Journal of Precision Teaching

Volume VII Fall 1990 Number 2

25th Anniversary of Precision Teaching
The Journal of Precision Teaching is a multidisciplinary journal dedicated to a science of human behavior which includes direct, continuous and standard measurement. This measurement includes a standard unit of behavior, frequency, a standard scale on which successive frequencies are displayed, the Standard Celeration Chart, a standard measure of behavior change between two frequencies, frequency multiplier, and a standard, straight-line measure of behavior change across seven or more frequencies, celeration. Frequencies, frequency multipliers, and celerations displayed on the Standard Celeration Chart form the basis for Chart-based decision-making and for evaluating the effects of independent variables.

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

Materials submitted for publication should meet the following criteria:
* be written in plain English
* contain a narrative that is brief, to the point, and easy to read
* use the Journal of Precision Teaching Standard Glossary and Charting Conventions
* format references according to the Publication Manual of the American Psychological Association
* contain data displayed or displayable on the Standard Celeration Chart to justify conclusions made
* direct data points may be submitted, so the Charting Macro program (Slocum, 1990) may produce an electronic version of the Chart
* original charts may also be submitted.

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

To encourage rapid dissemination of Precision Teaching research and successes only one reviewer need recommend publication for a manuscript to be included. Reviewers are encouraged to provide direct instruction to the author(s) to improve the article to ready it for publication.

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DEDICATION
by
Henry S. Pennypacker

This renaissance issue of the *Journal of Precision Teaching* is respectfully and lovingly dedicated to its founding Editor and Publisher, Patrick McGreevey. In 1979, Pat recognized the need for an archival source devoted to the methods and data of Precision Teaching. He also recognized the limited resources of its primary audience, classroom teachers, and established subscription rates accordingly. In the face of rising costs, he held the line as long as he could, finally supporting the Journal from his own pocket. When the burden became unbearable, he reluctantly suspended publication in 1986.

It is often said that we don’t appreciate some things until we lose them. The most tangible measure of our appreciation of the *Journal*, and of our respect for Pat, is in your hand. The new Editorial Board met and unanimously agreed the *Journal* had to survive. We hope it lives up to the standards set by its founding editor. We thank you, Pat, for your creation. May it continue to be the source of pride and satisfaction for you it has become for us.
Thanks to the encouragement of the entire Precision Teaching/Learning community, the Journal of Precision Teaching has been resurrected. Published in the Center for Individualized Instruction at Jacksonville State University, Jacksonville, AL, the Journal will be published biannually beginning with Volume 7—with a Spring and a Fall issue.

This issue (Volume 7, number 2) celebrates twenty-five years of Precision Teaching and the many thousands of students and teachers whose lives have been enhanced by this powerful performance-based technology. In this Jubilee issue we celebrate our roots by honoring Patrick McGreevy for beginning the Journal of Precision Teaching and keeping it afloat almost single-handedly. The last manuscript submitted by Eric Haughton, who died in 1985, celebrates his dedication and commitment to this measurably effective instructional technology. Lovingly edited by Abigail Calkin, Eric’s article is accompanied by remembrances from Carl Binder and Michael Maloney. This issue also encompasses the history and predicted future of Precision Teaching as charted by John Eshleman and encouraged by Ogden Lindsley. It compares Precision Teaching with an instructional approach using many similar procedures in Carl Binder’s article. Effective procedures across multiple skills are demonstrated in a learning center setting by Michael Maloney and his able staff of Annie Desjardens, and Pam Broad while effective procedures to enhance reading skills in mildly handicapped students are documented by William Wolking and his colleagues Carolyn Harris, Jolenea Ferro and Jack Scott. The effect of concrete to abstract instructional sequence for developing place value skills is described by Susan Peterson, Pam Hudson, Cecil Mercer, and Pam McLeod. SAFMEDS, a basic procedure of Precision Teaching, is evaluated by comparing student performance under three protocols by Claudia McDade and Charles Olander. The use of precision measurement outside the classroom is demonstrated by Abigail Calkin as she charts changes in behavior by individuals who have suffered the death of a loved one.

Special thanks for this Jubilee issue go to Charles Groover, Head of the Department of Art at Jacksonville State University, for the cover design and to the College of Letters and Sciences, Jacksonville State University for its assistance.

The Fall ‘90 issue of the Journal of Precision Teaching celebrates our twenty-five years of developing a multi-purpose system of measuring changes in performance. Not only is Precision Teaching tremendously effective in increasing student skills levels, but it results in teacher/researcher success as well—all of which is showcased here.

While the Journal maintains its original purpose, as noted inside the front cover, some changes are inevitable. Electronic submissions on computer disks with accompanying hard copies are encouraged from practitioners and researchers. Computerized versions of the standard celeration chart which maintain chart integrity, as well as behavior constructed charts, are accepted.

Twelve people have consented to serve as consulting editors to the Journal of Precision Teaching for one to three year terms. These include the following:

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Editor Emeritus - Ogden Lindsley

Many others have offered to serve as guest reviewers. All Precision Teachers are encouraged to become guest reviewers by writing the Journal of Precision Teaching, Center for Individualized Instruction, Jacksonville State University, Jacksonville, AL 32265.
Instructional technologists participating in the conference, Enhancing Instructional Technology: From Research to Reality, developed the following strategic plan to increase the influence of effective educational strategies throughout educational systems and training settings. Each participant committed to use at least one tactic to contribute to the overall goal. Progress on these goals will be discussed at a strategic planning workshop at the International Precision Teaching Conference in October, 1990. All interested instructional technologists are encouraged to adopt at least one tactic over the next year.

Goals
--to develop better communication of effective instructional strategies
--to influence the power structures in existing educational systems, legislatures, colleges of education (i.e., teacher training settings), foundations, corporations
--to develop cost-effective, private schools which evaluate their effectiveness by student gain
--to increase use of instructional technologies with “gifted” or accelerated students

Strategies
Communication
--Utilize popular press and professional organizations outside of ABA
--Get into print anywhere and everywhere
--Learn more about other instructional technologies
--Become acquainted with existing exemplary programs
--Determine whether instructional technology can benefit from the “peace dividend”

Influencing power structures
--Demonstrate effective instructional technologies to corporate America
--Court power structures
--Market instructional technologies on the basis of cost-effectiveness
--Teach teachers, teacher trainers

Developing effective private schools
--Demonstrate and showcase economically viable, effective schools
--Encourage behaviorally responsive investing with strong portfolios

Tactics
Communication
--Develop... policy statements: Direct Instruction, Precision Teaching, individualized instruction bibliography film, video library new videos of exemplary programs, effective instructional techniques (courseware) list of exemplary programs directory of correct addresses of instructional technologists film of Stephanie Bates (featured in early charting film) now series of case histories of students whose lives were enhanced by instructional technologies

--Resurrect Journal of Precision Teaching
--Provide Direct Instruction workshop for other instructional technologists at ABA ’91
--Communicate with lay public:

write or respond to editorials and letters to editor in newspapers, newsletters, popular press
approach national public radio, public television, consumer organizations (e.g., Ralph Nader’s education representative)
submit articles to popular press

--Submit articles, presentations, proposals to non-behavioral professional organizations, publications

--Submit articles, presentations, proposals to behavioral professional organizations, publications

--Increase network, influence by subscribing to CompuServe and accessing behavioral bulletin board at least weekly

--Circulate success stories among network

--Use only effective technologies in personal teaching, tutoring situations

Influencing Power Structures
--Homework: Research organization being targeted
--Court organization:

Define purpose; set objectives
Develop plan for using existing money in different way
Put something in writing (i.e., plain English); copyright it; take it with you
Offer to assist organization in meeting its goals—without cost when possible
Volunteer services
Become a staff developer or in-service training provider
Provide demonstrations of “learning at work.”
Go back, go back, go back
--Market instructional technologies on basis of student performance and cost-effectiveness
--Increase network of instructional technologists open workshops/seminars with well-known public figures
attract public figures who already show some interest (e.g., Barbara Bush)
--Design and implement a reinforcement system for each other and other approaches that are effective
--Support/endorse candidates who assist effective instruction
--Get elected to local school board
--Submit a list of speakers on effective education to school boards, colleges, chambers of commerce, civic organizations

Claudia E. McDade

This strategic plan was summarized from conference notes and videotapes by Dr. Claudia McDade. For copies or further information, contact the Center for Individualized Instruction, Jacksonville State University, Jacksonville, AL 36265.
Our Aims, Discoveries, Failures, and Problem
by
Ogden R. Lindsley

Here I outline our first aims, our discoveries, our failures, and our major problem. I describe our failures more fully than our discoveries, because the failures have been seldom described. Also, these failures are still good ideas and should be given a chance at wider use. Our discoveries are well known and adequately reported in the literature. Our discoveries are in fairly wide use. Therefore, I will merely call attention to our most important benchmarks. This outline does not detail or support these benchmarks with data. Query the references for detail and data support.

OUR FIRST AIMS

In 1965 we set out to introduce (1) rate of response with (2) standard (3) direct (4) continuous, and (5) self-recording to public school classrooms. Laboratory research had proven rate to be more sensitive than percent correct and other less direct behavior measures (Lindsley, 1956). Rate (frequency), we thought, might also prove more sensitive in monitoring classroom learning.

We met these initial five aims in our first three years in education. Our first class-wide frequency recording was in a Montessori class for special children (Fink, 1968). Elaine Fink showed we could effectively use rate of response with curricula as varied and as difficult to measure as Montessori materials. Clay and Ann Starlin showed an entire regular first grade class could correct, and chart their own academic work on standard celeration charts (Starlin, A., 1972, Starlin, C., 1971). Ron Holzschuh with Dorothy Dobbs and Tom Caldwell showed that academic frequencies (rates) recorded 40 times more effects of curricular changes than did percent correct (Holzschuh & Dobbs, 1966) (Caldwell, 1966). At the time Ron said that percent correct was the worst thing that ever happened to education. These and many other studies proved behavior frequencies significantly more sensitive to learning variables in the classrooms that percent correct and percent of time observed on task.

We successfully moved frequency of response to the classrooms. We produced a standard chart for teacher and child recording. We were successful beyond our dreams. Then we began training teachers to use Precision Teaching. We also began researching further applications of our standard chart. Phillip Hilts accurately reports our high excitement during that time (Hilts, 1974).

OUR DISCOVERIES

We did not set out to discover basic laws of behavior. Rather, we merely intended to monitor standard, self recorded performance frequencies in the classroom. We expected frequency would prove more sensitive and would produce more rapid learning.

However, along the way, as we collected thousands of learnings on standard charts, relationships began to emerge. Our plain English thinking and communicating made it easier to see new and unexpected relationships. Our discoveries were data-up (inductive). The massive amounts of easily compared data slowly induced counter-intuitive ideas. Our discoveries were not theory-down (deductive). Gradually we discovered surprising basic laws of behavior that had eluded us in the laboratories.

The most important discoveries are outlined below. Sometimes, when unexpectedly asked what we had found out, I would fail to remember one of our most important discoveries. If I couldn't recall them all, how could I expect others to? So I made a memory aid for myself. After the aid had successfully worked for me for a year, I shared it with others (Lindsley, 1977). Our memory aid for the five most important counter-intuitive laws of behavior is MUSIC.

M - BEHAVIOR MULTIPLIES
IT DOESN'T ADD

Our major discovery was that all behavior multiplies or divides. You should not even think increase or decrease. When thinking about behavior, you should think multiplying or dividing. It is proportional and almost always changing. We have proven this several different ways, but we have not
succeeded in getting even ourselves really to believe it. We use the standard celeration chart, but we talk about increases and decreases on it. Of course, we are trying to overcome 600 years of incorrectness about behavior.

It is similar to overcoming the notion that the world is flat. Thinking that all behavior is either multiplying or dividing is counter intuitive. It doesn't feel right. However, counter intuitive discoveries give us much more new power than discoveries we expected. They correct us.

As the nineteenth century humorist, Henry Wheeler Shaw said through his character, Josh Billings, "It ain't what a man don't know what makes him a fool, but what he knows that ain't so." Here's what we know that is so:

Behavior frequencies accelerate by multiplying and decelerate by dividing.
Behaviors bounce up the same multiple as they bounce down (homogeneous variance).
The total bounce stays the same multiple as the frequency changes (additive variance).
Frequencies across persons are spread the same multiple up as down.
Everything you look at about behavior is proportional or a multiple. Behavior lives in the multiply world. If you look for behavior in the add world, you will not find it and will not know why you didn't.

**U - BEHAVIOR IS UNIQUE NOT COMMON**

Everything about behavior is unique to that behaver. To maximize learning we had to customize many teaching procedures or values to each learner. Our one-minute timings on practice sheets have more problems than the fastest learner can solve automatically in the allotted time. These adjust the amount of work to each learner's performance. In the early seventies we devised the following slogans to describe customizing the Precision Teaching steps of: Pinpoint, Record, Change, and Try, Try Again.

**PRECISION TEACHING UNIQUENESS SLOGANS**

**SETTING:** Different BEDS for Different HEADS.

**MANIPULANDUM:** Different TOOLS for different FOOLS.

**PINPOINT:** Different STROKES for different FOLKS.

**AIMS:** Different GOALS for different SOULS.

**REWARDS:** Different BUCKS for different DUCKS.

**CHANGES:** Different TRYS for different GUYS.

**S - BEHAVIOR IS SPECIFIC NOT GENERALIZED**

We should expect behavior to occur at fluent frequencies only in the situation in which they were learned. If generalization is wanted, then it must be taught. The learner must practice fluently in each and every situation that fluency is wanted. We do not expect generalization to occur by magic. If we want generalization, we must teach it.

**I - BEHAVIOR IS INDEPENDENT NOT DEPENDENT**

The mistaken notion that as corrects go up errors must go down maintains using percent correct to measure learning. This see-saw effect occurs only when teachers hold the number of problems constant and so low that all learners can answer all problems in the allotted time.

Correct and error frequencies are independent.

Positive and negative behaviors are independent.

Positive and negative feelings are independent.

Positive thoughts and positive behaviors are independent.

Urges and their related behavior are independent.

In other words, everything about behavior is independent.

The biggest surprise was the independence of frequency (performance) and celeration (learning). I was convinced prior to our summary of 32,192 banked projects that the higher the frequency, the higher would be the celeration. I expected this because the higher frequencies of reinforcement at the higher frequencies of performance would produce steeper learning.

Carl Koenig broke each of the six times 10 cycles on the chart into 3 class intervals. This made a total of 18 intervals covering the range of frequencies from .001 a minute to 1000 a minute. The middle celeration of each frequency interval was selected for the acceleration targets and the same was done
for the deceleration targets. The median celeration for all except one of the frequency intervals was times 1.1 per week. There were no frequencies between 5000 and 1000 per minute. The median celeration for the interval from .01 to .02 per minute was times 1.2.

The median celerations were the same, times 1.1 per week for acceleration targets and divide by 1.1 per week for deceleration targets for each frequency band. This was almost like gravity - 32 feet per second per second no matter how heavy the object. Learning was times 1.1 per week no matter how frequent the performance. Learning (celeration) is independent of performance (frequency).

C - BEHAVIOR IS CONSEQUATED NOT CAUSED

We should realize that behavior is maintained by its consequences. Its antecedents or causes merely set the situations under which the consequences operate. When a child starts yelling in the classroom, you should not look at what happened just before the tantrum. If the counselor enters and says, "What caused that?" the answer is, "I don't know, he hasn't stopped yet!"

Behavior is pushed from its rear, not pulled from its front. What immediately follows the behavior is what maintains it.

DAILY PRACTICE

We found in many studies that daily practice is essential. One minute a day beats three minutes every other day. This work was supported by my own studies with graduate students at the University of Kansas. Sue Ellen Gabriel found the same thing in the classrooms of Great Falls, Montana schools.

FLUENCY REAPS FUN

Eric and Elizabeth Haughton developed the fluency aims in Hastings County School District of Ontario, Canada. Their data showed that practicing tool skills up to frequencies of 100 to 300 per minute, facilitated later learning of more complicated tasks involving these tool skills. In the early seventies Eric was urging reading fluency to aims over 100 words per minute (Haughton, 1972).

Eric designed the memory aid REAPS to list the benefits produced by high fluent frequencies:

R for Retention. High fluency produces longer retention.
E for Endurance. High fluency produces greater endurance.
A for Application. High fluency produces greater generalization to new environments.
P for Performance aims. Fluency gives you teaching aims.
S for Stability. Fluent performance is more stable and more resistant to distraction.

I added a further memory aid FUN to list three additional benefits of fluency:
F for Fun. It is more fun to perform fluently.
U for Understanding. Fluency generates interest in understanding what you are fluent in.
N for No cheating. Cheating slows the learner so much that it can't be used in fluency.

Carl Binder has recently published a further discussion of the relationship between fluency and Precision Teaching (Binder, 1988). Even more recently the relationship between fluency and attention span has been pointed out (Binder, Haughton, & Van Eyk, 1990).

OUR FAILURES

THE BEHAVIOR BANK

Because we collected school learning on standard charts, we went the next step and described the behavior, the setting, the curriculum and their changes on standard forms. An optical character reader read the standard form for each behavior project. An IBM mainframe computer stored the daily behavior frequencies and detailed description for each project. Data could be deposited for less than $1.00 per project.

Teachers could ask questions of the Behavior Bank to help their teaching. Researchers could ask questions to test their ideas and theories. Teacher trainers and researchers did not have to collect data any more to check ideas that were not yet in the literature. They only had to ask their questions of the projects in the Bank. The Bank did not sell access to its data. To share you had to contribute (Koenig, 1971b).

Over 11,947 projects were stored in the Behavior Bank by 1971 and their listings published in two volumes (Lindsley, Koenig, Nichol, Kanter & Young, 1971). In addition to the 5 compilers, there were 27 editors (depositors). There were 2,673 authors including the project behavers, managers, advisors, and trainers. Counts of the number of times in which a person appeared as either behaver,
manager, adviser, trainer, or depositor were provided for each author.

The first volume contained Procedure Lists: Editors, Authors, Pinpoints, Programmed Events, and Arranged Events. There were 1,223 different movement cycles using 1,046 different programmed events and 818 different arranged events. If the projects were laid end to end they would cover 2,359 years of daily frequencies, reaching from 1971 AD to 388 BC, or four years before Aristotle was born.

The second volume contained Summary Charts. Inexpensive graphical plotters did not exist at that time, so the Behavior Bank could neither read nor print standard celeration charts. However, the computer did print out summary charts of dots and lines for each pinpoint with five or more projects. For the first phase of each pinpoint: best, middle, and worst beginning frequencies; best, middle, and worst celerations; and best, middle, and worst ending frequencies were charted. The best celerations and best ending frequencies were summarized next. Finally, the best frequency and celeration multipliers (now called jumps and tums) were drawn completing each project's summary chart.

These volumes never sold well, but *Precise Behavior Facts* is still available from Behavior Research Company. By November 1973 there were 32,192 projects stored.

The Behavior Bank failed because the people who sent in the projects did not ask the bank questions. Maybe we should have sold access, and non-depositors might have asked questions. Our depositors really didn't want to know the facts about classroom behavior, even though they all said they wanted to know. Almost no one asked.

Hasn't worked yet.

**BEHAVIORGRAMS**

Our standard charts and the standard forms inputting behavior projects to the Behavior Bank led us to Behaviorgrams. The idea was a one page form to check out and fill in blanks to describe new ideas and methods that worked in classrooms. The size of the produced celerations would be reported. The sheet would be photo-offset and published. We hoped Behaviorgrams would shorten the writing task and help teachers share ideas. Haven't worked yet.

**PRECISION AS AN ADJECTIVE**

We chose the term "Precision Teaching" to describe using frequency and standard celeration charts (called standard behavior charts at the time) for three reasons. First was to separate our classrooms from Applied Behavior Analysis classrooms that mostly used percentage of the time observed behaving or percent correct on student work sheets. Second was to describe the measurement detail - the direct recording of each and every classroom behavior in real time as it occurred. And third was to make our method an adjective, so professionals could append the name of our method to their professional noun or verb to describe their application.

Thus we could have Precision Counseling, Precision Social Work, Precision Coaching, Precision Supervision, Precision Administration and Precise Personal Management. We hoped this would leave the professional egos intact and the adjectives "Precision" or "Precise" would describe the use of our standard cross-disciplinary methods.

Precise Personal Management (Zemke, 1974) and Precision Therapy (Johnson, 1972) got some early use by Ann Duncan and her students. But as far as I know, only Precision Social Work (Green & Morrow, 1972) and Precision Nursing (Dean, 1973) added "Precision" to the name of their specialty.

Hasn't worked yet.

**PLAIN ENGLISH**

We chose plain English to name new procedures and new discoveries. We used plain English for three reasons. (1) Plain English is actually more precise than higher order, academic English which prefers words like variability in place of bounce, spread, consistency, repeatable, or reversible. For example, fire (combustion) is consistent, seldom repeatable, and never reversible.

(2) Using plain English would widen our base across professional specialties, and also across the amount of training within a specialty. Not only would Precision Social Workers be able to rapidly learn to use the Plain English words, but beginning Precision Social Workers would learn the words as rapidly as fully trained Social Workers would learn them.

(3) Mounting evidence suggests that the most successful creative thinking at the frontiers of
science is done in Plain English. We have the most experience in our childhood language, therefore we are most comfortable and most assured using it as a tool. Comfort and assurance increase the chances of success in trying to understand difficult and complex new problems.

Pat McGreevy worked harder than the rest of us in furthering Plain English in our communications. He printed and passed out "Plain English" T-shirts. I still have mine, it is white with dark brown lettering. He titled his book *Teaching and Learning in Plain English* (McGreevy, 1981). He named his company that first published the *Journal of Precision Teaching*, "Plain English Publications." The first of the seven criteria for accepting publication material in the Journal was "1) be written in plain English" (McGreevy, 1980).

Recently, in reviewing an article for the Spring 1991 issue of the *Journal of Precision Teaching*, the excessive use of passive constructions, and the long convoluted sentences made it almost impossible for me to follow some of the logic. I ran a readability analysis on the article (Correct Grammar, 1990).

Guess what? Twenty-one percent of the sentences were passive. The average sentence length was 21 words. Seven percent of the sentences had over 32 words. The reading ease score was 19.4 - very difficult. The grade level required was 16 - available to only 5% of US adults!

Hasn't worked yet.

Dear, sweet, Plain English, why have we abandoned you?

**CHILD KNOWS BEST**

The "child knows best" was adapted from Skinner's phrase " the rat knows best". In practice it meant that each learner self recorded, charted, decided and then presented his or her own improvement procedures. Each learner self managed as teachers taught and coached self management methods (Lindsley, 1971).

Learner self management had five very important effects. (1) It cost less than teacher or observer recording. (2) It produced records as reliable and much more valid than other recording. (3) The effects produced were usually larger than teacher managed effects. (4) It developed a trust of the learner in contrast to the erosion of trust produced by double checking of counts by teacher and observer. (5) The learners developed higher order self management skills to take with them in later life.

We found that the first child in a classroom who learned to chart taught the rest of the children more effectively than did the teacher. A color slide and audio tape of 6 year old Stephanie Bates was widely used in teaching charting at workshops and schools (Bates & Bates, 1970, 1971).

The first issue of the *Journal of Precision Teaching* had a child (yet to be named) on the editorial board.

The special spring 1971 issue of *Teaching Exceptional Children* was dedicated to Precision Teaching with Ann Duncan as guest editor. Nineteen years later the special spring 1990 issue also covered Precision Teaching with Richard West and K. Richard Young as guest editors.

Comparing these two special issues shows what happened to Precision Teaching in 19 years. The number of authors per article went from 1.1 to 3.0. The number of teacher authors went from 6 (35%) to 5 (14%). One 1990 article had 5 authors and only 3 references. The number of program coordinator authors went from 3 (18%) to 7 (19%). The number of building principal authors went from 0 (0%) to 4 (11%). The number of child authors went from 3 (18%) to 0 (0%). The number of university professor and graduate student authors went from 4 (24%) to 19 (53%).

The Council for Exceptional Children has two journals, one for researchers and one for teachers. It looks like we are converting our failed teacher journal into a researcher journal. That still won't solve the problem. It actually is avoiding it. We will reinforce ourselves for pages published rather than bigger child learnings. We will place ourselves under the same contingencies that have come close to destroying university research. But, our teachers will still have no journal to read and write in.

In summary, in 19 years the portion of child or teacher authoring divided by 10 while the portion of school official authoring doubled, and the portion of university authoring doubled.

The exceptions to this loss of child self-management are the private non-profit school programs described below. The Ben Bronz Academy has an exceptionally high degree of learner involvement in its program. It is an exemplar of "the child knows best."
Also, here and there a hold-out still works to have children count and chart their own behavior. Kathleen Liberty and Mary Ann Paeth recently described self-recording devices for use by severely handicapped children (Liberty & Paeth, 1990).

Where have all the children gone?

Into photographs. Into photographs.

The 1971 issue had 44 (48%) child photographs and 41 (52%) adult photographs. The 1990 issue had 14 (64%) child photos and only 8 (26%) adult photographs. In other words in 1990 we picture the children twice as much but use them as authors not at all. A drawing on page 4 of the 1990 issue illustrates this trend. It shows a child sitting at a desk on the stage of a compound microscope through which a teacher peers with pencil behind ear and clipboard under arm. The child has become an object for teacher microscopy.

Where have all the children gone?

Under the teachers' microscopes.

INNER BEHAVIORS

Teachers who limit themselves to recording only external, reliability tested behavior, lose access to their pupil's thoughts and feelings. Ann Duncan and her students at Yeshiva University extensively researched adult and child charting of inner behaviors (Duncan, 1971b). Abigail Calkin compared first and second graders' perceptions of facts learned with their feelings of fun and freedom under different curricula and films. She found that free and restricted feelings follow the same laws as external behaviors (Calkin, 1979). Calkin maintains her interest in charting inners today. However, few others do.

The spring 1971 Teaching Exceptional Children Precision Teaching issue had 2 (13%) of its 15 articles on inner behaviors. The spring 1990 Teaching Exceptional Children Precision Teaching issue had none.

Worked but has lost ground.

PRECISION TRAINED BUILDING PRINCIPALS

In 1971 many of the special education teachers who we had trained to precision teach reported back to us that they were ordered not to use charts by their building principals. I decided that we should train some precision principals from the ground up. The plan was for me to transfer from the special education to the educational administration department. There I recruited experienced precision teachers who wanted administrator credentials. After receiving their doctorates and administrators certification, they should be able to set up their own school-wide Precision Teaching programs.

I should have known better!

Ann Starlin surveyed fifteen principals trained in Precision Teaching (Starlin, 1986). Seven (47%) had discontinued charting. Seven (47%) had at least a little charting going on in their school. Only one had a building-wide program with all teachers and students using Precision Teaching. That had been the goal for training precision administrators. Our success rate was 1/15 or 6%! Dismal for 10 years work.

Public school principals have no power to make instructional decisions for the school. All they can do is suggest. One disgruntled teacher can disgruntle a parent or two. If the disgruntled parent complains to the superintendent, or even worse to a board member, the principal is told to go slow.

Rarely works.

PUBLIC SCHOOL EXTERNALLY-SUPPORTED PROGRAMS

Peggy Albrecht Gayler surveyed ten major school Precision Teaching programs (Albrecht, 1984). Two of these (Father Flanagan's Boys Town and Spaulding Youth Center) were private schools and will be summarized below. Two of the eight: Seattle, Spokane, Tacoma-SST project PERFORM, directed by Harold Kunzelmann and Shawnee Mission Kansas project PRODUCT, directed by Henri Sokolove received external federal support with no real local support. Both of these did not survive beyond their first three years of federal funding.

The notion that federal money is seed money and the planted seeds will continue to grow after the federal funds stop is wrong. What actually happens, is that the school district would lose face if it could continue the program without federal funds. Why did they take the money in the first place if they can do it now with only local funds?

Work for a while but don't endure.
PRIVATE NON-PROFIT AGENCIES

Private not-for-profit agencies seem to be able to run Precision Teaching programs for a few years, but they also do not endure. If they get too big and too successful, they attract hostile take-over artists. One or two members of the board arrange for a political friend to take over the agency. The new director kills the Precision Teaching program.

Hostile take-over then slaughter killed the Precision Teaching project at the University of Florida. A dean took it over, in a year or so replaced the director, then killed the project.

Hostile take-over slaughter killed Operation Upgrade, Kansas City, Missouri (Johnson, 1971a, 1971b). The Kansas City school district took over the project; a year later the director, Nancy Johnson, was found tardy on routine reports and replaced. The next year the project was killed.

Hostile take-over then slaughter killed the precision program of Big Brothers of Kansas City. Ron Holzschuh started Big Brothers of Kansas City and set up its precision management program at the same time. A few years later, the board decided not to add a Big Sisters program. A separate Big Sisters program was formed directed by a former city health department professional administrator. A year later the board merged the two programs into Big Brothers, Big Sisters of Kansas City directed by a professional administrator. Ron resigned and the program was killed.

Exceptions to this vulnerability of non-profit agencies are the two excellent programs at Father Flanagan's Boystown, Omaha, Nebraska, and Jacksonville State University, Jacksonville, Alabama.

In 1979 the Boystown program started by requiring all teachers to use Precision Teaching after formal training. Only 2 out of 63 teachers quit. Directed by John Downs, the program is going into its eleventh year. The costs have decreased from $220 per teacher in 1979 to $35 per teacher. This extremely effective program shows what can be done with full administrative support. I have never heard of a public school that could require teachers to teach in a certain way.

In 1977 the Center for Individualized Instruction at Jacksonville State University, Jacksonville, Alabama was started by Charles Merbitz. The Center has continually grown and has prospered without external grant support since 1986. It currently teaches 4000 students per year using a staff of 10 faculty and 40 students. The Center combines Precision Teaching methods with computer-based and Personalized Instruction. Directed by Claudia McDade, the Center is working with TeleRobotics International, Inc. to get their course authoring system (CourseBuilder) to follow frequencies high enough to generate fluency.

A slightly less direct take-over occurred at Spaulding Youth Center, Tilton, New Hampshire. Welles Hively was director and built a comprehensive, effective Precision Teaching program in both classrooms and residences. Hively resigned to go back into research in St. Louis. The board replaced him with an open classroom, non-structured type of director, even though two highly qualified Precision Teaching trained administrators were applicants. The board said, we have had seven years’ success with this highly structured thing, now it’s time to try something else.

If they work, they need very strong administrative support, or they’re killed.

CURRENT SUCCESSES

PUBLIC SCHOOL

LOCALLY SUPPORTED PROGRAMS

Five of the major school programs in Albrecht’s survey were public school programs with strong local district and/or state financial and administrative support (Albrecht, 1984). As Table 1 indicates, all five of these (100%) have grown and prospered for 10 to 20 years.

The message is clear. Local support is crucial in starting and maintaining the public school Precision Teaching programs. Second, the cost of the program divided to figures in the $5 to $150 per teacher after the initial training is over. (The $400 per teacher for the Minneapolis project was inflated due to a validation phrase.)

PRIVATE NON-PROFIT SCHOOLS

Quinte Learning Center, Belleville, Ontario, directed by Michael Maloney; the Morningside Academy, Seattle, Washington, directed by Kent Johnson; the Ben Bronz Academy, West Hartford, Connecticut, directed by Aileen Stan-Spence and Ian Spence; and the Haughton Learning, directed by Elizabeth Haughton; all have successful, self-supporting Precision Teaching programs.
These private schools may well be the only places left with program-wide learner self-charting. The Ben Bronz Academy has a widely based learner managed program with the students generating their own newspaper and governance.

The Morningside Academy has recently moved into adult literacy, combining practice timings with direct instruction and Markle instructional design principles. Morningside can guarantee a one year gain in reading level within only five weeks.

These programs usually start out by running summer tutoring to catch children up to grade level before the fall semester. This summer tutoring success attracts parents who want after school and weekend tutoring throughout the year. It takes about two years to firmly establish these programs. By that time local supporters usually demand a full time program adding about a grade level a year.

The key here is to maintain full control of the staff, the curriculum, the funds and the board. Since it is a non-profit agency, it must have a fairly large board. Some make the mistake of having a broadly represented board. The broader the board, the greater the tendency for someone on the board to want to try something else.

These non-profit private schools are now working well, but are probably dependent on their current directors.

**OUR MAJOR PROBLEM: NO LEARNING COMMISSIONS**

All of the above failures that haven't been accepted yet were highly effective. However, they were too effective for school systems dedicated to empowering and securing educators. Maximizing learning threatens the security of teaching based on classroom or credit hours.

It appears that the more social, the more gregarious the precision teacher, the more fragile are his or her skills. This is because the more the precision teacher is influenced by social consequences, the easier it is for the educational establishment to use these social consequences to counter-reinforce the teacher's skills. This is a catch-22. The better the social skills of the teacher, the more susceptible to losing their skills.

Who keeps going the longest in the face of counter-reinforcement? The nerd, the misfit, the marcher to a different drummer, is most apt to continue in the face of strong social counter-reinforcement. But even they gradually lose the skills that are not supported by their environment. People say they have weakened, softened, mellowed, or matured.

Most of our academically placed researchers have worked on smaller and smaller problems. Reducing to further details is the trend in most sciences. They research details like, are 30 second timings more cost-effective than 60 second timings? They dream up new, more detailed chart codes. They try to reconcile charting with both traditional behavior analysis (multiple base lines) and traditional educational methods. For example, they conduct t-tests on the accuracy of predicting from celeration lines drawn on multiply charts compared with those drawn on add charts. They do this with classroom learning of less than times 1.1 celeration per week. They do not realize that every possible transformation fits a line of times 1.0 equally well.

<table>
<thead>
<tr>
<th>Year Start</th>
<th>City and State</th>
<th>First Director</th>
<th>Grades</th>
<th>$/Teacher First Year</th>
<th>$/Teacher in 1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>Bemidji, MN</td>
<td>Clay Starlin</td>
<td>K-6</td>
<td>$25</td>
<td>$5</td>
</tr>
<tr>
<td>1972</td>
<td>Minneapolis, MN</td>
<td>Marie Blackburn</td>
<td>K-12</td>
<td>$125</td>
<td>$400</td>
</tr>
<tr>
<td>1973</td>
<td>Great Falls, MT</td>
<td>Ray Beck</td>
<td>K-12</td>
<td>$8000</td>
<td>$90</td>
</tr>
<tr>
<td>1977</td>
<td>Weber County, UT</td>
<td>Betty Nowak</td>
<td>K-9</td>
<td>$400</td>
<td>$10</td>
</tr>
<tr>
<td>1980</td>
<td>Orange County, FL</td>
<td>Marilyn Heffren</td>
<td>K-9</td>
<td>$5000</td>
<td>$150</td>
</tr>
</tbody>
</table>
The lower the acceleration, the less difference the type of chart makes. All such topics are trivia compared to our major problem.

Our PROBLEM is global, is social, is organizational. We need to find a way to positively reinforce, to REWARD ourselves, our administrators, our teachers, and our learners for more effective learning. We need LEARNING COMMISSIONS. Until we do that, at best we will become a small, academic group, arguing with each other about trivia that no one else even understands, much less cares about. Then our journals can be in jargon, since there will be no need for plain English.

Our researchers, our university people, should work to find systems to arrange major rewards tied to the magnitude of behavior change produced. Our researchers should find ways to arrange these payoffs for the entire Precision Teaching team. Researchers, administrators, supervisors, teachers, aides, tutors, parents, children, and janitors all should receive some commission when each learner accelerates his or her performance.

What is the best mix of learning commissions for production and salary for security? Precision Teaching methods are so effective that we would actually be most secure on learning commissions alone, without any salary. The fact that we do not put ourselves on learning commissions proves that we ourselves do not realize the power of our methods. If we did, we would feel more secure on learning commissions than on salaries controlled by unions and administrators. We have the only method which can continually monitor, compare, and signal major accelerations and decelerations in performance. If we were on learning commissions, our effectiveness would be our security.

If we can reward ourselves, our administrators, our teachers, our parents, our learners for celeration, then all else will take care of itself. Our public will not want learning until they are paid well for it. We will not want more learning until we are paid for it.

FUTURE POTENTIAL

PRIVATE FOR-PROFIT SCHOOLS

It seems to me that for-profit schools promise our most secure future. We need only work out the pricing structure. How do parents pay for learning accomplishments rather than tuition? How do we amass the capital to deliver the teaching before we get paid for the accomplishment? How do we certify the accomplishment? We know how to measure learning and fluency, but how do we certify it? Even more importantly how do we certify its absence before learning? Clearly, we could have parents place money in a bank escrow account. When their learner reaches a sub-goal, then we pay the entire school team. Each member of the team gets an appropriate portion as a learning commission. The learner would, of course, be included.

The gain of one year in reading level in five weeks produced at the Morningside Academy could be easily cost accounted. A 30 to 50% profit could be added, and a preliminary charge per grade level determined. This would provide a start for escrow payment prior to instruction. Then the learning commissions earned by each team member could be determined. These learning commissions would be delivered upon learner accomplishment.

We clearly have the learning skills to do this now. What we lack is the financial details, the logistics. Of course we also lack the courage of our own conviction. We lack trust in our own methods.

Anyone ready for such a venture can count me in as an investor and major participant.

HOW TO IMPROVE YOUR OWN PRECISION SKILLS

You can maintain your skills with weekly or monthly local chart sharing sessions. Each participant has 2 minutes at an overhead projector to share a chart. After all have shared a chart, the sharings recycle and each participant presents his or her second chart. Sharings recycle until all charts have been shared.

However, I have seen little evidence that chart sharing improves precision skills. It maintains skills. It broadens skills, by rapidly and efficiently communicating different charting applications. But it is not enough to generate major new discoveries.

Major advances in Precision Teaching methods have leveled off. Is this because we have learned all there is to know about learning? Or is this because we already know more about learning than we need to know to meet our current demands?

We already get in trouble in public schools by teaching too much. The first grade precision teacher who ends up the school year with the whole class reading at third grade level is in deep trouble with the third and second grade teachers. This
teacher's accomplishments will not only be ignored, but will actually be punished.

You need a reason to improve your own Precision Teaching skills. Unless rewarded for producing more learning, your skills will atrophy rather than improve. The best way to improve your skills is to conduct afternoon, weekend, and summer tutoring based totally on learning commissions. You can start in a room of your home, and have only your time to invest. It will take some time to learn the appropriate price schedule for learnings. It will take about two years for the community to learn of your success and for clients to refer other clients.

When we are finally producing learning for profit, and making a profit, Precision Teaching methods will be secure in our society. Major Precision Teaching discoveries will once again be frequent.

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The History and Future of Precision Teaching
by
John W. Eshleman

Certain historical trends in a science can be discerned from a frequency and celeration analysis of its literature base. Such analysis could be performed by compiling an exhaustive list of references pertaining to that science, next coding them with various keywords and by various attribute, and then sorting them by year to give a count per year frequencies. This paper describes just such a compilation of Precision Teaching literature. Assembled into a HyperCard stack database are 1200 references to works pertaining to Precision Teaching and standard celeration charting. These works include publications, conference presentations, dissertations, and unpublished documents. Spanning the years 1964 to 1990, the data indicate (1) that there was an overall acceleration of references until 1981, which was followed by an overall deceleration, and (2) that conference presentations greatly outnumber publications by more than two to one. The data support a contention that Precision Teaching has become largely an “oral tradition,” with possible adverse effects on the long-term prospects of the field.

Any scientific discipline has many aspects, including an archival literature base comprised of journal articles, books, and other published functions as a means of communication. Such a literature base not only helps define a science, it also functions as a means of communication. Scientific disciplines are also verbal communities, and it is characteristic for the members of a particular scientific community to meet periodically and share what they have done or what they have to say in regard to the science. Papers presented at conferences are thus at least quasi-members of the archival literature base of a science. Citing such presentations is certainly as proper a scholarly activity as referring to publications. In any event, publications and presentations are the two primary modes by which scientific discussion and communication proceeds.

A reference points to a particular work, be it published, presented, unpublished or some other achievement. References typically include the name of the author(s), the title and publication data, and most importantly for historical research purposes, the year during which the work was either developed or shared. Since any healthy science generates a certain number of works that can be referenced, the year of every reference can be noted. Accordingly from that a count per year can be obtained. Plotting the yearly counts of references will thus present an overview of the amount of activity in a science. We can determine whether scientific activity is increasing or decreasing, or whether stability exists. Further, once the references are compiled, if they are coded using certain key words or attributes, a finer examination of historical trends is possible. Such an historical analysis, based on counts per year of references, has been done with that part of behavior analysis known as Precision Teaching and forms the basis of this paper.

As a part of behavior analysis, the roots of Precision Teaching extend back to Skinner’s early work in operant conditioning (e.g., Lindsley, 1981). For practical purposes, however, Precision Teaching can be given an arbitrary starting date of 1964 with the publication of Lindsley’s paper “Direct Measurement and Prosthesis of Retarded Behavior.” This publication articulated many of the foundational precepts of Precision Teaching. Within a couple of years of this article came the other principal feature of Precision Teaching, the standard celeration chart (e.g., Pennypacker, Koenig, & Lindsley, 1972). With that arrival, Precision Teaching was on its way to becoming a distinctly identifiable area of research and application.

Historical trends in Precision Teaching can be discerned from a frequency and celeration analysis of its publication and presentation archival literature base. To accomplish this analysis, for the past decade I have compiled a data base in excess of 1,200 references pertaining to Precision Teaching works, or works using the standard celeration chart. These references include published articles, books and other items, unpublished manuscripts, dissertations, theses, and conference presentations. The data base covers the years 1964 to the present, and represents an updated revision of an earlier data base that had been assembled several years ago (Eshleman, 1983).
Method

Sources. The "subjects" of the present research were references to works pertaining to Precision Teaching and/or the standard celeration chart, and the objective was to find them. The main objective was to find and compile them. No previous comprehensive bibliography of the work done in the area of Precision Teaching existed. Early searches of Psychological Abstracts and ERIC proved largely fruitless. Two early but small compilations done by others in the mid-1970's provided a couple hundred references (Rutherford, 1975; Precision Media, 1976). Reference listings at the end of journal articles or bibliographies in books provided another source. The Journal of Precision Teaching provided a discrete set of articles, as did a scattering of papers in other journals (mostly special education publications), including Teaching Exceptional Children. Relevant conference presentations were relatively easy to find in the conference program guides of both the Association for Behavior Analysis and the Precision Learning/Precision Teaching meetings. Finally, the publication of the article about the earlier Precision Teaching data base included a request for persons in the field to send in references, and several did so (sending their vitae).

Procedure. The goal in assembling the data base was to be exhaustive. I believe the data base discussed in this paper to be the most complete and extensive data base of Precision Teaching works in existence. For inclusion a work had to be about either (1) some aspect of Precision Teaching or the standard celeration chart, or (2) present data on standard celeration charts. The two categories are not necessarily identical or coterminous.

Whereas the earlier 1983 version was simply a text listing constructed using a word processor, this new version has been entered into a HyperCard stack on a Macintosh computer (see Goodman, 1987 for a discussion of HyperCard). The new version contains data that the earlier version lacked, including (1) keywords, (2) type of reference (publication, conference presentation, dissertation, thesis), (3) reference source, and (4) a capability to sort the references by any of these data types or by author or year. Such a capability permits one to ask various questions about trends in the field.

Figure 1 illustrates how a reference card appears in the HyperCard data base and explains the various features of each card and of the stack. Each reference card contains (1) a sequential code number that indicates the location of the card in the stack, (2) a reference field containing a reference entered using a format similar to APA style, (3) a field indicating the type of work, whether it was a conference presentation or publication or dissertation, (4) a field containing additional data about the source (e.g., if it were a conference presentation, whether it was presented at ABA or the PL/PT conferences), (5) a separate year field for making sorting by year easier, (6) a "notes" field that can contain keywords and notes about the reference, (7) a "mark" button and field so that the user can "mark" the card for later searching, sorting, and retrieval, and (8) various HyperCard navigational buttons as well as buttons that perform other functions.

On top of the Macintosh, buttons are activated by placing the cursor on top of them and pressing the mouse, a hand-driven input device. The button labeled "Buttons" changes the visibility of 17 additional buttons, which are not shown in the figure. These additional buttons were programmed to either (1) put data into the text fields, and thereby semi-automate the data entry process, or (2) tally and compute yearly frequencies (the "Count" buttons).

Reliability. Since the objective of this undertaking has been to exhaustively capture everything ever published or presented in Precision Teaching, no explicit inter-rater reliability has been conducted. Improving accuracy of the data is an ongoing objective, however. References from the 1984 Precision Teaching conference are still not in the stack, and there may be data from one or more other conferences held within the past 15 years that are also missing. Readers are invited to inform me about references that should be either (1) deleted, (2) added, or (3) modified.

Results

Yearly frequencies are presented in Charts 1--5.

Overall Historical Trends. As Chart 1 shows, there has been an overall celeration of x1.8 per 5 years increase in Precision Teaching references. A trend-following celeration (e.g., Lindsley, 1980) reveals that this overall increase is characterized by a couple of celeration turn-ups and turn-downs. There was an early acceleration of x12 per 5 years from 1964 to 1971. This was followed by a turn-down of +1.5 per 5 years from 1971 to 1978. The beginning of the Association for Behavior Analysis (ABA—which began in 1975 as the Midwestern Association for Behavior Analysis) had no immediate effect on the frequency of Precision

Figure 1 Card #635 in the Precision Teaching references database. The stack is sorted by senior author's last name and by year.
Teaching works. From 1978 through 1982 there was a second flurry of activity, with an acceleration of +1.8 per 5 years. During the 1980's, however, there was a general turn-down of +1.8 per 5 years --

Trends in Publications. Chart 2 depicts the yearly frequencies and trend-following accelerations with respect to publications. Of particular note was the effect of the start of the Journal of Precision Teaching in 1980, which not only halted the acceleration turn-down of the 1970's, but also resulted in an immediate frequency jump-up of x7. When the Journal temporarily ceased publication after 1986, there was a frequency jump-down of +3.2 that accompanied a steep -9 per 5 years deceleration.

Trends in Presentations. The history with respect to conference presentations is somewhat more interesting, if only because there have been considerably more presentations than publications. Presentations outnumber publications by two to one. As Chart 2 shows, presentations began increasing in frequency in 1975, and by 1977 were already exceeding the number of publications. This trend has continued unabated. Chart 3 indicates the number of presentations at ABA conferences dealing with Precision Teaching. Even though there is an overall x1.3 acceleration, the trend-following accelerations more accurately portray what has happened. After a rapid x18 per 5 years acceleration across the first seven years of ABA, there has been a slow, steady turn-down since 1981.

Precision Learning/Precision Teaching conference presentations, on the other hand, have been more stable. When conferences were held, approximately 45 presentations were made. Of additional note here is that data from at least one PLPT conference are still not in the data base, but when these are added, the disparity between presentations and publications will only increase.

Discussion

The data illustrate two principal periods of growth in the field of Precision Teaching: an early one lasting from the mid-1960's to the early 70's, and another one from the late 70's to the early 80's. Both steep accelerations were followed by gradual declines. The source of the second acceleration is easily attributable to establishing the Journal of Precision Teaching, as well as convexing conferences explicitly about the field. Both circumstances opened avenues of communication that previously did not exist, and both helped cause Precision Teaching to flourish.

Of even greater note, however, has been the enormous number of presentations compared to publications. This situation differs from behavior analysis in general, where the number of published works in the major behavioral journals exceeds or more closely approximates the number of presentations. The demise of the Journal of Precision Teaching from 1986 to 1990 only further exacerbated the disparity, which grows even larger if only the years during which presentations have been a factor (since 1975) are considered.

Of more general concern, however, is the data indicate that precision teaching has become largely an "oral" tradition. The science tends to be communicated orally via presentation much more than it does by print. The reason for concern is that unless presentations are recorded and made available, they are otherwise ephemeral, affecting only those in attendance. Publications, on the other hand, are more permanent vehicles for scientific communication, even if such communication is only one way. They provide the interested scholar or researcher a source of information--a set of verbal stimuli that function as discriminative stimuli for various verbal repertoires. These can be consulted and read, and thus reacted to in a way that the ephemeral presentation cannot function. Their effect is much more lasting than a presentation. This becomes critical, especially as long stretches of time--years and decades--pass. Researchers from later generations will not be able to learn from presentations when their only permanent product is a reference pointing to them. Considering that presentations have outnumbered publications by more than two to one, a vast amount of verbal behavior with respect to Precision Teaching has been lost.

Perhaps the temporary demise of the Journal of Precision Teaching and the deceleration in Precision Teaching presentations at ABA indicates that as a field Precision Teaching has lost its vitality and has fewer new ideas to offer. I beg to disagree. The data illustrate the effect of a journal on scientific communication. Now that the Journal of Precision Teaching has resumed publication, we may yet see a third acceleration in Precision Teaching activity.

Data-based Literature Reviews. One other aspect of the present research deserves comment. This project demonstrates that a review of the literature...
can be data oriented. Further, the literature review section of a paper or dissertation (e.g., Eshleman, 1988) can be just as data-based as the results section. A literature review that analyzes the growth or decline of a field in terms of frequency and celeration can give the reader an additional perspective with which to evaluate the field in general and the paper in particular.

References


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Precision Teachers offer some of the most accurate, sensitive and valid formative data available in the human service area. The use of B.F. Skinner’s frequency as a basic datum and of O.R. Lindsley’s monitoring of successive frequencies of thousands of human behaviors account for Precision Teaching’s accuracy, sensitivity and validity.

Some of us in teaching or research run into confrontations with our historical measurement precedents. Test styles have been so rigid for the past 40 years that new approaches, however clear and operational, are often placed on the defensive. My own experiences as an early field advisor and supervisor causes me to be sensitive and practiced in discussing this interesting and complex area.

In the past few years I’ve been developing an overhead and handout to attempt to explore this labyrinthian, nether region.

Contrasts

Repeated measurement forms a cornerstone of the foundation of information different from traditional or commercial testings. Testing attempts to relate group data to static individual data. Actuarial data (such as insurance and testing companies use) cannot forecast an individual’s outcomes. Precision Teachers monitor performance on the standard culmination chart to observe and to forecast change. As we measure individual and program concerns, we compare the individual’s charts to group or other reference data. Commercial tests cover the waterfront on a wide spectrum of topics to meet market demands and administrative needs—not the needs of individuals. Both measuring systems attend to the two major quantities: Quantity 1 is temporal (calendar and interval); Quantity 2 is the content of performance. Frequency is our constant unit of information, while standardized tests inherently obscure frequency data.

Both systems work to insure the accuracy of data. Precision Teachers break performance into significant packages to explore and meet aims such as corrects, skips, and learning opportunities. Traditional testing generally relates only to accuracy, while obscuring accuracy into the artifacts of percentile and stanine rankings.

Measuring - from Testing to Monitoring

Commercial/Personal. Standardized tests often commit to multiple-choice and machine scoring formats for economic considerations. These formats can be intimidating and distracting to both behaviors and managers. Precision Teachers strive for a fully informed team of learner and instructor, involving usual and relevant behaviors, high comfort and trust levels. Data on my personal pinpoints are for, and belong to, me personally.

Minifeedback/Maxifeedback. In the worst testing situations, teachers do not learn the results. In the best, they receive them, but often find them difficult to interpret, let alone to use them to improve student learning. Behavers who chart regularly receive maximum, immediate feedback while managing their own projects. They operate as self-managers and resource seekers.

Average/Proficient. Standardized tests relate performance to the mean of peers. On any standardized test, by definition, half must fall below the norm. Suppose you are in the first grade, and the mean peer-norm is 50 words correct per minute on oral reading. Is 50 words per minute competent, fluent, proficient? No. Or suppose the mean peer-norm is 250. Is 249 words per minute incompetent, stumbling, in need of improvement? No.

We Precision Teachers use different frames of reference depending on the behaver’s interests, desires, and needs. We may ask for a personal aim at the start—“better than I was.” We may use some peer data. In the final analysis, we owe it to each behaver to determine levels that will insure retention, endurance, and application of his/her learning. Many of us recognize this topic as deserving immediate study. Since we are a “Nation at Risk”, we

*Special thanks go to Abigail Calkin for salvaging and editing this manuscript. (Claudia McDade, Editor)
need to determine and implement education based on substantial proficiency levels. Few decision guidelines exist. What performance levels do you use when deciding on a new phase? How much is enough?

Fail/Support. If you cannot answer items on standardized tests, you fail the item. One of the classic IQ items is “What is Mars?” If Robin answers, “Candy bar,” she fails. In Precision Teaching we structure monitoring to support Robin through changes. There is no failure in Precision Teaching. (“Feel better, Robin?”)

Snapshot/Continuous. Testing, even pre and post-testing, is a one-shot event. In Precision Teaching we check performance repeatedly based on regular calendar cycles.

Now/Forecasts. Not navigators, weather folks, physicians, physicists, behavers, managers, not you, and certainly not I, can forecast from a single observation. Therefore snapshot, commercial tests offer at best only a static hint about a person’s strengths and needs. Since we don’t know the rate of change, we can’t estimate the intensity of intervention required, or if any is required. Ten day screening data improves people at x1.3 M/m/week. We Precision Teachers have learned not to project a flat line from an initial frequency, an unfortunate and incorrect assumption in current testing and statistical approaches. Slope is one of our big power pieces for understanding measurement and individuals.

Unrelated/Relevant. U.S. federal law 94-142 requires that measurement relates to behaver’s program and goals. Good-bye I.Q.! Adios, much traditional diagnostic and labeling testing! Au revoir, heterogeneous test sections! Hello, valid, reliable, usually homogeneous items with SENSITIVITY! We must give more consideration to the fact that our data are sensitive

Prompt/Produce. Prompted, test-taking behavior in multiple-choice format differs from normal performance ecology. Surely you know several anecdotes about people who have guessed their way to “success” on prompted tests. Monitored performance is similar to real-life production, often requiring multiple, compound channel sites. This is in marked contrast to commercial testing’s slavish use of See/Select.

Monoview/Multiview. Traditional tests report some aspect of the quality of effort, then translate the statistically adjusted score, or artifact, into a meaningless grade-level statement. Does anyone know what 4.2 in math means? What exactly does that child know? What is “equivalent to grade 10 level of reading”? Can that person read any chemistry book, any novel? Our data set includes categories of performance (correct, legible, requires improvement, learning opportunities, skips, etc.), as well as presenting the rate of change through the family of Standard Celeration Charts. Changing the rate of change is our goal as we strive to maximize performance gains for each person.

Validity/Valid. Tomes have been written to justify the use of remotely chosen items presented on commercial tests. (If you wish to study this topic from an historical perspective, check the history of “operational definitions.”) Our data are valid because when we measure a topic, we measure our area of programming and of concern. This approach allows us to verify empirically and continuously our data in each setting, on each project.

Metaphor/Relation. Perhaps one day society will deem it unprofessional or unethical (or both) to translate raw data into the unknown. We do not know what age 2.6 on a Denver (or any preschool test) means. We are unable to interpret what mental age of 6.9 means. We cannot program for a child who “scores” 8.2 on the language section of the California Test of Basic Skills or the Iowa Test of Basic Skills. On the other hand, directly quantified performance of a specific topic monitored over time, aids everyone’s understanding. We Precision Teachers require clear awareness of relationships between events and performance.**

Afterward

About 20 years ago, Og Lindsley presented ideas about the deficits of standardized testing. Maybe it was in a course, perhaps at a local or national conference, maybe in a marathon rap session in some motel room in North America. He pointed out that we were in the process of standardizing the information format and flow relating to people, that we would gain significantly from our implementation of frequency monitoring using standard celeration

** We have the tools to emerge fully from the alchemy of education and psychology. The question is how do we improve our measurement and strategies, and thus our communication to the rest of the world about this unique and superior system of measurement. (an editorial comment of Abigail B. Calkin, Consulting Editor.)
charts. Traditional testing has worked strenuously to structure procedures, instructions, page format, administrative minutiae, as well as to attempt to determine appropriate content and sequence.

Overconcern and testing biases applied to inappropriate areas of classroom and research efforts contribute to weakening people. Certainly one of the leading causes of the failure of the education system is its lack of effective monitoring of student performance. If we assume that this lack is one of the lesser causes of education’s failure, then we shall never know our error and therefore, shall be unable to correct it.

Historically and presently, performance levels have been seldom observed or recorded prior to the efforts of Precision Teachers. Our expectations are challenging. We support the behavior thoroughly while delighting in his/her gains. We are humble in the realization of the magnitude of our task and the potential gains to individuals and to the communities associated with maximizing personal development.

References


Abigail B. Calkin

Dr. Eric Haughton was one of the pioneers of Applied Behavior Analysis and Precision Teaching and also served as a contributing editor to this journal from its inception in 1980. At the time of his death in 1985, Eric was a faculty member at Loyalist College, Belleville, Ontario, Canada.
Eric was a visionary. He saw his world not as it was or what it was expected to be by others, but as what it could become in the hands of fluent performers. Learning, to Eric, was the principal means of becoming. Eric pushed the envelope of conventional wisdom in the same way that test pilots push the limits of prototype aircraft. Like a Chuck Yeager, Eric was flying high and fast, a specialist at the pinnacle of technical excellence in his field.

Eric's visionary bent often led to controversy with established ideas.

One of the clearest images I have of Eric is contained in a story Annie Desjardins related to me about a case conference of a severely developmentally delayed child with whom Annie worked. Annie and Eric were working on gross motor development skills including teaching Linda to walk. The physiotherapist was aghast when Eric indicated that they expected Linda to learn to walk at 130 steps per minute. "Impossible" she declared, "Nobody walks at 130 steps a minute!"

"How quickly do they pace?" inquired Eric. "I'm not sure, but probably more like 30-40 steps a minute," retorted the now angry physiotherapist. "Show me," said Eric. "I'll count and you walk."

Pushed to the professional brink in front of an audience of colleagues, but unwilling to concede anything, the poor physio tried to walk at 30 steps per minute. Perched on one foot for 2 minutes then on the other, continually in danger of falling flat on her face in a physical, as well as a professional sense, she finally sat down.

"We'll teach Linda to walk at 130 steps per minute," summarized Eric. "I think she'll be happier that way." And they did.
Working with Eric Haughton had a major impact on my commitment to and understanding of Precision Teaching. The concept of "fluency" to which he introduced me and many others, along with the use of fluency aims, represented a quantum leap from the more traditional thinking of "behavior modification" that many of us brought to early applications of the Standard Celeration Chart. In practice, he taught us about the implications of fluency for development of retention, endurance or attention span, and application of tool skills and skill elements. In my view, these concepts form the most fundamental principles of Precision Teaching practice and curriculum design, along with use of celeration as a direct measure of learning.

Conducting fluency research with Eric in the classroom of Elizabeth Haughton and other Precision Teachers in Hastings County, Ontario, added new dimensions to my conceptual framework. Having studied with B. F. Skinner and learned about the nuts and bolts of behavior analysis from Bea Barrett, I now learned from Eric and Elizabeth about combining science with day-to-day work in the classroom with children.

Eric taught me never to use the chart unless I have a real question in need of an answer. The question might be as simple as "Is the student learning?" Or "How fast is the student learning?" Or "What helps the student learn most?" In that case, daily charting and frequent decision-making, involving the children whenever possible, serve a real purpose in day-to-day classroom practice. But when teachers chart just for the sake of charting, as a process without a question or need to know, the chart loses its value. In fact, charting without a real desire to answer questions and make decisions actually devalues the entire process. It's sad to see how many so-called Precision Teachers simply "go through the motions" rather than looking, with their students, for better and faster learning -- using the chart to answer questions, make decisions, and keep the learning process exciting and new.

Eric brought an almost child-like curiosity to his work -- one of the many reasons he seemed so easily able to engage children (and most adults). He really wanted to KNOW. Eric lacked the buttoned-down look and attitude of stereotyped scientists -- one reason he often came into conflict with academics and bureaucrats. But his curiosity, his genuine desire to answer questions using the standard chart, made him among the most important and contributing scientist-practitioners in the field of education. Thanks to Eric Haughton for planting so many of the seed questions that have grown in 25 years of Precision Teaching.
Precision Teaching and Curriculum Based Measurement

by

Carl Binder

Background

Precision Teaching (PT) began when Lindsley (1964) first applied the principles of functional behavior analysis and the use of count per minute measures to the "direct measurement and prosthesis of retarded behavior." By designing a powerful new tool, the Standard Behavior Chart (Pennypacker, Koenig, and Lindsley, 1972), and conventions for using it to graph and make decisions about behavioral and curriculum interventions, Lindsley literally put science in the hands of students and teachers (Lindsley, 1990).

By the early 1970's, PT had become a new force in both regular and special education (Lindsley 1968;1972). Its practitioners had begun to make important discoveries about the use of count per minute fluency standards or "aims" (Haughton, 1972), and about how to move students through curriculum sequences on the basis of fluency standards at each step along the way (Starlin, 1972). These were powerful new insights that added force to the practice and concepts of criterion-referenced instruction by defining mastery as accuracy plus speed, or fluency -- not accuracy only.

Demonstration projects during the late 60's and early 70's confirmed the power of this approach, showing that as little as 20 to 30 minutes per day of Precision Teaching in regular and special class-rooms could boost children's achievement test scores by as much as 20 to 40 percentile points (Beck, 1979). Various large-scale assessment programs demonstrated the predictive validity of brief count per minute performance samples in distinguishing between "at risk" and successful students (e.g., Magliocca, Rinaldi, Crew, and Kunzelmann, 1977).

During the early 1980's, many papers and articles about Curriculum Based Measurement (CBM) appeared in the professional literature (e.g., Deno, 1985), exhibiting a number of striking conceptual and practical similarities to Precision Teaching. Interestingly, some of the earliest Precision Teaching work in curriculum and assessment was carried out in Minnesota (Starlin, 1972; Starlin and Starlin, 1973a; 1973b; 1973c), the birth-place some years later of CBM. One of the more common references in CBM articles is a text on Precision Teaching (White and Haring, 1981). Evidence suggests that those now promoting CBM were strongly influenced by early work in PT. At the 8th International Precision Teaching Conference in San Diego (March, 1989), practitioners of CBM attended and held discussions with Precision Teachers.

This article is an effort to clarify some of the similarities and differences between Precision Teaching and Curriculum Based Measurement. Hopefully it will stimulate further discussion and clarification of methods and assumptions between these two "relatives" in the field of education.

Similarities

Perhaps the most obvious commonality is that both PT and CBM use frequent, and usually brief (e.g., 1 to 5 minutes) timed measures of student performance on specific curriculum pinpoints to make decisions about individual students' placement and programming. The use of time-based performance measures separates them from mainstream educational practice, and allows practitioners of each approach to make sensitive distinctions between multiple levels of student achievement, not possible with conventional untimed measurement procedures (Barrett, 1979).

Both PT and CBM use graphic displays of performance over a calendar base for recording and decision-making. They each rely on graphic analysis by teachers as a tool for individualized instructional programming. They even use some of the same graphic conventions, e.g., upside down "tear drops" for displaying median performances on the charts (Kunzelmann et al, 1970; Deno, 1986).
Differences

An important difference between CBM and PT is their choice of graphic display (Deno, 1986). CBM uses equal interval or "add/subtract" graphs, not always standardized with a count per minute scale. Precision Teaching is founded on the Standard Behavior Chart (a.k.a. the Standard Celeration Chart), a six-cycle semi-logarithmic (or "multiply/divide") count per minute graph (Pennypacker, et al, 1972). The Standard Chart is a powerful tool for communication and analysis, in large part because of its standardization. Once teachers and students become accustomed to its dimensions and features, they are able to communicate and make decisions rapidly about behaviors occurring throughout the entire range of human frequencies, within a single graphic format. In fact, Lindsley (1990) reports that standardization of the chart cut teachers' analysis and communication time by a factor of ten.

The specific features of the Standard Chart give it tremendous analytic power in contrast to non-standard add/subtract charts (McGreevy, 1984). In particular, the multiply/divide count per minute scale turns "learning curves" into learning lines, or 'celerations' (Pennypacker, et al, 1972). The expression of learning as a multiplicative factor per week provides the first simple quantification of learning in the history of behavioral science. Early empirical research on the predictive power of the chart demonstrated that straight-line projections reliably predict the future course of behavior and that the chart maintains homogeneity and symmetry of variance, important features for both scientific analysis and classroom decision-making (Koenig, 1972).

Another difference between PT and CBM is in how they establish performance criteria. Precision Teachers assume that there is a level of performance for any given skill that will support retention and maintenance, endurance or attention span, and application or transfer of training (Mercer, Mercer and Evans, 1982; Binder, 1988). One of the most critical early discoveries in Precision Teaching concerned the importance of setting high aims (Haughton, 1972) for prerequisite or "tool" skills in order to ensure smooth progress through curriculum.

CBM seems to suggest using class averages as performance criteria (Marston and Magnusson, 1985). This is a dangerous practice in several respects. If an entire class performs below the mastery level (i.e., that level of performance required to support effective function) then the class norm is not a fair mastery criterion. Because of the decline in teachers' use of classroom practice exercises over the years, we might guess that this is often the case. For example, most competent adults can write answers to between 70 and 100 simple addition problems in a minute. Few classrooms provide either the materials or sufficient practice to enable students to achieve this level, although children in Precision Teaching classrooms routinely do so. We know that students will often come up to high expectations, or settle for low ones. If our objective is merely to keep students from falling below the average, to keep them out of the "special needs" category, then the CBM strategy may suffice. But if we seek to support true mastery at each step in the curriculum, to help all children become masterful students, then we must use performance criteria that are objective definitions of competence.

This difference is apparent in the two systems' definitions of fluency. Tindal (1989) says that in CBM "There is no objective standard of fluency. We have to know the normative information." Precision Teachers, on the other hand, maintain that fluency represents an objective standard of performance that can be determined objectively: the level of speed plus accuracy sufficient to ensure retention, endurance and application of skills and knowledge (Haughton, 1972; Binder, 1988).

This objective definition of fluency has influenced a number of Precision Teaching researchers over the years. For example, Haughton (1972) first demonstrated the relationship between application and minimum levels of performance. Bower and Orgel (1984) demonstrated the relationship between fluency and retention. Binder, Haughton and Van Eyk (1990) demonstrated relationships between fluency and endurance or attention span. And research in other fields (e.g., LaBerge and Samuels, 1974) have supported many of these findings.

Conclusions

PT and CBM together represent a powerful minority position in education. Precision Teachers, although they have been making discoveries and demonstrating the power of their methods since the mid 1960's, have published very little. Therefore, although their methods and understanding of curriculum and behavior have continued to grow over the last 25 years, broad public or professional awareness of PT has been lacking.

Curriculum Based Measurement, although in some respects merely rediscovering or re-stating several of Precision Teaching's long-standing principles,
has published vigorously in recent years, and therefore may be more likely to attract a following within the educational establishment. Precision Teachers might take notice, if they hope in the end to influence education broadly.

Each of these groups of professionals has things to learn from one another. Let us be careful not to obscure the power or influence of our common methods by engaging in academic disputes that distract us from improving educational practice at large. On the other hand, as Precision Teachers, let us be clear about the strengths of our approach as compared with CBM, especially in our use of the Standard Celeration Chart and setting of objectively determined high performance aims.

References


Teach Your Children Well
by
Michael Maloney, Anne Desjardins, and Pam Broad

Three mature behavioral technologies—Behavior Analysis, Direct Instruction (DI) and Precision Teaching (PT) were integrated into a comprehensive academic program to produce substantial gains in basic skills for 19 elementary special education students in a private school setting. Results indicated development of fluent performances on a common set of 16 academic pinpoint in tool, basic and advanced skills in reading, writing, reading comprehension, spelling, grammar and arithmetic. Post-test scores on standardized tests showed a mean increase of 2.4 years during the first year of the program. All students were successfully reintegrated into regular education classrooms.

During the last three decades, much has been made of the “crisis in education” at all levels. It has been reported in the professional and public press, been the subject of government commissions, including a presidential commission. It has attracted the attention of industry and leading business figures and has been the subject of task forces including one by the Association for Behavior Analysis (Barrett, et al., 1990).

One of the consistent concerns has been the continual failure of school systems to deal with children at risk of failure because of special needs or as a result of other factors which mitigate against academic success. Simultaneously educators, administrators, politicians and policy makers have continued to overlook research which clearly demonstrates that certain pedagogical approaches are almost always successful in remediating the difficulties of students at risk of failure.

The Follow Through Project (Education as Experimentation, 1976) clearly demonstrated that Direct Instruction (Engelmann, 1969) developed at the University of Oregon and Behavior Analysis, the University of Kansas model, were the only two consistently effective models in the Follow Through experiment (Bushell et al., 1974).

The Sacajewea Project in Great Falls, Montana (Beck, 1974) also gave clear evidence that the use of Precision Teaching in elementary classrooms dramatically improves student performances in basic academic skills.

While these technologies have been demonstrated effective in their own right, no attempt at integration occurred until the middle 1970’s when an informal integration developed at Hastings County Board of Education in Belleville, Ontario as the result of the work of several behavioral consultants. Eric and Elizabeth Haughton with expertise in Precision Teaching, Linda Youngmayr and Linda Olen with expertise in Direct Instruction and Michael Maloney, a behavior management consultant, began to cooperate in staff development presentations. A large number of teachers were trained in one or more of these methods during a three year period. Resistance to some or all of the applications eventually resulted in the Hastings County Board withdrawing support from the project, despite clear empirical evidence of its efficacy.

The current study is the first planned integration of these three proven behavioral approaches in a private setting to determine their combined effectiveness. This work was done primarily as academic remediation and secondarily as applied research. It suffers from all of the design faults associated with in situ research but has sufficiently strong results to warrant further consideration.

The integration involved bringing students under instructional control using behavior analytic procedures, teaching concepts and operations using Direct Instruction programs and measuring progress using Precision Teaching techniques. It also involved giving sufficient practice using Direct Instruction student materials and specially designed practice materials similar to those in the Sacajewea Project. It included bringing student performances to fluent levels. Fluent performances are those which are within a specific range of rates for correct responses and errors (learning opportunities). This range was operationally defined as the level at which the behavior was produced quickly and accurately, and did not deteriorate without daily practice.
Method

Subjects. The subjects were 19 elementary school students, age 10 to 15, enrolled in a full-time remedial academic program at the Quinte Learning Centre. Students were nominally enrolled in Grades 3 - 8, but were significantly behind their age and grade level peers. Pretest scores on standardized tests indicated that these students were 1.8 years below grade level.

Procedures: Pre- and post-test procedures. Students were pretested using the Wide Range Achievement Test and the Canadian Test of Basic Skills during the first week of classes. The same tests were administered during the final week of the school year. These measures were taken to allow sharing data with educational professionals who are less than fully cognizant of behavioral measures.

Direct Instruction procedures. Students were administered placement tests for the Direct Instruction programs in reading, reading comprehension, spelling, expressive writing and arithmetic. Each student was placed in groups of 5 - 8 pupils in each of 5 DI programs. Direct instruction groups met at least once a day for each DI program and completed at least one lesson per day in each program.

Classes in each program were generally held at the same times each day. Progress was checked using the 5 lesson mastery tests within DI programs.

Precision Teaching procedures. Students were taught to chart using the daily standard celeration chart (Maloney, 1982). At any given time, each student's program contained 10 to 15 pinpoints in reading, spelling, grammar, math and tool skills. Students were provided practice sheets with examples and non-examples of the concept or operation being learned, each as the final "e" rule in spelling or the rule for analogies in reading comprehension. Several different forms of most practice sheets were available. Students also started at random points on the practice sheets to minimize order effects. They did a daily measurement on each pinpoint, charted their scores, completed the work-sheets as practice and consulted with their teacher regarding progress on each pinpoint. Program changes were made if the data showed no improvement for three consecutive days. Once a student reached the fluency range, the behavior was measured weekly for three consecutive weeks. If no deterioration occurred in terms of the rate and quality (accuracy) of the behavior, the pinpoint was replaced with a new one. Where necessary, pinpoints were returned to weekly or daily measurement. Class data was summarized on the 15th of each month and presented to the parents and students at a monthly pot-luck dinner meeting. Parents were taught to read the daily charts and to review their child's progress at each meeting. Participation at the monthly meetings was stipulated in the contract between the school and the clients.

Behavior Analysis procedures. A token economy was developed to allow the class to earn free-time activities by earning points as a group. Points were awarded for following four classroom rules and were lost for failure to follow the classroom rules which were posted on the blackboard. Activities and the points required to earn them were negotiated with the students.

The classroom rules were:
1. Work quickly and quietly.
2. Bring all materials to class.
3. Keep your hands and feet to yourself.
4. Say only good things.

It was found that virtually any classroom behavior could be subsumed under these four rules. The rules were used as prompts and as feedback to the children. Students learned to recite the rules, and if an infraction occurred, were asked to determine which rule they had failed to follow. Examples of following the rules were also requested when points were awarded to the class.

Results

Standardized Test Scores. Results of the standardized tests indicate a median increase of 2.4 years on the Wide Range Achievement Test, and a median increase of 2.3 years on the Canadian Test of Basic Skills.

Standard Celeration Chart Data. Since each student typically had between 10 and 15 pinpoints at any given time, there were an abundance of both individual and group data that could be reported. A representative sample of 16 pinpoints common to each student's program is reported here. These 16 pinpoints in 6 areas include:

Oral Reading: See/Say Story 11 CRP-B
See/Say Story 22 CRP-B

Grammar:
See/Mark Nouns
See/Mark Verbs
See/Mark Sub/Pred

Spelling:
Hear/Write Root Words
See/Write Final E Rule
See/Mark Morphographs
See/Write CVC Rule

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The data regarding each pinpoint is outlined below, beginning with the Oral Reading. All data are reported for all students currently completing that pinpoint. High, low and median scores are reported for both corrects and learning opportunities. These data are conservative in that students who reached fluent levels were given new tasks, were no longer keeping data on that specific pinpoint and were no longer reported in that month's data.

Results on Chart 1 indicate that students read Story #11 from the Corrective Reading Program, Decoding Level B for a period of one minute. Results indicated that in September, the poorest reader was able to read only 28 words per minute, the median score for the class was 70 words/min. and the best reader decoded 275 words/minute. By October, the least skilled reader was at 120 words/min., the median score was 200/min. with a high score of 290/min. Scores continued to increase until the end of December, when all students read Story 11, “Ron and His Hot Robe”, at 200-250 words per minute. Learning opportunities decreased from a high of 12 per minute in September to a high of 4 per minute in December.

These data on Chart 2 indicate the reading rates for the same students on their second oral reading passage, Story #22 of the Corrective Reading Program, Level B, Decoding. The lowest score by October 15 was 140 words/min. The median score was 200/min., with the highest score at 290/min. In November, December and January, the high score remained at 290 words/min; the median, at 200; and the lows at 100, 140 and 140 respectively. February’s scores were 250 for the high, 200 as a median and 190 as the low.

The pinpoint on Chart 3 was from the grammar track of the Corrective Reading Comprehension Program, Level B, which among many other things, teaches students parts of speech. Results indicated that students were able to discriminate the subject from the predicate of a sentence at a median rate of 32 sentences per minute. The most competent student discriminated 85 subjects/minute, while the least competent marked 10 subjects per minute during the first month of instruction and practice. Learning opportunities ranged from 10 per minute to 1 per minute, with a median of 4 per minute. By October, the highest score reached 90 per minute, the median was 70/min. and the lowest was 30/min. Learning opportunities dropped to zero. By November, the high score became 110/min., the median 90/min. and the low 60/min. Learning opportunities were not reported. In December, the high score remained 110/min., the median became 100/min., and the lowest score was 90/min. No learning opportunities were reported.

Results shown in Chart 4 indicate that students could underline nouns in sentences at a median rate of 32 nouns per minute. The best performance was 100 per minute, while the lowest performance was 12 nouns underlined per minute. By October, the high score was 110 per minute, the median was 55 per minute, and the low score was 20 per minute. In November, the high score remained at 110 per minute, the median score was 90 per minute and the low score was 55 per minute. By December, the high score was 100/minute, the median was 90/minute, and the low was 80/minute. In January, all scores were 100/minute.

Results depicted on Chart 5 describe the students’ performances in discriminating verbs in sentences. In September, the best performance was 80 verbs per minute. The median was 30 verbs/min. and the low was 10/min. In October, the high became 110/min., the median was 50, and the low was 30 verbs per minute. By November, the high was 130/min., the median was 90/min., and the low was 70/min. In December, the high was 110, the median 100, and the low 90 per minute.

Data in Chart 6 show the students’ performances on a reading comprehension task from the Corrective Reading Program, Level B, Comprehension, writing the conclusions to deductions. The first data reported was for November, the first month that students attempted this task. November’s data indicated a high score of 10 conclusions to deductions written per minute. The median was 6/min., and the low was 2/min. By December, the high score remained 10 per min., the median score was 9/min., and the low score was 8 per minute.

Chart 7 depicts monthly student performances in another reading comprehension task from the same
The grey wolves ate meat.
He stopped to eat.
A fish is to water

As a bird is to air

As a worm is to soil

As a monkey is to leaves

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CALCULATION SYSTEMS

DATA AND INFORMATION

ANALYSIS AND INTERPRETATION

CONCLUSIONS AND RECOMMENDATIONS
program—completing analogies. No data was available until January, when the first students attempted this topic. The high score for See/Write conclusions to analogies was 20 analogies per minute, the median was 8 and the low was 6 per minute. In February, the high became 30/min., the median was 20/min. and the low was 10/min. In March, the high became 40/min., the median 30/min., and the low was 20/min. In April, the high was 45/min., the median was 40/min. and the low was 30/min.

Data from Chart 8 report progress from the Morphographic Spelling program. Students were asked to divide words into morphographs. September's data showed the top performer was at 120 words per minute. The median was 90/min., and the low was 25/min. Learning opportunities ranged from 10 per minute to 1 per minute with a median of 4 per minute. By October, the high score was 115/min., the median was 95/min., and the low was 55/min. By December, the high was 125/min., the median was 110/min., and the low was 95/min. Learning opportunities were at zero.

Student performance for writing root words from the appendices of the Morphographic Spelling student’s workbook when these words were presented at 60 words per minute are summarized on Chart 9. In September, the best score was 30 words/min., the median score was 20 words/min. and the lowest score was 6 words per minute. In October, the high score was 30 words/min., the median score was 20 words/min. and the low score was 20 words per minute.

Data on Chart 10 describe the students' performances in discriminating the use of the final “e” rule in a word before adding an ending in such words as “hoping” but not in words such as “hopeless.” The first data, for November, indicated a high score of 18 words per minute, a median score of 13 words/min., and a low score of 8 words/minute. In December, the high score was 26 words per minute, the median score was 15 words/min. and the low score was 10 words/minute. The January data showed a high score of 30 words/min., a median score of 22 words/min. and a low score of 10 words/min. The February data had a high of 30, a median of 25, and a low of 21. In March, the high was 30, the median 28 and the low 25.

Developing tool skills to enable students to perform at fluent levels on basic and complex skills are indicated on Chart 12. Number writing at 160 digits per minute is a tool skill for writing math facts at 80 facts per minute. These data indicated a high score of 160 digits per minute in September, a median score of 100/min. and a low score of 50 digits per minute. October's results indicated a high score of 200, a median score of 130 and a low of 80 per minute. November’s data showed a high of 200, a median of 150 and a low of 120. December and January were nearly identical with highs of 200, medians of 180 and lows of 150 and 160 respectively.

A second tool skill pinpoint indicated on Chart 13 involves counting backwards at fluent rates as a preskill for subtraction. September’s high was 200 counts per minute, the median was 100/min., and the low was 65 per minute. October's data showed a high of 220 per minute, a median of 150 per min. and a low of 80 per minute. While November's data showed improvements with a high of 220, a median of 190 and a low of 140, the data from December indicates more variability with a high of 270, a median of 200 and a low of 100. January results were a high score of 240, a median score of 200 and a low of 150 digits per minute. Learning opportunities for September range from a high of 8 to a median of 5 and a low of zero.

The arithmetic data selected in Chart 14 is for subtraction facts and operations. The first data is for facts of 18. In September, the best score was 92 facts per minute, the median 51 fact/min. and the low at 6 facts per minute. By October, the high became 100 facts per minute, the median was 60, and the low was 30. November’s high remained at
CALENDAR MONTHS

MONTH: JANUARY - FEBRUARY - MARCH - APRIL - MAY - JUNE - JULY - AUGUST - SEPTEMBER - OCTOBER - NOVEMBER - DECEMBER

COUNT PER WEEK:

- 1,000,000
- 500,000
- 100,000
- 50,000
- 10,000
- 5,000
- 1,000
- 500
- 100
- 50
- 10
- 5
- 1

HOPE + YNG = HOPING
HOPE + YUL = HOPED

PRINCIPAL
TEACHERS
STUDENTS
SUPERVISOR
MANAGER

WRITE Root Words

STUDENTS (N=19) 10-15 4-8 See Words
BEHAVIOR
AGE
LABEL
COUNTED

DEPOSITOR
QUINTE LEARNING CENTRE
TEACHERS
STUDENTS
DEPARTMENT

CHART #10

WRITE words using final "e" rule
100, the median rose to 70 and the low to 45 facts per minute. December and January results described highs of 100, medians of 80 and 90 respectively and lows of 70 and 80 respectively.

The data on 2-digit subtraction facts without regrouping on Chart 15 indicated only two students in October, a high of 40 problems per minute and a low of 15 problems per minute. November and December data was virtually identical with highs of 50 problems per minute, medians of 26 and lows of 15. January, February and March had identical highs of 50 per minute, increasing medians of 35, 40 and 45 respectively and lows of 25, 30 and 40 respectively. No learning opportunities data were reported.

The final data presented in Chart 16 describe writing fractions operations using subtraction of simple fractions. The pinpoint was first attempted in December, yielding a high of 30 problems a minute, a median of 18 and a low of 6 problems per minute. In January, the high became 50 per minute, the median became 40 and the low was 15. The high remained at 50 for February, March and April. The medians were stable at 40, 40, and 45 problems per minute for those three months. The lows increased from 25 in February to 30 in March and to 40 in April.

Discussion

These data indicate a number of important findings for students who are considered at serious risk of failure at school. In the first place, these students were consistently able to develop fluent performances across a wide range of curriculum. Their performances were consistently as good, and in most cases better than their "normal" peers. Their performances, for that matter, were as fast and error-free as those of their teachers. This is remarkable in that they were typically asked to perform tasks which were somewhat more difficult than those found in the Sacajewea project. These measurements involved practice sheets that often had both examples and non-examples of concepts or operations forcing the student to decide whether a rule applied. They may also be more difficult than a standard DI implementation where aims for rated performance are much lower and where mastery tests measure quality of response without emphasis on pace.

Often in the past, these students failed to learn concepts and operations as completely as their peers. They almost never reached levels of mastery as indicated by their initial performances on any of these or other topics. Incomplete learning may deteriorate more quickly and easily than fluent performances, resulting in a relative loss of the amount learned due to lack of mastery. This, coupled with curriculum which moved forward because of temporal considerations, would help account for students' previous lack of success.

The Quinte Learning Centre setting provided clear instruction, sufficient practice and measured standards which determined when new curriculum was introduced. The consistent gains, as seen in these data, were clearly attributable to the ways in which these students were given instruction, practice, feedback based on performance data, precise expectations and clearly evident rules. Developing skills to fluent levels allowed the students to gain control of their curriculum. They not only learned, but they learned to learn. They learned Engelmann’s adage that "if you work hard, you get smart."

Fluency on one pinpoint also seemed to assist in faster acquisition of similar skills in related tasks. Initial oral reading scores on Story 22, the second passage, showed a x5 increase over the initial reading of the first story for the poorest reader. It showed a x2.5 increase for the median score and even a modest increase for the already fluent highest score. It should be noted that the high scores on much of the September data were reported by the same student, who had just spent 8 weeks in Quinte’s summer school program. Initial scores on subsequent stories continued to increase until students began reading aloud at 200-250 words per minute on initial reading of new material. The same increase was in the initial attempts on math facts scores in subtraction.

These data suggest that fluency is a fairly stable phenomenon across students on the same task, (e.g 200-250 words per minute in oral reading, 30 words/min. in writing, 80 math facts/min., etc.). The overall trend in the data showed a consistent reduction of variability across all pinpoints as student performances approach fluency. As expected, the largest changes in performance were always seen in the scores of students with the lowest initial scores. Moreover, students were consistently able to reach fluent levels of performance on a wide range of academic material. The high scores across all students on any pinpoint show a large degree of consistency. There may be an artificial "ceiling effect" in the data which occurred because students changed pinpoints upon reaching that particular range and level of accuracy.
Fluency was generally higher than expected. It was the same for all students, regardless of age, grade, or label. Initially fluency was operationally defined as the score the teacher could achieve on the pinpoint. The students soon taught us that their practiced performances were, as a rule, about x1.5, our initial attempts. Known fluency standards from the work done at Hastings County were integrated into the project.

Students were able to maintain fluent levels of performance on weekly and monthly probes using the levels that had been established. Such fluent performances across all students across all pinpoint into question the stated reasons for the lack of success of these pupils in other settings. Literally every student learned skills which they had failed to learn previously. Moreover, they learned them to levels their “regular” peers and even their teachers could not match. These data seriously question the expected levels of performance of students at any “grade.” Specifically, they call into question the assumptions that children with “learning disabilities” need different standards, “adapted” curriculum—or, for that matter, need to be at risk of failure at all.

All of the students, regardless of age, grade or label, were able to complete a variety of Direct Instruction programs to the levels stipulated in the program guides. The post-test scores on standardized tests were x3 the gains usually reported for children diagnosed with “learning disabilities.”

These results are not attributable to a difference in teacher-pupil ratio. Many classrooms of children with “learning disabilities” have a ratio of 1 to 6 or better. The program is also cost-effective. Tuition fees for Quinte Learning Centre were less than the total special education grant subsidy available for these students at the local school board. Especially given the academic growth, these program costs are much lower than other settings. Similarly these results are not a function of some “naturally gifted” teachers who worked their “special magic” on these particular children. The same kinds of results have been reported by Kent Johnson and his staff at Morningside Learning Centre, by Aileen and Ian Spence at The Learning Incentive and by Laural Alkenbrack at the Lennox Learning Centre. The “special magic” is the ability to deliver effective instruction, sufficient practice, daily measurement and data-based decision making with the diligence which is the hallmark of any effective teacher.

As was clearly demonstrated by the use of these technologies singly, for Directly Instruction and Behavior Analysis in the Follow Through Project, and for Precision Teaching in the Sacajewea Project, any of these three methods could remediate academic problems. These data suggest that an integration creates a synergism which increases the effectiveness of any one method.

Conclusion

These methods used together produced dramatic results, but a great deal more investigation needs to be done. Precision Teaching would benefit by incorporating the instructional design components of Direct Instruction into the tasks they teach and measure. Direct Instruction would be strengthened by the inclusion of the concepts of fluency and daily measurement from Precision Teaching. Behavior Analysis might be well served to consider the heightened emphasis on instruction and measurement of PT and DI, as well as the judicious use of rewards.

There is much to be done to clarify notions of fluency, its characteristics, and the most facile means of reaching fluent levels of performance on all types of skills. The question of retention, rates of decay and re-learning of performances at or near fluent levels is largely unexplored territory with significant ramifications for teaching and training. The impact of these combined technologies on the rate of acquisition of new skills needs to be determined, as well as the relative contributions of each component on particular tasks. Fortunately, these are empirical questions and can be answered with careful experimentation.

One main effect stands out clearly in these data, despite their blemishes and warts, namely that with the use of the best behavioral technologies, all students learn.....if you teach your children well.

References


Watkins, C.L. (1990, May). What good is Alpo if the dog won’t eat it? Invited address to Enhancing Instructional Technology: From Research to Reality Conference, Nashville, TN.
Effects of Text Grade Level on Oral Reading with Mildly Handicapped Students

by

Bill Wolking, Carolyn Harris, Jolenea Ferro and Jack Scott

Readability has been a central construct of reading instruction for the past half century or more. It is determined by an analysis of the structure of text. Counts of the number of words per sentence, number of syllables per word, number of times words appear in a passage, and number of subordinate clauses per paragraph are typical of the data used in readability formulas (Giordano, 1987; Yarington, 1979). Grade level classifications are the outcome of applying readability formulas to reading passages. Structurally determined grade levels are the foundation on which basal reading series are built. Many school systems require teachers to use basal reading series and to use the instruction found in their manuals when placing students and teaching reading (Goodman, 1987). It is estimated that between 80 and 95% of elementary school teachers use basal readers (Cassidy, 1987; Yarington, 1979). When most teachers speak of the readability of a passage, they mean the assumed difficulty based on structural characteristics of the text.

In spite of their common use, structural approaches have been criticized. Some educators believe readability formulas sacrifice meaning and comprehensibility to the control of text dictated by their use (Bell & Willems, 1986). More emphasis is placed on writing a ‘grade level’ passage than on writing an interesting passage. Strict control over student progress by time on grade level without giving enough weight to student mastery is another criticism of the structural approach (Cadenhead, 1987).

Functional approaches to readability are developing. Mounting criticism of structural approaches combined with a growing awareness of direct measurement and curriculum based assessment strategies are two possible reasons for the explorations of functional approaches to readability. Functional approaches are based on an analysis of student reading performances rather than on the structural characteristics of text passages. Mills (1988) and Kaufman (1989) have studied the effects of a range of grade levels of text on the speed and accuracy of student oral reading performances. Both Mills and Kaufman found that as grade level of passages increased there was a moderate decrease in the speed of oral reading, but only a slight increase in error rates. Kaufman also studied the effect of grade level on comprehension, finding a moderate decrease in comprehension with increasing grade level. Scott (1988) & Scott et al. (1990) studied the effect of high-challenge reading passages on rate of learning. High-challenge passages were defined as those that produced frustration level performances on first reading according to traditional placement criteria for percentage of errors made. He found that learning on high-challenge passages was equal or superior to learning on passages at recommended “instructional” placement levels.

The present research extends the exploration of functional approaches to readability. It reports 22 single case experiments (or a single case experiment with 21 systematic replications) of the effects of grade level on the rate of learning and also on the frequency of correct error responses. This work combines the structural and functional approaches. The passages used had previously been assigned grade level classifications based on structural analysis. Student performances were then studied across a range of structurally different passages.

METHOD

Teacher Researchers. Twenty-two preservice trainees of the Department of Special Education at the University of Florida conducted these experiments. They had just completed a six week, ten hour a week, course in precision teaching in which they had conducted a study of the effects of three widely disparate levels of text difficulty on the reading performance of their lab partners. This

1The authors express their appreciation to the teachers and students whose caring and dedicated work produced the studies reported in this paper.

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study was a training exercise designed to provide a model for the research reported in this article. Following these experiences, each teacher was assigned to tutor an underachieving or special education student.

Students. The students were referred by their classroom teachers for an after-school program of tutoring by precision teaching trainees. They ranged in age from 6 to 15, two-thirds were male, and most were from lower-middle and lower socioeconomic families. They were referred because they had demonstrated learning, behavior, achievement, or motivation problems. All the students attended a laboratory school that does not classify students by traditional special education labels (learning disabled, behavior disordered, etc.). If these students were attending public school classes in the same county, the majority of them would have been classified as learning disabled or behavior disordered. About 30 percent had attended our after-school program previously, so had some experience with precision teaching.

We are not able to report detailed information on IQs, family socioeconomic status, sensory modality strengths and weaknesses. We intentionally discourage our teachers from using this type of information. We train them to use more immediate and instructionally relevant information obtained from curriculum based assessment timings, and we also encourage them to adopt the philosophy that it is the job of special education teachers to produce substantial rates of learning and retention regardless of the demographic and educational status of a child from the traditional psycho-educational perspective.

Setting. Tutoring took place in three classrooms in the laboratory school mentioned above. Younger students were taught in classrooms in the elementary wing. Between five and eight tutor-tutee pairs worked in each room. Instruction took place about 10 minutes after the end of the regular school day, three times a week for ten weeks. The duration of the experiments described in this study was between two and five weeks—4 to 16 rated days, within a range of 8 to 35 calendar days.

Research Procedure. Each of the 22 studies conducted was a single subject experiment using an alternating treatments design. This design was used to control for sequence and maturation effects, and also to produce daily opportunities to observe experimental effects as the learning outcomes from each of three levels of text were charted. All students were taught reading in three consecutive mini-lessons, each 5 to 8 minutes long. Each mini-lesson used a different grade level of text. The within-day sequence of lessons across grade levels was randomized so that each grade level was either first, second, or third approximately the same number of days.

Instructional procedures. In the precision teaching course just completed by these students, we taught and recommended the use of a rereading instructional procedure. It involved having the teacher model how to read the passage correctly, fluently and with good inflection. The readings were either live or tape recorded. The student was asked to mimic the teacher as the reading occurred. Most teachers modeled the passage two or three times. These modeling-imitation tactics were followed by opportunities to practice especially troublesome words or phrases and then by at least two timings, with the best one charted.

Most teachers followed this procedure closely, but some added contingent error correction and additional timings. All made a written record of their procedures and used the same procedure across the three grade levels and for the duration of the study. Clinical supervisors monitored the implementation of teaching procedures on a daily basis to ensure that they were faithful to written plans and that they did not ‘drift’ from the original implementation over time. We did not force a strict adherence to a single instructional procedure across teachers, but almost all stayed close to the modeling-imitation procedure we recommended.

Grade level placements for the instructional level passage were determined by following a method published by Woods & Moe (1985) as part of a system of individualized reading instruction. The instructional level so determined is designated as the Level 1 passage in this report. Levels 2 and 3 passages were selected by using material interesting to the student that also were a minimum of one and two grade levels higher respectively. We encouraged teachers to be daring in their selection of the higher grade level passages. However, a few were timid and a few were tutoring slow learning first grade students whose behavior was essentially shut down by jump-ups or leap-ups of several grade levels.

All plans and outcomes were recorded on a form specifically designed to accommodate precision teaching instructional procedures and learning outcomes. These forms were used by the teachers when entering their procedures and outcomes into a
Our teachers use a computer data base for all of their instructional plans and learning outcomes. This gives our students experience with desk top computer management of educational data, and it gives faculty supervisors an opportunity to have all plans and outcomes in a standard and easily readable and editable form.

A Macintosh SE computer running the FileMaker II data base application comprised the hardware and software used. Data for each instructional plan (phase of instruction) was entered and became a record in the TLPO data base. Each record includes: identifying information and codes (five fields), the pinpoint and instructional plan (eight fields), the primary learning outcomes data (six fields), and a number of learning outcomes computed by the program (fourteen fields). The computed learning outcomes appear instantly as the last item of information is entered into the record, giving the teacher a full and immediate quantitative description of the effectiveness of the plan. Of course the teacher has seen these outcomes previously in graphic form on the standard celeraion chart. The computed learning outcomes serve a different purpose. They are not a prime source of information that controls instructional decisions. They do provide an opportunity for teachers to view and evaluate their teaching from a larger perspective, across plans, students, pinpoints, etc. More importantly from the perspective of this study, they give supervisors an opportunity to monitor all instruction and to provide constructive feedback quickly, in a standard format, that is closely tied to facts of instructional plans and outcomes.

Data from the TLPO data base were exported to JMP and Data Desk Professional, Macintosh statistical applications. These programs produced the variable distributions, descriptive statistics, and correlations on which our results are based.

**RESULTS**

The results are presented in two ways. Table 1 presents a summary of the data for each of the 22 single case studies. These results are presented in a table rather than on the standard celeraion chart to save journal pages. Although a preferred format, it would take many chart pages to present the data in Table 1. Table 2 presents aggregated data for the 22 studies. Chart 1 depicts the aggregated data on the standard celeraion chart. Table 3 presents correlation coefficients between selected variables.

**Data for Individuals.** Results of the 22 single case experiments appear in Table 1. Starting with the column on the left and moving a column at a time to the right, the columns contain: the case code and number of rated days, grade levels of the three passages used, first and last frequencies for correct responding, first and last frequencies for error responding, celeraions of correct responding, and celeraions for error responding in the last column on the right. The 22 experiments are arranged in ascending order by the grade level of the instructional (lowest) level passage for each case.

A criterion of .20 (20% per week) in the difference between celeraions for the lowest and highest grade levels was used to evaluate the effect of grade level on rate of learning. This criterion was selected to represent a difference in the rate of learning which would be educationally significant in brief, two to three weeks, periods of instruction. The educational significance of a .20 difference in celeraion over two and three week periods of instruction is easier to appreciate with an example. If a student had celeraions of 1.25 and 1.45 for words read correctly (a .20 difference in celeraions) respectively on their Level 1 and 3 passages for two weeks, there would be a 54.5 wpm difference. At the end of three weeks the difference in rate of reading words correctly would be 110 wpm.

**Grade level and correct celeraions.** In 18 of the 22 studies, the celeraions of the lowest and highest grade level passages did not meet this criterion. That is, by our criterion there was not an educationally significant difference in the rate in learning when Level 1 and 3 passages were compared. In all four cases that met the criterion the celeraion of correct responding was higher on the highest grade level passage. These celeraions are followed by double asterisks in the fifth column from the left of Table 1.

**Grade level and error celeraions.** Using the same criterion, .20 with the celeraions for error responding, 11 studies found no educationally significant difference in the rate of error reduction comparing the lowest and highest grade level passages. In 7 of the 11 cases that do meet the criterion, the higher rate of error reduction is associated with the most difficult level of material. These celeraions are marked with double asterisks in the sixth column from the left of Table 1.
### Table 1: Data for 22 teacher-student cases
Arranged in ascending order by Level 1 text grade level

<table>
<thead>
<tr>
<th>Case Code</th>
<th>Text Grade</th>
<th>Correct Responses First-Last</th>
<th>Error Responses First-Last</th>
<th>Celerations/Correct Responses</th>
<th>Celerations/Incorrect Responses</th>
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<td>/ 1.05</td>
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<td>6-3</td>
<td>x1.20</td>
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<td>88-230</td>
<td>2.2</td>
<td>x1.20</td>
<td>/1.00</td>
</tr>
<tr>
<td>medla</td>
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<td>73-131</td>
<td>4.0</td>
<td>x1.25</td>
<td>/1.75</td>
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<td>8</td>
<td>69-106</td>
<td>17.5</td>
<td>x1.25</td>
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<td>80-108</td>
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<td>wlicer-</td>
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<td>0.0</td>
<td>x1.10</td>
<td>/1.00</td>
</tr>
<tr>
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<td>7</td>
<td>112-208</td>
<td>1.0</td>
<td>x1.80</td>
<td>/1.00</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>94-204</td>
<td>4.2</td>
<td>x1.10</td>
<td>/1.40**</td>
</tr>
<tr>
<td>stren</td>
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<td>2.1</td>
<td>x1.50</td>
<td>/2.00</td>
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<td>137-204</td>
<td>4.0</td>
<td>x1.60</td>
<td>/4.30</td>
</tr>
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<td>/2.50**</td>
</tr>
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<td>cumka-</td>
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<td>x1.00</td>
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<td></td>
<td>8</td>
<td>160-232</td>
<td>2.0</td>
<td>x1.20</td>
<td>/1.30</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>162-200</td>
<td>2.0</td>
<td>x1.10</td>
<td>/1.00</td>
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<tr>
<td>colma</td>
<td>7</td>
<td>157-213</td>
<td>1.1</td>
<td>x1.07</td>
<td>x1.00</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>100-202</td>
<td>4.1</td>
<td>x1.25</td>
<td>/1.36</td>
</tr>
<tr>
<td></td>
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<td>97-187</td>
<td>2.0</td>
<td>x1.14</td>
<td>/1.03</td>
</tr>
<tr>
<td>ranpa-</td>
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<td>124-210</td>
<td>3.0</td>
<td>x1.25</td>
<td>/1.20</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>142-190</td>
<td>3.1</td>
<td>x1.10</td>
<td>/1.20</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>112-189</td>
<td>0.2</td>
<td>x1.20</td>
<td>/1.00</td>
</tr>
<tr>
<td>plato</td>
<td>6</td>
<td>211-230</td>
<td>1.0</td>
<td>x1.10</td>
<td>/1.10</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>112-132</td>
<td>6.3</td>
<td>x1.15</td>
<td>/1.80</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>119-124</td>
<td>9.3</td>
<td>x1.15</td>
<td>/3.30**</td>
</tr>
</tbody>
</table>

*First and last frequencies (movements per minute) for each grade level of text.

**Celerations for correct responding exceed the .20 difference criterion and show faster rates of learning with the high grade level of text.

***Celeration for error responding exceed the .20 difference criterion and show faster rates of learning with the low grade level material.
Grade level and first frequencies for correct responding. Grade Level 3 text was associated with a decrease in the first frequency of correct responding in 16 of the 22 cases. These 16 students dropped between 7 and 92 wpm. In four cases students read faster on Level 3, compared to Level 1 passages. Level 3 was read faster by 31 to 49 wpm in these four experiments. In two cases the grade level of the passages had essentially no effect on first frequencies, only 6 and 7 wpm differences between Level 1 and 3 passages.

Grade level and frequencies for error responding. Effects of text grade levels on first frequencies for error responding were less consistent. In 12 studies errors on Level 3 text were higher. Increases ranged from 1 to 13. In six studies there was no difference in errors between Levels 1 and 3 passages. In four studies errors decreased by between 1 and 3 per minute on Level 3 passages.

Grade level and reaching performance standard. While not the only justifiable value, 200 wpm was used as a standard to represent minimally proficient oral reading in this study. The proportion of cases in which students reached or exceeded 200 correct wpm at each level are: Level 1 passages, 13 of 22 (59%); Level 2 passages, 11 of 22 (50%); and Level 3 passages 9 of 22 (41%). These findings must be interpreted conservatively since the number of rated and calendar days was not held constant across the 22 studies. Those teachers choosing to teach longer had a higher probability of reaching performance standard. However, it is interesting to note that within relatively short instructional phases (median 7 rated days within a period of 17 calendar days) more than one-third of the students reached or exceeded the performance standard on text several grade levels above traditional placement levels.

Group Data. Highest, median, and lowest frequencies and celerations for correct and error responding are presented in Table 2 and depicted in Chart 1. The median celerations for correct responding on Level 1, 2 and 3 passages are X 1.20, X 1.25, and X 1.23 respectively. Median celerations for error responding on Level 1, 2, and 3 passages are /1.06/1.19, and /1.11 respectively. Median celerations for both correct and error responding vary by no more than 50% per week.

Chart 1 depicts the highest, median, and lowest celerations. Each median celeration line is drawn from the median first frequency for that cell in Table 2, e.g., highest celeration for corrects, median celeration for errors, etc. The celeration lines extend for 17 calendar days to depict the median length of each experiment. The median experiment was seven rated days within a period of 17 calendar days. The overall impression conveyed by Chart 1 is that grade level of material typically has only a small effect of the rate of learning for both correct and error responding. In other words, most students similar to the ones taught in these experiments learn about as well using any grade level of text within a range of four to eight grade levels above instructional placement level. A study of Chart 1 also leads to the observation that the grade level of text used to teach oral reading does have an effect of the speed of correct responding. Reading a Level 3 passage (median 9th grade level) was 23 wpm slower than reading a Level 1 passage (median 4th grade level). This is approximately a four to five word per minute decrease in speed for each increase in grade level. Median error responses for Level 1 and 3 text increased from 1.93 to 3.10 errors per minute. This is an increase of .23 errors per minute for each increase in grade level of the text.

Other Findings. Several questions might be asked in an attempt to understand more completely the effects of grade level of student learning and performance. What are the relationships between absolute grade level and celerations for correct and error responding? The Pearson correlation coefficients for correct and error responding respectively were -0.130 and +0.155 (N=66). What is the relationship between jump or leap-up size and celerations for correct and error responding? The correlations between jump-up size and celerations for correct and error responding respectively were -0.102 and -.247 (N=22). What is the relationship between initial frequency of correct and error responding and the celerations for correct and error responding? The correlations between initial correct frequencies and the celerations for correct and error responding were -.270 and +.020 (N+66). The correlations between initial error frequencies and the celerations for correct and error responding were -0.119 and +0.437 (N=66).

Initial error frequencies are associated with about 19% of the variance in celerations for error responding. None of the other correlations support a conclusion that would detract from the interpretation that grade level of text is the variable responsible for our results.

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Table 2: Highest, median and lowest beginning frequencies, celerations, and ending frequencies for correct and error responding at each of three text grade levels.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>First Frequencies*</th>
<th>Celeration# Value</th>
<th>Last Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1: Grade level text.</strong>&lt;sup&gt;▲&lt;/sup&gt; Median 5th grade level. Range from 0 (preprimer) through 9.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest correct</td>
<td>211</td>
<td>x 1.90</td>
<td>311</td>
</tr>
<tr>
<td>Median Correct</td>
<td>115</td>
<td>x 1.20</td>
<td>206</td>
</tr>
<tr>
<td>Lowest Correct</td>
<td>57</td>
<td>x 1.07</td>
<td>112</td>
</tr>
<tr>
<td>Highest Error</td>
<td>4.00</td>
<td>/ 3.40</td>
<td>9.00</td>
</tr>
<tr>
<td>Median Error</td>
<td>1.93</td>
<td>/ 1.06</td>
<td>1.23</td>
</tr>
<tr>
<td>Lowest Error</td>
<td>0</td>
<td>x1.96</td>
<td>0</td>
</tr>
<tr>
<td><strong>Level 2: A step- or jump-up from grade level text.</strong> Median 7th grade level. Range from 1 through 11.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Correct</td>
<td>160</td>
<td>x 1.80</td>
<td>278</td>
</tr>
<tr>
<td>Median Correct</td>
<td>101</td>
<td>x 1.25</td>
<td>196</td>
</tr>
<tr>
<td>Lowest Correct</td>
<td>52</td>
<td>x 1.10</td>
<td>104</td>
</tr>
<tr>
<td>Highest Error</td>
<td>17</td>
<td>/ 4.30</td>
<td>7</td>
</tr>
<tr>
<td>Median Error</td>
<td>3.37</td>
<td>/ 1.19</td>
<td>0.50</td>
</tr>
<tr>
<td>Lowest Error</td>
<td>0</td>
<td>x1.75</td>
<td>0</td>
</tr>
<tr>
<td><strong>Level 3: A jump- or leap-up from grade level text.</strong> Median 9th grade level. Range from 2 through 13 (college level).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Correct</td>
<td>162</td>
<td>x 3.00</td>
<td>230</td>
</tr>
<tr>
<td>Median Correct</td>
<td>92</td>
<td>x 1.23</td>
<td>182</td>
</tr>
<tr>
<td>Lowest Correct</td>
<td>28</td>
<td>x 1.10</td>
<td>97</td>
</tr>
<tr>
<td>Highest Error</td>
<td>17</td>
<td>/ 4.30</td>
<td>6</td>
</tr>
<tr>
<td>Median Error</td>
<td>3.10</td>
<td>/ 1.11</td>
<td>1.07</td>
</tr>
<tr>
<td>Lowest Error</td>
<td>0</td>
<td>x1.76</td>
<td>0</td>
</tr>
</tbody>
</table>

* Frequency = movements per minute
# Median number of rated days per experimental phase = 11. Range from 4 to 16.
▲ Grade level determined by traditional IRI placement procedures
**Chart 1:** Highest, median & lowest celerations for correct and error responding across Level 1, 2 & 3 reading passages.

(Each celeration line on this chart starts at the median frequency for the subgroup represented and extends for 17 calendar days, the median phase length, at a slope representing the celeration value.)
Lindsley (1990) has held that correct and error frequencies and correct and error celerations are each functionally independent. Based on our data, the correlations between correct and error initial frequencies and correct and error celerations respectively were -0.024 and +0.206 (n=66). These data support an interpretation of independence between these two pairs of variables.

**DISCUSSION & CONCLUSIONS**

We have been careful not to use words such as equate grade level of text with the difficulty of teaching or learning. Many teachers use ‘grade level’ and ‘difficulty level’ as synonyms, apparently on the assumption that there is a high correlation between the two. The results of the experiments reported in this paper support the conclusion that for most of our students there was only a loose association between the grade level of the text used in teaching oral reading and difficulty of teaching and learning. However, our findings indicate that speed of correct responding is affected by grade level of text used in teaching. There was a 4.6 wpm (4%) decrease in speed for each increase in grade level.

We draw two general conclusions from these results. First, rate of learning is not usually adversely affected by teaching reading with text that jumps- or leaps-up above instructional placement levels by several grades. Second, absolute performance rates for both correct and error responding are adversely affected. As far as our findings go we have a trade-off. Increasing grade level above instructional level generally has a positive effect on rate of learning and a negative effect on absolute rate of correct and error responding. To us, the increase in error frequencies seems surprisingly small in almost all cases.

Our findings do not provide relevant data on the issue of whether the higher rates of learning and lower absolute rates of ending correct responding necessarily go together. Our teachers were instructed to end their teaching on all three grade levels when they believed they had enough data to draw a conclusion about the effects of grade level on rates of learning. Although we measured the final performance in relation to a performance standard, we made no attempt to have teachers continue instruction until performance on each level flattened or reached the performance standard. In retrospect this was an error and should be a tactic to consider in future research. Continuing instruction until there was no more improvement or a performance standard was reached could provide information about whether ending performance frequencies on high grade-level passages could equal or exceed those on instructional level passages.

Direct, but unmeasured and unrecorded, observations of our teachers and students lead us to suspect that there are valuable side-effects of learning to read on text above instructional placement levels for both students and teachers. Although initially resistant to reading the high grade level passages, most students were expressing surprise at, and pride in their achievement when the experiments ended. Some said that the stories were more interesting and easier to read, and some were observed to spend more time reading and to request additional reading materials to take home. Many of the teachers were also skeptical about using the above-instructional-level passages, but almost all became enthusiastic about using the higher grade level reading material. We believe it will prove worthwhile to investigate these and related side-effects on teachers and students.

**REFERENCES**


Drs. William Wolking is Professor of Special Education at the University of Florida, Gainesville. Carolyn Harris is a doctoral student in the Department of Special Education at the University of Florida, Gainesville. Jack Scott and Jelena Ferro are members of the faculty of the University of South Florida at Tampa.
SAFMEDS Design: A Comparison of Three Protocols

by
Claudia E. McDade and Charles P. Olander

Individuals seeking to integrate elements of precision teaching (Lindsley, 1983) into their courses want to know the best way to use SAFMEDS. There probably are as many different SAFMEDS designs in postsecondary institutions as there are precision teachers. The purpose of this study was to compare three commonly used SAFMEDS protocols to determine if design has any effect on student preference or performance.

Method

Participants. In Fall Semester, 1986, seventeen undergraduate students completed Psychology (PSY) 335: Theories of Personality, in the Center for Individualized Instruction at Jacksonville State University. All students were majors or minors in Psychology.

Procedure. PSY 335 was precision taught within the Personalized System of Instruction (Keller, 1968). Students were required to use SAFMEDS in each of the thirteen units of material. Two doomsday clauses were included in the course design: (1) seven of the units had to be completed before mid-term and (2) the last six units had to be completed by the last day of the semester. Mastery criterion for each unit was 30 correct responses per minute. Students were also required to plot their performances on daily standard celeration charts (Pennypacker, Koenig, & Lindsley, 1972). Using the Findley Forced-Choice Procedure (Findley, 1962), students were required to use each of three SAFMEDS protocols, with mandatory change after two successive units in the same protocol.

Three SAFMEDS protocols were used: (1) Questions and Answers (SAFMEDS: Q&A) - students were given questions and answers which they were required to write on cards with the question on one side and the answer on the other; (2) Student Generated (SAFMEDS: S) - students were given a list of terms; they were required to construct a question for each, as well as an answer with assistance from the textbook (DiCaprio, 1983); they wrote the questions and answers on cards; (3) Instructor Generated (SAFMEDS: I) - students were tested on SAFMEDS generated by the instructor which they had not seen before their initial testing on each unit; again, questions were on one side of a card with answers on the other.

Three dependent measures were used to assess the effect of SAFMEDS design on student performance: (1) the highest frequency of correct responses on each unit, (2) the number of attempts to reach mastery on each unit, and (3) the length of time to completion of the unit in each protocol. Student preference was measured by the Findley Forced-Choice Procedure.

Results

Figure 1 shows the SAFMEDS performance of one student on 13 units across the three protocols, while Table 1 indicates mean performance of students for the three protocols. Data analysis across all students indicated no significant difference in the highest frequency of correct responses on each unit. There was also no significant difference in the number of attempts to mastery on each unit. Analysis of the average time to completion of units revealed no significant difference among the three protocols either.

Even a cursory review of the students' standard charts revealed that they worked until they completed requirements for midterm, took a break, and then rushed to master the rest of the material by the end of the semester. The rest period taken by students ranged from 21 to 57 days with the average respite duration of 31 days. This result is predictable. When latency period to mastery in each unit was calculated with the rest period removed, there was a strong correlation between student preference of SAFMEDS protocol and the period of time needed to complete the units. Students progressed faster in their preferred mode and slower in their non-preferred ones. (See Chart 2.)
CHART 1

A: SAFMEDS: Q x A
B: SAFMEDS: S
C: SAFMEDS: T

COUNTING PERIOD FLOORS

SUCCESSIVE CALENDAR DAYS

SUPERVISOR
ADVISER
MANAGER

J.S.
BEHAVER
AGE LABEL COUNTED

McCade
CII
JSU
TABLE 1
Comparisons of SAFMEDS Protocols, Means

<table>
<thead>
<tr>
<th>Variable</th>
<th>SAFMEDS: Q&amp;A</th>
<th>SAFMEDS: S</th>
<th>SAFMEDS: I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest frequency of correct response</td>
<td>33.82</td>
<td>32.78</td>
<td>32.77</td>
</tr>
<tr>
<td>Number of attempts to master units</td>
<td>1.57</td>
<td>1.44</td>
<td>1.54</td>
</tr>
<tr>
<td>Average time to master units, days</td>
<td>1.16</td>
<td>1.06</td>
<td>1.16</td>
</tr>
<tr>
<td>Student preference, Findley value</td>
<td>0.78</td>
<td>0.66</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>n = 7</td>
<td>n = 3</td>
<td>n = 0</td>
</tr>
</tbody>
</table>

A definite student preference among SAFMEDS protocols was seen. Seven students preferred testing with SAFMEDS: Q&A, while 3 students preferred SAFMEDS: S, and 3 students exhibited no preference. Chart 1 also indicates a student with no particular preference. No one preferred SAFMEDS: I. The students who demonstrated a strong preference (i.e., the Findley value was greater than 8) completed units in their preferred protocol at a rate of 1.7 times faster than in their non-preferred protocol.

Discussion

As expected there was no significant difference in frequency of correct responses, in the number of attempts to mastery, nor in length of time to mastery across the three protocols. This is not a surprising result since students were required to perform the same task in all protocols. The data on mean time to completion of each unit among the various protocols were confounded by the doomsday clause imposed by the instructor. As has been demonstrated in earlier studies (Lea, McDade, & Olander, 1983; McDade, Austin, & Olander, 1986), students will manipulate their testing environment in order to choose a testing mode which will accomplish their individual purpose. In this study, students exhibited a strong preference for the SAFMEDS protocol in which they progressed fastest.

The implications of this study are striking. Since there was no performance difference across SAFMEDS protocols, the Precision Teacher can take political concerns into account in determining which design to require of students. When students must be convinced of the efficacy of Precision Teaching, SAFMEDS: Q&A may assist by allaying fears of students. When skeptical colleagues must be convinced, SAFMEDS: Student Generated may be more effective because the instructor is not "giving away answers."

A major criticism of individualized approaches to instruction is the tremendous amount of time and energy necessary to develop curriculum materials. This study suggests the instructor could reduce that investment by Precision Teaching a course using SAFMEDS: Questions. The major implication of these results is that the instructor can choose among three SAFMEDS protocols which are equally effective.

References


Chart 2

A: SAFMeds: Q & A
B: SAFMeds: S
C: SAFMeds: T

Successive Calendar Days

McDade

Supervisor  Adviser  Manager

Psy 335: See-Say

M.L.  Behaver  Age  Label  Counted


Claudia E. McDade & Charles P. Olander

Dr. Claudia McDade is Director of the Center for Individualized Instruction and Professor of Psychology at Jacksonville State University. Dr. Charles Olander is Professor of Biology at Jacksonville State University. Contact Claudia McDade for reprints or further information.
Changes in Behavior As the Result of the Death of a Relative

by Abigail B. Calkin

I received a letter from a friend who asked forgiveness "for being strangely dumb", i.e., according to Webster (1976) and Oxford (1962), destitute of the power of speech, unable to speak from astonishment or shock. This friend was experiencing two losses, and it was a short note after a long silence. His letter reminded me of three charts I have and I began to think of the difference between clinical, poetic, and behavioral statements about reactions to death.

Bowlby (1980) stated that losing a person one loves is the most intensely painful experience to have. The purpose of mourning that loss is to reduce its emotional impact—to accept simultaneously the value of the person lost and the death. He described the common elements everyone experiences: loss of appetite, insomnia, neglect of family, home, and career.

As a result of her research, Kubler-Ross (1969) listed five stages we experience in our reactions to dying and death: denial, anger, bargaining, depression, and acceptance. Denial occurs when one refuses to believe that the loss has occurred; often there is a numbness so that the loss cannot be fully absorbed or comprehended. Anger is that frustrating—and often misdirected—animosity for experiencing the loss. In the bargaining stage one attempts to negotiate simultaneously the acceptance and the reversal of the loss. Depression is the deep sadness one experiences as the pain of the loss soaks in. Arriving at acceptance means the person has absorbed the reality of the loss and moved on to full, healthy functioning.

I looked specifically at depression and found it does not produce an increase in behavior; in fact, it is a "lowering in quality, vigor, value, or amount: (a) reduction in activity" (Oxford, Illustrated Dictionary, 1962.). Wolpe (1982) summarized Beck as stating that depression is characterized by "motor and verbal retardation, crying, sadness, loss of mirth response, loss of interest, self-devaluation, sleeplessness, and anorexia." Coppen (1970) says that depression will often be manifested by "a lack of feeling (since everything is becoming more and more meaningless)...diminished interest and drive...or apathy toward hobbies and social life, so that he has to spend more time and effort just getting through daily life."

Poetry is riddled with cryptic references to death and loss. Anna Akhmatova disparaged the personal and national losses in Russia, of both the revolution and World War I. In a sentence from her Requiem she wrote: "And eyes I love are closing on the final horror." (Akhmatova, 1957/1985). Perhaps one of the more famous lines has been Dylan Thomas's (1952), "Do not go gentle into that good night," in which he admonished his father to maintain his integrity in the face of death. A most powerful first line is his "A Grief ago:"

While there has been considerable research in the last ten years on death and extensive poetry for thousands of years on the topic, we don't often have an opportunity to look behaviorally at an individual's reaction. The information on Charts 1, 2, and 3 was gathered by chance. Betty and C.J. were taking classes when a relative's death occurred. Abigail had some data from earlier years that she retrieved.

Betty was counting the chewing of hangnails all day (see Chart 1). C.J. was doing one minute timings on see-say computer fact flash cards (see Chart 2). Both recorded their data on Daily Standard Celeration Charts. Abigail had been keeping a journal for approximately 20 years when she gleaned the information by counting the number of lines per page and the number of pages per year (see Chart 3). Her data are recorded on a Yearly Standard Celeration Chart.

While Betty's and Abigail's losses were immediate and unannounced, C.J. knew her loss was coming. As Chart 2 shows, however, advance knowledge did not lessen the deceleration of subsequent behavior.
Study more
Use computer more

Frequency jump
Corrects ÷ 75
Errors x 11

Chart 2
Successive calendar days
C.J.
27
See-say
Computer counted
In analyzing the data I looked at pauses in recording, frequency changes, and celerations. The frequency jump-downs and the pauses give the greatest information. Each of the three charts shows a lowering of activity where, immediately following the death, the counting or the behavior no longer occurred. Betty's chart shows she stopped recording for two weeks. According to her verbal report to me at the time, however, the behavior did not stop. As shown in C. J.'s chart, the behavior stopped occurring for three weeks. Both were forced to continue counting since each was enrolled in a university class for which she wished to obtain credit. In Abigail's case, the behavior ceased to occur for a total of four years, all of the three years shown and portions of 1959 and 1963.

When the counting or behavior resumed, the frequency changes were large and varied. Betty's chart shows a frequency jump-down of +4.8; Abigail's of +10, and C. J.'s of +75 on correct responses and frequency jump-up of X11 on errors (which included skips). Changes in overall celerations were also evident. In Betty's and Abigail's cases, the celerations changed from +1.5 to x1.4, and from +10 to x1.2, respectively. C. J.'s charting stopped after one day--too soon to determine celeration.

The changes in Charts 1, 2, and 3 offer a behavioral definition of the shock and depression of three normal people reacting to the death of a relative. The immediate absence of recording or of behavior may express the numbness. The frequency jump-downs on each chart are a measure and definition of depression. (C. J.'s increase in errors included skips and shows a decrease in total flash cards turned). It seems not relevant whether the behavior was an acceleration or decelerating. Depression is, at minimum, a temporary cessation or slowing of behavior, a lowering of value or amount, a reduction in a particular, observed activity, a state of reduced vitality.

Charts 1, 2, and 3, however, say nothing about the myriad of other behaviors these people emitted before and after, the death. We do not know whether some behaviors are lost entirely. Do any behaviors increase, and if so, which ones? Crying, or other expressions of sadness, could increase as did Betty's hangnail biting and Abigail's journal writing. Do we develop certain avoidance behaviors that verge on superstitious behaviors?

How frequently do people engineer a second loss in an effort to deal with the first loss? C. J. and Abigail discussed this. C. J. stated she was pursuing two on-going professional activities at what she estimated was a steep celeration. After the death she reported that she pursued each of them "harder and faster." She dropped each at the first signs of painful stimuli. Abigail's engineered second losses are reflected in a drop in journal pages written from 1965 to 1969. Journal pages written during these years had a median of 41 per year, while it was 86 during the remaining years. C. J.'s and Abigail's behavior in these two situations suggest the possibility some people engineer a second loss to help them deal with the first. Further investigation in this area is needed.

It will be difficult to answer these and other questions for their answers depend on our sensitivity to, and counting of behavior and environmental changes at a time when death, divorce, or other major loss vents occur. The charts shown and discussed provide a glimpse into a behavioral definition and analysis of reactions to death.

References


Dr. Abigail Calkin is principal of Quinton Heights Elementary School in Topeka, KS. For further information, contact her at 631 Lane, Topeka, KS 66606.
The Effect of the Concrete to Abstract Teaching Sequence on Acquisition and Retention of Place Value Skills

by

Susan K. Peterson, Pamela J. Hudson, Cecil D. Mercer, and Pamela D. McLeod

The development of meaning and understanding within the learner's capacity to perform has become a recent goal for school mathematics (Underhill, Uprichard, & Heddens, 1980). According to Ashlock (1986), students frequently do not have prerequisite understandings and skills needed to learn new ideas and procedures. He states that teachers who introduce paper-and-pencil procedures to students who still need to work problems with concrete aids are encouraging students to memorize a complex sequence of mechanical acts. Such memorization lends itself to faulty algorithms and frustration for the student and teacher.

Reisman (1982) concurs with Ashlock and further suggests that students must develop a basic understanding of mathematical relationships before they can succeed at arithmetic computations. Gaps in mathematical foundations occur when relations underlying computational algorithms are not fully understood. One strategy that promotes conceptual understanding of mathematical skills involves using a teaching sequence that begins with the manipulation of objects, then uses pictures for instruction, and finally uses the abstract symbols (i.e., numbers) in isolation (Underhill, et al., 1980).

The purpose of this article is to share results obtained when the concrete to abstract teaching sequence was implemented for place value instruction. Student performance was evaluated in terms of skill acquisition, retention, and generalization to a new setting.

METHOD

Subjects. The three subjects in this study were males categorized as learning disabled and enrolled in grades 2, 1, and 4 respectively. They were referred to the Multidisciplinary Diagnostic and Training Program's (MDTP) classroom at the University of Florida, which they attended for five weeks and then returned to their home schools. All three participants exhibited varying degrees of difficulty with mathematics skills. The subjects were determined eligible for the study based on a 10-item place value pretest. Criterion for study participation was a score of 70% or less.

Design. The primary purpose of the study was to test the effectiveness of three learning activities at the concrete, semiconcrete, and abstract instructional levels on the acquisition, retention, and generalization of place value skills. A multiple baseline design (Baer, Wolf, & Risley, 1968) was used.

Procedure. Three experimental conditions were included in the study: baseline, treatment, and posttreatment (see Figure 1). Baseline and treatment conditions were implemented in the MDTP classroom. The posttreatment condition was implemented in the participants' home schools.

Baseline. During the baseline condition, one-minute timings were administered to each subject on a daily basis. The same instructor met daily with each subject. The same teacher dialogue was used to initiate the timing on each occasion (i.e., “I want you to tell me how many ones or tens the underlined number represents.”) Figure 2 illustrates the probe sheet used to conduct the timings. Teacher feedback regarding student performance was withheld. Baseline data were gathered for a minimum of three days (Tawney & Gast, 1984).

Treatment. During the treatment condition, the three subjects were taught place value using a concrete, semiconcrete, and an abstract teaching sequence. Three activities were presented for each step in this sequence. Materials used for concrete instructional activities included one-inch plastic
was set for acceptable performance. If the criterion was not met, the activity was repeated. The duration of the treatment phase ranged from 9 to 15 days for the three subjects.

Posttreatment. Immediately following the last instructional activity each student was given a posttest identical to the pretest. Direct instruction on the mathematical skill was discontinued and the students returned to their home schools. The baseline probe sheet was used to administer periodic one-minute timings for two weeks to serve as maintenance checks. Maintenance checks were then discontinued for one week. Then, a retention probe sheet (an alternate form of baseline probe line sheet) was used to conduct one one-minute timing. An alternate form of the posttest was also administered.

RESULTS

As shown in Table 1, all three participants made dramatic gains on the criterion-referenced pretest-posttest measures. More importantly each participant retained the newly acquired skill. Data from the one-minute timings are displayed in Charts 1–3. During the baseline condition all three participants exhibited more error responses than correct responses. During the treatment condition, correct responses increased while error responses decreased. For subject 1 and 3, however, this improvement was not evident from the timings until introduction of semiconcrete instruction. This improvement was maintained during the posttreatment condition. An additional timing also demonstrated retention.

DISCUSSION

The daily and pretest-posttest measures suggest that the treatment was effective for all three participants. Additionally, the data demonstrate skill maintenance and retention. Since the posttreatment measures occurred in the students' home school, generalization to a new setting was also demonstrated. The concrete to abstract teaching sequence was easy to implement, yet significant in its effect. Replication across skills and subjects would add to the existing data base.
CALENDAR WEEKS

BASELINE C S A POSTTREATMENT RETENTION

C = concrete
S = semiconcrete
A = abstract

SUCCESSIVE CALENDAR DAYS

SUPERVISOR ADVISER MANAGER

DEPOSITOR AGENCY TIMER COUNTER CHARTER

SUBJECT

BEHAVIOR AGE LABEL COUNTED VALUE

DAILY BEHAVIOR CHART (DEP-BENT)
6 CYCLE - 140 DAYS (20 WKS)
BEHAVIOR RESEARCH CO
BOX 3351 - KANSAS CITY, KANS 66103
CHART 2

Baseline  Treatment  Post-treatment Retention

C = concrete
S = semi-concrete
A = abstract

SUCCESSIVE CALENDAR DAYS  Subject 2  See/Say place

SUPERVISOR  ADVISER  MANAGER  BEHAVIOR  AGE  LABEL  COUNTED
CALENDAR WEEKS

6 CYCLE - 140 DAYS (20 WKs)
BEHAVIOR RESEARCH CO
BOX 3351 - KANSAS CITY KANS 66103

 Baseline Treatment Posttreatment Retention

C = concrete
S = semi-concrete
A = abstract

CHART 3

COUNT PER MINUTE

1000 |

500 |

100 |

50 |

10 |

5 |

1 |

0.5 |

0.1 |

0.05 |

0.01 |

0.005 |

0.001 |

0 |

SUCCESSIVE CALENDAR DAYS

SUPERVISOR  ADVISER  MANAGER

DEPOSITOR  AGENCY  TIMER  COUNTER  CHARTER

Subject 3

Behavior  Age  Label  Counted Value

see/say place
Figure 2  See-Say Place Value Probe

References


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* LEARN facts quickly and easily
* KNOW facts like second nature
* REMEMBER facts
* UNDERSTAND facts conceptually

SO THEY -
* Learn complex operations faster and learn more easily.
* Complete long operations like column addition and long division quickly & accurately.

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  Guarantees mastery of facts
Is self-paced
Guarantees retention of facts

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[3] REVIEW PROBES - Review all facts the student has learned on all slices.
[4] MIXED PROBES - Practice all addition-subtraction or multiplication-division facts, mixed randomly.

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