

# Precision Teaching — Precision Learning<sup>1</sup>

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**ABSTRACT:** Precision Teaching represents a set of procedures for deciding if, when, and how an instructional program might be improved to facilitate pupil learning. A brief summary of those procedures is provided, along with their rationale and an overview of studies that demonstrate the efficacy and efficiency of Precision Teaching in applied educational settings.

No single instructional strategy works all the time. Even with careful screening and diagnostic assessments to match a program to the initial needs of the pupil the program will often lose its effectiveness as the needs and abilities of the pupil change. Almost universally, therefore, educators recommend the frequent evaluation of pupil progress to determine if, when; and how the program should be modified (Sailor and Guess, 1983; White, 1985; Zigmond, 1986). Essentially, in order to be responsive to the pupil's needs the teacher must be a student of the pupil's behavior, carefully analyzing how that behavior changes from day to day and adjusting the instructional plan as necessary to facilitate continued learning. Precision Teaching offers a set of procedures designed to assist in that process.

Precision Teaching does not dictate what should be taught or how instruction should proceed. Rather, it represents an approach to the systematic evaluation of whatever instructional tactics and curricula a teacher might employ. At times that evaluation will merely confirm that the instructional plan is working as expected. When the need for a change is identified, effective modifications are usually possible without changing the teacher's basic approach to instruction. As noted by Lindsley (Lindsley and A. Duncan (interviewer), 1971), the originator of Precision Teaching, adopting Precision Teaching does not mean abandoning a "hard learned style" (p.119) of teaching, but becoming more effective and efficient in adapting that style to meet the individual needs of each pupil.

## GUIDING PRINCIPLES

Lindsley borrowed five major tenets from B. F. Skinner's experimental analysis of behavior (Lindsley, 1971; Lindsley and A. Duncan (interviewer), 1971): the principle that the learner knows best; a focus on directly observable behavior; the use of frequency as a universal measure of behavior; a standard chart for the evaluation of learning patterns; and the systematic description and analysis of environmental conditions that appear to influence behavior.

### The Learner Knows Best

The fundamental guiding principle of Precision Teaching is simply that the learner knows best (Lindsley, 1971). If a child is progressing, then the program is "right" for that child. If progress falters, then the program is inappropriate and must be changed. Regardless of what the research literature or our experience as educators with other pupils might lead us to expect, only the learner's actual progress can be fully trusted to guide us in developing and continuously refining appropriate programs.

### Focus on Directly Observable Behavior

To form a clear, unambiguous picture of pupil progress, it is important to focus on concrete, directly observable behavior. In some cases, as in a program designed to increase a child's skill in pulling-to-stand from a kneeling position, the behavioral target will be obvious. In other cases the link between what educators monitor and what they actually want the pupil to learn may be 'less direct.

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<sup>1</sup> This was first published in a special issue of *Exceptional Children* White, O. R. (1986). Precision Teaching — Precision Learning. *Exceptional Children, Special Issue: In search of excellence: Instruction that works in special education classrooms* 52(6): 522-534. entitled "In Search of Excellence: Instruction that works in Special Education Classrooms. I have made some minor updates to the text and figures, but the basic content remains unchanged.

"Silent reading," for example, can only be "observed" by the reader. If the teacher is to be systematically responsive to the child's changing needs, such "private behavior" must somehow be made "public." The child might be asked to read aloud, so decoding skills can be checked on a word-by-word basis, or perhaps the child will be asked to verbalize the answers to questions to check comprehension. In any event, it is far too easy to be led astray unless the focus is placed on what can be easily observed, counted, and recorded.

### Frequency As a Measure of Performance

The evaluation of pupil performance and progress in Precision Teaching is based on the analysis of behavior frequencies, that is, the average number of behaviors observed during each minute of the assessment period. Skinner first introduced the use of frequency in the 1930's as a "universal measure of behavior," and proclaimed it as one of his major contributions to science (Sidman, 1960; Skinner, 1968; Johnston and Pennypacker, 1980).<sup>2</sup> The qualities of behavior frequency that make it so useful to science also make it very useful to the educator.

First, it is often the case that the frequency of a behavior will ultimately determine its usefulness. It is interesting to note, for example, that 98% of all adult Americans "do not compute" (Horton, 1985). It is not that most people cannot perform computations, only that their fluency is so poor that they do not compute.

Consider also Patsy, a third grade learning disabled student with a minor problem in pronouncing short vowels. When Ruth Mundt, Patsy's teacher, taught her to say the sounds as well as her typically developing peers (40 correct sounds per minute), Patsy still said the sounds incorrectly during her daily activities. Patsy was not successful in integrating the new skill into her daily life until she could say the sounds at a rate of 80 per minute (twice the fluency of her normal peers) (White and Haring, 1980; White, 1985; White, 1985; White, 1985; White, 1985).

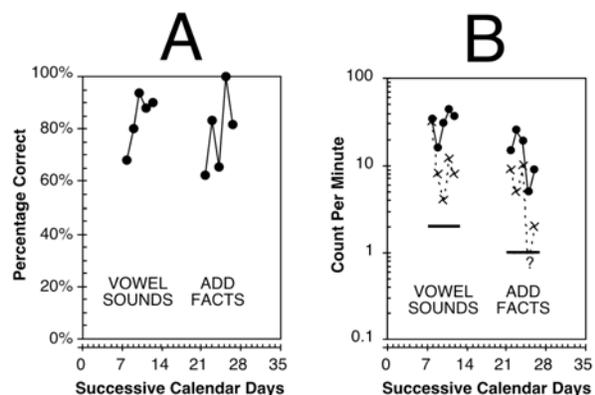
Patsy's difficulty in using her new skill had nothing to do with her basic ability to say the sounds correctly. At one point she had achieved nine days in a row without any errors (an accuracy criteria far in excess of that which even the strictest

perfectionist would impose), yet she still failed to incorporate the skill into her daily activities. Patsy's problem was that she was still more fluent in her old behavior pattern, a pattern that she had employed for many years. To break that old habit, Patsy needed to achieve a level of fluency that made it easier to speak correctly than incorrectly.

Of course, there are some situations where the quality or accuracy of a behavior is much more important than quantity or speed, so why not simply assess pupil ability in terms of percentage correct? The answer is that frequency of response can reveal a great deal about the quality of an individual's behavior that is obscured by accuracy statements alone. The performance records in Figure 1 provides an illustration.

Judy's accuracy records for saying short vowels and in writing the answers to simple addition facts are presented in Figure 1A. Except for being a bit "bouncy" in addition facts, she is generally improving in both programs. If anything, she seems just a bit better with addition, in which she achieves 100% accuracy on at least one day. The frequency records presented in Figure 1B tell a different story. Her correct frequencies in saying short vowels are staying about the same or improving slightly, while her errors are decelerating from day to day—an overall improvement in performance

Figure 1: Percentages & Frequencies



by any standard. In addition facts, however, Judy was only successful in reducing her errors when she slowed way down from a high of over 40 facts per minute to only 5 to 9 facts per minute. Judy is probably slowing down to a point where she can count on her fingers to arrive at an answer—hardly what most people would call "knowing your addition facts." Even if Judy's teacher did not care about the actual speed with which Judy performs

<sup>2</sup> Skinner actually used the phrase "rate of response to identify what precision teachers have come to call frequency.

her calculations, her frequencies still provide information useful in deciding how well the instructional program is working.

### THE STANDARD 'CELERATION CHART'

The efficient evaluation of a pupil's daily progress is greatly facilitated through the use of a chart. Most educators make their own charts by simply sketching scales on a piece of graph paper and labeling the scales with whatever numbers seem appropriate for the behavior in question. For example, a scale might be labeled from zero to 400 behaviors per minute to chart reading behavior, but from zero to only 0.8 (eight behaviors in 10 minutes) to show out-of-seat behavior. The scale appropriate for one behavior would not be appropriate for the other (see Figures 2A and 2B). A standard chart, which uses the same scale to track all behaviors, offers several advantages.

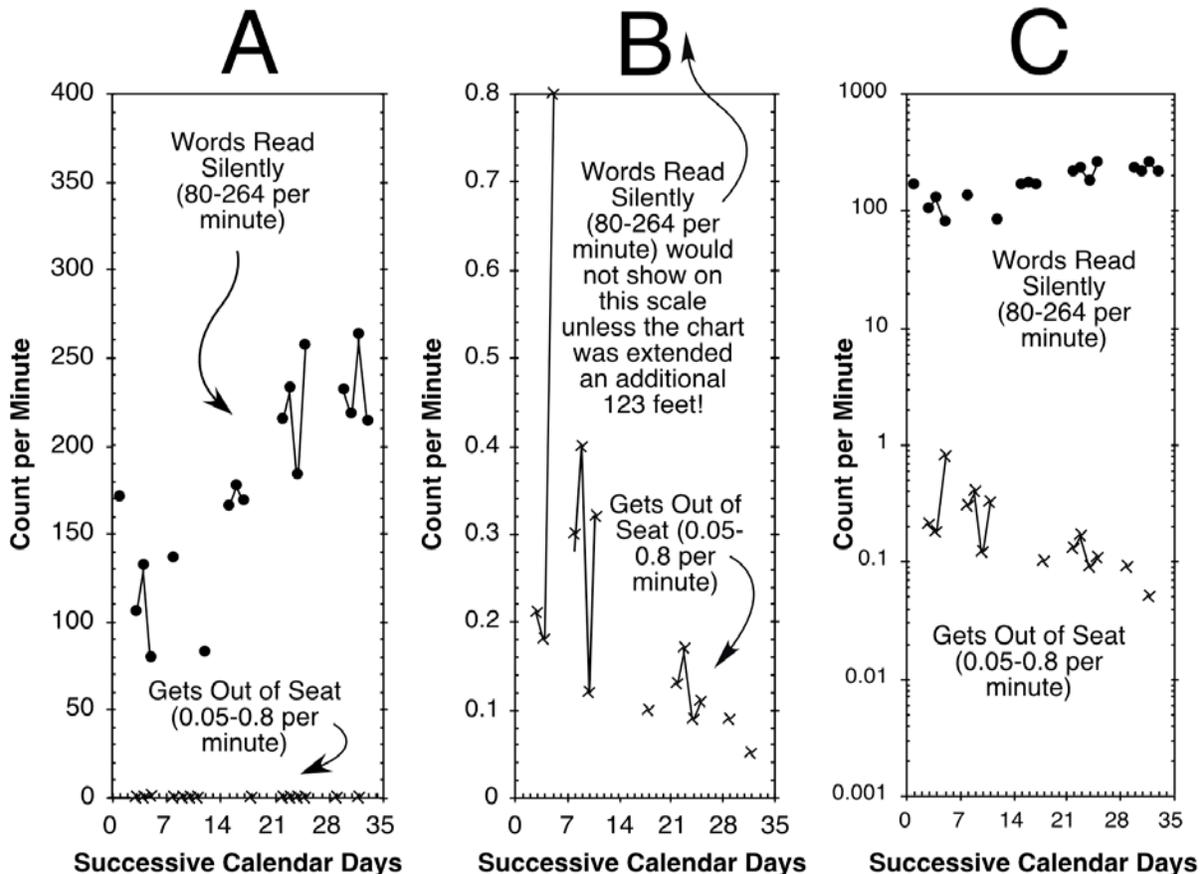
First, a standard chart saves the time otherwise required for drawing the chart and labeling the scales. Second, once the educator becomes familiar with the standard chart, time is saved in reading and interpreting the progress record. Lindsley

(1971) found that teachers often took as long as 30 minutes to explain a program to other teachers when each program used a different "homemade" chart, but only needed 2 or 3 minutes for a program when all were shown on standard charts.

More important than any savings in time, however, is that changing the scales on a chart can inadvertently alter the appearance of the performance record, possibly distorting one's impression of the pupil's progress. The only difference between Figures 2A and 2B is that the vertical scale in Figure 2A has been compressed to allow a wider range of frequencies to be shown. As a result, the deceleration in out-of-seat behavior so apparent in Figure 2B is impossible to see in Figure 2A. When teachers allow themselves the luxury of making a new chart for each behavior and learner, different pictures of progress are formed, the comparison of one program with another is difficult, and the evaluation of how well a program is working can be in error.

Skinner realized the advantages of using a standard approach for displaying performances and developed the cumulative recorder, an electromechanical device that automatically

Figure 2: Add/Subtract and Multiply/Divide Charts



charted the performances of his research subjects on a standard scale. Lindsley adopted and expanded the idea of a uniform visual display by creating the Standard 'Celeration Chart. The term 'celeration is the root acceleration and deceleration, the two ways in which frequencies can change over time. The chart is called a standard 'celeration chart since it always depicts rate of change or progress in a standard manner, regardless of the initial frequency of the behavior.<sup>3</sup>

The Standard 'Celeration Chart allows behaviors to be meaningfully charted and displayed over a frequency range of .000695 per minute (one behavior in 1,440 minutes or 24 hours) to 1,000 per minute over the course of 140 calendar days (see Figure 3). To accomplish that feat, a ratio scale is employed, rather than the add-subtract scale found on most charts.

A "ratio" scale derives its name from the fact that equal ratios of performance change will appear the same size no matter where they occur on the chart. For example, a change from a frequency of 1 to 2 (a times-two change) will appear the same size as a change from a frequency of 100 to 200 (also a times-two change). On an add-subtract scale, adding or subtracting the same absolute amount will produce changes that appear to be the same size no matter where they occur. Changing from 1 to 2 (a plus-one change) will appear the same size as changing from 100 to 101 (also a plus-one change).

Figure 2C shows how the ratio scale solves the problem of comparing high-frequency reading behaviors with low-frequency out-of-seat behaviors. Both the out-of-seat behavior and reading behavior are easily displayed on the same chart in a manner that shows all of the important daily bounce and progress over time. Comparisons of progress across programs are simple and direct, and the chances of misinterpreting the charted record are greatly reduced.

## DESCRIBING ENVIRONMENTAL CONDITIONS

To construct and manipulate an effective instructional environment, one must be aware of the elements within that environment which might influence behavior. The labels Skinner used to classify elements of the environment were all functionally defined in terms of the impact they

had upon behavior. A positive reinforcer, for example, is defined as an event that follows a behavior closely in time and that is found to increase the frequency or probability of the behavior (White, 1971). Simply put, a reinforcer is not so much a thing (like an M & M) as anything that affects behavior in a particular manner. Functional definitions continually force one to consider an environmental element's impact on behavior, rather than being sidetracked by behaviorally irrelevant characteristics of the element. What, however, does one call a potential reinforcer before its impact is known? Lindsley (1964) solved that problem by formulating two parallel systems for describing an environment—the IS Plan for describing what "is" in the environment before one has ascertained effects on behavior, and the DOES Plan to describe those elements of the environment that analyses have shown "do" influence a pupil's behavior.

Several versions of the IS-DOES Plan have been developed since Lindsley first introduced them in 1964. The versions I prefer were developed by Waechter (White, 1971) and are outlined in Table 1. More complete descriptions of each plan may be found in Kunzelmann, Cohen, Hulten, Martin, and Mingo (1970), White (1971), or White and Haring (White and Haring, 1980).

## IMPLEMENTING PRECISION TEACHING

Implementing Precision Teaching has been described as a three-step process: pinpoint, count, and chart. To actually realize the potential of Precision Teaching, however, it is not sufficient to simply monitor the performance of a learner on the standard chart. One must also evaluate the information thus obtained and make systematic decisions concerning how instruction should proceed.

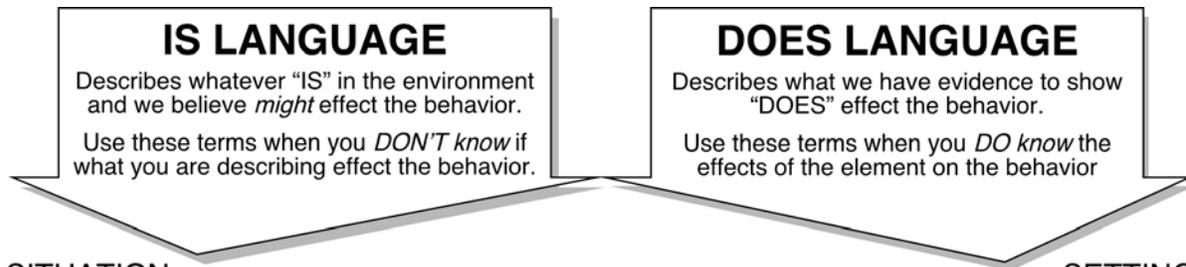
### Pinpoint

Two qualities of behavior are of particular importance when trying to pinpoint the target of a program: movement and repeatability.

**Movement.** Any directly observable behavior will involve physical movement of some sort, like walking, talking, writing, grasping, pointing, and smiling. Occasionally educators target something that does not involve movement, like helping a child "be quiet." Such targets really represent the absence of behavior, however, and education programs will generally be more effective if they focus on the movements that really represent the

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<sup>3</sup> The Standard 'Celeration Chart may be purchased from *Behavior Research Company*, Box 2251, Kansas City, KS 66103.



**IS LANGUAGE**

Describes whatever "IS" in the environment and we believe *might* effect the behavior.

Use these terms when you *DON'T* know if what you are describing effect the behavior.

**DOES LANGUAGE**

Describes what we have evidence to show "DOES" effect the behavior.

Use these terms when you *DO* know the effects of the element on the behavior

**SITUATION**

The general environment in which the behavior will be observed and/or assessed. Includes at least the place, time of day, materials and equipment, people present, and the general background activities in which people are engaged (e.g., playing, quite study time).

**SETTING**

**EVENTS BEFORE**

The general environment in which the behavior will be observed and/or assessed. Includes at least the place, time of day, materials and equipment, people present, and the general background activities in which people are engaged (e.g., playing, quite study time).

**STIMULI**

**MOVEMENT CYCLE**

The target behavior. The term movement cycle is used to remind us that the target should involve some physical movement with a repeatable cycle. After we have shown that the behavior is "responsive" to at least some known environmental elements, it's called a response. Examples include "writes digit," "says word," "takes step," "laughs," or "does something to make the teacher laugh."

**RESPONSE**

**EVENTS AFTER**

Events which follow the movement cycle or response closely in time. Such events might represent potential or actual reinforcers or punishers (e.g., praise or criticism) or they might simply provide additional guidance to the learner (e.g., feedback). It is important to make note of the arrangement between events-after or consequences and the movement cycle (e.g., "5:1" would mean that for every five responses, one consequence would occur).

**CONSEQUENCES**

Table 1: IS/DOES Language

problem. Instead of helping the child to be quiet (no movement), educators might target and count the number of inappropriate vocalizations the child makes (movement).

Lindsley suggested a Dead Man Test to determine if a target really represents behavior: If a dead man can do it or look like he's doing it, then it's not behavior. A dead man can sit still and look like he is being attentive. Those are not behaviors. In some cases educators can identify the movements that represent the converse of the nonbehavior (e.g., getting out of the seat instead of sitting still). In other cases, they will need to identify some arbitrary movement to serve as an indicator of the private behavior of concern (e.g., having the child repeat what the educator has just said to see if he is "attending"). Of course, educators should take care to select indicator movements directly related to the skill they want to teach and easy for the pupil to perform (White, 1980).

Repeatability. Each time a behavior occurs, the pupil has the opportunity to learn some-thing. If a pupil has the opportunity to read many words aloud, then he or she has many opportunities to get feedback concerning how well they were read. It is

important to target behaviors that can be repeated many times during each instructional or training session and to establish conditions that encourage the behavior to be repeated often.

Educators can sometimes enhance the repeatability of behavior simply by redefining the target of their concern. Instead of counting whole dressing sequences, they might count and provide feedback for individual steps within the sequence; instead of counting whole words spelled correctly, they might count and give feedback concerning individual letters-written-in-sequence. If a child writes very slowly, then the repeatability of indicating the answers to math-facts might be enhanced by allowing an oral response. Ideally, target movements will be selected and conditions established that allow the behavior to occur at least 10 times during any given instructional or training session. That may not always be possible, but it usually is.

**Count**

Pupil progress is monitored by counting the number of times the movement cycle occurs and keeping track of the time we spend counting. It is

usually best if the pupil has the opportunity to practice and demonstrate the skill daily. While natural circumstances may provide a reasonable number of opportunities for the demonstration of some movements, few, if any, situations exist where opportunities cannot be - improved upon. Even in toileting programs, for example, it is possible to increase the number of opportunities for practice by encouraging the ingestion of larger than normal amounts of liquid.

With some skills, like toileting educators should devise a system for monitoring the behavior throughout the entire day. With other skills, like identifying various objects by name, situations might be arranged which allow the behavior to be practiced and assessed many times within the span of a minute or so. If fatigue, interest level, or attention span seem to be a problem, practice can be divided into several short periods spaced throughout the day. -Also, although assessing a behavior continuously while working with a pupil is frequently easy, setting aside only a minute or so at the end of an instructional session for the

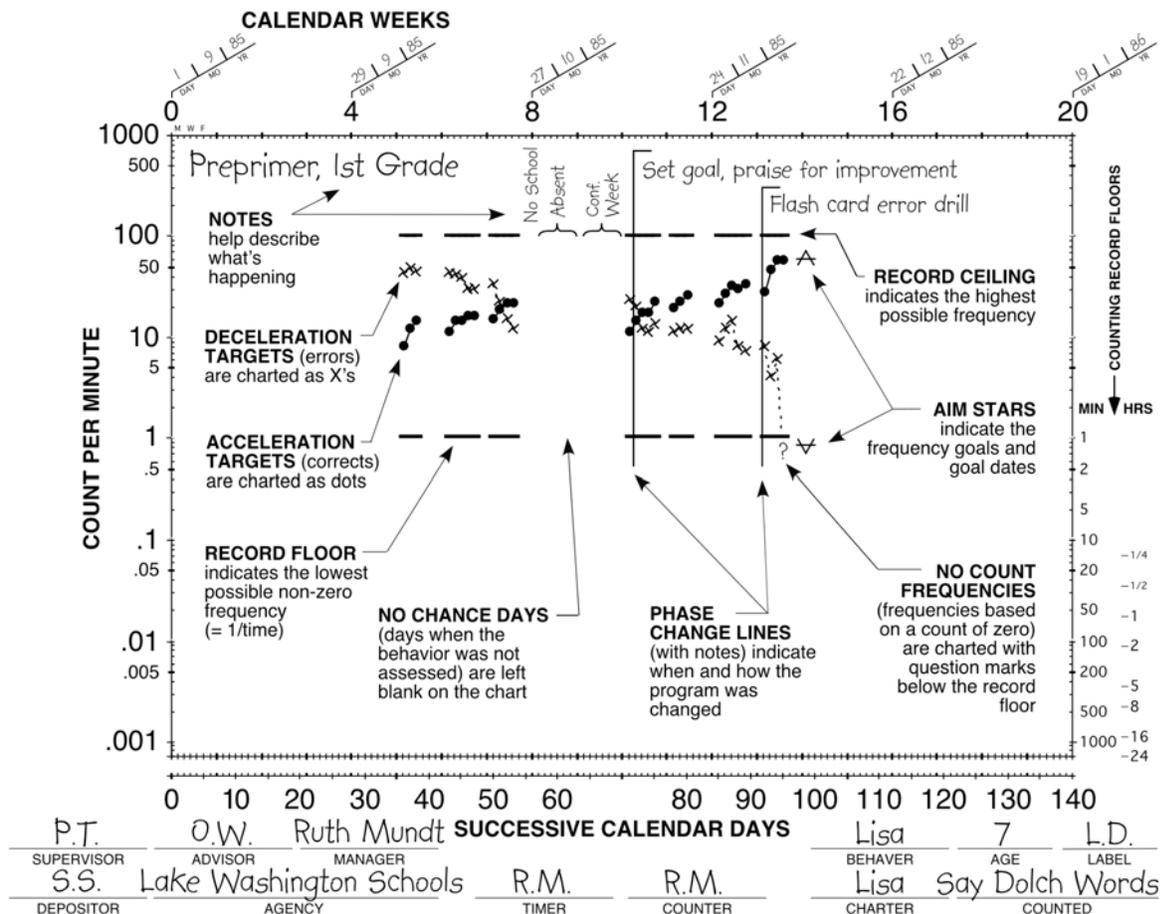
assessment is sometimes more convenient.

Finally, keeping the length of the assessment period the same from one day to another is usually best. Factors like fatigue and warm-up time will then be reasonably constant for all the assessments. In some cases, however, the natural cycle of a behavior will make the use of a constant assessment period inadvisable. To keep a dressing program as close to natural conditions as possible, it might be better to simply time the entire sequence (however long that lasts) and count "steps completed without assistance" and "steps completed with assistance."

### Chart

The results of each assessment should be charted as soon as possible. Waiting even a day may mean that some important aspect of the pupil's progress is overlooked and that valuable program changes are needlessly delayed. In any event, charting is a quick and simple process which, after a little practice, should take no more than 3 or 4 seconds

Figure 3: Standard Celeration Chart



to complete.

Charting on the Standard Acceleration Chart proceeds much as it would with any chart. The frequency (count divided by assessment time in minutes) is simply plotted by placing a dot or x on the appropriate day-line of the chart. Devices even exist that permit the automatic calculation of frequencies directly on the chart, thereby making the charting process even faster.

To make the chart easy to interpret, a number of basic charting conventions are usually followed. A few of those conventions are illustrated in Figure 3. For a more complete description of each convention and a detailed explanation of their rationale, as well as for discussions of the "frequency finder," the reader should consult Penneypacker, Koenig, and Lindsley (Penneypacker, Koenig et al., 1972), or White and Haring (White and Haring, 1980).

### Evaluate

Simply "dropping dots on the chart" will not fulfill the purpose of Precision Teaching. One must carefully evaluate the pupil's progress daily, determine whether progress is satisfactory, and, if not, devise changes in the program to facilitate continued learning. Originally, only two decision rules were specified in precision teaching: If the pupil is progressing in the right direction, leave the program alone, if the pupil is essentially "flat" or going the wrong way, then change the program. In many cases, those rules are adequate for making appropriate decisions. Over the past decade, however, a number of Precision Teachers have developed much more formal guidelines to assist them in deciding precisely when and how a program should be changed (Liberty, 1972; White and Liberty, 1976; Liberty, Haring et al., 1980; White and Haring, 1980; Albrecht, 1982; Albrecht, 1982; West, 1982; White and Haring, 1982).

Most of the rules that have been developed are strictly objective and can be applied very precisely using only the data displayed on the standard behavior chart. Indeed, several computer programs have been written to apply those rules and prompt teachers concerning the need for program changes as they arise. One such program was selected by The Council for Exceptional Children as the most outstanding piece of educational software for 1984 (Hasselbring and Hamlett, 1983).

While space does not permit the description of those formal decision rules here, several studies described later in this article have demonstrated

that such rules can be very effective in helping teachers make timely and appropriate program change descriptions. However, one must understand that the application

of any system of rules derived from the analysis of previous pupil progress may fail to address the needs of current pupils. It is important to remember the fundamental guiding principle of Precision Teaching: The learner knows best. Educators must not apply any predefined system of rules so strictly and blindly that they become insensitive to a pupil's unique characteristics, needs, and abilities. Existing data decision rules provide useful guidance, but educators must always look to the individual learner for confirmation that their efforts are appropriate.

### Getting Help

Many teachers devise and implement their own Precision Teaching programs with no outside assistance, but for those who want them, there are an almost limitless number of resources available which can be of tremendous help. The Great Falls School District, for example, has compiled a library of more than 10,000 probe sheets and assessment guidelines for helping in the evaluation of pinpoints ranging from simple pointing skills through complex academic behaviors in the social and physical sciences (Great Falls Precision Teaching Project, Undated).

Teacher aides are an obvious resource for implementing programs, and since Precision Teaching is so straightforward, programs can also be run quite easily by parents, volunteers, and cross-age tutors (Butler and Memmott, 1985; Heinzig, 1985). The most important resource, however, is the learner. Even very young children learners with severe disabilities can play an active role in selecting pinpoints, counting behaviors, charting their progress, and deciding when and how programs should be changed (Butler and Thompson, 1985; Liberty, 1985). The little extra effort it takes to develop such skills in learners and to encourage their use will pay for itself many times over. The teacher will be relieved of certain chores, the program will probably run more smoothly, and the learner will have acquired a skill that will be of use throughout life.

### DOES IT WORK?

As mentioned earlier, Precision Teaching is not a way of teaching, but a way of evaluating whatever teaching strategies and curricula one might be

using. As such, it is not the sort of thing one puts on "automatic" and then ignores. It demands constant attention and a willingness to accept the fact that one might be able to improve what one is doing. The question is not so much whether Precision Teaching works, but whether it can help teachers and learners discover new and better ways

of helping themselves. The answer, it would appear, is yes.

Precision Teaching has been used successfully to facilitate the progress of learners ranging from people with severe disabilities to university graduate students, from the very young to the very old. A few of the more extensive and well-controlled studies are summarized in Table 2.

Table 2: Selected Precision Teaching Impact Studies

STUDY	DESIGN	MEASURES	RESULTS
Great Falls Precision Teaching Project (Beck, 1979)	Children with skill deficits in grades 1, 2, & 3 in six schools; 3 schools employed precision teaching (PT), 3 schools did not. Total experimental n = 532; control n = 476. Pretest- posttest design over circa 1 school year.	Time probes in writing numbers randomly, writing numbers dictated, and saying letters.	PT group posttests significantly superior in 15 (79%) of the comparisons; no differences in 3 (16%) of the comparisons; non-PT group superior in 1 (5%) of the comparisons.
Great Falls Precision Teaching Project (Beck, 1979)	Study 1: 134 regular 1st, 2nd, & 3rd graders in a school using PT compared pre/post over one school year with 155 similar children in a carefully matched school not using PT.  Study 2: Regular fourth graders at a PT school (n = 294) compared with students in a matched non-PT school (n = 312) over a period of 4 years.	Iowa Test of Basic Skills, math and reading subsections.	Study 1: No initial differences; 1st and 2nd grade PT groups ended up significantly superior to non-PT groups in reading; 2nd & 3rd grade PT groups significantly superior in math. In no case did the non-PT group significantly outperform the PT-group.  Study 2: By the end of four years, the PT 4th graders were performing at the 95th percentile in reading and the 86th percentile in math; the non-PT school students were performing at the 71st and 54th percentile, respectively.
Great Falls Precision Teaching Project (Beck, 1981)	538 2nd, 3rd, & 4th graders and 30 teachers assigned to 4 groups: (1) non-PT; (2) PT daily assessments; (3) PT daily assessments + charting; (4) PT daily assessments + charting + use of special data-decision rules. Pre-post assessments over 7 months.	Iowa Test of Basic Skills, math subsection.	10 of 11 comparisons showed significant effects in favor of one or more of the PT groups; no significant differences found in the 11th comparison. The use of decision rules (the third PT condition) proved superior in 7 (63%) of the comparisons.
Great Falls High Schools Basic Skills Improvement Project (Beck, 1981)	Two high schools, 123 sophomore and junior students in eight classes (four math; four English) assigned to four groups (one PT and one non-PT in each class type). All students were performing at least 3 years behind grade level on a standardized test, qualified for remedial help, and read orally at less than 120 words per minute. Pre-post assessments were conducted over one school year. In the PT group, students evaluated their own progress using PT.	Comprehensive Test of Basic Skills: math comprehension, math application, language mechanics, and language expression.  Timed probes in oral reading, parts of speech, and vocabulary meaning.	Significant effects were found for all four parts of the Comprehensive Test of Basic Skills in favor of the PT groups; an analysis of covariance was used to correct for initial differences in language expression, but also showed the PT group to be significantly superior. The PT group was superior in 5 of the 7 timed-probe comparisons, no differences were found in the other 2 probes. Discipline and dropout rates were also lower for the PT groups.
Haring, Liberty & White (Haring, Liberty et al., 1970-80)	31 teachers working with 343 pupils with moderate to severe disabilities were taught to use PT daily assessments, charts, and a set of predefined rules for using PT data in deciding when and how to change programs. Comparisons were made of remediation success when the rules were followed, versus cases in which the rules were not followed.	Pupil progress before and after individual program changes. Programs involved individual pupil IEP objectives.	Overall, teachers were 2 to 5 times more effective in selecting effective intervention strategies when PT procedures and decision rules were followed. PT data-based rules proved to predict 84% of the variance in remediation outcome; 97% of the participating teachers stated that the procedures accelerated pupil performance and that they would continue to use them.
Bohannon (Bohannon, 1975)	48 children mild or moderate disabilities, grades 1 to 3, assigned to two groups. 15 resource teachers each worked with at least	Pupil performance in phonic skills and sight-word	22 (92%) of the 24 PT pupils had successfully remediated their deficits in phonic skills (placing above the 25% percentile of their typically

STUDY	DESIGN	MEASURES	RESULTS
	one child from each group. With one group the teachers were allowed to do anything to teach reading. With the PT group they could only assess, chart, and use a simple procedure to decide if and when to employ any of three simple techniques (1 min. of practice; showing charted progress; error drill; awarding gummed stickers for progress). The study lasted 28 days.	vocabulary, compared with the performances of typically developing peers.	developing peers' scores), only 2 (8%) of the non-PT group performed as well. 16 (67%) of the PT group placed above the 25% percentile in sight-word vocabulary, as opposed to 4 (17%) of the non-PT pupils. Total daily instructional time for the PT group never exceeded 10 minutes, but was never less than 30 minutes for the non-PT group.

Several features of the studies summarized in Table 2 are particularly interesting. First, the series of studies conducted by the Great Falls Precision Teaching Project (Great Falls Precision Teaching Project, Undated) often involved entire schools, not just individual (and possibly exceptional) teachers and pupils within those schools. Nevertheless, in one case the average performance of pupils of an entire school using Precision Teaching was raised to the 95th percentile in reading and the 85th percentile in math on standardized measures. A carefully matched school where Precision Teaching was not used was only able to achieve the 71st and 54th percentiles in math and reading.

The studies by Haring, Liberty, and White (Haring, Liberty et al., 1970-80) and Bohannon (Bohannon, 1975) reinforce the belief that Precision Teaching works well with a range of learners and can even save considerable teacher time. Haring, Liberty and White found that while teachers of pupils with severe disabilities may have to try three or four tactics before finding something that worked when they did not use systematic data-based rules, more than 80% of their attempts were successful on the first try with such rules. Those results have since been replicated several times (c.f., Eaton, 1982; Browder, Liberty et al., 1985). Bohannon's study showed a similar improvement in success and savings in time with pupils who had mild disabilities. Teachers in that study were not only roughly 5 to 10 times more effective in remediating their pupils' reading difficulties, they were able to reduce the length of instructional sessions from more than 30 minutes to less than 10 minutes (see also Mirkin, 1978).

Training time and costs also appear very reasonable. Haring, Liberty, and White (Haring, Liberty et al., 1970-80) demonstrated that teachers could be taught the fundamentals needed for effective Precision Teaching decision making in about 3 hours of direct instruction or, alternatively, by reading a short manual. The Great Falls Precision Teaching Project (Great Falls Precision Teaching Project, Undated), which has trained thousands of teachers across the country, calculated that very

extensive training at their project site and follow-up visits to the teachers' own classrooms costs only about \$200 to \$230 per teacher (\$7.50 for each pupil served by those teachers). The annual cost for materials was \$45 per class, or \$1.50 per pupil (Beck, 1979; Beck, 1979).

In sum, Precision Teaching appears to be an effective, cost-efficient set of procedures for evaluating and improving instruction. Precision Teaching does not require that you abandon curricula and teaching strategies that have already proven useful. It does, however, require a willingness to modify and adapt strategies as the learner's progress records indicate the need. That sort of flexibility and willingness to change takes a certain amount of courage. For those that try, however, the rewards can be great.

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