

**Reference to this book chapter:**

Lindsley, O. R. (1997). Precise instructional design: Guidelines from Precision Teaching. In C. R. Dills & A. J. Romiszowski (Eds), *Instructional development paradigms* (pp. 537-554). Englewood Cliffs, NJ: Educational Technology Publications.

# 31

## **Precise Instructional Design: Guidelines from Precision Teaching**

**Ogden R. Lindsley**  
Behavior Research Company  
and  
University of Kansas, Lawrence

### **Overview**

This chapter presents the guidelines for instructional designers that would follow from the discoveries and methods of Precision Teaching. First described are the what, where, and why of Precision Teaching. Next shown is how Precision Teaching fits Kuhn's definition of a scientific field or paradigm. Six major Precision Teaching principles are then described, followed by evidence of its superior effectiveness. Precision Teaching do's and don'ts for instructional design are listed, followed by myths that block fluent learning. Some special problems encountered in designing computer assisted instruction are mentioned. Next, two competing viewpoints are specified followed by models supporting daily charting, and teaching to fluency. Concluding weak points and concluding strong points are spelled out.

### **What Is Precision Teaching?**

Precision Teaching is a system of tactics and strategies for the self-monitoring of learning. I have recently described Precision Teaching in more detail elsewhere (Lindsley, 1992a). The most visible sign of Precision Teaching is the Standard Celeration Chart (see Figure 1 on page 541) on which students monitor, project, and analyze their own learning easily and daily. This is called "the chart" by students. At Precision Teaching's core are daily timed practice sessions. Students develop both fluency and accuracy in frequent, short (usually one minute), daily practice sessions. These are called "timings" by students. Students practice by themselves on carefully designed practice sheets. Both questions and answers must have no more than one or two letters or syllables for rapid performance at frequencies

haven't been able to. Neither was I able to convince students of mine to enter education and try to install response frequency in classroom teaching. So, in desperation, I closed my Harvard Medical School laboratory and entered teacher training in Special Education at the University of Kansas Medical Center to try to get frequency used by teachers and students to monitor classroom performance.

Precision Teaching was developed in special education, where it was absolutely necessary to individualize instruction fully (Lindsley, 1971a). Later it became clear that frequency monitoring methods were even more powerful when used in regular classrooms with regular (Beck, 1981) and gifted (Duncan, 1972) classes.

Reacting to teachers' complaints that they were unable to practice Precision Teaching because of lack of support from their building principals, I moved in 1972 into the administrator training program to produce doctorates in educational administration who were well versed in Precision Teaching. I had hopes that these school administrators would not only support precision teachers, but would set up building-wide Precision Teaching programs. As it turned out, these precision principals did support a teacher or two, but were too controlled by the entrenched myths of the school district, other teachers, and parents to be able to install anything as drastic as self-charting by students. Here and there a principal tried it and was promptly removed, usually with trumped up charges like "insubordination," or "overly demanding of teachers," or "installs 18th century educational practices." No one looked at improvements in the academic performance of students.

### **Why Precision?**

We chose the word "precision" to describe the daily performance monitoring feature taken from free-operant conditioning. This would clearly distinguish it from Behavior Modification and Applied Behavior Analysis, also taken from free-operant conditioning, that used single subject research design, operant descriptive terms, and emphasis on consequences, but used traditional percent correct and percent of time observed on task. At that time it seemed important to make the word for our methods an adjective rather than a noun, so that practitioners could see that their methods were mainly left intact and were merely improved by more precise daily monitoring feedback (Lindsley, 1972, p. 9). We envisioned Precision Counseling, Precision Social Work, Precision Administration, and Precision Law—all united by a common research and monitoring system. Precise Self-management actually got going as a field for a while (Duncan, 1969, 1971; Johnson, T. S., 1972), but its practitioners left for the more lucrative fields of law and clinical psychology, where the high pay is for contact hours and there is no motive to improve effectiveness by performance monitoring.

### **Why Self Counting and Charting?**

One of our first classroom discoveries was that student's performance often improved when they merely counted and recorded it. Charting their own performance, so they could see their daily progress, often produced further improvement. Student self-counting and charting made maintaining daily charts of three to four academic and one or two social behaviors possible in a classroom of 30 students without need for external observers or teacher

---

<sup>1</sup>In one of our many laboratory examples, one puff on a cigarette produced an interruption and brief acceleration in a patient's response frequency with no effect on percent correct in a free-operant discrimination task. It took smoking at least one cigarette (30 puffs), and sometimes a whole pack of cigarettes (600 puffs) to show effects on percent correct discrimination. This meant that frequency was a 30 times to 600 times more sensitive response measure than percent correct.

above 60 per minute. These “practice sheets” must have more questions than could ever be answered in the allotted time. This gives the frequency scores real meaning since no one can ever finish; there is just too much on each sheet.

In addition to the charts, timings, and practice sheets, Precision Teaching strategies have developed inductively from hundreds of thousands of students, teachers, and supervisors. Here are a few slogans expressing these strategies:

“The child knows best.”	Try each student’s own improvement suggestions before other’s.
“A dot a day makes an A.”	Charted daily practice is essential and guarantees top grades.
“Different strokes for different folks.”	Expect different practice sheets, error drill, explanations, rewards, and penalties for each student.
“Jaws gobbles up math.”	The learning picture with steep acceleration of corrects and steep deceleration of errors looks like a wide open shark’s mouth, and is the best learning picture to most rapidly climb every learning curriculum.
“Celerate, then celebrate.”	Socially celebrate steep learning slopes as they happen.

Mostly a monitoring, practice, and decision-making system, Precision Teaching combines powerfully with any curriculum approach. The combination always refines the curriculum by pinpointing spots in the ladder that need more or different steps. The combination always produces much more learning than the curriculum produced alone. Our very first combination was with the Canadian Montessori curriculum in a class for exceptional children (Fink, 1968). Combinations of Precision Teaching with Direct Instruction (Engelmann & Carnine, 1982) have been used successfully at the Quinte Learning Centre (Maloney & Humphrey, 1982), the Haughton Learning Center (Freeman & Haughton, 1993a), and the Cache Valley Learning Center (Desjardins & Slocum, 1993). The latest (a triple combination) is with Direct Instruction and Tiemann-Markle instructional design (Markle, 1983; Tiemann & Markle, 1990) in the Morningside Phonics Fluency (Johnson, 1992a), and the Morningside Mathematics Fluency (Johnson 1992b; Johnson & Streck, 1992).

### **What Are the Origins of Precision Teaching?**

Precision Teaching came from laboratory free-operant conditioning. This history has also been described recently (Lindsley, 1971a; 1990). A broader, more scholarly history covers its roots in nineteenth century physiology and medicine (Potts, Eshelman, & Cooper, 1993). Briefly put, we applied the principles that had guided our laboratory research with chronic psychotic patients from 1953 through 1964 (Lindsley, 1960) in inexpensive classroom research.

The reason for doing this was that almost all early appliers of operant methods to classroom teaching used operant reinforcers, schedules, and descriptive terms, but they did not use rate of response (Bijou & Baer, 1961). I considered rate or frequency of response to be Skinner’s greatest contribution, since it had proven to be 30 to 600 times more sensitive than percent correct, percent of time observed on task, or response duration in our human laboratory research.<sup>1</sup> So, to me, this was overlooking Skinner’s most powerful contribution. I could not get the early applied behavior analysts to change their recording methods—and still

assistants (Starlin, 1971). The students conducted their own timings, monitored by a friend, and charted and filed their own charts on the classroom walls.

### Why the Standard Celeration Chart (SCC)?

During the first year of teacher training, I noticed that in a three-hour weekly class of 18 teacher trainees, we could not share more than three or four student charts per night. The trainees usually procrastinated, waiting to update their charts the night before the class in which they were scheduled to present. This meant they monitored their student's learning charts only once or twice a semester! Daily recording has little value if it is only analyzed once a month.

One night, when 40 minutes were taken by a trainee to present her student's chart, I noticed that the majority of the time had been spent describing the counting and charting details. And even then, others in the class had misunderstood what was happening to the student's learning. I then realized that we must have a standard chart to eliminate this endless, error producing world of highly different personal charts made by each student and teacher. Often teachers made up a different chart scale for each student in their class.

Later that night I designed our first standard chart. It was called a "Standard Behavior Chart" because it covered the full range of human behavior frequencies—from one a day, to 1,000 per minute. This chart had a multiply (logarithmic) scale up the left for frequencies, and an add (arithmetic) scale across the bottom for days of the week. It was designed to cover a school semester of daily practice on one 8.5 by 11-inch sheet.<sup>2</sup> We experimented with different paper and ink colors to find the light blue that produced the fewest errors with school children charting in black pencil. Charts were made commercially available and a handbook describing standard chart features and uses was published (Pennypacker, Koenig, & Lindsley, 1972). Later we discovered inductively that all human behavior frequencies grew by multiplying and decayed by dividing—as straight lines on the chart (Koenig, 1972). This meant that students could project their learning courses from two weeks of daily charted performance to see when they might reach their aim. This made baselines and reversal research designs unnecessary, since deviation from the projected course could be used to determine the effect of instructional procedure changes.

Figure 1 displays a sample Standard Celeration Chart together with its standard charting conventions taken from an article by Owen White (White, 1986). Even later, when we started recording group and organizational performances, we made charts for weekly, monthly, and yearly frequencies.<sup>3</sup> These charts were designed to synchronize with the daily chart so that a growth line showing doubling every growth (celeration<sup>4</sup>) period was at the same angle (34°) on each chart. Lower left to upper right corner represented doubling every week, every month, every six months, or every five years, depending on the chart. What this set of four charts had in common was the angle of that celeration line so that users could directly perceive learning magnitude without resorting to protractors or formulas. Organizational and national performance also grew and decayed as straight lines on these charts as did personal

<sup>2</sup>At first we tried to get one full calendar year on a sheet, but the lines were too close for easy student charting.

<sup>3</sup>Daily, weekly, monthly, and yearly Standard Celeration Charts are available by mail order from Behavior Research Company, P.O. Box 3351, Kansas City, KS 66103.

<sup>4</sup>The term "celeration" was coined for the general class of both acceleration (gradual increase in frequency) or deceleration (gradual decrease in frequency). "Celeration" was not in Webster's unabridged dictionary (Gove, 1961), but it should have been. "Celeration" follows so naturally that even first graders learn the concept and use the term correctly almost immediately.

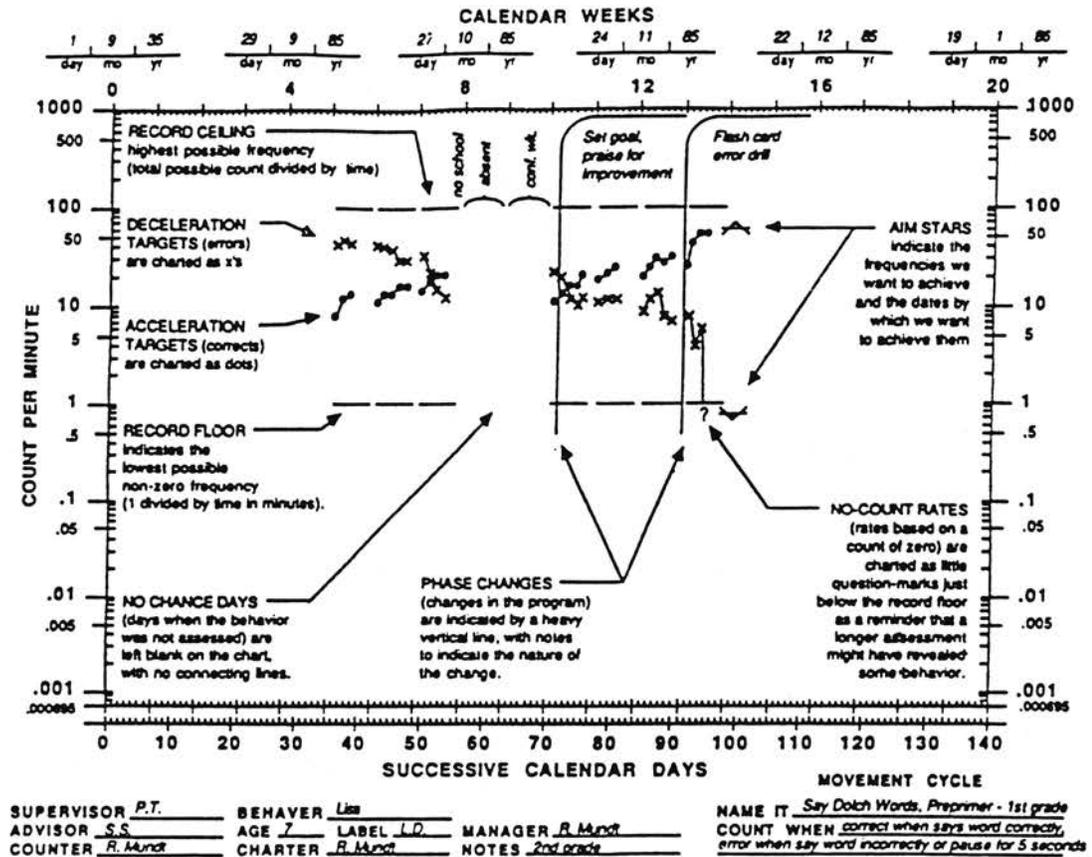


Figure 1. Standard Celeration Chart and charting conventions.

behavior on the daily charts. Organizational performance was more accurately projected on these charts by free-hand than by using least squares and geometric projection formulas from the data (Oliva, 1981).

The major advantages of the Standard Celeration Chart are that the *magnitude* of learning (celeration) can be directly seen and compared within and between student charts. Learning is easily projected by simple straight-line extrapolation. Changes in learning are not seen as simple increases or decreases; but are seen in more detail as either immediate jumps or gradual turns or combinations such as jump up and turn down.

A practical advantage of the Standard Celeration Chart is that valuable teacher, student, or researcher time is not wasted trying to figure out the coordinates of a unique learning chart. Using the Standard Celeration Chart in our in-service teacher training classes reduced case presentation time from a median of 20 minutes to a limit of two minutes per case! A teacher can survey the wall-posted personal charts of his/her 30 different students in less than 10 minutes to determine which students need help today.

### Precision Teaching Fits Kuhn's Definition of a Scientific Paradigm

Thomas Kuhn defined a scientific field or paradigm by the two characteristics of: (1) attracting an enduring group of students, and (2) being sufficiently open-ended to leave all

sorts of problems for practitioners to solve (Kuhn, 1970). Precision Teaching clearly satisfies both these requirements.

An enduring group of students is demonstrated by a journal, an annual international conference, and university based doctoral and master's programs. The *Journal of Precision Teaching* is now more than a decade old, edited by Claudia McDade, and currently published from Jacksonville State University, Jacksonville, Alabama. A conference is held each year. Doctorates in Precision Teaching are available from the Universities of Florida, Washington, Central Washington, and Texas at Denton, and Ohio State, Tennessee State, and Utah State Universities,<sup>5</sup> to mention the longest established. Strong undergraduate programs are available at Jacksonville State and Youngstown State Universities,<sup>6</sup> among others.

The open-ended nature of Precision Teaching is demonstrated by at least twenty major questions requiring further classroom and/or laboratory research. These include:

- (1) Further proof of the multiplying nature of human performance, daily variability, and learning.
- (2) Further proof that daily practice produces more learning than twice the amount of practice every other day.
- (3) Further proof that daily practice in two channels (see-write and hear-say) produce steeper learning than the same amount of practice in only one channel (see-write).
- (4) How many and what practice channels produce the most efficient and rapid progress up curriculum ladders?
- (5) Is more rapid progress up a curriculum ladder produced by teaching accuracy before fluency or by teaching fluency before teaching accuracy?
- (6) Further support for independence of three parts of behavior change or learning—jumps, turns, and bounce.
- (7) Are there any other differences between reinforcers that produce jump-ups (in addition to turn-ups) and those that do not?
- (8) Are there any other differences between punishers that produce jump-downs (in addition to turn-downs) and those that do not?
- (9) Are there any differences between behaviors that are jumped-up by reinforcers and those that are not?
- (10) At exactly what frequencies for what performances does fluency occur?
- (11) How does fluency relate to laboratory "behavioral momentum" (Nevin, 1992)?
- (12) How does fluency relate to generalization (stimulus equivalence) (Epstein, 1985)?
- (13) How does fluency relate to generative instruction (Johnson & Layng, 1992)?
- (14) Is it necessary to establish accuracy prior to building fluency?
- (15) What are the best tactics for establishing endurance?
- (16) What are the rules for shortening facts to permit fluent performance (>60 per min.)?
- (17) What variables produce abrupt changes in daily variance (increases or decreases)?
- (18) What variables produce gradual changes in daily variance (converges or diverges)?
- (19) Is the learning of learning (celeration of celeration) linear on a multiply scale (equal distances are the same multiple) as is learning, or does the learning of

<sup>5</sup>At Florida, contact William Wolking or Henry Pennypacker. At Washington, contact Thomas Lovitt or Owen White. At Central Washington, contact Libby Nesselroad Street. At Texas at Denton, contact Guy Bedient or Sigrid Glenn. At Ohio State, contact John Cooper. At Tennessee State, contact Robert Spangler. At Utah State, contact Timothy Slocum, Richard West, or Richard Young.

<sup>6</sup>At Jacksonville State in Jacksonville, Alabama, contact John Brown or Claudia McDade. At Youngstown State in Youngstown, Ohio, contact Stephen Graf.

learning require a power scale (equal distances are same powers or number of times it multiplies by itself)?

- (20) What changes in the way Precision Teaching is presented and taught will produce more acceptance by the public school, educational research, and behavior analysis establishments?

Precision Teaching has produced many more research questions, but this list of twenty clearly proves it is open-ended.

### Precision Teaching's Six Major Principles

Precision Teaching's six major principles are:

- (1) self-chart performance frequency daily,
- (2) use Standard Celeration Charts,
- (3) separately chart desired and undesired pairs,
- (4) aim at fluency,
- (5) monitor learning (celeration), and
- (6) teach in more than one channel at once.

(1) *Self-chart performance frequency daily.* Our early research demonstrated that self-charting was preferred by learners over teacher charting, and it was more efficient since each second grader could easily maintain as many as 19 different academic charts (Starlin, 1971). Also, the only way we could guarantee that the learners could read charts and knew how steeply they were learning was when each learner kept and maintained his or her own charts. We also discovered that one-minute timings each day produced steeper learning than two one-minute timings every other day. Such data convinced us that, as with athletics and the performing arts, academic practice must be daily.

(2) *Use Standard Celeration Charts.* Precision teaching requires Standard Celeration Charts for four reasons. First, chart reading time is reduced by a factor of ten when charts are standard. With over 10 charts for each learner in a classroom of 25 students, it would be impossible to read all 250 charts in a few minutes if they were all different. There is a tremendous saving of teacher time when the students maintain and read their own charts. Students only ask for their teacher's advice when they and their charting partner are stumped and need help in suggesting a curricular improvement to increase the slope on one of their learning charts.

The second reason Standard Celeration Charts are required is that they represent learning to do and learning not to do as straight lines on the chart. Straight line projections are easy to make by eye or by ruler. Differences in the slope of these straight learning lines are easy to estimate in comparing steepness of learning within and between charts.

The third reason Standard Celeration Charts are required is that they both normalize and equalize the variance (daily bounce) period. Normalizing makes the daily up-bounce the same size as the down-bounce. Equalizing makes the total daily bounce the same distance on the chart when it is bouncing from three to nine per minute as when it is bouncing from 30 to 90 per minute. The normalized and equalized bounce makes it much easier to project the learning lines.

The fourth reason Standard Celeration Charts are required is that with normalized daily bounce, it is possible to recognize statistically significant outliers on the chart which could not have happened by chance alone. These exceptional outlier days permit inductive discovery of unique variables to improve the learning. Exceptionally good days (peaches) reveal things to do to improve the learning. Exceptionally poor days (lemons) reveal blocks and problems to avoid in improving the learning. It is interesting that this normalizing and equal-

izing of the variance on the Standard Celeration Chart is very similar to the normalized and additive variance required by traditional parametric statistics.

(3) *Separately chart desired and undesired pairs.* In the early days we called these "fair pairs," thinking it was only fair to accelerate a performance if we were trying to decelerate a performance (Duncan, 1969). Later, when it became clear that corrects and errors independently accelerated and decelerated, we called these academic pairs "learning pictures" (All, 1977). There were 13 different patterns of learning pictures in a single class of junior high school students.

(4) *Aim at fluency.* At the core of Precision Teaching practice is fluency building. This comes mainly from classroom practices and discoveries, led by Eric and Elizabeth Haughton (Haughton, 1974).<sup>7</sup> When elementary school students performed basic tool skills (e.g., add facts) at frequencies from 100 to 200 per minute, they had more retention, more endurance, and more application (generalization) than when they were taught to full accuracy but at lower frequencies, around 20 per minute (Haughton, 1981). These advantages of teaching to fluency have been found at all grade levels, including graduate school courses. Fluency has been shown to increase confidence (Binder, 1990). Fluency has also been the aim in teaching industrial sales persons new product knowledge (Binder & Bloom, 1989). Recently fluency has been related to the laboratory derived concept of "behavioral momentum" (Nevin, 1992), to generalization and stimulus equivalency (Epstein, 1985), and to generative instruction (Johnson & Layng, 1992).

(5) *Monitor learning (celeration).* Since performance frequency is a dot on the Standard Celeration Chart (SCC), and learning is a line of dots connected across days, both performance and learning can be easily seen on the SCC at once. That is the true power of the SCC. Many who use the SCC in their teaching actually do not monitor the learning or slope. They merely monitor the performance frequency by seeing how high up the chart their dots are. They ignore the slopes of the lines. Hence, they ignore the learning (celeration). It is easy to tell by looking at the charts in a classroom whether learning is being monitored. If most of the charted lines are flat, or only very slightly sloped at 10 degrees (celeration of x1.1 per week), it is a dead give-away that the class is not focused on learning. The whole class could regularly produce learning slopes of 34 degrees (celerations of x2.0 per week) when learning is monitored and the celeration aim is at least doubling every week! Celerations of x2.0 per week are routine and expected at Morningside School and Malcolm X Community College (Johnson & Layng, 1992).

(6) *Teach in more than one channel at once.* Performance channels are Precision Teaching's way of describing precisely and in plain English the input-output relationship of a particular practice method. The rules are: active verbs, present tense, with a verb and object for the input stimulus and the related verb and object for the output response. For example: "see the capital letter "A,"—write the lower case letter "a." That is one throughput "see-write" channel. Another might be "see the picture of the dog—say its sound." That is a "see-say" channel. And again, "see the picture of the dog—write its sound (e.g., bow, wow)." That is a see-write channel. Ever since we discovered that learning to read in three different graded readers each day produced independent learning pictures (Johnson, N. J. A., 1971), it also became clear that learning the same material in different channels produced different learning pictures.

<sup>7</sup>Maximizing frequency existed as a seed in the parent free-operant laboratory research. It was essential to design rat levers and pigeon keys that did not put ceilings on the response frequency. Back as far as 1938, Skinner was unhappy that the levers used in his classic research published in *The Behavior of Organisms* took one second to reset. This placed a 60 per minute ceiling on the rats' response frequency. Skinner immediately designed new levers that could be operated up to 300 times per minute and placed no ceiling on the animals' performance.

The more different channels skills or concepts are taught in, the more generalization to other environments occurs. Eric Haughton was working on large matrixes of learning channels when he died in 1985. He had reported some of this work at annual Precision Teaching conferences, but none was in print. No one has systematically followed up on this work. Teaching to several learning channels at once appears to produce stronger performance, steeper learning, and more generalization, and is more fun for both learner and teacher. Ideal mixes of learning channels for particular skills need to be discovered. Learning channels research is one of the most promising yet most neglected in the field of Precision Teaching.

### **How Effective Is Precision Teaching?**

Wherever Precision Teaching has been used, it has almost always doubled student learning at a median additional cost per teacher per year no higher than \$90 (Albrecht, 1984). That figures out to be only \$3 per student per year over current costs.

Precision Teaching has been selected as a nationally accredited educational model—Great Falls (Beck, 1976; Beck & Clement, 1991). Precision Teaching has had some success in public schools in special education. However, the strong bias against structure, monitoring, and frequent timed practice has kept it out of most public school regular classrooms. This is tragic because it could be used to develop a strong base of fluent tool skills in the pre-primary grades which would prevent many of the so-called learning and attention disorders which appear in the later grades.

Precision Teaching's most effective demonstrations are in learning centers and private schools which are not limited by anti-practice bias and lock-step curriculum controls. The Quinte Learning Centers in Belleville, Ontario (Maloney & Humphrey, 1982), the Haughton Learning Center in Napa, California (Freeman & Haughton, 1993a), and the Cache Valley Learning Center in Logan, Utah (Desjardins, 1993) are only three of the successful learning centers using Precision Teaching methods. The high effectiveness of one of the private schools using Precision Teaching is described below.

Morningside Academy in Seattle was established in 1980 and combines Precision Teaching to fluency with Direct Instruction and Tiemann-Markle instructional design. Teaching children with learning and attention problems, Morningside guarantees two grade levels gain per year in all subjects or tuition money back. In the seven years since offering the guarantee, Morningside has never had to return tuition for failing to produce two grade level gains per year (Johnson, 1989).

In 1987, Morningside added an adult literacy program in reading, mathematics, and writing for the Job Training and Partnership Act. Morningside agreed to be paid only for those students who progressed at least two grade levels in two skills in 21 months. Of the 32 African-American males in the first group, 29 exited with skills above the national eighth-grade literacy standard. They gained an average of 1.7 grade levels in two skills per month (20 hours of instruction). The U.S. government standard requires only one grade level gain per 100 hours of instruction. Therefore, Morningside Academy produces over 10 times the gain required by the government standard. Morningside's director attributed part of this success to the contingency that the faster the students advance, the sooner Morningside is paid (Johnson & Layng, 1992; Snyder, 1992).

In 1991, the Morningside Model was disseminated to the Academic Support Center at Malcolm X College in Chicago. During five weeks in January, April, May, June, and July, Malcolm X tutors were trained to teach a sequence of over 250 objectives in mathematics, from simple addition through solving ratios and equations with one unknown, a span of about six grade levels. The tutors practiced their new teaching skills with each other between training visits. The learners had high school diplomas but could not read at the sixth grade level. Beginning in July, for three hours per day, four days per week (Monday through Thursday)

for six weeks, the learners were tutored and practiced to fluency. Every Friday the tutors met with Johnson, Layng, and their in-training supervisors to share charts, discuss successes, brainstorm problems, and have their questions answered. Learners with entry math skills at the fifth grade level gained over six years in math computation, and over two years in math concepts and problem solving. After only 20 hours in timed reading practice, learners gained an average of 1.1 years in reading level (Johnson & Layng, 1992).

All of these gains at Seattle and Chicago occurred without any homework! None to turn in. None to grade.

### **Precision Teaching Do's and Don'ts for Instructional Design**

There are more than a dozen guidelines for designing instruction that follow from discoveries made by precision teachers and their supervisors (Lindsley, 1992a). These are counter-intuitive and go against the common and cherished beliefs of most educators now in power. Traditional instruction is designed to be too slowly paced, and involves too little practice, too few practice channels (only see-write), and too little learning progress feedback.

Here I briefly list ten Do's and three Don'ts drawn from Precision Teaching discoveries.

- Do count the number of all learner practice actions.
- Do time each practice session.
- Do shorten learner responses to two syllables to permit frequencies up to 200 per minute.
- Do have more practice sheet questions than any student can answer in the allotted time.
- Do have more negative instances than positive instances in practice materials.
- Do teach and require practice of the same material in several channels each day.
- Do build fluency first and accuracy later.
- Do separately chart both correct and error frequencies each day (learning pictures).
- Do use standard celeration charts so straight-line projections can be made by eye.
- Do use standard celeration charts so amounts of learning can be compared by eye.
- Don't monitor percent correct.
- Don't use finishing an assignment as a reward.
- Don't assign homework. (If you do it *must* be both timed and charted.)

This list could be extended by going further into detail. However, readers should get the flavor of Precision Teaching from these thirteen Do's and Don'ts.

### **Myths that Block Fluent Learning**

At least twelve myths entrenched in our culture block fluent learning. These are deep seated and very difficult to overcome by argument alone. In combination they are deadly! No wonder public school instruction is so ineffective! The only way to overcome these myths is to produce learning two to ten times greater than public school learning without using the tactics suggested by the myths. This must be done in private learning centers. Several of these centers were described earlier. The twelve blocking myths follow:

- (1) Performance improves by adding. WRONG!  
It improves by multiplying.
- (2) There is an ideal curriculum and system for all children. WRONG!  
Ideal learning needs are more unique than students' clothing needs.
- (3) See-Saw Theory—as corrects go up, errors must go down. WRONG!  
Correct and error learning are independent.

- (4) Things learned generalize automatically to other situations. **WRONG!**  
Performing is specific to the situation it was practiced in. Generalization must be carefully taught, using fluency and different channels.
- (5) Feedback is effective even if it comes a week after the performance. **WRONG!**  
Corrective feedback (did, didn't) should come immediately after performing.  
Instructive feedback (do, don't) should come just before the next performance.
- (6) Understanding must come before skills are learned. **WRONG!**  
Understanding is not necessary. It is a luxury!  
Understanding is most effective **AFTER** the skill is fluent.  
In academics, the mind still rules and is thought to learn more by understanding than practice.  
We know daily practice is essential in performing arts and sports.  
But we still believe understanding is more important than practice in academics.
- (7) A strong positive self-concept is required before skills can be learned. **WRONG!**  
A strong positive self-concept results from (comes **AFTER**) fluent, accurate skills.  
Telling learners they are good before they are fluent doesn't fool them; they know better—you merely invalidate your approval.
- (8) Accuracy must come first before speed. **WRONG!**  
Our most effective learning picture starts with high error frequencies (60 per min) and low correct frequencies (10 per min)—called "Jaws cross-over."
- (9) A high frequency of errors will break the learner's spirit. **WRONG!**  
High error frequencies decelerating rapidly each week build curricular spirit.
- (10) A high frequency of errors will teach the learner bad habits. **WRONG!**  
Learners actually need more practice on what not to do than on what to do.
- (11) Thirty minutes are needed for a topic, so one minute sessions are useless. **WRONG!**  
Charted practice sessions as small as 10 second "sprints" are more effective than long 20 to 30 minute sessions.
- (12) Speed tests produce anxiety which blocks what the learner really knows. **WRONG!**  
This only appears when the learner is only tested a few times each semester.  
With daily timed practice, the timing anxiety disappears within two weeks.

This list of entrenched myths that block teaching to fluency and rapid learning could be enlarged. There are several other entrenched myths about learning and performance that are just plain wrong. However, this list is long enough to give a notion of the kind of cultural blocks that effective teaching practices face in public school application.

### **Special Problems with Computer Assisted Instruction**

From 1985 to 1992, I advised a corporation which produced authoring systems for computer assisted instruction and custom courses for Fortune 500 clients. This company tried to combine the very best principles and procedures from Applied Behavior Analysis and Precision Teaching in its authoring system and courses (Silverman, Lindsley, & Porter, 1991a). Four major problems were encountered. First, the company executive officers and programmers believed more in the incorrect popular myths of how best to learn than they did in Precision Teaching's proven results. This produced almost constant stumbling, misinterpretation, and time-wasting in instructional design. They wanted the instruction to be comfortable for the student throughout. Second, there was a very real problem in getting the computer programs to refresh the screens fast enough to permit fluent students to respond at the exciting speeds

of 60 a minute and above. Computer arcade games do this, but it was like pulling teeth to get the programmers to make courseware that fast. Third, almost all clients wanted to use the courses in single sessions of two or three hours duration, treating this new technology very much like their familiar training lectures and workshops. They were told that they would get much better learning and learner satisfaction from brief daily practice sessions, but almost none used the courses that way. Fourth, almost all of the clients said they purchased the company's courses because of guaranteed results. But few looked at the results, and only one customer compared the results of the training with the employees' on-the-job performance (Silverman, Lindsley, & Porter, 1991b).

It is possible, if the developers *and users* of computer programs believe in fluency enough to override their cultural myths, to develop and use computer programs that get up to low fluency of 30 answers per minute. Both "Think Fast," developed for the IBM PC by Joseph Parsons<sup>8</sup> and "FluentLearn," developed for the Macintosh by Claudia McDade<sup>9</sup> accomplish 30 per minute. But these frequencies are far below the fluencies of 60 to 100 per minute reached with properly designed and used fluency cards. Fluency cards are called "SAFMEDS" to remind users that they must "Say All Fast a Minute Every Day Shuffled." And SAFMEDS' frequencies are far below the high fluencies of 200 to 300 per minute reached in see-say channels using properly designed practice sheets (Freeman & Haughton, 1993a). And practice sheet frequencies are below the high fluencies of 400 to 500 per minute reached in the think-say (sometimes called free-say) channel in which learners freely respond to directions with no immediate limiting stimuli (Freeman & Haughton, 1993b).

### Competing Viewpoints

There are two almost insurmountable competing view points that Precision Teaching must defeat. The first is the general cultural entrenchment of measurement habits of percent and base ten scaling. The second is the dominant small group research design with its associated intermittent measurement, independent observer, and analysis of variance probability statements.

Closely related to the small group research design is the extreme resistance to self-recorded data and a total dependence upon data observed by more than one "external observer." This brings up their stress on reliability to the exclusion of validity. How many times the teacher smiled at Tommy is *only* validly recorded by Tommy. (How many times that two observers saw the teacher smile at Tommy may produce a comforting notion of reliability, but if Tommy didn't see the smiles, then the "reliable" records are not valid). Statistical dogma assumes that you can't have validity without reliability. But you certainly can.

Variability is a datum—what we call daily bounce—not an error! This principle is further described in detail elsewhere (Johnston & Pennypacker, 1980).

### Models Supporting Precision Teaching's Daily Charting

Formative evaluation (Bloom, Hastings, & Madaus, 1971) and curriculum-based measurement (Deno, 1985) are both measurement models related to the daily counting and charting of Precision Teaching. Precision Teaching developed independently at approximately the same time as formative evaluation, and 15 years before curriculum-based measurement.

<sup>8</sup>*Think Fast* for the IBM PC is commercially available from Joseph A. Parsons, University of Victoria, P. O. Box 1700, Victoria, B.C., Canada V8W 2Y2.

<sup>9</sup>*FluentLearn* for the Macintosh is commercially available from McLAB, Inc., P. O. Box 571, Jacksonville, AL 36265.

Precision teaching is the ultimate in formative evaluation. Not only is the performance monitored while it is changing rather than after, but the performance on each and every day is recorded, charted, and projected in real time. Having learners count and chart their own performance in Precision Teaching ties the evaluation even more closely to the performance than when psychologists or teachers test occasionally during formative evaluation.

### **Models Supporting Precision Teaching's Fluency Aims**

Englemann's "firming" procedure (Englemann & Bruner, 1968) and Bloom's "automaticity" goal (Bloom, 1986) are both related to the fluency aims of Precision Teaching. Precision Teaching fluency aims developed independently at about the same time as Englemann's firming and 15 years before Bloom published his goal of automaticity.

In the Direct Instruction model, "firming" of mathematics and reading skills is related to fluency (Englemann & Bruner, 1968; Englemann & Carnine, 1970). Reading and arithmetic skills are considered firm when the student can perform them quickly and accurately. This firm performance is only loosely and not precisely defined. Questions such as "How does one know when a student is fluent" or "What is the frequency criterion for fluency" are as yet unresolved for Direct Instruction users (Williams & Albin, 1984).

Bloom's "automaticity" of performance, which he now claims should be one of the goals of instruction (Bloom, 1986) is related to fluency. However, "automaticity" is not precisely described. From reading Bloom, one cannot tell how you determine precisely when a performance is "automatic." Programming and practice frequencies are not given for producing automatic performance. Bloom does not even mention whether practice must be daily or not in order to produce automaticity. Also, the notion of automaticity was in the literature (Denekla & Rudell, 1974; Haughton, 1972, 1974) years before Bloom wrote about it.

### **Concluding Weak Points of Precision Teaching**

The weakest points of Precision Teaching are its confrontations with entrenched but faulty cultural myths and practices. I have recently described the paradox of how the work ethic, discipline, and competition are avoided in our public school academics, but welcomed in athletics (Lindsley, 1992b). Precision Teaching is seen as comprising all three of these and so is also avoided. "Drill and practice" is currently bad news in education, while "learning styles," "whole language," and "facilitated communication" are *in*.

The weakest point of Precision Teaching is its confrontation with massive cultural entrenchment of percent correct. Ron Holzschuh spent two years of post-doctoral research comparing the sensitivity and productivity of percent correct with frequency correct and incorrect as classroom performance measures. He found that frequencies correct and incorrect picked up 40 times more effects of routine changes in teaching procedures than did percent correct (Holzschuh & Dobbs, 1966). Also, teaching decisions based on percent correct monitoring were less productive and more difficult to make because the teachers could not tell what was happening to the correct or error learning. For example, if percent correct was staying the same, teachers could not tell whether the correct and error frequencies were both accelerating, both maintaining or both decelerating—they simply knew that the proportion was the same. For another example, if percent correct was increasing, the teacher did not know whether this was because both corrects and errors were accelerating with the corrects accelerating more steeply, whether the corrects were maintaining and the errors decelerating, or whether both corrects and errors were decelerating with the errors decelerating more steeply. These three different learning pictures require different remedial teaching procedures, which cannot be prescribed based on percent correct. This was true for different subject matters, and different grade levels. Ron concluded with the statement, "Percent is the worst thing that ever happened to education."

Base-five scaling (five fingers = one hand) is another entrenched procedure in education that Precision Teaching confronts. It has proven extremely difficult to get administrators and researchers to count the frequency of complaints or feelings of satisfaction with a school or its methods. The entrenched habit is to have parents, students, teachers, or administrators rate their satisfaction on a scale of five. The majority of research studies over the last two decades in educational administration have used questionnaires, Likert scales, small group design, and the analysis of variance, and as far as I know has discovered nothing of import.

Possibly the next weakest point is the educational establishment's entrenched use of tests and educational and school psychologists to do the testing. There is just no need for regular testing once each student's actual timed practice and learning is charted daily. In anticipation of resistance from school psychologists, I joined the Association for School Psychology and applied for and obtained American Board of Professional Psychology certification as a School Psychologist. I spent several years trying to recruit school psychologists to become learning specialists and advise teachers in solving the learning problems revealed on their student's charts. It seemed to me a natural (Lindsley, 1971b). They were in the schools. They were better trained in research and statistics than teachers. Presumably they liked numbers and general concepts and different learning and teaching techniques. However, I overlooked one thing. School Psychologists were imprinted with and dedicated to testing. Testing was their life, their blood. I advised them to estimate Binet and WRAT scores to get out from behind their long list of students who had already been placed in special classrooms by teacher request and now must be tested to justify the placement. This would be so that they could get into the classrooms and help teachers. We found out that the school psychologists preferred to have a huge pile of untested students in their in-basket—it was their security blanket. They were *testers*. In no way would they become *teacher helpers*!

Probably the next weakest point is its confrontation with the educational research establishment. Educational researchers should welcome Precision Teaching's power, find some cooperating public school classrooms, and start collecting what would be to them massive amounts of valid learning data already processed and charted. All they would have to do is collect and analyze the results. But they are now so caught up in their tactical procedures that they cannot even think, much less research, outside of the frame of their Latin Square, small group, reversal, crosstabs, analysis of variance and covariance research designs. These are so cumbersome that the researchers hardly ever get a study done on over two hundred students learning in real time under different curricular conditions.

One of the most powerful research potentials that Precision Teaching fell upon is the opportunity to determine rapidly the most effective of several curricula by trying three or more on the same student at the same time.

It looks like we may have to wait for a new generation of educators to adopt Precision Teaching methods. Max Planck once said, "A new scientific truth does not triumph by convincing its opponents . . . but rather because its opponents eventually die" (Barber, 1961, p. 597). In the same vein, Skinner sadly said, "I am convinced now that science never progresses by converting . . . It really takes a new generation" (Hall, 1967).

### Concluding Strong Points of Precision Teaching

The strongest point of Precision Teaching is that it works! It is one of the few measurement systems that *always* greatly enhances rather than interferes with the performance being monitored.

It is universal—all-inclusive. Every performance, from the most minute keyboard action or phonic utterance (Johnston, T. S., 1972) through previously considered unmeasurable events like thoughts, feelings, and urges (Calkin, 1981; Duncan, 1971) to global performances like books written and major creative ideas had, can be counted and divided by the time over

which they were counted, and charted. Everything we have seen charted, from felt fetal kicks (Edwards & Edwards, 1970) to world armed attacks (Taylor & Hudson, 1975), accelerates as straight lines on Standard Celeration Charts.

It is sensitive. Precision Teaching learning pictures have proven to be two to forty times more sensitive to changes in learning conditions than other monitoring and evaluating methods (Holzschuh & Dobbs, 1966). It reveals aspects of learning never before seen clearly.

It reveals two very different kinds of learning processes—jumps and turns. Jump-ups or jump-downs in frequency (performance) occur and are independent of turns in celeration (learning). At this time we know very little about what causes jumps and turns, the relationships between them, or why they are independent. We do know this independence poses serious problems for education and applied behavior analysis. We do know that a large proportion of the published data charts in the literature contain counter-turns (Lindsley & Rosales-Ruiz, 1984). A counter-turn is a jump-up followed by a turn down, or a jump-down followed by a turn-up. Counter-turns are counter-productive because over time you lose the effect you are trying to produce. In jump-ups followed by turn-downs, the abrupt, immediate effect of the reinforcer is gradually lost by the later deceleration (satiation) in the performance frequency. In jump-downs followed by turn-ups the abrupt, immediate effect of the punisher is gradually lost by the later acceleration (adaptation) in performance frequency.

Precision Teaching does not provide a comprehensive theoretical framework for understanding instructional design. This is because it is primarily an inductive system. If there is an underlying theory, it is that frequency monitoring on standard celeration charts is powers of ten more sensitive than percent or duration monitoring. However, even this has been proven by classroom research—so it is more correctly thought of as a proven method than a theory.

However, Precision Teaching does provide a comprehensive framework in which instructional development procedures and models can be evaluated while being developed, compared after development, and enhanced during their use later in the classroom.

Precision Teaching methods are the most powerful tools yet discovered to aid instructional design. Designers stubbornly resisting using these promising new tools seriously handicap the poor student required to learn from their imprecisely designed materials. Designers using the powerful tools of precision teaching, monitoring trial learner's Standard Celeration Charts continuously throughout instructional development, will earn my blessing, and the endearing gratitude of generations of student learners. They also will have earned the proud title *Precise Instructional Designer*, or *Precision Designer* for short.

## References

- Albrecht, P. L. (1984). *Summary of ten major school precision teaching programs*. Unpublished doctoral dissertation, University of Kansas, Lawrence.
- All, P. (1977). *From get truckin' to jaws, students improve their learning picture*. Unpublished master's thesis, University of Kansas, Lawrence.
- Barber, B. (1961). Resistance by scientists to scientific discovery. *Science*, 134, 596–602.
- Beck, R. J. (1976). *Report for the Office of Education Dissemination Review Panel, 1976, Special Education*. Great Falls Public Schools, Precision Teaching Project: Great Falls, MT.
- Beck, R. J. (1981). *High School Basic Skills Improvement Project: Validation Report for ESEA Title IV-C*. Great Falls Public Schools, Precision Teaching Project: Great Falls, MT.
- Beck, R., & Clement R. (1991). The Great Falls Precision Teaching Project: An historical examination. *Journal of Precision Teaching*, 8(2), 8–12.
- Bijou, S. W., & Baer, D. M. (1961). *Child development: Vol 1. A systematic and empirical theory*. New York: Appleton-Century-Crofts.

- Binder, C. V. (1990, Sept.). Closing the confidence gap. *Training*, 49-56.
- Binder, C. V., & Bloom, C. (1989, Feb.). Fluent product knowledge: Application in the financial services industry. *Performance and Instruction*, 17-21.
- Bloom, B. S. (1986). Automaticity: The hands and feet of genius. *Educational Leadership*, 43(5), 70-77.
- Bloom, B. S., Hastings, J. T., & Madaus, G. F. (1971). *Handbook on formative and summative evaluation of student learning*. New York: McGraw-Hill Book Company.
- Calkin, A. B. (1981). One minute timing improves inners. *Journal of Precision Teaching*, 2(3), 9-21.
- Denekla, M. B., & Rudell, R. (1974) Rapid "automatized" naming of pictured objects, colors, letters, and numbers by normal children. *Cortex*, 186-202.
- Deno, S. L., (1985). Curriculum-based measurement: The emerging alternative. *Exceptional Children*, 52(3), 219-232.
- Desjardins, A. (1993). Teaching addition and subtraction word problems. *Journal of Precision Teaching*, 10(2), 25-28.
- Desjardins, A., & Slocum, T. (1993). Integrating Precision Teaching with Direct Instruction. *Journal of Precision Teaching*, 10(2), 20-24.
- Duncan, A. D. (1969). Self application of behavior modification techniques by teen-agers. *Adolescence*, 6(4), 541-556.
- Duncan, A. D. (1971). The view from the inner eye: Personal management of inner and outer behaviors. *Teaching Exceptional Children*, 3(3), 152-156.
- Duncan, A. D. (1972). The gifted count and chart. In J. B. Jordan & L. S. Robbins (Eds.), *Let's try doing something else kind of thing: Behavioral principles and the exceptional child* (pp. 51-55). Arlington, VA: Council for Exceptional Children.
- Edwards, D. D., & Edwards, J. S. (1970). Fetal movement: Development and time course. *Science*, 169, 95-97.
- Engelmann, S., & Bruner, E. (1968). *DISTAR reading level I*. Chicago: Science Research Associates.
- Engelmann, S., & Carnine, D. W. (1970). *DISTAR arithmetic I*. Chicago: Science Research Associates.
- Engelmann, S., & Carnine, D. (1982). *Theory of instruction: Principles and applications*. New York: Irvington.
- Epstein, R. (1985). The spontaneous interconnection of three repertoires. *Psychological Record*, 35, 131-143.
- Fink, E. R. (1968). *Performance and selection rates of emotionally disturbed and mentally retarded preschoolers on Montessori materials*. Unpublished master's thesis, University of Kansas, Lawrence, KS.
- Freeman, G., & Haughton, E. (1993a) Building reading fluency across the curriculum. *Journal of Precision Teaching*, 10(2), 29-30.
- Freeman, G., & Haughton, E. (1993b) Handwriting fluency. *Journal of Precision Teaching*, 10(2), 31-32.
- Fuchs, L., & Deno, S. L. (1981). *A comparison of reading placements based on teacher judgement, standardized testing and curriculum-based measurement* (Research Report No. 53). Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities.
- Gove, P. B. (Ed.). (1961). *Webster's third new international dictionary of the English language (unabridged)*. Springfield, MA: G. & C. Merriam Co.
- Hall, M. H. (1967). An interview with "Mr. Behaviorist": B. F. Skinner. *Psychology Today*, 1(5), 20-23, 68-71.
- Haughton, E. C. (1972). Aims—growing and sharing. In J. B. Jordan & L. S. Robbins (Eds.), *Let's try doing something else kind of thing: Behavioral principles and the exceptional child* (pp. 20-39). Arlington, VA: Council for Exceptional Children.
- Haughton, E. C. (1974, March). Define your act and set your fluency goals in personal, social, and academic areas. *Special Education in Canada*, 48(2), 10-11.
- Haughton, E. C. (1981). REAPS. *Data Sharing Newsletter*. Waltham, MA: Behavior Prosthesis Laboratory.
- Holzschuh, R. D., & Dobbs, D. (1966). *Superiority of rate correct over percent correct*. Unpublished manuscript, Educational Research, University of Kansas Medical Center.
- Johnson, K. R. (1989). *Executive summary*. Morningside Corporation (810 18th Ave., Seattle, WA 98122).
- Johnson, K. R. (1992a). *Morningside phonics fluency: A Precision Teaching approach*. Seattle: Morningside Academy.
- Johnson, K. R. (1992b). *Morningside mathematics fluency: A Precision Teaching approach*. Seattle: Morningside Academy.

- Johnson, K. R., & Layng, T. V. J. (1992). Breaking the structuralist barrier: Literacy and numeracy with fluency. *American Psychologist*, 47(11), 1475-1490.
- Johnson, K. R., & Layng, T. V. J. (In Press). The Morningside Model of generative instruction. In R. Gardiner, D. Sainato, J. O. Cooper, T. E. Heron, W. L. Heward, & J. Eshleman (Eds.), *Behavior analysis in education: Focus on measurably superior instruction*. Pacific Grove, CA: Brooks/Cole Publishing Company.
- Johnson, K. R., & Streck, J. (1992). *Scope and sequence: Morningside mathematics: Revised edition*. Seattle: Morningside Academy.
- Johnson, N. J. A. (1971). *Acceleration of inner-city elementary school pupils' reading performance*. Unpublished doctoral dissertation, University of Kansas, Lawrence.
- Johnson, T. S. (1972). Precision therapy is the way to go. In J. B. Jordan & L. S. Robbins (Eds.), *Let's try doing something else kind of thing: Behavioral principles and the exceptional child* (pp. 40-50). Arlington, VA: Council for Exceptional Children.
- Johnston, J. M., & Pennypacker, H. S. (1980). *Strategies and tactics of human behavioral research*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Koenig, C. H. (1972). *Charting the future course of behavior*. Unpublished doctoral dissertation, University of Kansas, Lawrence.
- Kuhn, T. S. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago: The University of Chicago Press.
- Lindsley, O. R. (1960). Characteristics of the behavior of chronic psychotics as revealed by free-operant conditioning methods. *Diseases of the Nervous System*, 21 (monograph supplement), 66-78.
- Lindsley, O. R. (1971a). Precision Teaching in perspective: An interview with Ogden R. Lindsley; Ann Duncan, interviewer. *Teaching Exceptional Children*, 3(3), 114-119.
- Lindsley, O. R. (1971b). The beautiful future of school psychology: Advising teachers. In M. C. Reynolds (Ed.), *Proceedings of the Conference on Psychology and the Process of Schooling in the Next Decade: Alternative Conceptions* (pp. xxiii, 116-120). Minneapolis: Univ. of Minnesota, Dept. of Audio-Visual Extension.
- Lindsley, O. R. (1972). From Skinner to Precision Teaching: The child knows best. In J. B. Jordan & L. S. Robbins (Eds.), *Let's try doing something else kind of thing: Behavioral principles and the exceptional child* (pp. 1-11). Arlington, VA: Council for Exceptional Children.
- Lindsley, O. R. (1990). Precision teaching: By teachers for children. *Teaching Exceptional Children*, 22(3), 10-15.
- Lindsley, O. R. (1992a). Precision Teaching: Discoveries and effects. *Journal of Applied Behavior Analysis*, 25, 51-57.
- Lindsley, O. R. (1992b). Why aren't effective teaching tools widely adopted? *Journal of Applied Behavior Analysis*, 25, 21-26.
- Lindsley, O. R., & Rosales-Ruiz, J. (1984 May). Standard celeration meta-charting of overcorrection literature. In W. L. Heward (chair), *Exploring and assessing response deceleration procedures*. Symposium conducted at the 10th Annual Convention of the Association for Behavior Analysis, Nashville, TN.
- Maloney, M., & Humphrey, J. E. (Interviewer). (1982). The Quinte Learning Center: A successful venture in behavioral education—an interview with Michael Maloney. *The Behavioral Educator*, 4(1), 1-3.
- Markle, S. M. (1978, 1983). *Designs for instructional designers*. Champaign, IL: Stipes Publishing Company.
- Nevin, J. A. (1992). An integrative model for the study of behavioral momentum. *Journal of the Experimental Analysis of Behavior*, 57, 301-316.
- Oliva, C. M. (1981). *A comparison of the accuracies of five future projection methods*. Unpublished doctoral dissertation, University of Kansas, Lawrence. *Dissertation Abstracts International*, 1982, 42, 2956A (University Microfilms No. 81-28, 733).
- Pennypacker, H. S., Koenig, C. H., & Lindsley, O. R. (1972). *Handbook of the standard behavior chart*. Kansas City, KS: Precision Media.
- Potts, L., Eshelman, J. W., & Cooper, J. O., (1993). Ogden R. Lindsley and the historical development of Precision Teaching. *The Behavior Analyst*, 16, 177-189.
- Starlin, A. (1971). Charting group and individual instruction. *Teaching Exceptional Children*, 3, 135-136.
- Silverman, K., Lindsley, O. R., & Porter, K. L. (1991a). Overt responding in computer-based training. *Current Psychology: Research and Reviews*, 9(4), 373-384.

- Silverman, K., Lindsley, O. R., & Porter, K. L. (1991b). A computer intelligent tutoring system versus on-the-job tutoring. *Journal of Organizational Behavior Management*.
- Snyder, G. (1992). Morningside Academy: A learning guarantee. *Performance Management Magazine*, 10, 29-35.
- Taylor, C., & Hudson, M. (1975). *World handbook of political and social indicators*. New Haven: Yale University Press.
- Tiemann, P. W., & Markle, S. M. (1990). *Analyzing instructional content: A guide to instruction and evaluation* (4th ed.). Champaign, IL: Stipes Publishing Company.
- White, O. R. (1986). Precision Teaching—Precision Learning. *Exceptional Children*, 52, 522-534.
- Williams, J. A., & Albin, R. (1984, Spring). Fluency and skill maintenance by the handicapped. *Direct Instruction News*, p. 20.