reviewed together; (4) the third group of letters was taught; and (5) all letters were combined and reviewed together.

Each group was moved from one phase of instruction to the next when most of the group members were saying the letter sounds correctly with a frequency of 50 per minute or better and when all were at least well along in fluency building, with frequencies of 30 or more correct sounds per minute. It was felt that these criteria would place the group firmly within the range demonstrated by their competent peers during the initial assessments.

Instruction for each group was provided by a high school student who volunteered to work in the kindergarten class as part of a district tutoring program. She was trained in direct instruction procedures and was monitored at least twice a week. The small group sessions lasted approximately 15 minutes and took place 3 days a week over an 11-week period.

Identifying Pupils with Learning Problems

Monitoring each pupil's progress on the Standard Celeration Chart made it possible to differentiate clearly between pupils who had no difficulty in acquiring and becoming fluent in saying the letter sounds and those who had difficulty. When both the initial assessments and the instructional probe results were considered, three distinct groups emerged:

1. Children whose initial frequencies indicated that the skill had already been learned and brought to a reasonable level of fluency without need for special instruction after the initial assessment. Of the class of 21 pupils, 12 were

identified as members of this group during the initial assessment.

2. Children whose initial frequencies indicated a performance deficit but who responded well to the small group instruction and did not require further individualization to master the target skill. Six of the pupils originally identified as having a performance deficit fell in this group, and they responded well to the small-group instruction.

3. Children whose initial frequencies indicated a performance deficit and who did not progress well as a result of the small-group instruction. Three of the nine children originally identified as having performance deficit fell in this group, and they became the focus of increased efforts to individualize their instructional program.

Implementing More Highly Individualized Programs

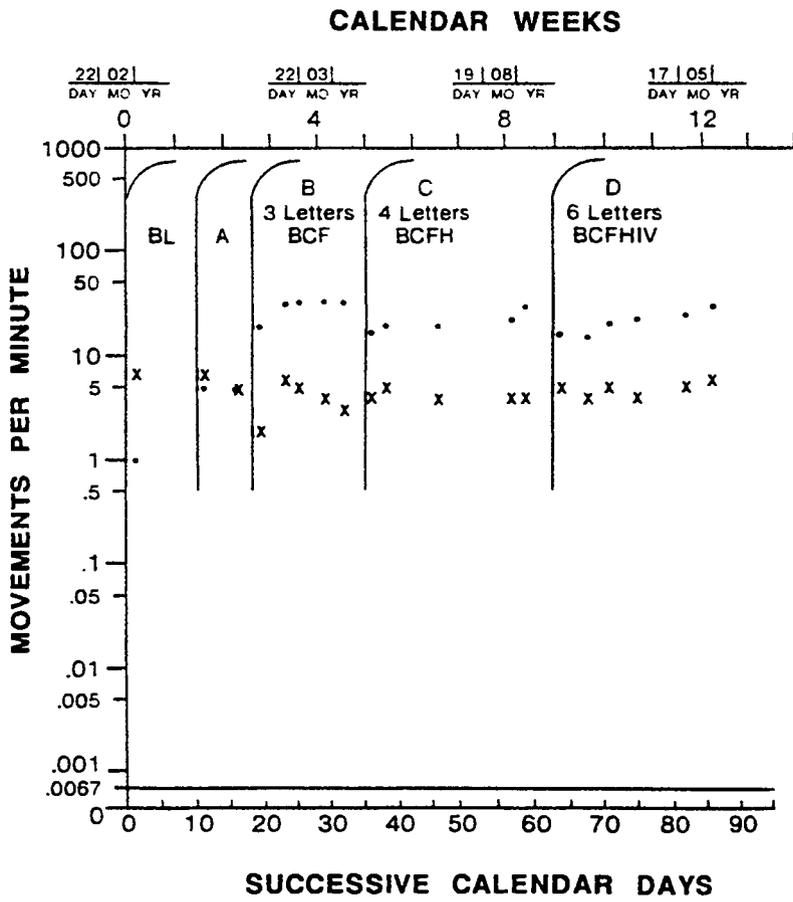
A Chart showing the effects of the increased efforts at individualization with one pupil are shown in Figure 2. During the initial assessment phase or baseline period (BL), the pupil's performances were clearly deficient, with only one correct response and seven errors. When exposed to instruction in the small group (phase A on the Chart), correct performances jumped to a frequency of five per minute, but no further progress was observed by the end of the next session and there was no substantial decrease in errors. It was decided at this point to provide more individualized instruction.

A new program was implemented with instruction provided on a one-to-one basis covering only the letters B, C, and F (phase B on the Chart). The general instructional strategies were the same as those employed for the small-group sessions.

Working with the smaller number of letters resulted in an improvement in both correct and error performances. When performances reached the minimal expectations outlined earlier for the small group, the letter H was added to the set being taught (phase C on the Chart). After an initial decrease in correct responses and a slight increase in errors, the pupil made gradual progress and met the

Figure 2

CHART FOR GROUP THREE



performance aims after five individual sessions completed over a 4-week period. That pattern of progress was repeated in the last phase of the program (phase D), in which the letters I and V were added to the instructional set.

The learning patterns shown in Figure 2 were typical for the three targeted pupils small-group remedial program. While some progress was made, it was clearly insufficient to correct the pupils' performance deficits before the end of the year. Perhaps if the program had been implemented earlier in the school year, or the individual sessions had been conducted more frequently, more progress might have been made. In any event, these three children have clearly been identified as being at risk for developing chronic learning problems, and they have been targeted for increased attention during the coming year.

A final probe was given to the entire class at the end of the school year. The procedures were the same as those used for the initial assessments, but they employed only the randomly ordered see/say letter sounds probe. For most of the children, meaningful gains were made on the targeted task. Five of the nine students in the remedial group moved from the bottom half of the class to the top half. The remedial group's median correct performance was 38 per minute, which was one point higher than the median correct performance for the rest of the class. Over all, therefore, the program was considered a success.

Implications for Practice

This project demonstrated that a curriculum-based Precision Teaching assessment and remediation program can help to identify children whose academic performance lags behind their peers. It also showed that relatively simple instructional procedures can be effective in helping most pupils overcome their deficits and that, by monitoring remedial efforts with the standard celeration chart, pupils with learning deficits can be identified and targeted for additional individualized attention. That is especially significant at a time when more emphasis is being placed on pupils' problems through prereferral procedures before the involvement of special education services. Finally, these procedures

are both inexpensive and efficient. They can be implemented easily in a regular education setting with a minimum of training and effort. Because the assessment and instructional targets are drawn from the existing curriculum, they can be adapted to meet local priorities.

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Setting Aims for Precision Learning

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Setting instructional goals is one of the most important activities of special educators. When goals are clearly known by students and teachers, corrective action can be initiated quickly to ensure continued progress when a student's performance deteriorates (Howell, Kaplan, & O'Connell, 1979). Setting ambitious goals has been shown to have a positive effect on how special education teachers teach, as well as how their students achieve (Fuchs, Fuchs, & Deno, 1985; Fuchs, Fuchs, & Hamlett, 1989).

Aims and Precision Teaching

Selecting performance goals, specifically *aims* (proficiency levels stated in terms of rate of correct and incorrect responding), has been an integral feature of the precision teaching and learning process from its inception (Gaasholt, 1970; Haughton, 1972). In one of the earliest discussions of aim selection, Haughton (1972) noted that certain performance frequencies are important to later growth in a particular response as well as in related responses. In other words, at certain levels of performance children struggle to improve; however, if they move beyond that level, they can accelerate to higher performance frequencies. Haughton asserted that frequencies in very basic skills, termed *tool skills* (e.g., letter writing or saying sounds), that are performed at sufficiently high rates correlate highly with a student's success on more complex skills that incorporate the tool skills. For example, if students wrote digits at a rate of 30 per minute, they would subsequently be successful in more complex mathematics problems (Gaasholt, 1970). Clearly, attention to aims is important to the special educator's instructional planning and decision-making process. Systematic procedures are needed to guide special educators in choosing aims that are high enough to ensure success on subsequent skill development, steady movement

through the curriculum, and attainment of performances valued by mainstream teachers.

Research on appropriate aims for various behaviors is a continuing process. Numerous investigators have pointed out that more work is necessary to identify performance frequencies that represent proficiency (Evans & Evans, 1985; Evans, Evans, & Mercer, 1986; White, 1985a; Wilson & Majesterek, 1989). Generally, research on aims falls into two categories: descriptive and developmental.

Descriptive Research

Descriptive research examines performance rates of different populations (e.g., students who are learning disabled versus those who have no handicaps) on various skills such as writing letters or numbers. An example of such data obtained on a particular population of students was reviewed by Howell and colleagues (1979). They reported data obtained from screening 11,000 primary age children in Washington State. Some of the minimal aims suggested were as follows:

- Say first- and second-grade words, 80-100 per minute.
- Say third-grade words, 100 per minute.
- Say words in context for first to third grade, 100 to 150 and up.

Wood, Burke, Kunzlemann, and Koenig (1978) reported adult performance rates across 40 topics in mathematics skills. They found, for example, that multiplication facts were written at 80 correct per minute with 0 errors and division facts at 47 per minute with 0 errors.

Deno and his colleagues (1982) probed a national sample of 562 students in grades 1

through 6 on standard tasks such as reading passages, spelling words, and writing samples. Some of their findings of mean correct and incorrect oral reading responses per minute using preprimer through grade 3 material were 57 correct and 10 incorrect in grade 2; 114 correct and 4 incorrect in grade 4; and 147 correct and 6 incorrect in grade 6. For spelling, data indicated mean correct/incorrect responses of 6/11, 19/8, and 27/6 words per 3-minute sampling in grades 2, 4, and 6. For writing, a story starter idea to stimulate students' writing responses yielded 16/4, 35/3, and 47/6 mean words correct/incorrect per 3-minute sampling for grades 2, 4, and 6.

Developmental Research

The second category of research on aims examines the relationship of certain performance rates to subsequent skill development. In one study, students who wrote answers to mathematics facts at a rate of 30 to 40 per minute moved through a curriculum of progressive difficulty more easily than those performing below a rate of 30 (Haughton, 1972). Similarly, a strong relationship was found between saying sounds correctly and oral reading fluency. Results from third and fourth graders in a study of reading indicated that an aim of 100 words per minute is important to advancing through subsequent reading curricula.

Evans and Evans (1985) conducted two studies. The first was to determine whether or not high (120), medium (90), or low (60) rates of saying sounds per minute among first graders were related to subsequent progress on saying consonant-vowel-consonant (CVC) real and nonsense trigrams. Results indicated that the optimum rate was 90 sounds per minute. The second study was similar to the first, except that writing answers to basic addition facts was related to mastery of addition facts at the next level of difficulty. An optimal rate was not found, but the fact-writing rate was found to be related to the mean number of other mathematics skills mastered (e.g., measurement or operations).

While research is limited, the evidence suggests that: (a) it is important to set sufficiently high aims to assist learners in becoming fluent in

skills; (b) aims assist teachers in instructional decision making; and (c) aims should be based on criteria reflecting the usefulness of a skill both immediately and for later functioning.

Selection of Aims

Suggested Proficiency Rates

Suggested proficiency rates have been drawn from various sources over the years. Some suggestions, such as those discussed earlier, result from data gathered from special project reports, studies, or expert opinions. Mercer and Mercer (1985) have completed a comprehensive review of a number of suggested proficiency aims in reading and mathematics skills. Table 1 shows ranges of proficiency values for some of those skills.

Peer Data

A commonly suggested data source for selecting aim values with local meaning is to use peer data (Epstein & Cullinan, 1979; Howell et al., 1979; Van Houten, 1979; White & Haring, 1980). The following steps are suggested:

1. *Select a class of nonhandicapped peers.* Typically, a special educator will know the mainstream class and teacher in which a student with handicaps is to be placed. The special educator should ask the regular educator to select a student (or group of students) with skill mastery in the area of interest. An average regular education student could be chosen, but average performance poses potential difficulties since it may represent mediocre achievement. Choosing a student who has thorough skill mastery, however, will provide a helpful example of proficient performance.

2. *Probe.* The teacher obtains timed 1-minute performance samples of the peer(s) for 3 days and selects the median correct rate and incorrect rate. The median value should represent typical performance on the task and serve as a guide to a proficiency aim. Teachers can construct written probes by writing items such as basic mathematics facts or functional vocabulary words to which students respond orally or in writing. Items can be placed in rows or in

<i>Table 1</i>

SUGGESTED AIM RANGES BY SKILL AND GRADE LEVEL

	<i>Correct</i>	<i>Error</i>
<i>Reading Rates</i>		
Say Isolated Sounds (K-3)	36-52	0-4
Say Words in Text (K-3)	50-132	0-2
(4-6)	100-200	0-2
(Adult)	100-252	0-2
<i>Written Math Rate</i>		
Digits in Simple Addition and Subtraction	50-125	0
Addition and Subtraction (2-3)	20-90	0-2
(3-4)	40-90	0-2
(4-5)	40-90	0-2
Basic Multiplication Facts (5-6)	40-90	0-2
Basic Division Facts (6)	40-90	0-2

boxes drawn on the probe sheet. There should be a sufficient number of items to provide students with activity for at least 1 minute. (Shorter or longer time periods for probes may be necessary, depending on the number of items to which the students must respond.) Students can write responses on the probe sheet or respond orally as the teacher follows along and scores on a duplicate probe sheet. After a 1-minute probe, the count of correct and incorrect responses can be recorded.

Adult/Child Proportional Formula

Using an adult-to-child proportional formula has been suggested as another way to select proficiency aims (Eaton, 1978; Haring & Gentry, 1976). This approach employs ratios of adult tool skill rates (or those of any competent performer) and adult performance rates in conjunction with student tool skill data to determine students' performance aims. The following steps are recommended:

1. *Select an adult and probe.* An adult is given a timed performance sample on a particular task such as multiplication problems. Next, the adult is probed on a tool skill necessary for the particular task. The student is probed on the same tool skill and is asked to work as fast and as accurately as possible.
2. *Use the proportional formula.* The formula that follows is solved to determine the student's performance aim for the particular task:

$$\frac{\text{Student aim rate (to be solved)}}{\text{Student tool skill rate}} = \frac{\text{Adult task performance rate}}{\text{Adult tool skill rate}}$$

For example, if an adult wrote 140 numbers per minute (tool skill rate) and wrote numbers in answers to multiplication problems at 70 per minute (task performance rate), and the student wrote numbers at 80 per minute, the student aim rate for multiplication would be $40 (x / 80 = 70 / 140)$.

Conclusion

Setting appropriate aims for students is an important tool in precision teaching or any other form of data-based instruction, and it requires experience and judgment on the part of teachers. The methods for determining aims described in this article can help teachers in this task. However, the best guides to aims are often learners themselves. Teachers should encourage students to go as fast as possible. (Some teachers achieve high aims by simply challenging students to beat their own best performance or to exceed the teacher's performance on the same task.) Teachers are often surprised by the high rate of performance and steady movement through the curriculum that can occur when their students are taught, in a stimulating manner, skills that possess functional utility. For a comprehensive discussion of issues and considerations important to determining aims, the reader is encouraged to read a series of articles by White (1984; 1985a; 1985b; 1985c).

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Speed Reading: A Technique for Developing Fluent Readers

Joyce Mounsteven

Fluent oral reading is an important skill because it aids the comprehension of both readers and listeners. The speed reading technique described here can develop fluent readers. It is a simple technique that is extremely effective with reluctant readers—those who read in an awkward or stilted way and need to learn to read in a natural, spontaneous manner. The speed reading activities require only a few minutes a day and are used as a supplementary reading tactic to build fluency, not to replace other reading programs. The technique uses a 1-minute timed probe that can occur during any part of the school day. Timings can be repeated several times a day with different reading materials, including reading in content areas as well as with basal reading materials.

In addition to increasing fluency, this technique heightens the motivation of students. In fact, one of the most exciting features of the technique is that students like it. They frequently ask for an opportunity to repeat speed reading activities.

Materials

One of the nice things about the speed reading technique is that it can be used with practically any reading material. The only requirement is that there be two identical copies of whatever reading material is used: one for the student and one for the teacher. If a teacher is using a basal reading program, the student can use a copy of the reader while the teacher reads from the teacher's edition. If the teacher is working from another book, a sheet of acetate can be placed over the passage being read, and the teacher can mark on it how far the student reads, all reading errors and omissions, and any passages or phrases with which the student is having difficulty. The same procedure can

be used with text from any content area in which the student is working.

In my class, I have used the Merrill Skilltext readers. This is a set of spirit duplicating masters for a series of reading passages. The passages are ideal for building fluency and improving comprehension. Each passage is approximately one-half grade level above the previous passage. In addition to copies for the students, I run off one copy for myself, which is laminated to allow me to note errors, omissions, passages a student is having difficulty reading, and the point at which the student finishes a 1-minute timed reading. Each passage has a picture and a title and is about 400 words in length. On the teacher's copy, I mark off the words in 10s up to 250 words. This helps me to determine quickly how many words the student has read in the 1-minute timing.

Using the Technique

The students are given time to look at the passage, chat about the picture and the title, make some predictions about the story, and ask about any unfamiliar words. I start with a passage at a reading level that is below their functional reading level so that decoding is not a problem. I want the students to become fluent on this first passage as quickly as possible. It is important for them to be comfortable with the reading passage and not have to sound out words or struggle with the material. As the students reach the aim (or goal) of 250 correct words read per minute in the 1-minute oral timing, they then move on to the next higher passage in the sequence. The prereading activities take longer on the first presentation of a passage, while subsequent presentations go much faster. At the beginning, it is often desirable to allow

students to have a "dry run" before timing begins; however, this is not necessary if students are familiar with the procedure.

Each student is asked to read the excerpt quickly for 1 minute, without skipping words or making errors. I time the student with a stopwatch, take notes on any reading errors on my copy of the passage, and mark the final word that the student has read at the end of the 1-minute trial. During the reading, I may supply words that are causing difficulty to keep the student moving through the passage.

Self-Recording

Each student has a personal progress chart showing the achievement level (aim) to be reached on a passage before moving on to the next level. Each day, after the 1-minute timing, the students are responsible for recording the number of words read correctly in 1 minute on their charts. (I have asked students to record only the number correct, but the number of errors per minute may also be recorded.) Students continue to read the same passage until they reach the aim of 250 words per minute. Since students frequently want to do more than one 1-minute timing per day, they usually progress quickly toward the aim, reaching it within 1 to 2 school weeks. Students are motivated to see their progress on the chart. A reward system can be built into this procedure, but my experience has shown that reaching the goal has been reward enough for most students.

Fluency-Building Strategies

An important part of this program is discussion with students about the types of strategies they can use to improve their daily performance. For example, looking at the passage before a student reads to pinpoint the difficult words and practice those words ahead of time helps the student feel confident and improves reading fluency. Likewise, if the teacher has noted that a student has had difficulty with certain phrases, the student can practice reading those phrases before taking the timing on the whole passage.

Another strategy that encourages students to succeed is looking at and discussing their progress on their charts. The students'

awareness of the evolving pattern on their charts (i.e., their learning picture) is an important motivation tool. When students see the dots on the charts climbing toward their aim, they become eager to practice. When they hit plateaus, additional practice can get them climbing toward their aim again.

I used this speed reading technique in a self-contained classroom for students with behavior disorders in a regular public school. I had eight students in grades 4 to 6. All of them had learning difficulties in addition to their behavioral problems. Using the speed reading technique, the students improved their reading fluency.

Benefits

I have found the following benefits of using this speed reading technique:

1. Students quickly develop fluency in reading. In fact, they can learn to read orally at a rate of over 250 words per minute. They begin to "chunk" phrases together and start to read ahead in order to speed up their reading.
2. The improvement in speed on each trial increases students' motivation, and they often ask to do two or more trials in a day, which increases their rate of progress even further.
3. This is a short, quick exercise that can fit easily into a teacher's schedule.
4. Students can be taught to do the 1-minute timings with a buddy. This has the added benefit that the partner has to track the reading at a fast rate. Students can then switch roles; the learner becomes the tutor while the second student works on improving reading fluency.
5. As students improve their reading fluency on the timed reading activities, it begins to transfer to their other regular reading activities throughout the school day.

This is a teaching technique that requires little teacher time and places few extra demands on the teacher's work day. Students enjoy it and ask to do it, and it works.

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Self-Recording for Students with Severe and Multiple Handicaps

Kathleen A. Liberty and Mary Anne Paeth

Precision Teaching involves collecting frequency data to make decisions about instruction and intervention. Because frequency data have point-to-point correspondence with the behaviors they represent, there is a need for devices and procedures to collect these data. Both regular class students and those with mild handicaps collect data on their own performance, and teachers work with them to make decisions. Usually, students use paper and pencil to record their performance, but mechanical and electronic devices such as calculators also can be used. Students with severe and multiple handicaps can also learn to collect the data needed for decision making, using adapted mechanical counting devices to record their own behavior and skills.

Purpose

Self-recording has many advantages for both learners and teachers. A student who has learned this skill is gaining independence and has learned a useful self-management skill—one that can be used with many different target behaviors. In fact, self-recording often acts as an intervention to improve the behavior or skill itself. For the teacher, it can free time for other activities that was previously spent collecting data on student performance. It also provides a way to collect information about the performance of private behaviors such as bathing, and it can be collected discreetly in public places such as grocery stores and movie theaters, where an outside observer would be intrusive, expensive, or distracting for the student.

The performance objective for self-recording is that the learner will count the target skill or behavior reliably. Reliability is an estimate of

the accuracy of the self-recording. It is determined by dividing the number of times the target skill or behavior actually occurred during observation probes by the number shown on the learner's self-record at the end of the observation period. Around 85% reliability is usually acceptable in research studies. The reliability level selected becomes the performance criterion for the objective.

Materials

The only material needed is a device for recording the skill or behavior; the most common device is a paper and pencil. However, students with severe and multiple handicaps may not be able to work with paper and pencil. For these students, alternative recording methods need to be selected.

The first step is to determine what type of movement the student is able to make. The nature of the movement will determine the type of recording device and modifications needed. To learn to self-record, the student should have voluntary control over one particular response such as an arm movement, a leg movement, eye movement, or hand and finger movements. This movement will be used to actuate the recording device.

The next step is to shop for a suitable device, keeping the types of movements the learner can make in mind. Many different types of devices that can be used for self-recording are commercially available in sporting goods stores and departments, variety stores, and grocery stores. Devices can generally be purchased for under \$10.

Many other items can be adapted, for example, a calculator (press the + button); a tape recorder (record the number of minutes the tape was on or use a digital tape counter); a toy abacus; a stopwatch; a digital timer (start and stop to accumulate the total time); and a jar mounted on the edge of a table (slide a block into the jar).

After surveying the student's movement possibilities and selecting some recording devices, the teacher should work with the student to see whether he or she can operate any of the devices selected. Each device will require slightly different movements to operate while most counters require the students to use fingers; some, such as the Pro Count™ and the Aristo Tally™, can be actuated with other parts of the body such as elbows, palms, and toes.

If a device cannot be operated by the student, it may be possible to modify it. All of the devices shown can be modified for students with physical disabilities or difficulties in motor control. For example, the size and shape of the button activator can be changed by gluing wood, fabric, or plastic objects to the button or extending its length with a wooden dowel. The position of the device can be changed, and it can be mounted on a piece of wood or plastic and affixed to a table or wheelchair tray, so that a particular movement will activate it and it is not necessary to hold it in the hand. Materials can also be handmade. For example, a wrist abacus can be made with fewer and larger beads.

Modifications of a mechanical device for four students with cerebral palsy were made. The actuating buttons were replaced by pieces of wood using machine screws and bolts. Several trial-and-error sessions were needed in order to arrive at an arrangement that the students could use. Most commercial counters are also of simple construction, and it is easy to dismantle them for modification.

If a student does not have good control of the device, it will probably improve during instruction. For some students, the opportunity to learn to self-record is motivation to develop or improve existing movements, perhaps with the assistance of physical prompts and shaping during the first trials.

The next step is to position the device. Placement depends on where and how the target skill will occur as well as on the type of counter used and the method of actuation. If the target skill consists of a chain of responses such as completing a puzzle, assembling a bicycle brake, or making a peanut butter sandwich, the counter can be placed next to the final item in the chain. If the target skill will occur on a table, the counter can be placed on the table or on a workbench next to the materials used in performing the skill. If the target skill will be performed in many different locations, the counter can be positioned on the student's wrist, belt, wheelchair tray, or walker.

It is important for the student to be able to see and hear the counter as well as actuate it. When the student actuates it, the numbers change in the visual display and the counter makes an audible click. The movement and the sound appear to be natural reinforcers for self-recording, so it is important to make sure that the counter can be seen and heard by the student in the position in which it is set. Masking tape can be used to cover distracting words, labels, or display elements that are not required.

Finally, the different target skills or behaviors that the student will be self-recording must be taken into consideration. To improve discrimination, distinctly different devices should be used for each self-recording program.

Directions

Most commonly, self-recording is taught with the same procedures that are used for teaching other skills to students with severe handicaps or multiple disabilities. Self-recording can be taught at the same time a skill is learned, or it can be taught after the skill has been acquired.

In some cases, however, instruction in self-recording requires special consideration, it may interfere with instruction or performance of the target skill or behavior. The student may confuse verbal prompts or directions to self-

record (e.g., "Push it") with directions to complete the target skill (e.g., "Push it in") or to refrain from the target behavior (e.g., "Don't push"). If this is a problem, use a nonverbal prompting procedure such as silently pointing to the device.

A second consideration is that the reinforcement for self-recording may be confused with reinforcement for the target behavior. For example, the learner could perform incorrectly and then record accurately. Praise for self-recording might reinforce the incorrect performance of the target skill.

Instead of providing any additional overt positive reinforcement for self-recording, use the reinforcers for the target behavior to also reinforce self-recording. In this case, reinforcement for the target behavior is delayed until the learner successfully self-records. This nonverbal procedure works well with the pointing prompt.

Self-recording a desired skill can actually increase it, while self-recording a deceleration target behavior can decrease it. Since the mechanical device associated with an acceleration or deceleration can itself become reinforcing or punishing, the teacher should be careful when changing to a different device or removing a device.

Evaluating Success

Student progress in learning to self-record can be evaluated using Precision Teaching practices. The teacher charts the number recorded by the learner, using the length of time the student recorded as the record floor/time base for the frequency calculation. To check student reliability, the number of items or pieces completed is compared with the student's record. If the skill or behavior does not produce a concrete product, the teacher continues to collect the data until satisfied with the student's reliability. Reliability problems can be improved by providing verbal corrections such as "Push once" for the student who pushes several times, by changing the position of the device or changing devices. Mechanical problems can affect the devices, so 100% reliability is neither possible nor necessary for successful decision making.

At Work in the Classroom

Once a device has been selected and adapted, teaching self-recording can add as little as 2 seconds to the target behavior, but it can have big payoffs. Self-recorders benefit not only from changes in their target behaviors, but from the increased independence as well. Students with counters are also treated differently by their peers, adults, and others in the community. In our practice, we found that students with counters were asked questions more frequently, with more complicated content, and with more expectation of a response than when the counters were absent. It is likely that they were perceived to be more competent simply because they had a complicated-looking device attached to their wheelchairs.

Students with severe and profound mental retardation can learn to self-record even though they do not count objects or count by rote, recognize numbers, or understand the concepts of *more* or *less*. The cognitive skills of counting, recognizing numerals, or matching numbers are not a prerequisite to learning to self-record. Students with severe and multiple handicaps have learned to reliably record their own skills and behavior, including answering questions, pointing to pictures, completing work assemblies, making noises, preparing sack lunches, talking to themselves, and others.

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Chart Share Guidelines

Precision Teachers wishing to share interesting Charts without writing lengthy articles are encouraged to submit a Standard Celeration *Chart-share*. Each *Chart-share* is limited to two pages in length--one Chart and a maximum of one page of explanatory text. The Chart and accompanying text will be printed on reverse sides of the same page to ensure they will not be separated if removed from the *Journal* for copying.

The Chart: The Chart should be as self-explanatory as possible. All the information at the bottom of the Chart (i.e., Supervisor, Adviser, Manager, etc.) should be completed as descriptively as possible. All charting conventions should be followed. If additional symbols or extensions of the conventions are required, they should be explained in an appropriate "Key." For example, if in addition to charting "words said correctly" with a • and "words said incorrectly" with an x, you wish to note "words omitted" with a Δ, that should be noted on the Chart. Each phase of a multi-phase project should be clearly labeled with brief but descriptive phrases. For example, instead of labeling phases, "Phase I, Phase II," etc., the phases might be labeled, "One minute of practice; teacher charts results," and "Same practice; learner charts results." Additional notes should be provided as necessary to explain the project, unplanned events which appeared to affect performances, and other features of interest.

The Back: The back of the Chart may be used to explain the project in more detail. At a minimum, try to provide the following:

1. title for the project;
2. your name and affiliation;
3. names and affiliations of other people involved in the project (first names, initials, or pseudonyms may be used to protect privacy, if necessary);
4. the purpose or goal of the project;
5. the specific measurement cycle(s) or target(s) being evaluated;
6. a brief statement of what you learned from the project.

Space permitting, you may add as much additional comment or discussion as you wish. If the submission exceeds the space available, the Journal editors will make whatever changes are necessary while trying to preserve the basic message of the Chart-share.

-- Owen R. White, Consulting Editor

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Editorial Board Meeting
Washington, D. C.
May 27, 1995

Present at the meeting were Claudia McDade, Ann Poe, John Brown, Ogden Lindsley, Abigail Calkin, John Cooper, John Eshleman, April Miller, Bill Sweeney, Carl Binder, Tim McLaughlin, Clay Starlin, Chuck Merbitz, Julie Vargas, Steve Graf, Jim Pollard, Bob Stein, Kent Johnson.

After much discussion, the decision was made unanimously to change the name of the *Journal* to the *Journal of Precision Teaching and Celeration*. This change will take effect with the thirteenth volume, beginning in Fall '95. We will continue to use the old stationery until it is depleted.

Firm deadlines for submission of manuscripts will be published inside the front cover. July 31 will be the deadline for possible inclusion in the Fall issue; Jan 31, for the Spring issue. Also, dates of publication within the academic year will be listed.

Discussion concerning the relationship between the *Journal* and the Standard Celeration Society resulted in these decisions:

- 1) dues paid to SCC as a sustaining or charter member will entitle the member to receive two copies of each issue
- 2) money collected by the SCC will be routed through the Jacksonville State University Foundation so that publication costs may be paid in a more timely manner. (The SCC elected Claudia McDade as treasurer.)
- 3) invoices for membership dues/subscription renewals will be sent to members/subscribers to prompt them to pay without interrupting their service
- 4) include date when renewal is due on mailing label.

Suggestions for innovative ideas to keep the *Journal* active included the following:

- 1) publish special issues (e.g., fluency, applied uses, state of art uses, reference of what PT/celeration is)
- 2) solicit data shares, reprint rights to articles on celeration published elsewhere, course syllabi, curriculum from active PTERS
- 3) get the *Journal* indexed in ERIC
- 4) explore other possible electronic retrieval systems (e.g., CARL from Univ of Colorado; UNCOVER, a commercially available system)
- 5) include JPTC on the Internet
- 6) develop an index of all JPT articles
- 7) communicate as much as possible on e-mail.

Vacancies on the Board of Consulting Editors were filled with the enclosed list of editors and their terms. Steve Graf agreed to serve as "Jump-Up Editor".

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The association for Precision Teaching provides a "home" for charting and Precision Teachers. It is a network of colleagues and friends devoted to improving teaching and learning. A variety of benefits to members includes:

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History

The Association evolved from a 25-year history, beginning with the founding of Precision Teaching by Dr. Ogden Lindsley, supported by the Precision Teaching Project in Great Falls, Montana, and maintained with ten international Precision Teaching Conferences. In 1990, PT leaders from around North America decided it was time for an organization with expanded scope--to serve a broader range of needs for communication and networking among Precision Teachers and to make PT methods available to those seeking measurably effective educational alternatives. The APT, as part of the Standard Celeration Society, will address those needs with more than a conference, including the *Journal*, a membership directory, and opportunities to serve on committees and special projects.

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