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A Publication of The Standard Celeration Society
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Chart Share:
Steffi Graf's Pro Tennis Career

Keynote/Invited Addresses by Ogden Lindsley
Do Times Two, Then Go for Four,
Or More: PT Aims for the 21st Century

Our 5 Number Worlds™:
Measurement Scales Made Clear

Celeration and Agility
for the 2000s

Does Autism Involve Excess Will and Control: Can this Control be Shared using Free Operants?

The Standard Celeration Society

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- A society to encourage the science of human behavior and the Standard Celeration Chart.

- A society to create functional applications derived from the science of behavior.

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- Regular meetings during the Conventions of the Precision Teaching Conference and the Association for Behavior Analysis.
Contributions from the international scene include Anick Legault, Michael Maloney, and Normand Giroux's attempt to predict the amount of time required to reach fluency on the Corrective Reading Series at their QLC Educational Services, located in Belleville, Ontario, Canada. Calling for wider Precision Teaching implementations in their Northern Ireland, Claire McDowell and Mickey Keenan discovered that several children having difficulty in school were dysfluent in the component skills needed.

Bill and Susan Sweeney, along with Paul Malanga, demonstrated the efficacy of warm-up cycles prior to one minute addition timings. Using a Direct Instruction flash card strategy, Andrea Delli Sante, T. F. McLaughlin and Kimberly Weber assisted two students with developmental delays in reaching multiplication facts mastery.

Tana Teigen, Paul Malanga, and Bill Sweeney used a combination of repeated readings and error correction to improve reading fluency with a 10 year old boy, while Kim Killu, Kimberly Weber, and T. F. McLaughlin used repeated readings across various timing periods to increase the performance of a university student with learning disabilities in multiple channels.

Melissa Judy used herself as a subject in a study co-authored with Paul Malanga, Randy Seevers, and John Cooper. She used encouraging self-statements to reduce her frequency of detected forgets. An endurance setting with three undergraduate students reading Hindi characters is described by Christine Kim, James Carr, and Amy Templeton to demonstrate steady rates in endurance. They also included a distraction condition which produced mixed results. Lastly, Warren Barnes and Hank Pennypacker replotted some well-known historical data on the Standard Chart, producing clear endurance ceilings.

Handouts from recent presentations by Ogden Lindsley and a Chart Share from Steve Graf round out this last issue under my editorship. I wish Rick Kubina and Clay Starlin all the best as they take over editing and managing JPT&C. They need manuscripts from practitioners and researchers, so support them with your writing, ideas, subscriptions, and dues to the Standard Celeration Society!

To subscribe for new issues or procure back issues of the first 16 volumes of the *Journal of Precision Teaching (and Celeration)* contact:

Rick Kubina, Ph.D., Assistant Professor <rmk11@psu.edu>
Pennsylvania State University
Department of Educational and School Psychology and Special Education
231 CEDAR Building
University Park, PA 16802-3109.
The *Journal of Precision Teaching and Celeration* (ISSN 1088-484X) is a multidisciplinary journal that is dedicated to a science of human behavior which includes direct, continuous and standard measurement. This measurement includes a standard unit of behavior, *frequency*; a standard scale on which successive frequencies are displayed, the *Standard Celeration Chart*; a standard measure of behavior change between two frequencies, *frequency multiplier*, and a standard, straight-line measure of behavior change across seven or more frequencies, *celeration*. Frequencies, frequency multipliers, and celerations displayed on the Standard Celeration Chart form the basis for Chart-based decision-making and for evaluating the effects of independent variables.

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

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

Articles which are not data-based and do not include data displayed on Standard Celeration Charts may be included. These articles should substantially contribute to the development or dissemination of Precision Teaching/Learning.

The *Journal of Precision Teaching and Celeration* staff:
Claudia E. McDade, Editor, Donna Groat, Managing Editor
John M. Brown, Assistant Editor

**Board of Consulting Editors:**

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**Editors Emeritus**

Ogden R. Lindsley
Patrick McGreevy

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A Publication of
The Standard Celeration Society
Cumulative Dysfluency: Still Evident In Our Classrooms, Despite What We Know

Claire McDowell and Michael Keenan

This study was conducted in order to assess the extent to which learners experiencing difficulty achieving competent performance in a composite skill were dysfluent in the component skills of that task. Seven learners who were experiencing difficulties in particular curriculum areas were assessed for fluency in their performance of a composite academic task over several sessions. Their performance in 2 or 3 component skills of that task was then tested for fluency over several sessions. The experimenter found that all 7 learners were dysfluent in the 2 or 3 component skills tested.

Fluency-orientated teaching programs are designed to increase the frequency of component skills rather than composite performances. In such programs composite skills are analyzed for their key component elements and the frequencies of these elements are then increased, under conditions of free-operant responding, to predetermined frequency aims (Haughton, 1980; Johnson & Layng, 1992). Increased fluency in the composite performance then often happens as a result of increasing fluency in each component skill (Binder, 1996). Over many years of using frequency aims to teach skills to fluent levels, Precision Teachers and other fluency-orientated educators began to notice a phenomenon recurring time and time again in the data collected in their classrooms. A new understanding of educational failure derived from the recognition that behavior components with fluency deficits, despite their accuracy, accumulate when they are layered on top of one another. This accumulation of dysfluent skills, which Precision Teachers have termed cumulative dysfluency, limits and may even prevent acquisition of composite skills that depend on them. Cumulative dysfluencies in component skills mount to make progress through the curriculum increasingly difficult (Johnson & Layng, 1992; Binder & Pennypacker 1992). In fact, fluency-orientated educators are coming to the conclusion that "cumulative dysfluency may be the single most important factor in long-term student failure" (Binder, 1996, p 184). This study was conducted in order to assess the extent to which cumulative dysfluency existed among pupils experiencing difficulties learning particular curriculum skills.

METHOD

Participants
Seven learners, five males and two females, participated in this experiment.
Six of the participants (four males and two females) attended a school for children with learning difficulties and one (male) attended a regular primary school where he attended remedial classes for help with reading and math. The participant ages ranged between 8 and 11 at the time of the experiment. Target composite skills were selected based on teacher's and parent's recommendations of curriculum areas in which learners were experiencing difficulty. Fluency aims were set based on Precision Teaching (PT) recommendations or by having competent performers (in this case university undergraduates) perform the skill for 1 minute, several times, and taking an average of their highest scores. The learner’s target skills and aims were as follows:

Learner M - see/write answers to x4 multiplication problems (70-90 digits)

Learner L & P - see/write answers to x2 multiplication problems (70-90 digits)

Learner C - see/write answers to +2 addition problems (70-90 digits)

Learner D, E & J - hear/see/point to isolated key words (40-50 words)

Each composite skill was analyzed for key component skills, and 2 or 3 component skills were selected for testing. Again, aims were based on PT recommendations or on the competent performer’s average scores.

Component skills and aims were as follows:

Learner M
Tool skill 1 - see/dot multiples of 4 on number grid (60-80 dots per min.)

Learner L & P
Tool skill 1 - see/dot multiples of 2 on number grid (80-100 dots per min.)
Tool skill 2 - see/write answers to add 2 problems (70-90 digits per min.)

Learner C
Tool skill 1 - see/say numbers 1-50 (60-80 numbers per min.)
Tool skill 2 - think/write numbers 0-9 (120-160 digits per min.)
Tool skill 3 - see/write answers to add 1 problems (70-90 digits per min.)

Learners D, J & E
Tool skill 1 - see/say letter sounds from flashcards (60-80 sounds per min.)
Tool skill 2 - see/say 2 letter syllable sounds from flashcards (60-80 sounds per min.)

Procedure
The learners were assessed for fluency on the composite skill by asking them to perform that skill over several one-minute timings. No instruction or teaching occurred during these sessions. Scores were charted as rate of correct and incorrect responses per minute. Each learner’s performance on the component skills was tested by asking him/her to perform that task over several one minute timings. Again, no teaching or instruction took place during these sessions. Scores were recorded as rate of correct and incorrect responses per minute.
RESULTS AND DISCUSSION

Each learner's correct and incorrect responses during testing sessions for target skills are presented in Table 1. These results show that all seven learners were not fluent in the skills being taught in the classroom. Correct and incorrect responses during testing of the component skills are presented in tables 2-8. These results show that all seven pupils were dysfluent in 2 or 3 component skills of the composite task they were having difficulties learning. While several learners responded fairly accurately in all sessions, with low rates of incorrect responses occurring (learners M, L & P, tables 2, 3 & 4), it would appear that accuracy alone in composite skills was insufficient to facilitate learning of related composite tasks. It appears that although the repeated practice of performing the component skills did result in increases in rates of correct responses for some of the learners (M, L, P, D & E, tables 2, 3, 4, 6 & 7), this period of practice was not enough to reach fluent levels of accurate responding. Further practice or additional instruction would have been required to reach fluency. These results support claims made by PT literature, suggesting that cumulative dysfluency is, and continues to be, an important factor in long-term academic failure (Binder, 1996). Despite this evidence showing that component skills must be fluent before compound skills can be taught, regular classrooms appear to concentrate on teaching skills to accuracy and continue to ignore the accumulation of dysfluent components. Barrett, (1979), wrote that equating accuracy with mastery makes it difficult to detect dysfluency in skills prior to its ultimate cumulative effect. Apart from the studies undertaken by the researchers at this university, PT is not practiced in schools throughout Northern Ireland. Although based on a very small sample, these results suggest that an important starting point in establishing PT in schools in the province will be in the teaching of component skills to fluent levels to redress the problem of cumulative dysfluency in our classrooms.

REFERENCES


Editor's Comment: Since submission of this article, Claire McDowell has added more data for comparisons between the LD students and regular students, as well as charted data on Standard Celeration Charts. Look for a revision in a later issue.

Claire McDowell and Michael Keenan are affiliated with the University of Ulster at Coleraine, Northern Ireland.
### Table 1

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<td>10/8</td>
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* indicates scores below aim
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* Indicates score below aim
Effects of Fluency Building on Performance over “Long” Durations and in the Presence of a Distracting Social Stimulus

Christine Kim, James E. Carr, and Amy Templeton

The present study attempts to conduct and develop a systematic way of setting a frequency level that would allow an individual to perform a task for long durations and in the presence of a distracting social stimulus. Hindi speakers determined where to set frequency levels that could possibly lead to fluent performance on the endurance of a reading task. The same frequency level obtained by Hindi speakers served as a criterion in which undergraduate students read Hindi characters. For all three undergraduate participants, a steady rate of responding occurred while assessing endurance during 20-min timings. This suggests that performance for long durations without a significant reduction in responding may be a characteristic of fluent outcomes. During the distracting-stimulus phase, however, the data produced inconclusive results.

Two fundamental determinants of academic achievement include the amount of time that students actively engage on a task and the degree of success they experience with that task (Fisher, C. W., Berliner, D. C., Filby, N. N., Marliave, R., Cahen, L. S., Dishaw, M. M., & Moore, J. E., 1978). Some of the behaviors that enable a student to perform well in school settings include attention to a task, staying on a task for extended periods of time, and performance in the presence of everyday distractors. Kalilus and Stokes (1978), for example, examined the effectiveness of a preschool peer-tutor in facilitating generalized responding occurred function. On some days, normal preschool children took up to eight times as long to complete the same discrimination task in the presence of a peer tutor relative to in its absence. The implication in the literature suggests that small changes in the environment can produce significant changes in the completion of the task. In a typical school setting, students must stay on task for long durations in an environment consisting of multiple distracting stimuli. A mastery criterion that facilitates on-task behavior and performance in the presence of everyday distracters may increase a student’s performance over time. Distractions may alter the performance of a task, depending on the different response class involved in the specific task. Margolin Grieble, and Wolford (1982) instructed undergraduate students to perform two distracting tasks independently (i.e., counting aloud and responding to a threshold shock) while reading or listening to a word or phrase.
The authors reported that both distracting tasks led to higher on-task performance for a listening task relative to a reading task. Other studies have shown that susceptibility to a distracting stimulus may be related to the difficulty level of the primary task. If a reduction in the difficulty level of the task occurs, then a distracting stimulus might not interfere with the primary task. Students with developmental disabilities often engage in inappropriate behaviors when performance drops significantly for long periods of time. A technique that allows an increase in attention to a task while simultaneously decreasing the frequency of inappropriate behaviors would provide practical implications for classroom instruction. By varying practice and measurement durations, teachers may better predict performance over long durations and performance in the presence of everyday distracters. Binder (1996) discussed two unpublished pilot-data sets as templates for future research on the persistence of responding across various conditions. In the first study, Binder (1984) observed students in kindergarten through eighth grade practicing writing math digits 0 through 9 as rapidly as possible. Teachers changed the duration of timing while keeping all other conditions constant. Students wrote for 15 s, 30 s, 1 min, 2 min, 4 min, 8 min, or 16 min.

The students who reached a rate of 70 responses per minute performed at the same level regardless of whether the duration was 15 s or 16 min. In contrast, some students who wrote at about 20 digits per min actually stopped writing before the end of 16 min. These observations suggest that students who have not yet attained minimal levels of performance necessary for a particular skill could not be expected to continue for longer than a brief duration without considerably slowing down.

In the second pilot study, Binder (1979) taught college students to say specific numbers to the point of 100% accuracy when presented with a printed Hebrew character. The students listened through headphones to a voice reciting random numbers as they performed the task. This auditory distracter inhibited task performance for participants with low-frequency levels. For some participants, the addition of the auditory distracter caused responding to stop completely. However, when the participant said the numbers paired with Hebrew characters at a high rate, the performance of the participant in the presence of the distracter was consistently paced. Binder concluded that after sufficient amounts of practice beyond a 100% accuracy, people could respond quickly and accurately without being distracted or slowed down by unexpected actions of the experimenter. In the behavioral literature, fluency can be defined functionally as a skill performed at a speed that produces REAPS outcomes (Binder, 1988; Binder, C., Haughton, E., Van Eyk, D., 1990). The literature suggests that individuals fluent at a skill enjoy several benefits. First, fluency can be characterized as a greater ability to maintain a response over time (i.e., retention) (Olander, Collins, McArthur, Watts, & McDade, 1986; Orgel, 1984). Orgel (1984) found that college students who showed high frequencies of correct responses performed twice as accurately on calculus formulas at a six-week follow-up than did students who did not obtain high frequencies. Second, fluency allows
a person to perform for extended periods of time and in the face of a distracting stimulus (i.e., endurance) (Binder et al., 1990).

Third, fluency may improve the combination of complex skills (i.e., adduction), (Binder, 1987; Evans, Mercer, & Evans, 1983). A crucial feature of fluency training depends on how to set a frequency level that will enable one to be fluent. Therefore, research investigating how to set levels and testing outcomes systematically to ensure fluency should be investigated in detail. Johnson and Layng (1992) illustrated the complex relations between retention, endurance, and fluency. The authors found that on a multiplication task, a student’s frequency of writing answers to a long multiplication task equaled 50 correct answers per min. When tested 30 days later her correct answers per min remained the same. However, when the 1-min timing was extended to a 5-min timing, the number of correct answers dropped to 10 per min with the occurrence of many errors. When the 1-min performance increased to 70 correct answers per minute, her performance remained at 70 per minute a month later during a 5-min timing. Johnson and Layng concluded that teachers need to adjust the retention aim to build endurance. For example, by increasing the number of correct answers written per minute on a multiplication task, students performed better over a longer timing. By investigating these outcomes individually, one may better select a frequency level that leads to fluent performance in specific areas.

The present study attempts to develop a systematic method for establishing frequency levels that allows an individual to perform a task for long durations and in the presence of a distracting stimulus. Undergraduate participants read Hindi characters at the same frequency level obtained from expert Hindi-readers. The undergraduate participants determined if the frequency level resulted in greater endurance on an identical task on a 20-min timing and in the presence of a distracting stimulus.

**METHOD**

**Participants and Setting**
Three female undergraduate students (Lynn, Cassie, and Helen) between the ages of 20 to 30 years and in their third or fourth year of undergraduate training served as participants. The participants solicited from the psychology classes had no prior history reading Hindi characters. A screening process ensured that the participants said sounds correctly and accurately and moved flash cards from one stack to another with ease. All sessions conducted in a classroom on a university campus consisted of 8 large tables, 20 chairs, and a dry-erase board in the front of the room. All sessions included a participant, experimenter, and another individual videotaping.

**Data Collection and Dependent Variables**
The dependent variables included the number of correct and incorrect responses per minute of saying the English translation when presented with a Hindi character on a flash card.
A response considered correct consisted of the participant saying the exact pronunciation of the Hindi character. A response considered incorrect consisted of the participant saying the wrong name or if the participant turned the flash card over to read the correct answer. The experimenters counted and graphed correct and incorrect responses and conducted the experimental conditions on consecutive days. The task of reading Hindi cards eliminated any confounds that occurred in which college students may have had prior exposure to this particular task. The experimenter conducted all sessions at approximately the same time each day. Trained undergraduate observers recorded correct and incorrect videotaped responses and used a counter to record the number of correct and incorrect responses for each minute within the session. The experimenter counted and reported correct and incorrect responses as count per minute.

Inter-observer Agreement
Research assistants conducted interobserver agreement checks for 30% on skill acquisition and 25% on the endurance tests. Minute-by-minute IOA calculation consisted of dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100%. Mean IOA for Lynn, Cassie, and Helen, respectively, for each phase are as follows: (1) acquisition 99.6% (spread, 98% to 100%), 99.2% (spread, 97% to 100%), and 99.5% (spread, 98% to 100%), and (2) experimental phases 95.9% (spread, 89% to 100%), 96.2% (spread, 90% to 100%), and 98.9% (spread, 93% to 100%).

Experimental Design
Skill acquisition employed practice sessions of 1-min timings in which the experimenter recorded and graphed answers until the participant’s reached the mastery criterion of 90 to 100 flash cards per min. The first condition after skill acquisition involved a fluency check. The fluency check ensured that the participants reached the criterion of 90 to 100 flash cards per minute before conducting endurance tests. The first condition consisted of assessing endurance during 20-min timings, followed by another fluency check, and finally ending with assessing endurance with distraction condition. The experimenter employed a multiple-treatment reversal design (ABAC) in the present study.

Setting Frequency Levels
Three Hindi speakers 20 to 30 years of age with at least 10 years of experience speaking and reading Hindi characters established the frequency goal for the participants. These three individuals could say Hindi phonics sounds at 80 responses per minute. The three individuals moved flash cards from one stack to another saying the English translation when presented with a Hindi character during two 20-min assessments. Undergraduate observers recorded correct and incorrect videotaped responses. Trained observers used a counter to determine the number of correct and incorrect responses for each minute within the session. Observers counted correct and incorrect responses and reported them as responses per minute. The Hindi-speakers used a stack of laminated flash cards with 25 different randomly chosen Hindi characters. The stack consisted of
200 flash cards on which 8 sets of 25 characters were written. The participants moved the flash cards from one stack to another as fast as they could and said the English translation during a 1-min timing. Several practice trials (e.g., 3 to 7) allowed speakers to orient themselves with and feel comfortable with the task. Three 1-min timings ensured that no warm-up effects occurred. Following the 1-min timing, the readers moved the flash cards for a 20-min timing. The observer recorded the number of correct and incorrect responses per minute during a 20-min timing. In another session, two additional individuals were present as Hindi readers entered the room. The additional individuals practiced a phonics task in which another student said Hindi phonic sounds as fast as possible while being timed by another individual. These individuals served as a possible visual and auditory distracter throughout the entire session. Three 1-min timings ensured that no warm-up effects occurred and determined the Hindi reader's performance following the introduction of a distracting stimulus (i.e., the two additional individuals). The timing involved a 20-min timing with the addition of the distracting stimulus. The highest number of correct responses during the 1-min and 20-min timing for each participant equaled 90 answers per minute. The spread was set at 90 to 100 correct answers per minute and served as the criterion for undergraduate participants.

**PROCEDURE**

*Skill Acquisition.*
The participants first practiced 8 flash cards, and then learned another set of 8 cards. The participants now practiced these 16 learned flash cards together. Next, they practiced a final set of 9 new flash cards. The performance standard that allowed a participant to move to new flashcards equaled 90 to 100 correct answers per minute with 25 flash cards for three consecutive sessions. During skill acquisition with 1-min timings, the experimenter modeled the correct pronunciation of the character and instructed the participant to repeat the sound three times for all of the flash cards. The experimenter gave the participant a stack of laminated Hindi flash cards and told her that if she was unsure of the sound that was paired with the character, she was permitted to flip the flash cards to see the answer. Therefore, the skill acquisition phase consisted of a self-feedback and correction method in which participants used flash cards by responding and checking their answers as they went through the flash cards. For all phase, a 1-min timing began once the participant read the flash cards. The experimenter gave the participants a stack of laminated flash cards with 25 different Hindi characters chosen randomly for the experiment. The stack consisted of 200 flash cards and included 8 sets of 25 characters. Each participant moved the flash cards from one stack to another as rapidly as possible and said the English translation during a 1-min timing. This skill acquisition phase continued until 25 Hindi characters could be read at the predetermined frequency of 90 to 100 flash cards per minute. During the fifth 1-min timing of each skill acquisition phase (i.e., with 8, 9, 16, or 25 flash cards), a distracting stimulus introduced during the timing, determined if the distracter had a major impact on the frequency of responding with an non-fluent performer.
The distracting stimulus condition consisted of having two other individuals present in the room performing a similar phonics task. The additional individuals engaged in a phonics task that involved a teacher timing a student. The phonics task consisted of having another student say the Hindi phonic sound as fast as she could while being timed by another individual. The fifth timing was chosen because each participant’s performance had stabilized by this point in the experiment. In addition, the participant would not have achieved a fluent performance by this time. The criterion for passing the acquisition phase for the participant included 3 consecutive minutes of reaching or surpassing the frequency level of 90 to 100 correct answers per minute. The participants moved to the second phase of the experiment, assessing endurance, after achieving the selected frequency level.

Assessing endurance during 20-min timings.

The experimenter told the participants that the new timings would be longer than the I-min timings. The experimenter recorded the number of correct and incorrect responses per min during a 20-min timing. If the performance did not equal 90 to 100 correct responses per min, additional timings conducted allowed the participant to reach this fluency level for three consecutive sessions.

Assessing endurance with distraction

This condition used the same procedures as described under “assessing endurance during 20-min timings”, with the exception that another student read Hindi characters as fast as she could while being timed by another teacher. The additional teacher and student served as a possible visual and auditory distraction throughout the 20-min performance of the three participants.

RESULTS

The results for Lynn are shown in Charts 1 to 3. Lynn’s total acquisition and experimental sessions lasted approximately 4.5 hours. During skill acquisition, a steady acceleration in correct responding occurred with a subsequent deceleration in the number of errors until she reached the fluency level. Lynn’s number of correct responses per min decelerated with the distracting stimulus (i.e., additional student and teacher) but had no effect on the frequency of errors. In the second acquisition phase, Lynn produced similar frequencies and errors upon completion of the mastery criterion. There was no apparent effect on the frequency of correct and incorrect responses with the reintroduction of the additional student and teacher in the third phase. The total acquisition (i.e., 25 flash cards) results showed similar outcomes to previous sessions in which the number of correct responses accelerated steadily and the errors subsequently decelerated to near no occurrences when the criterion of 90 to 100 correct answers per min was reached.

Stability was seen during the first and third phase, “Assessing Endurance during a 20-min timing”. In the second phase, an initial deceleration in frequency occurred with the introduction of the distracting stimulus (i.e., additional student/teacher). A stable rate of responding was observed throughout the
Chart 1

Set One (8 cards)

Set Two (8 Cards)

Combined Set (16 Cards)

*=Distracting Stimulus

Christine Kim

Lynn

Amy Templeton

S/S Hindi Cards

Amy Templeton

Amy Templeton
fourth phase. In all of the experimental phases, there was slight bounce and low levels of errors.

The results for Cassie are shown in Charts 4 to 7. Cassie's total acquisition and experimental sessions lasted approximately 5 hrs. During skill acquisition, there was a steady acceleration in correct responding and a subsequent deceleration in number of errors until the fluency level was achieved. The introduction of the distracting stimulus accelerated Cassie's correct responses with a corresponding acceleration in errors. The total acquisition (i.e., 25 flash cards) results showed similar outcomes to previous sessions in which the number of correct responses accelerated steadily, and the errors subsequently decelerated to near no occurrences when the criterion of 90 to 100 correct answers per min was reached. There was no apparent effect on the number of correct responses with the introduction of the distracting stimulus in the second acquisition phase. The final distracting stimulus produced results similar to the first acquisition phase in which the number of correct responses accelerated with an acceleration in error rate. Upon completion of skill acquisition, the endurance tests produced stable rates across the two conditions. Few error were seen across the four phases.

The results for Helen are shown in Charts 8 to 10. Helen's total acquisition and experimental sessions took approximately 4 hours to complete. During skill acquisition, there was a steady acceleration in the correct responding and a subsequent deceleration in the number of errors until the fluency level was reached. The distracting stimulus did not have an effect on the rate of correct and incorrect responding for he first phase (8 cards). The second and third distractions in acquisition showed a deceleration in the rate of correct responses. Upon completion of skill acquisition, the endurance tests produced stable rates across the two conditions. An acceleration in the number of errors was observed across the endurance tests.

**DISCUSSION**

All three of the non-fluent speaking participants developed stable responding across the three experimental conditions. This suggests that one characteristic of fluent performance is one can perform for long durations without a major reduction in responding. Assessments that included distractions, however, produced inconclusive results. These inconclusive data do not answer questions concerning the role of distraction with the performance of a fluent participant. The results of this study demonstrated a systematic way to set a frequency goal on a particular task in which a fluent performance is critical. The frequency level of non-fluent participants following practice in the experimental conditions matched the frequency of fluent-speaking participants. A systematic method in which an average frequency level of three fluent-speaking participants may establish an expert base rate for use with novices to produce similar performances.

In addition, this study contributes to the literature by providing further research on the use of a naturalistic distracter in a
Set Two (8 Cards)

Combined Set (16 Cards)

Set Three (9 cards)

* = Distracting Stimulus

Christine Kim

Cassie

S/S Hindi Cards
Chart 7

Without Distraction

With Distraction

Without Distraction

With Distraction

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← Successive Minute-by Minute Performance during a 20-min counting period
1-min = fluency probe

Christine Kim  S/S Hindi Cards

Cassie

Selly Bird

Selly Bird
Chart 8

Set One (8 cards)

Set Two (8 Cards)

Combined Set (16 cards)

*=Distracting Stimulus

Christine Kim

Helen

Amy Templeton

S/S Hindi Cards
<table>
<thead>
<tr>
<th>Christine Kim</th>
<th>Helen</th>
<th>S/S Hindi Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Distraction</td>
<td>With Distraction</td>
<td>Without Distraction</td>
</tr>
</tbody>
</table>

Chart 10

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*Successive Minute-by-Minute Performance during a 20-min counting period*

1-min=fluency probe

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classroom setting. Many studies (Margolin, C., Griebel, B., & Wolfd, G., 1982) employ loud noises as possible distracters; however, they are arbitrarily chosen and are not representative of a typical classroom setting. The distractions that were chosen for this study provided an analogous situation to an educational setting. This study presents an initial investigation in the area of fluency and endurance and the results should be interpreted with caution. It is imperative to acknowledge some caveats and issues that together may be considered limitations in this study. First, the distractions during skill acquisition showed a corresponding deceleration in correct responses per min for only four of the nine assessments with distractions across participants. Therefore, it is not entirely clear as to the effects of the distractions on the performances of the participants. This study might have better tested the distracters before the experimental phases were conducted to ensure that the condition chosen served a distracting function. Future studies must address this issue to determine what the role of fluency has on the performance of an individual in the presence of everyday distracters. A second limitation of this study is the use of an “error-ful” method, which was used in the acquisition phase to teach the non-fluent speaking participants the Hindi characters. The experimenters choose an error-ful method because it consists of teaching in a more natural way in which students typically learn. The literature suggests both positive and negative attributes when using the error-ful method compared to the error-less method for acquisition (e.g., Jones & Eayrs, 1992). Future studies might replicate this study by using errorless method procedures in the acquisition phase to determine whether this may affect results.

Third, the experimenters noted a reduction in responding in the 20-min timings immediately following a fluency check. During the acquisition phase, the participants needed to meet a mastery criterion of 90-100 correct responses per min before moving on to the next acquisition phase. During the experimental conditions, however, the experimenters did not tell the participants their rate for each minute since it was a 20-min timing. The condition preceding assessing endurance during a 20-min timing closely resembled the condition during the fluency check; therefore, there should not have been a sharp reduction immediately following the first experimental condition. There may have been a lack of motivation to “go fast” during these conditions because there were no social contingencies present during these phases in which an experimenter said the rate for each minute. In addition, the experimenter did not present a criterion to be reached during these conditions. Fourth, the present study might have incorporated control participants responding at lower levels to determine if fluency affected the performance. Future studies might conduct control conditions in which participants are trained to different frequency levels to determine the effect that a specific rate has on the performance over long durations and in the presence of everyday distracters. Studying different rates in fluency research will determine a critical frequency level that would lead to optimal performance. A sequence-effect confound may be another limitation of
the present study. All experimental sessions started with assessing endurance during a 20-min timing followed by assessing endurance with distraction condition for two times with each participant. Future studies might switch the order of the design to determine if the sequence of the design affected the individual’s performance. Future research might also examine specific mechanisms that may be responsible for fluent performance. Specific variables might be studied in greater detail to determine what feature of fluency training leads to greater performance standards. Perhaps the rate of responding is what leads to expert performance. Another hypothesis might be that individuals who are fluent have more practice on a particular task. Therefore, practice effects may be responsible for optimal performance. This study serves as a model for preliminary research in the area of fluency and endurance. There has been a dearth of research thus far that addresses issues of endurance systematically and that are fundamental to our understanding of this concept. More research should be conducted to extend the literature on fluency training in greater detail.

REFERENCES


Christine Kim is affiliated with the Ohio State University; James E. Carr is affiliated with Western Michigan University; and Amy Templeton is affiliated with University of Nevada, Reno.
A Self-Experimentation on the Detection of Forgets Using Encouraging Think/Say and Hear/Tally Statements

Melissa Judy, Paul R. Malanga, Randy L. Seevers, and John O. Cooper

This self-experiment investigated the effects of daily encouraging self-statements said orally within a one-minute counting period on the frequency of detected forgets. We used six weeks of initial baseline data (i.e., the Before condition) to assess the frequency of detected forgets in the absence of the intended treatment of encouraging self-statements. We observed an immediate change in frequency of detected forgets following the initiation of the encouraging self-statements. As the frequency of encouraging self-statements accelerated, the frequency of detected forgets improved to a total frequency spread of no occurrences, to 1 occurrence per counting period during the final five weeks of intervention. The frequency of detected forgets remained low for the four weeks without the counting periods for the daily self-statements.

Within the past 50 years, self-experimentation has remained mostly unexplored in the behavioral sciences. Rarely do behavioral scientists and practitioners experimentally analyze their own behavior. More often, scientists experiment on and observe non-humans in operant chambers or humans in laboratories, classrooms, clinics, and other numerous settings (Neuringer, 1981). Experiments with other participants provide meaningful and necessary information about human behavior. As B. F. Skinner (1953) expressed in Science and Human Behavior, however, there exists a part of the universe enclosed within the skin, and this portion of the universe remains relatively uncharted. Exploration and discovery of the inner self have the potential to provide great insight concerning one's inner problems and the solutions to those problems. Self-experiments have a long history in the medical and behavioral sciences. In the medical field, for example, over a period of 30 years, Sanctorius studied the energy expanded by living organisms by weighing all the food he consumed and then weighed his excrement. Some experiment involved more physically challenging procedures. For instance, Forssmann placed a catheter through the veins in his arm to his heart to demonstrate the feasibility of this medical procedure. Helsted used LSD in a self-experiment. Henry Head severed the nerves in his arm to study the regeneration of pain. Lazear performed the ultimate sacrifice in self-experimentation—he died from his experiment with yellow fever (Neuringer, 1981).
Experimental psychologists have a history of reporting their own experiences. The early volumes of American Journal of Psychology and Psychological Review document numerous cases in which the experimenter was the sole or major subject in his experiment. For example, Lombard (1890) examined the effects of fatigue on muscular contractions using his own muscles. Thorndike (1900) conducted a series of experiments on mental fatigue where he served as the primary subject. Dressler (1891) investigated his own response frequencies as functions of time of day and of physical and mental exercise. Ebbinghaus's (1913) inquiry into his own memory in an extensive series of experiments lasting for more than two years provided some of the most renowned studies of self-experimentation in psychology. His discoveries continue to influence experimental psychology. More recently, Neuringer (1981) used himself in an experiment to study the effects of physical activities on intellectual tasks and behaving randomly. Also a number of Neuringer's students performed self-experiments of various conditions (Neuringer, 1996, May). Calkin (1981) and Conser (1981) performed self-experiments measuring inner behaviors of positive and negative thoughts and feelings. A number of reasons exist that encourage self-experimentation. Foremost, it expands our understanding of human behavior (Neuringer, 1981). Neuringer appears to believe that discoveries derived from non-human and human laboratory research ultimately offers only hypotheses about our own behavior. "If my interest is my own behavior, I must test on myself any hypothesis offered about me by the experimental analysis of animals or other people." (p. 89). Experiments conducted on humans and other animals in controlled settings may yield limited applicable results. Neuringer (1981) advocates that "A simple behavioral 'law' obtained from laboratories may be relevant for some people some of the time, but rarely will the law be relevant to all, all of the time." (p. 89). Ultimately, self-experimentation "is compatible with the experimental analysis field and, indeed, can be viewed as the next step in the evolution of that field: from the experimental analysis of the behavior of rats to the behavior of psychotic people to the behavior of normal people to one's own, ongoing behavior." (Neuringer, 1981, p. 90).

Some experimenters have concerns with doing and reporting self-experimentation as science. Neuringer addressed a number of these concerns in *Self-experimentation: A Call for a Change* (1981) and challenged those concerns. One major concern addresses the difficulty of replication. Consequently, this difficulty makes it harder to acquire knowledge about general human nature. Nevertheless, the difficulty of replication occurs with most experiments. Some experiments will yield more or better general insights than others. A second concern addresses experimenter bias, where expectations may be self-fulfilling. Experimenter bias, however, can exist in all areas of experimentation. Neuringer believes the checks and balances that accompany the scientific process will make the experimenter bias issue associated with self-experimentation less salient. Low experimental control presents a third concern from those who question the reliability of self-
experimentation. Consider, though, that Copernicus and Darwin worked within extremely complex and uncontrolled subject areas that resulted in gains in scientific progress (Neuringer, 1981). Fourth, self-experimentation takes time away from engaging in leisure activities not associated with experimentation. A fifth possible reason may be the lack of models who demonstrate the promise and benefits that can come as a result of employing and analyzing our own behaviors. The final concern, that some believe is the greatest, is the absence of measuring and reporting interobserver agreement. Ultimately, truth by agreement merely provides an indication that two independent observers agree to the existence of an occurrence or nonoccurrence of an event based on a definition under the control of similar contingencies. Consequently, this "agreement" has the potential to occur solely based on method rather than philosophy. Simply because the determinations of a response are only accessible to the individual performing the behavior does not make the response less real or less valid (Moore, 1995). These concerns possess a degree of validity. Nevertheless, overcoming these concerns is not an impossible task. Many scientists have succeeded, despite the obstacles, in performing self-experiments that produced great contributions to behavioral science.

We analyzed the effects of self-statements on the first author's (Melissa Judy) encounters with items previously forgotten. These self-statements focus on encouraging Melissa to improve her memory. To quantify this encouragement, she made a daily tally of the number of self-statements that she said orally during a one-minute counting period. Her remembrances of items forgotten appear as the total number of detected forgets within 24-hour counting periods. This self-experimentation on inner behavior represents the distinguishing feature of our research. We addressed the following questions. What effects will daily encouraging self-statements said orally for one-minute have on daily encounters with items previously forgotten? Will encouraging self-statements be functionally related to the frequency of forgets detected? How will the number of daily self-statements change over the course of the experiment? How will encouraging self-statements affect the number of "quickies" (i.e., items expected to be completed within approximately 5 minutes but are forgotten) encountered each day? What effect will the absence of encouraging self-statements have on the frequency of detected forgets?

**METHOD**

Note: We wrote the Method section in first person singular to emphasize that the first author (i.e. Melissa Judy) served as the manager and behaver in this experiment.

*Participant*

The nature of this experiment dictated that I, Melissa Judy, serve as the sole participant of the study. As a 28-year-old college student, I engage in a number of activities and responsibilities. I spend a large amount of personal time working on school related activities such as papers, study guides, projects, or reading. In addition, I work 3 to 4 days a week doing in-home personal care for individuals with disabilities. My father
and I frequently engage in social activities at home and in the community. For instance, we attend movies or the theater, eat out, and vacation together. I take care of many errands and household responsibilities for him as well. I coach and play sports (softball) from spring to fall and try to attend some professional sporting events and do other recreation with friends whenever possible (e.g., attend movies, eat out, talk). I often and quickly forgot things that caused me personal, professional, and academic difficulties. This behavior pattern generated concern and produced emotional distress and unpleasant consequences as a function of forgetting. Clearly, my behavior made me a suitable candidate for this research topic.

**Settings**
I counted detected forgets during each day of the study, in all settings and situations that I engaged. For example, I counted forgets while at home, at school, driving in my car, in every social setting, and during all activities. I collected data at any place and time of the day that I encountered an item previously forgotten.

**Pinpoints**
The number of detected forgets that occurred in daily twenty-four hour counting periods defined the pinpointed counts. I counted three characteristics of forgets. One characteristic included any thought or planned action for the future, whether immediate or distant, that I forgot to do in a designated or sufficient amount of time to complete the action. For example, I planned on my way home from school to buy bread and milk at the store. I bought the milk, but did not buy bread. If I "remembered" the bread after leaving the store, I counted that event a detected forgot. A second characteristic of detected forget included any piece of information that I did not remember within a 15-second period. For example, when I could not immediately recall the name of a person or a book title for instance, I counted that event a detected forgot. I called the third characteristic of detected forgets a "quickie." A "quickie" was any action I thought of with the expectation for it to occur within a short amount of time (approximately five minutes), but I forgot to do it. For example, my call-waiting signal sounded while my brother and I talked on the telephone. I answered the call-waiting to receive a call from my graduate adviser. I told my adviser I was on another line and asked if he would mind holding while I said good-by to my brother. After saying good-by, I disconnected the line and did not speak with my adviser. When I learned I left my adviser holding a dead telephone line, I counted that event as a "quickie" forgot. I measured the dependent variable daily throughout a twenty-four hour period beginning and ending at 8:00 AM each day during the study. I selected this counting period as a result of the variable amount of sleep that I receive each day. I usually go to bed between 1:00 AM and 3:00 AM in the early morning and rise sometime between 7:00 AM and 8:00 AM. The twenty-four hour interval enabled me to record data at any time. For example, I could record when I tended to stay up later than normal, or if I woke up and remembered something forgotten. Consequently, I displayed counts on a Standard Celeration Chart with the counting period floor marked at the 24-hour frequency line.
Experimental Design
I used a single-subject withdraw design (A1 A2 B A2) to assess the effects of encouraging self-statements on the number of forgets occurring in a twenty-four hour period. I measured the number of detected forgets during two baseline conditions (i.e., Before conditions), a treatment condition (i.e., During condition), and a return to baseline condition (i.e., After or Maintenance). I defined stability as celerations multiplying by x1.1 or less or dividing by /1.1 or less per week. Following a stable celeration in the last three weeks of the second Before condition, I began the daily encouraging self-statements. After ten weeks in the treatment condition, I then returned to the After condition where I removed the daily encouraging self-statements, but continued to measure the number of detected forgets.

Materials
(1) I used Standard Celeration Charts (Pennypacker, Koenig, & Lindsley, 1972). (2) I used a wrist counter that has a button on the side that I pushed once per each count to keep track of detected forgets. Three windows on the face of the counter indicate the number of counts to 999. The counter increases at increments of 1 by pushing the button on the side, or manually operated knobs located on the face of the counter increase by 1's or 10's or 100's (Lindsley, 1968). (3) I used one data sheet to record the type of forget, the description of the detected forget, and whether the forget was a "quickie". I used another data sheet to display the total number of encouraging self-statements said daily and the date. (4) An audio tape recorder, GE model # 3-5363A. (5) Pad of paper for tally marks, and (6) Pens and pencils.

Procedures
Before1
Following the first week of data collection, I altered the initial definition of detection of forgets to the one described previously in the "pinpoint" section. Initially, the definition did not include the characteristic of a "quickie," and only involved detecting forgets that were concrete (e.g., to call someone, leaving a book at home, locking the door). It did not include forgets concerning mental issues, for example, people's names, things I wanted to say, and whether I forgot a forget. The following conditions used the improved definition.

Before2
This Before condition consisted of 5 weeks of data collection until I established a steady state of responding. When I detected a forget, I marked a count on the wrist counter. I also wrote the type of forget, and the description of the forget on the data sheet that I carried with me throughout the day. The different types of detected forgets consisted of "interpersonal," that applied to any forget that pertained to or directly affected another person (e.g., returning a call), "academic," that encompassed anything directly relating to school, or "personal," which pertained to all other detected forgets. A detected forget that would have acquired the characteristic of a "quickie" included any item that required execution within approximately 5-minutes, and that I subsequently forgot before completion. I transferred the information to the identical data sheet on my computer and charted on a Standard Celeration Chart the total number of detected forgets that occurred in a counting period of twenty-four hours. I
repeated this procedure each day except for those days that I voluntarily chose to postpone charting until the following day. I never exceeded two days without charting the data.

**During**
After I achieved a steady state of responding in the Before2 condition, I introduced daily one-minute oral encouraging self-statements (e.g., I will have less forgets. I will have more remembers. I will perform better. I will not forget anything today.). I created and used these self-statements to provide incentives and motivation to decrease the number of detected forgets and improve the amount of items remembered. I performed this intervention daily in the morning usually close to the beginning of the counting interval at 8:00 AM, as think-to-say and hear-to-tell learning channel sets. I said the statements into the audio tape recorder for one minute, I then listened to the recording, tallied the number of statements while it played, and transcribed the total number of self-statements I said on a data sheet that indicated the total number and the date. Approximately every day, I charted this information on a Standard Celeration Chart.

**After (Maintenance)**
I measured the maintenance of the behavior beginning in the 16th week of the study. Then I concluded the intervention of making oral encouraging self-statements and returned to the Before2 condition. I recorded detected forgets in the same manner as exercised throughout the study. When I detected a forget, I tallied it on the wrist counter, wrote the relevant information on the data sheet, and subsequently charted the data on a Standard Celeration Chart.

## RESULTS

The overall results show an accelerating frequency of encouraging self-statements counted in one minute and a decelerating frequency of total daily detected forgets. The Standard Celeration Chart #1 displays the count per 24-hour period of detected forgets during initial Before conditions, the self-statement condition, and the After condition. The Chart shows the Before2 condition with the final three weeks of steady state of detecting forgets. The Before2 condition indicates a performance spread from no occurrences to 12 counts per 24-hour counting period. The During condition continued for approximately ten weeks, with the one-minute counting of self-statements in effect. The Chart displays an initial turn-down in celeration from the Before condition to the During condition. The total frequency for the During condition spread from no occurrences to 4 occurrences of detected forgets. The After condition consisted of 24 days of data collection. A steady state of responding occurred during the After condition, with a frequency spread from no occurrences to 1 occurrence. An exception to that frequency spread was the outlier data points charted on 6/29/96, 7/9/96, and 7/20/96.

Concerning the categories of detected forgets, I observed a higher frequency of personal forgets than of interpersonal or academic types. This may be because of the increased opportunity of personal activities and events. The personal category encompassed everything that was not interpersonal or academic. The count of encouraging self-statements charted displayed a total performance
change from 15 to 74 counts per minute. The frequency of encouraging self-statements said during a one-minute counting period had an acceleration value initially of x3, then an ending acceleration of x1. Standard Celeration Chart #2 displays the same counts as shown on Chart #1, except on Chart #2 we present these data by calendar weeks rather than by successive calendar days.

**DISCUSSION**

Following the implementation of the one-minute encouraging self-statements, we observed an immediate improvement in frequency of detected forgets. Melissa experienced a more profound effect on the frequency level of her detected forgets than on the celeration. This is consistent with findings in Calkin's (1992) analysis. Calkin noted that lower frequencies of troubling inners occurred following the introduction of positive one-minute counting periods with a jump-down in frequency rather than a deceleration. The lower frequency of detected forgets continued until approximately the final 5 weeks of the During condition where the total frequency bounce was no occurrences to 1 occurrence of detected forgets per day. During the 15th week of the study, there were 4 days when Melissa did not count detected forgets. This occurred because she went out of town and believed that the variety and type of activities she would engage presented numerous possible confounding variables likely to affect the accuracy of her counts.

When an experiment indicates that an event can be made to happen by manipulating another event, it is said that a functional relation exists between the two events (Cooper, Heron, & Heward, 1987). Following the removal of the independent variable at the onset of the After (Maintenance) condition, the frequency of detected forgets remained low. From a therapeutic point of view, this type of responding is desired. From an experimental standpoint, this is not desired because it limits the possibility of experimentally establishing a relationship between the counts of detected forgets and the self-statements. Melissa's counts displayed on the Standard Celeration Chart do, however, suggest the existence of a functional relationship between frequency of self-statements and detected forgets.

The acceleration of self-statements corresponded with a frequency change in the detected forgets. This pattern may indicate an increased concentration focusing on improving her behavior. It is possible that our results occurred because the self-statements focused Melissa's attention on remembering and becoming more aware of her forgets and how to prevent them. Melissa reported that she consciously forced herself not to forget as many items as she had during the previous day or days. Once she noticed that her behavior improved, Melissa said that the improvement encouraged her even more to continue trying to increase the daily self-statements and decrease her frequency of forgetting.
CHART # 2

SELF STATEMENTS
THINK/SAY HEAR/TALLY

BEFORE 1
BEFORE 2
DURING
AFTER MAINTENANCE

SUPERVISOR ADVISER MANAGER BEHAVIOR LABEL COUNTED

COTTRICE MABANGA MELISSA L. SUBY

CALANDER WEEKS

0 10 20 30 40 50 60 70 80 90 100

COUNT PER WEEK

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

100,000

50,000

10,000

1,000

500

100

50

10

5

1

The limitations of this study preclude the demonstration of a suggested functional relationship between the one-minute counting periods and the detection of forgets. This study did, however, (a) emphasize the importance of an apparently effective instructional method, and (b) emphasize a demonstration of improving troublesome inner behavior. This self-experiment showed a change in frequency of detected forgets, the maintenance of improved inner behavior, and a replication of response patterns as reported by other experimenters (e.g., Calkin, 1992; Cooper, 1991). This analysis of replicated patterns follows the experimental procedures exemplified by Ferster and Skinner’s (1957) experiments with schedules of reinforcement rather than the use of steady state logic in the search for functional relationships (Sidman, 1960).

An increase in frequency of daily self-statements occurred in the During condition. On the first day of the intervention, Melissa orally made 15 self-statements. On June 20, she made 74 self-statements. Melissa demonstrated a steady acceleration of self-statements. This is most likely because of practice that enabled her to quickly develop an extensive repertoire of self-statements and the opportunity to repeat previously verbalized statements.

Melissa experienced a deceleration of the number of "quickies" recorded in a 24-hour counting period immediately following the implementation of the encouraging self-statements. Again, this could be attributed to the increased attention Melissa placed on her performance, and the improved thoughtfulness and focus on her daily activities.

During the 31 days of the After condition, the frequencies of detected forgets spread from no occurrences to 1 occurrence. Three days of data collection contained outlying data points. We considered these frequency counts outliers because they were not consistent with the counts observed in the other 21 days in the after condition. Additional environmental factors may have contributed to the increased frequency recorded on those days. Without encouraging self-statements, Melissa achieved a steady state of responding that was consistent with the last 5 weeks of the During condition.

One limitation of the study involves the inability to establish accuracy concerning whether a detected forget was actually something forgotten. No other person can confirm the occurrence of a detected forget, nor can another individual verify the true value of the frequency of detected forgets within a counting period of 24 hours. This relates to the problem of experimenter bias, a concern of self-experimentation. If the results of the study indicate a potential self-fulfilling prophecy, no one can prove or refute that possibility.

A second limitation relates to time constraints and follow-up assessments of generality. Data collected at additional points after the study may improve the believability of the effects of self-statements on the frequency of detected forgets.
Some suggestions for further research include conducting more self-experiments measuring inner behaviors. Research involving a number of participants engaging in self-experimentation who possess a variety of backgrounds and living situations may provide understanding regarding behavior change techniques, especially with inner behaviors. The more information we learn about ourselves and our own behavior, the more we can apply this information to help others with their problem behaviors.

Self-experimentation is an underdeveloped area of research. To expand on this research, individuals can simultaneously measure remembered pinpoints and detection of forgets. This type of information may provide a better picture of the effectiveness of the intervention. Calkin's (1981) study that reported the effects of one-minute timings on both positive and negative thoughts illustrates this suggestion. She found that there was a negative correlation between the frequency of positive and negative thoughts and feelings. Simultaneously, as the frequency of negative thoughts decreased, the frequency of positive thoughts increased.

A second suggestion is to monitor the context (e.g., daily events, situations) to analyze the effects of a constantly changing context on frequency of inners. Days spent relaxing in front of the television may possess less potential for a large amount of items remembered or forgotten than, for instance, a day beginning at dawn that is filled with numerous errands and chores to do. Furthermore, analyzing the context may provide additional information about whether specific events or stimulus conditions are correlated with higher frequencies of forgets and remembers or negative and positive self-statements.

We suggest using distributed practice of encouraging self-statements as a third area for future research. Instead of performing the intervention for one-minute in the morning, perhaps the participant can say the self-statements during four 15-second or six 10-second counting periods distributed throughout the day. We believe it would be worth trying distributed counting periods with difficult to change inner behaviors.

Fourth, an experimenter may also attempt to alter or expand the categories of forgets. Melissa's categories included personal, interpersonal, and academic. Other participants could reduce Melissa's classifications into additional, smaller, or more specific categories. In addition, the data pertaining to the frequency of each category could be monitored and analyzed to determine which, if any, occur independently of each other.

Finally, it would be desirable for researchers and practitioners to realize the potential of self-statements as an intervention technique for changing inner behaviors. Ultimately in this study, we found that a successful change in the frequency of detected forgets accompanied daily accelerated encouraging self-statements. Calkin (1992) also witnessed success in her analysis of the 45 studies assessing the effects of interventions on inner behavior. She found that using one-minute positive self-thoughts (they were not oral statements) can improve behavior.
We proposed to determine the effects of encouraging self-statements on the frequency of detected forgets, and to improve Melissa's interaction with her environment. At the end of this study Melissa said, "My personal and academic life have benefited from this experience. I remember more items necessary to function efficiently in my day-to-day life, and I feel better about my behavior and myself. I believe other persons can apply the procedures I used in numerous situations and settings for improving both inner and outer behaviors."

REFERENCES


An Evaluation of Repeated Readings Across Various Counting Periods of See to Think, Think to Say, and Think to Write Channels with a University Student with Learning Disabilities

Kim Killu, Kimberly P. Weber, and T.F. McLaughlin

The purpose of this research was to determine the effectiveness of repeated readings across various timing periods with a university student with learning disabilities. A time series design was employed to evaluate the various interventions for see to think, think to say and say to write. The overall outcomes indicated jump ups in all measures. In addition, the student’s performance increased throughout the study. The benefits of employing precision teaching procedures with postsecondary students are listed.

There has been an increase in the number of students with learning disabilities enrolled in post-secondary institutions. Current estimates indicate that approximately 60% of post-secondary institutions have students with specific learning disabilities (U.S. Department of Education, 1999). Through Section 504 of Rehabilitation Act of 1991, students with disabilities are entitled to reasonable accommodations. Frequent modifications in post-secondary institutions include extension or removal of time limits on exams, quiet non-distracting test environments, and note takers to supplement class notes. Though provided with necessary accommodations, students in post-secondary institutions typically do not receive direct modification to actual instruction provided by the faculty.

Students with learning disabilities often display deficits in the areas of reading comprehension, reading retention, and interpretation of material read (Mercer & Mercer, 1998), a deficit that, without question, has a pervasive effect across all academic areas. Since reading comprehension requirements substantially increase as students progress through the academic ranks (Deshler, Ellis, & Lenz, 1996), and since course work and successful performance in post-secondary rely heavily on reading comprehension, students with learning disabilities in post-secondary institutions may be especially challenged. Undoubtedly, receiving instructional modifications targeting this skill deficit would benefit students with learning disabilities in post-secondary institutions.

Several instructional strategies have been presented in the literature to promote reading comprehension for students with learning disabilities. (See Mastropieri & Scruggs, 1997, for review). One such strategy, repeated readings (Samuels, 1997) has been demonstrated to improve reading rate, accuracy, comprehension (Dowhower, 1987). Improved reading comprehension is a desired outcome from the method of repeated readings because additional readings allow the student to attend more to the content of material than to the process (e.g., decoding) of reading. Consequently, re-reading text enhances reading comprehension. In a study conducted by O’Shea, Sindelar, & O’Shea (1987),
students with learning disabilities read more fluently with multiple re-readings of the same text (3 times vs. 7 times). Students in that study also improved story retells after three readings. Sindelar, Monda, & O'Shea (1990) similarly reported an improvement in fluency, accuracy, and story retellings after three readings of the same text. Ellis and Graves (1990) also found that multiple repeated readings (3 to 4) of the same passage positively affected fluency and comprehension.

In addition to deficits in reading comprehension, students with learning disabilities have been found to have lower performance in recall procedures, reflecting poorer reading comprehension (Montague, Maddus, & Dereskiwsky, 1990; Weaver & Dickinson, 1982; Worden, 1986; Worden, Malmgren, & Gabourie, 1982). Students with learning disabilities also provide less complete retelling of information based on their reading (Carlisle, 1999). This poor recall performance has been attributed to poorer understanding of the passage (Worden, 1986). Understanding (e.g., learning), however, involves practice (Shuell, 1986). Though John Dewey (1916) indicated that “students learn by doing”, actual student responding has only recently re-gained momentum as an instructional strategy. The term “opportunity to respond” (Greenwood, Delquadri, & Hall, 1984; Hall, Delquadri, Greenwood, & Thurston, 1982) has been used to describe active student responding during the course of instruction. The research in this area demonstrated that students learn more (e.g., emit relevant response) when engaged in instruction that requires active responding (Rosenshine & Berliner, 1978). A strong correlation is also noted between active student responding and achievement (Greenwood, Delquadri, & Hall, 1989).

Thus, as active student responding allows direct measurement of a student’s specific responses (Heward, 1994), and of changes in that responding (Alexander, 1983), active student responding is reflective of learning that has taken place. One method for supplemental active student responding is by employing the techniques of Precision Teaching. Known more as a system for directly measuring performance (Lindsley, 1991), Precision Teaching is used to record and chart the frequency of a student’s responding, providing a visual image of changes in performance over time. This performance is based on standards as related to a student’s retention, endurance, and application (Binder, 1996). As Precision Teaching is not a specific methodology for instruction, but rather a method for evaluating the effectiveness of instruction, it can be used as a natural supplement to any strategy yielding impressive results.

The purpose of this investigation was to examine the combined role of Precision Teaching and practice through repeated readings and repeated oral and written recall in improving a learning disabled student’s comprehension of information obtained from published articles related to special education.

METHOD

Participant and Setting
The participant, Susan, was a 24-year-old female completing her final semester
at a 4-year university in urban southeastern Michigan. The student, labeled as "learning disabled," received accommodations through Disability Resources Services within the university. She reported difficulties in the areas of reading comprehension and written expression. A general studies major, Susan expressed interest in learning more about issues in special education through independent study with the first author. Sessions with Susan were held on campus during the course of a full semester. Sessions typically occurred 2 consecutive days per week and lasted approximately 60 minutes.

Silent Reading
The movement cycle for silent reading was the number of words read during a one-minute timing. The learning channel for silent reading was see/think. The number of words read within an assigned passage was charted.

Oral Recall
The movement cycle for oral recall was the number of concepts stated during a 1 min (sessions 1-5) or 15 s (sessions 6-25) counting period. The learning channel for oral recall was think/say. The number of concepts verbally stated was charted.

Written Recall
The movement cycle for written recall was the number of words written during a 3 min (sessions 1-5) or 1 min (sessions 6-25) counting period. The learning channel for written recall was think/write. The number of words written was charted.

General Procedures and Materials
During each session, Susan was provided with an article from an issue of the journal *Teaching Exceptional Children*. A total of 25 articles were selected from the September 1996 issue through the January/February, 1997 issue (6 issues total). Table 1 lists the articles used throughout the study.

For each session, Susan was provided with an article. Each session followed a specific cycle of events. First, Susan silently read for 1 min. Immediately after the reading, she counted the number of words read and charted her performance. At this point, she orally recalled concepts from the article for 1 min (sessions 1-5) or for 15 s (sessions 6-25). She then wrote a summary of what she had read for 3 min (sessions 1-5) or for 1 min (sessions 6-25), and again charted her performance. Susan repeated this cycle of reading/oral recall/written recall 5 or 6 times for each session. After each session, Susan took the article home, read it in its entirety, and submitted a 2-page written summary of the article at the next session.

RESULTS
The results are displayed in Charts 1, 2, and 3. Additional data on silent reading, oral recall, and written recall are provided in Tables 2, 3, and 4. Although Susan read the same article and recalled information five or six times per session, the data presented reflect only the lowest and highest score. The highest scores are charted to display the range of performance within each session.

Chart 1 and Table 2 display the results of the silent reading (see-think). The number of words per minute ranged from a low of 214 to a high of 582. The average and median were calculated for
Table 1

Articles Used During Instruction

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<th>Author(s)</th>
<th>Title</th>
<th>Journal</th>
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<tr>
<td>Angle, B.</td>
<td>5 steps to collaborative teaching and enrichment remediation.</td>
<td>Teaching Exceptional Children, 29</td>
<td>8-10</td>
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<td>Appl, D.J.</td>
<td>Recognizing diversity in the early childhood classroom: Getting started.</td>
<td>Teaching Exceptional Children, 29</td>
<td>22-25</td>
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<td>Buck, G. H., &amp; Gregoire, M. A.</td>
<td>It's music to my ears! Teaching music-related leisure skills to secondary students with disabilities.</td>
<td>Teaching Exceptional Children, 29</td>
<td>44-47</td>
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<td>Cooper, C. S., &amp; McEvoy, M. A.</td>
<td>Group friendship activities: An easy way to develop the social skills of young children.</td>
<td>Teaching Exceptional Children, 29</td>
<td>67-69</td>
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<td>Culross, R. R.</td>
<td>Concepts of inclusion in gifted education.</td>
<td>Teaching Exceptional Children, 29</td>
<td>24-26</td>
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<td>Ellsworth, J.</td>
<td>“PEPSI”: A screening and programming tool for understanding the whole child.</td>
<td>Teaching Exceptional Children, 29</td>
<td>33-39</td>
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<td>Gartin, B. C., Rumrill, P., &amp; Serebreni, R.</td>
<td>The higher education transition model: Guidelines for facilitating college transition among college-bound students with disabilities.</td>
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Articles Used During Instruction

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Articles Used During Instruction

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<tr>
<td>---------</td>
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<tr>
<td>1</td>
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<tr>
<td>18</td>
<td>337</td>
</tr>
<tr>
<td>19</td>
<td>465</td>
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</table>
Table 2 (continued)

Silent Reading (see-think) Scores for Words Read Per Minute

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<thead>
<tr>
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<th>Low&lt;sup&gt;a&lt;/sup&gt;</th>
<th>High&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Increase&lt;sup&gt;c&lt;/sup&gt;</th>
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<tr>
<td>20</td>
<td>445</td>
<td>509</td>
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<td>21</td>
<td>472</td>
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<tr>
<td>23</td>
<td>448</td>
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<tr>
<td>24</td>
<td>429</td>
<td>548</td>
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<td>25</td>
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<td>481</td>
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<tr>
<td>Mean Score</td>
<td>258</td>
<td>321</td>
<td>80</td>
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<tr>
<td>Median Score</td>
<td>341</td>
<td>442</td>
<td>77</td>
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<sup>a</sup> Represents the lowest score out of 6 trials

<sup>b</sup> Represents the highest score out of 6 trials

<sup>c</sup> Represents the difference between the lowest and the highest score for the 6 trials
<table>
<thead>
<tr>
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<td>16</td>
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<tr>
<td>2</td>
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<td>3</td>
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<td>10</td>
<td>15 s</td>
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<td>High&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Increase&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
<td>Median Score</td>
<td>28</td>
<td>48</td>
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</tbody>
</table>

<sup>a</sup> Represents the lowest score out of 6 one minute trials or 5 fifteen second trials

<sup>b</sup> Represents the highest score out of 6 one minute trials or 5 fifteen second trials

<sup>c</sup> Represents the difference between the lowest and the highest score
Chart 3
Table 4

Written Recalls (think-write) Scores for 3 or 1 min Timings as Counts Per Minute

<table>
<thead>
<tr>
<th>Session</th>
<th>Counting Period</th>
<th>Low&lt;sup&gt;a&lt;/sup&gt;</th>
<th>High&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Increase&lt;sup&gt;c&lt;/sup&gt;</th>
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Table 4 (continued)

Written Recalls (think-write) Scores for 3 or 1 min Timings as Counts Per Minute

<table>
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<th>Counting Period</th>
<th>Low&lt;sup&gt;a&lt;/sup&gt;</th>
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</table>

<sup>a</sup> Represents the lowest score out of 6 trials

<sup>b</sup> Represents the highest score out of 6 trials

<sup>c</sup> Represents the difference between the lowest and the highest score for the 6 trials
both the low and high scores. The average low was 258, and the high was 321. The median score for the low was 341 with a high of 442; the average increase of words read per minute was 80 with a range of 8 to 140. It is important to note that 23 of the lowest scores occurred during the first practice for the 25 sessions. The highest scores occurred most often during the sixth (e.g., 15 out of 25 sessions) and fifth practice periods (i.e., 9 out of 25 sessions).

Chart 2 and Table 3 display the results of the oral recall (think-say). The number of words said per minute ranged from a low of 10 to a high of 68. The average and median were calculated for both the low and high scores. The average low was 30, and the high was 46. The median score for the low was 28, and the high was 48. The average increase of the number of words said per minute was 15.3 with a range of 0 to 28.

Chart 3 and Table 4 display the results of the written recall (think-write). The number of words written per minute ranged from a low of 5 to a high of 26. The average and median were calculated for both the low and high scores. The average low was 14.4, and the high was 18.9. The median score for low was 13.5 with a high of 19.5. The average increase of the number of words written per minute was 5.2 with a range from 1.5 to 8. Of the 25 sessions, 20 of the lowest scores occurred during the first (i.e., 15 out of 25 sessions) or second (i.e., 5 out of 25 sessions) practice period. It is important to report, two of the low scores did occur in the sixth practice period. The high scores occurred most often during the sixth (i.e., 17 out of 25 sessions) and fifth practice periods (i.e., 4 out of 25 sessions).

DISCUSSION

The results clearly indicate significant increases throughout the study in silent reading (see-think), oral recall (think-say) and written recall (think-write). As shown in Chart 1 and Table 2, the data clearly show consistent increases within sessions and a steady increase in number of words read (silent reading scores) per minute over the course of study. Since the passage changed each session, some variability would be expected in number of words read. In Chart 2 and Table 3, oral recall scores demonstrated an increase of output after practice with the materials. With this dependent variable, the counting period was changed from 1 min to 15 s practice sessions to assist in fluent responding. In Chart 3 and Table 4, written recall shows increased scores through practice although the amount of increase fluctuated within a typical range for the most part. This fluctuation may have some relationship to passage difficulty or the student’s experience with written responses.

Limitations of the study included limited instructional time, variability on reading levels, single subject design, and lack of maintenance or generalization data. The study was completed over an entire semester, yet instruction occurred two days per week. The limited days of instruction per week may have inhibited the amount of progress possible. It is likely that had the student received instruction three or more days a week, improvement may have been much higher. Next, because the reading materials used throughout the study were chosen to provide the student with
practical information in the field of special education, there was no control for variability in the reading levels of the articles. This lack of control may account for some of the fluctuation in student improvement overall. Also, as the study was conducted with only one student, the data are not adequate to generalize to larger populations. Finally, as the student's participation concluded at the end of the semester, no follow-up data are available to show maintenance or continued growth in the targeted areas.

There were several strengths to this study including the feasibility of self-instruction and individualized instruction, increased faculty-student interaction, potential use in other academic areas, usefulness of article content, and use of active response forms for remediation. Students in post-secondary settings are expected to be more independent learners, and often individualized instruction is considered impractical. The instructor's role in this study was minimal, with the student taking responsibility of timing and charting. Such strategies should prove promising in teaching students to program their own instruction to improve learning and performance. The individualized instruction provided was easy to implement. The student spent approximately 60 minutes each session during the professor's scheduled office hours. Not only does this approach provide specific instruction to directly meet student needs, it fosters a more personal interaction with faculty and students in a mentoring role with minimal time commitments. Because of its simplicity, this type of instruction would be amenable to usage in other academic content areas. The articles used in the study were purposely selected in the area of study most relevant to the student's most probable post-baccalaureate employment setting. The information obtained in the articles thus becomes a supplement to the student's current education. The instructional approach required the student to actively engage with materials provided. This active involvement increased student output of words read, words stated, and words written, addressing the specific areas of need for the student. These outcomes have also been reported across a wide variety of students (Ellis & Graves, 1990; Greenwood et. al., 1989; et. al., 1982).

This study also replicated the use of repeated readings (Alexander 1983; Dowhower, 1987; O'Shea et. al. 1987; Sindelar, et. al., 1990) as an effective intervention. In the present case report, a university student served as the participant. This research adds to the growing literature as to the effectiveness of repeated readings.

The context and effects of this intervention demonstrate its broad utility and application. Further research is necessary in this area with having students direct and manage their own instruction using precision teaching strategies, similar to having students self-manage their own behavior (Workman & Katz, 1995). Future research in this area should also focus on application to other students with disabilities in a larger and greater variety of settings, and with other less pursuit may be to combine peer tutoring with Precision Teaching strategies for students in post-secondary settings. The strategies employed may prove promising in other post-secondary settings as well, where counseling offices frequently provide workshops to students.
on effective study skills.

Post-secondary institutions should increase academic assistance to students with learning disabilities in addition to typical accommodations. Usual accommodations may not be sufficient to assist students with disabilities with their academic performance, and other intervention strategies, whether directed by faculty or student directed must be facilitated or taught. As we have shown here, specific instruction designed to meet individual student goals need not be labor nor time intensive. Effective instructional techniques are available and can be used to enhance the basic or supplemental education for students with learning disabilities.

REFERENCES


Kim Killu is affiliated with the University of Michigan-Dearborn, Kimberly Weber and T. F. McLaughlin are affiliated with Gonzaga University.
Combining Repeated Readings and Error Correction to Improve Reading Fluency

Tana Teigen, Paul R. Malanga, and William J. Sweeney

A repeated readings procedure was used simultaneously with an error correction package that included modeling, prompting, paired reading, neurological impress, and chaining procedures to increase reading fluency in a student attending a university sponsored summer school clinic. An A-B experimental design (Cooper, Heron, & Heward, 1987; Kazdin, 1982) was used to evaluate the frequency of correct and incorrect read words across one-minute timing periods. During baseline, the student read fewer than 60 correct words per minute. A jump-up occurred in both corrects (X 1.5) and incorrects (X 8.0) upon introduction of the repeated readings procedure. Reading performance improved with corrects accelerating and incorrects decelerating, with a bounce of 0-3, across the final six days of repeated readings and error correction instruction. The minimum fluency criterion of 180 correctly read words per minute was met in seven sessions. The data shows a substantial and sustained improvement in reading fluency with the introduction of the repeated readings and error correction package.

Reading is perhaps the most important, yet difficult skill to acquire. One can conceptualize the global skill of reading as consisting of three basic skill domains: decoding, fluency, and comprehension. While each domain may be, and often is, taught separately, they are clearly interrelated. The ability to decode words and read fluently are prerequisite to understanding the information in a text (McCormick, 1995). Without fluent reading skills, the acquisition of a general knowledge base, including civics, history, and science, to name a few, is likely to be hindered. In a broader sense, poor reading skills are likely to hinder the acquisition of cultural literacy, which is critical to effectively communicate with others given many references in daily conversation assume a common knowledge base (Hirsch, 1988). Therefore, instruction designed to produce fluent reading skills is essential for students to be able to participate, contribute, and function in a literate society. A literate society is one whereby its citizens share a common knowledge base. Shared background knowledge enables individuals within a society to pick up a newspaper and read with an adequate amount of information so as to "get the point". To understand the meaning of the text then, the reader must possess a sufficient amount of background knowledge with respect to the topic (Malanga, 1997). Said another way, to understand the text, we must understand the context, and that is what background knowledge provides. Cultural literacy refers to this shared knowledge base (Hirsch, 1988). There is a substantial research base supporting the relationship between the acquisition of background knowledge and comprehension of prose (Erwin, 1992; Malanga, 1997; Pearson & Fielding, 1991; Pearson, Hansen, and Gordon, 1979; Stevens, 1982).
The broader the array of background knowledge a reader possesses the more intellectual capital.

A well-informed citizenry requires the accumulation of what Hirsch (1996) calls "intellectual capital". Intellectual capital refers to a common core of background knowledge required to effectively communicate in a democratic society (Hirsch, 1996). Intellectual capital can be understood in the same vein as money capital. In education circles, it is a commonly accepted assumption that the more information a person possesses, the more readily new information is assimilated and understood. The accumulation of new information results in an increase in intellectual capital, which fosters the accumulation of additional new information. Simply stated, background information is intellectual capital. Very little intellectual capital can be acquired, however, without a firm foundation in basic reading skills. The presence of a firm foundation of basic reading skills is what defines a competent reader. However, the question remains, what skills does a competent reader possess? Competent readers can, at minimum, describe information read in a text. Said another way, they can comprehend what they read, which is the main point of reading. The development of fluent reading and comprehension of text, however, is contingent on the firm development and generalized application of decoding skills (McCormick, 1995). The composite ability to comprehend text, then, is contingent on the development of component skills such as phonological awareness, alphabetic understanding, and automaticity with the code (Kameenui, Simmons, Baker, Chard, Dickson, Gunn, Smith, Sprick, & Lin, 1998).

Phonological awareness refers to the ability to hear and manipulate sounds. This includes the ability to segment words into sounds, blend individual sounds to form a word, manipulate sounds within words, and perceive words as sequences of sounds (Kameenui, et al., 1998). These skills, combined, form the foundation for the development of alphabetic understanding.

Alphabetic understanding refers to the knowledge that words consist of letters and the grapheme-phoneme relationship (McCormick, 1995; Kameenui, et al., 1998). Alphabetic understanding is prerequisite to the development of effective decoding skills. This said, it follows that firmly established decoding skills are required for the acquisition and generalization of word recognition skills. Once a word recognition repertoire is established, one can develop automaticity, or fluency, with the code. Competent readers demonstrate automaticity with the letter-sound code. Further, readers who can automatically decode unfamiliar words are likely to develop fluent reading skills, skills that require no conscious attention (LaBerge & Samuels, 1974). Fluent reading then, is reading that occurs quickly and without hesitation with few errors. Higher levels of comprehension of connected text have been correlated in readers who exhibit these characteristics (Anderson, 1981; Fowler, 1993; Howell & Lorson-Howell, 1990). Moreover, higher levels of literal comprehension of textual information has been shown to be functionally related to higher levels of oral reading fluency (Sweeney, 1992). Conversely, slow
readers perform poorly in comprehension tasks due, in part, to frequent repetitions and hesitations which breaks up the continuity of thought (Downs & Morin, 1990). Succinctly stated, skill at comprehending important information from prose is a skill that distinguishes good from poor readers (Baumann, 1984). This said, it follows that it would be desirable to identify and refine an instructional method that results in efficiently producing fluent reading performance. One empirically validated instructional strategy that has been found to increase reading fluency is repeated readings (Sweeney, Omness, Janusz, & Cooper, 1992; Polk & Miller, 1994).

Fluency is defined as accuracy plus rate of response and is correlated with increased skill retention and transfer to untrained settings (Binder, 1993; Carroll, McCormick, & Cooper, 1991). Fluent reading performance is also correlated with increased comprehension ability (Polk & Miller, 1994). Simply stated, students with fluent reading skills can recall what they read, which is the main point of reading (McCormick, 1995). A repeated readings procedure allows a reader to reread the same passage until a minimum fluency aim is achieved (Sweeney, 1992). The immediate feedback students receive after the end of a reading episode often results in improved performance levels due, in part, to the specificity and immediacy of the feedback. In effect, specific and immediate feedback allows the student to set personal goals on a minute-by-minute basis, thereby increasing a student's level of achievement (Shirley & Pennypacker, 1994). Repeated readings have been empirically validated as an efficient method for substantially increasing reading performance (Polk & Miller, 1994; Daly & Guldswog, 1992; Bolich & Sweeney, 1996; Brosovich-McGurr, 1991; Carroll, et al., 1991; Stroeh & Sweeney, 1999). Polk and Miller (1994) assessed the effects of flashcards and repeated readings on reading performance with secondary students with emotional disabilities. Flashcards were used to remediate errors each student made on the previous day. Immediately after reviewing correct pronunciation of incorrectly read words, the students were provided two opportunities to orally read the same passage. All students evidenced an acceleration in words read correctly and a deceleration in the number of incorrectly read words compared to baseline performance. Carroll, McCormick, and Cooper (1991) used a modified repeated readings procedure to increase the reading performance of four elementary students with severe reading disabilities. Repeated readings were conducted with the same passage twice per session until a performance criterion of 100 correct and 3 or fewer incorrect responses was achieved. Error correction was provided for each word missed immediately after the first one-minute timing by requiring students to correctly see/say the missed words when presented on flashcards. A second one-minute timing was then provided. All students demonstrated rapid increases in the number of correctly read words and decreases in the number of incorrectly read words when the repeated readings and error correction procedures were introduced.

Besides working with students with emotional and behavioral problems, repeated readings have shown beneficial
for a variety of students, in a variety of settings, and across numerous curriculum and academic areas. For example, repeated readings procedures were successfully employed for improving the oral reading fluency of a 43-year-old adult with severe reading and oral language deficits (Sweeney et al., 1992). Lee (1990) combined peer tutoring with repeated readings to improve the reading performance of third graders experiencing reading difficulties. Brosovich-McGurr (1991) implemented repeated readings procedures to improve oral reading successfully with secondary students with learning disabilities. Additionally, the effects of both oral reading fluency and literal comprehension (i.e., retelling comprehension) were shown with academically at-risk fourth- and fifth-grade regular education students (Sweeney, 1992). Repeated readings have also been successfully used to assist in the acquisition of second languages. For instance, Bolich and Sweeney (1996) utilized repeated readings combined with SAFMEDS and a See/Write-Think/Write practice procedure to develop fluent oral reading in Hebrew with an 11-year-old girl. Stroeh and Sweeney (1999) also used repeated readings and SAFMEDS with an eighth-grade male to improve his functional performance at reading and speaking Spanish as a second language. The aforementioned studies demonstrate the robust nature of repeated readings and repeated practice procedures for improving an individual's performance in oral reading fluency, comprehension, and acquisition and fluency of second languages. While the reviewed studies demonstrated measurably superior performance gains with the use of repeated readings procedures and an instructional package across a variety of settings and student characteristics, one cannot infer the external validity of one instructional package across students with different learning characteristics or alternative instructional methodologies. None of the repeated reading studies reviewed incorporated an error correction package that included modeling, prompting, paired reading, neurological impress, and chaining procedures to remediate reading difficulties. The current investigation assessed the effects such a treatment package in conjunction with repeated readings. The purpose of the current study, then, was to determine the effect of repeated readings and an error correction package on the number of correct and incorrect words read per minute.

**METHOD**

**Participant**

Michael was a 10-year-old boy who was assessed and placed in a special education resource room by his local school for specific academic problems in reading and written expression. Michael received special education services for two years at his local school prior to attending the summer school program. Michael's special education teacher referred him to the summer school program as an extended school year placement option, for additional remedial reading and written language instruction. The summer school program, based at the local university, serves students with a variety of academic, social, and behavioral difficulties.
The summer school program ran four days a week, Monday through Thursday, for four weeks during the month of July.

Setting
Thirty-five students, kindergarten through grade 9, attended the summer school clinic. Five teachers and two paraprofessionals worked with small groups of students in this setting. The five teachers were all special education teachers completing a summer internship that served as the culminating instructional experience in their masters programs. The two paraprofessionals were both undergraduate special education majors completing requisite practica experiences prior to their respective student teaching experiences in regular and special education. Each teacher worked with approximately 5 to 7 students who were grouped based on their developmental levels. (e.g., kindergartners and first graders, second and third graders, fourth and fifth graders, sixth and seventh graders, and eighth and ninth graders). The primary modes of instruction employed in summer school program were small group and one-on-one instruction. A small conference room, adjacent to the main classroom was used for individual, one-on-one instruction. Michael and the first author met daily in the small conference room for individual reading instruction and assessment. No other teachers or students were present during instruction. Each instructional session lasted approximately fifteen minutes.

Materials
A passage from the book, *Little House and the Big Woods* (Wilder, 1976), was used for repeated readings. The passage contained 265 words and was selected based upon Michael's initial reading performance of 57 correctly read words per minute with only one error.

Performance
The movement cycle targeted for Michael to improve was oral reading fluency. The learning channel used for practice and assessment for oral reading was See/Say. The correct/incorrect pair used to evaluate repeated readings was the number of words read correctly or incorrectly during a one minute counting period. Incorrects were defined as repetitions, substitutions, omissions, and insertions. One-minute timings were used as the timing period throughout the evaluation periods. The instructional aim for the student was 180 to 210 correctly read words.

Procedure
After reading the passage through once with the instructor to correct any initial reading problems, Michael was told that it was time for his repeated readings. To complete the repeated readings procedure, the instructor told Michael to read as much of the passage as possible in a minute. The instructor explained the importance of both speed and accuracy and that she would be counting the number of words read correctly and incorrectly within the one-minute timing period. The student was told to skip words he could not pronounce. The text chosen was determined to be challenging based on Michael's baseline performance. Each day following the initial baseline, the student chose a goal of number of words read per minute that he wanted to reach. Michael was allowed four one-minute timings during a session to increase his reading fluency. The instructor began timing after Michael
started the first word of the passage. As Michael read, the instructor marked errors on a duplicate copy of the reading passage. The instructor marked a "I" to indicate the beginning and ending point related to the total number of words read. The student and instructor counted the number of correct and incorrect words read immediately after each repeated reading. The student and instructor charted Michael's best daily score of the repeated readings immediately after completing the assessment procedure.

**Error Correction**
The instructor used modeling, prompting, paired reading, neurological impress method, and chaining procedures to remediate reading difficulties as determined by an error analysis of each reading event. Modeling consisted of the instructor correctly pronouncing the word and requiring Michael to reread that word properly. Prompting consisted of providing a phonetic prompt to assist Michael in decoding difficult to read words. Paired reading consisted of the instructor reading a sentence or two from a passage followed by Michael reading the next few sentences in the passage. Paired reading was repeated until Michael read without hesitation one time. The neurological impress method consisted of the instructor and Michael simultaneously reading the passage, thereby allowing Michael to hear how a fluent reading performance sounded. Chaining required Michael to read a section of words quickly. For example, Michael was asked to reread, "Jack and Jill went up the hill" until he could read this phrase without hesitation or pauses for decoding. Subsequent to that performance, an additional section of words was added to the previous section of words. For instance, "to fetch a pail of water" was then practiced and later chained with the original phrase to form a complete sentence (i.e., Jack and Jill went up the hill to fetch a pail of water). The student was allowed to ask questions or ask for help if needed during the instructional time.

**RESULTS**
The data indicate improvement in oral reading performance with the use of repeated readings. During baseline, the number of words read correctly was 57, with one incorrect. Upon the introduction of the repeated readings procedure, there was a concurrent jump-up in the number of correct and incorrect words read. Michael's number of correct words jumped-up approximately X 1.5, while the number of incorrect words jumped-up X 8.0 on the first day of repeated readings. The number of correctly read words improved on each successive instructional day. Results show an accelerating trend for correctly read words and a decelerating trend for incorrectly read words. The slope of the acceleration for the number of correctly read words was X 1.75, while the slope of the deceleration for incorrectly read words was ÷ 2.1 during the repeated readings condition. During the repeated readings condition, the median number of correctly read words was 149 with scores ranging from 88 to 228. The median number of incorrectly read words was 4 with scores ranging from 0 to 8. The overall frequency change for the accelerating number of correctly read words was 140 and the overall frequency change for the decelerating learning
opportunities was 8 during the repeated readings condition. Michael's overall performance change during the repeated readings procedure was X 2.7 for correctly read words, while his overall performance change from baseline to his highest repeated reading timing was X 4.0. Michael's overall performance change during repeated readings for incorrectly read words was +8.0.

**Maintenance**
The natural maintenance check occurred as the result of the clinic's schedule. Each week, three successive days passed between the last instructional day of one week and the first instructional day of the following week. Each Monday's performance was higher than the Thursday performance of the previous week. This suggests a certain amount of "robustness" in the instructional package employed.

**DISCUSSION**

Improvements were demonstrated in oral reading fluency when using repeated readings. The number of correctly read words increased each day while incorrects decreased. Michael achieved the minimum fluency aim of 180 correctly read words within seven repeated reading sessions and improved for two consecutive days to reach a high of 228 correctly read words with 0-1 incorrects. Michael was excited about meeting his daily goal and showed more interest in wanting to read for the instructor during the repeated readings procedure. Even after being away from the classroom setting, Friday through Monday, the student displayed an increase in number of correctly read words. The results of this demonstration project are consistent with the established repeated readings research base. It is interesting to note that the overall acceleration value for Michael during intervention is steeper than was evidenced in the Carroll, et al. (1991) study. This is also the case for three participants on their initial passage in the Polk and Miller (1994) study. A number of factors may account for this difference. First, in each of the above-cited studies, two one-minute timings were conducted. Four were conducted in the current study. The sheer number of practice opportunities could account for the steeper slopes. Second, the error correction procedure in the current demonstration project incorporated five methods: paired reading, chaining, modeling, neurological impress method, and prompting. It is reasonable to assume the cumulative effect of these five instructional procedures resulted in faster acquisition rates compared with error correction procedures incorporating fewer methods. Future research might focus on conducting a component analysis of the error correction procedures used in this study. A component analysis would help determine the relative efficacy of each procedure when combined with repeated readings. Such an analysis may reveal that one or more methods was of negligible effectiveness, thereby allowing a more efficient error correction instructional method to be developed. Limiting the number of one-minute timings to two would also provide an equitable comparison with the existing research base. If, for example, comparable frequency jumps and acceleration values were demonstrated with fewer timings, this would lend evidence to the overall efficacy of the instructional
package and reduce the total amount of time required to reach predetermined fluency aims.

Finally, given the inherent limitations of the case study design (Cooper, et al, 1987; Kazdin, 1982), one cannot rule out the possibility of confounding variables. However, given the significant jump-up/turn-up values, this would seem unlikely. A multiple baseline design across students would lend itself well to establishing experimental control and demonstrating prediction, verification, and replication of treatment effects (Cooper, et al, 1987).

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were recorded by the teacher and each student and plotted on Standard Celeration Charts.

**Experimental Design**
A single subject two-tier multiple baseline across participants design was used to evaluate the effects of the Direct Instruction flash card procedure. A description of the various conditions follows.

**Procedures**
Prior to beginning the research, the researcher compiled 54 flash cards containing single digit math facts. Problem types ranged from $2\times2 = n$ to $9\times9 = n$.

**Baseline**
During baseline, fifteen flash cards were presented each day. No specific instruction or corrective feedback was provided. Then, the 100-problem fact sheet was presented to the participants, and their performance was recorded. The baseline data on the multiplication problems were gathered for 3 to 4 school days.

**Direct Instruction flash card procedures**
During this condition, the flash cards were sorted and contained 12 cards that the student could rapidly respond with a correct solution and 3 cards on which the participants had erred during baseline. The researcher presented the complete set of flash cards. Using a Direct Instruction format (model, lead, test, and retest), the researcher presented the 15 facts three times and spent approximately 5 minutes tutoring each student. When the child was able to name the fact for three consecutive sessions, it was removed and replaced by a new fact that had been missed during baseline. At the end of each flash card session, data were measured using a 100-problem fact sheet.

**Reliability of Measurement**
A second independent observer was trained by the researcher to evaluate reliability. The trained independent observer assessed the student's accuracy of written answers twice during baseline and four times during the Direct Instruction flash card intervention for a total of 6, 20 sessions or 30% of all sessions. The number of correct written responses and errors was determined using a timer and calculator by both the researcher and independent observer. Interobserver agreement was calculated by dividing the number of agreements per test by the number of agreements plus disagreements and multiplying by 100. An agreement was defined as both observers independently marking an answer as correct or both marking an answer as an error. A disagreement occurred if one observer marked an answer as correct, but the other observer marked the answer as incorrect. The mean agreement was 100%.

**RESULTS**

**Correct and Error Rate**
Charts 1 and 2 show corrects and errors for each participant. Compared to baseline performance, each student showed improvement during the Direct Instruction flash card procedure. These data are summarized in Table 1.

Baseline data for Participant-1 had an average of 4.75 for corrects (range 3 to 6) and 12.25 errors (range 10 to 14). During the Direct Instruction Flash Card intervention accuracy increased for
Table 1. The Mean and Standard Deviation for Each Measure by Participant for each Experimental Condition.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Corrects</th>
<th>SD</th>
<th>Errors</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4.75</td>
<td>31.26</td>
<td>12.25</td>
<td>2.34</td>
</tr>
<tr>
<td>2</td>
<td>4.00</td>
<td>1.0</td>
<td>7.667</td>
<td>3.06</td>
</tr>
<tr>
<td>Direct Instruction Flash Card Procedure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant</td>
<td>Corrects</td>
<td>SD</td>
<td>Errors</td>
<td>SD</td>
</tr>
<tr>
<td>1</td>
<td>30.875</td>
<td>10.889</td>
<td>2.062</td>
<td>2.886</td>
</tr>
<tr>
<td>2</td>
<td>25.765</td>
<td>11.877</td>
<td>2.059</td>
<td>1.519</td>
</tr>
</tbody>
</table>

corrects (M = 30.8; range 12 to 47), and there was a decline in errors (M = 2.06; range 0 to 10).

Baseline data for Participant-2 had an average of 4 for corrects (range 3 to 5) and 7.6 errors (range 5 to 11). During the Direct Instruction Flash Card intervention accuracy increased for corrects (M = 25.765; range 10 to 43), and there was a decline in errors (M = 2.059; range 0 to 6.)

**DISCUSSION**

These data indicate that the Direct Instruction card procedures were effective to teach and increase mastery of basic math facts. This replicates the work of several researchers who have employed various drill and practice procedures (e.g. Skinner et al. 1989; Stading, Williams, & McLaughlin, 1996). In addition, these techniques were shown to be successfully implemented at school and at home.

Direct Instruction card procedures have been suggested as effective (Silbert, et al., 1990; Stein et al., 1997), and in the present report, data were presented to confirm such a conclusion with more confidence that if an AB design would have been employed.

The findings from this study also suggest that the Direct Instruction card procedure should be considered for students with disabilities as a valuable technique that can be implemented as a supplemental activity to school-based instruction. McLaughlin & Stone (2000) employed this same procedure in the home. Cards allow students increased opportunities to respond. Increasing opportunities to respond has also been linked to increased achievement by several researchers (Delquadri, Greenwood, Whorton, Carta, & Hall, 1986; Sacca, 1988; Maheady, Sacca, & Harper, 1987; Miller & Heward, 1992; and Thurston & Dasta, 1990) across a wide range of students, as well as subject-matter areas.
There were limitations in the present outcomes. First, only two participants were employed, and they were quite similar in age and disability. Additional replications could employ a wider variety of students and disability designations.

Another research project might employ baseline and card procedures using an alternating treatments design, or counter balancing the conditions might do much to answer the question of the efficacy of card drill with Direct Instruction.

The cost of the procedures was low and well within a school’s budget. The children enjoyed the procedures used and looked forward to math.

Further areas of study might include: (a) comparisons of these strategies to other tutorial and practice procedures (e.g., peer tutoring, computerized drill, in-home tutoring, and practice programs), (b) use of the procedure for students with disabilities and their parents, as well as with additional instructional content areas, and (c) monitoring of effects over time and (d) with practical tasks determine retention and potential generalization of skills, at home and school.

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Andrea Delli Sante, T.F. McLaughlin, and Kimberly Weber are affiliated with Gonzaga University. School of Education, Spokane, WA.
The Effects of One Minute Warm Up Procedures on Addition One Minute Fluency Timings

Susan R. Sweeney, William J. Sweeney, and Paul Malanga

This study examined the use of warm up timings with second and third grade special education students before addition one-minute math probes to improve addition fluency. The target behavior was the number of correct single digit answers on the one-minute probe given directly after a warm up probe of the same math problems. An A-B experimental design (Cooper, Heron, & Heward, 1987; Kazdin, 1982) was used to evaluate the frequency of correct answers written across the timing periods. During baseline, 13 practice sessions were conducted to establish a means of daily performance on the one-minute timing. During intervention, data were collected across 14 sessions. During intervention, students were given the same two single digit addition probes each day. The first probe was used as a warm up procedure, while the second one-minute probe was used as a fluency assessment. During intervention, three of the students' data indicated slight level increases, one student's data accelerated at a x1.75, and two students data appeared to decelerate during intervention. All but one student demonstrated higher frequency of correct answers during intervention indicating important performance changes in their overall single digit addition computation. These data suggests that using a warm up cycle before one-minute addition math probes may improve students' performance with the fluency of math facts.

Regular Education teachers as well as Special Education teachers are faced with the ongoing dilemma of teaching math skills to their students. Not only do they need to teach the skill, but they also need to accurately track the progress of their students. Out of this need to instruct students in basic math skills grows the need for effective instruction (Stein, Silbert, & Carnine, 1997). In order to determine the effective instruction, educators must understand that students learn what they are taught, and that they master what they practice (Binder & Watkins, 1989). Many variables influence student acquisition of mathematics. The following variables are at the center of the acquisition process: (1) instructional design, (2) presentation techniques, and (3) organization of instruction (Stein, Silbert, & Carnine, 1997).

In math, curriculum-based research appears to be focused on acquisition of accuracy and fluency with computational facts (Fuchs & Deno, 1992; Fuchs & Deno, 1991; King-Sears, Cummings, & Hullihen, 1994). Student are not only required to add, subtract, multiply, and divide, they are also expected to perform the task with accuracy and speed (King-Sears et al., 1994). Precision Teaching uses the term "fluency" to refer to accuracy plus speed of performance (Binder & Watkins, 1990). Teachers should be interested in the fluency of their students' responses for several reasons. First, rate, like accuracy, indicates how well a student knows his/her facts (Howell & Lorson-Howell, 1990). Second, fluency has functional implications. Some things must be completed quickly (Howell & Lorson-Howell, 1990). Third, fluency is thought
to be related to future generalization and maintenance of a skill (Howell & Lorson-Howell, 1990; Ivarie, 1986; Liberty, Haring, White, & Billingsley, 1988). The combination of the two dimensions of responding--accuracy and frequency of responses over time--gives an incomplete picture of the student's learning (West, Young, & Spooner, 1990; Whalen, Willis, & Sweeney, 1993).

Since fluency is deemed to be one of the primary tasks that teachers must devote instructional time to, Binder and Watkins (1990) advocate the adoption and implementation of data based instructional strategies (Whalen et al., 1993). Examples of data based procedures include Direct Instruction (Stein et al., 1997), Precision Teaching (Sweeney et al., 1992), and time trials (Miller & Heward, 1992). Precision Teaching offers superior tools for practice to the point of fluency, criterion-referenced assessment, and decision-making (Binder & Watkins, 1990). By using daily Charts, teachers and students using Precision Teaching can make timely decisions about teaching methods and teaching materials. Direct Instruction strategies and Precision Teaching evaluation approaches use teaching procedures that enable teachers to maximize the time students spend on instruction (Binder & Watkins, 1989).

Rate per minute is a more sensitive measure of changes in performance than accuracy alone (Howell et al., 1990; Whalen et al., 1993). Therefore, the use of time trial in the acquisition of math skills is an excellent way to increase fluency (Miller & Heward, 1992; Whalen et al., 1993). Through the use of Direct Instruction and Precision Teaching, the teacher can empower the student to become the leading force in their acquisition of knowledge. Through the use of Direct Instruction and Precision Teaching measurements, the teacher facilitates the learning, becoming the engineer and contingency manager, with responsibilities to the majority, rather than a small minority (Keller, 1968).

By the use of Precision Teaching and the Standard Celeration Chart, students can chart and record their daily performance in a given subject area. The student and teacher can visually see if progress is being made in the instructional material, presentation, or settings (Lindsley, 1992; West, et al., 1990). Students can also compare their present performance to their past performance (Lindsley, 1992), thus showing the students how to become actively engaged in their learning experiences. This process of frequent data collection and decision-making has been shown to increase students' achievement (Fuchs & Fuchs 1986; Howell & Lorson-Howell, 1990).

Through the use of time trials, students can improve fluency by having many opportunities to respond (Whalen et al., 1993). When teaching for fluency, some general considerations should be used: (a) ensure that all blocks to fluency, such as awkward materials, are removed; (b) model, prompt, and praise frequently; (c) avoid competition between students; (d)
remember that fluency is built primarily through repetition and can be boring; (e) use peers and para-professionals to make instruction efficient; and (f) make sure the rate criteria are appropriate for the individual students (Howell & Lorson-Howell, 1990).

According to West et al. (1990), an effective strategy should remain in effect as long as the student progresses towards the aim of instruction. The instructional aim represents the student's fluency in a particular skill (Lindsley, 1990; King-Sears et al., 1994; West et al., 1990). Decisions for each student's academic achievement are based upon individual progress toward an instructional aim. Rates of student responses are very sensitive to changes in instruction; therefore, effects of new teaching strategies are seen immediately, and changes in instruction can be made when necessary.

The purpose of this study was to evaluate the use of one minute warm up time trials that preceded the daily one minute addition probes as compared to students' performance on the daily one minute addition probes without a warm up session. These warm up sessions were employed to see if they would improve the students' fluency and celerations of single digit addition calculation.

**METHOD**

*Participants and Setting*

The participants in this study were 6 second graders and 1 third grader in a Mental Disabilities Self-Contained classroom. The second graders consisted of 4 girls who were 8 years of age and one boy who was also 8 years of age. The third grader was a girl 9 years of age. One the second-grade girls and one of the third-grade girls were English Second Language students. These girls were sisters and their primary language was Spanish. The remaining four students' primary language was English. These students were instructed in mathematics by using the "Touchpoint System".

The participants attend school in a lower socio-economic neighborhood in a moderately sized Mid-Western inner-city school district. The study took place in their primary classroom between 9:00 am and 9:30 am, Monday through Friday, when the students were present at school. Within the classroom, there were 4 other students and two adults (i.e., 2 first-grade students, 2 kindergarten students, a paraprofessional, and one special education teacher). The students sat at the same large table during time trials. Additionally, the room had two computers, several tables and chairs, a filing cabinet, tape player and reading table. During math trials, the first graders and kindergarten children were doing math activities with the paraprofessional.

*Movement Cycle and Materials*

The movement cycle was defined as the number of correctly written single digit addition answers during the one-minute time trial. The one-minute time trial consisted of addition problems that had a sum of 9 or less. The students worked on a 60 problem probe sheet, thus allowing the students to set an instructional aim of 60 correct problems per minute. The
learning channel used for this probe was see-write. At the end of the one-minute time trial, the students and the teacher counted, recorded, and charted the number of correct and incorrect responses made during the time trial.

Experimental Design
An A-B experimental design (Cooper, et al., 1987; Kazdin, 1982) was used to evaluate the frequency of correct answers written across the timing periods. The independent variable was the warm up procedure prior to the time trials; the dependent variable was number of correct single digit addition answers written during the one-minute timings. This allowed for comparison of fluency across repeated time trials.

PROCEDURE
Baseline
The baseline-assessed fluency rates over one minute time trials. During baseline, students were given a minute math trial sheet. The students were instructed in a "see-write" learning channel. The student saw the problem, and then wrote the answer on the 60 problem addition probe sheet. The students were asked to correctly complete as many problems as they could in one minute. Prior to implementing the one-minute timings, the teacher demonstrated and explained the procedures and the one-minute timings to the students. The teacher's instructions were as follows: "I will set a timer for one minute; after the timer is set, I will say, 'ready, begin'. At this point you start answering as many problems as you can. When the timer rings, I will say 'stop'. You all stop and put pencils down. At this point, I will come to each of you, and we will count the number of correct answers you have written, and then we will chart the answers on the Standard Celeration Charts." The students were asked to repeat the teacher's instructions to ensure that the students understood the directions. After the initial instructions and directions, students completed one addition probe every morning when coming to class during the baseline phase of the study.

Intervention
The intervention consisted of one phase where the students were given a one-minute warm up session using the same 60 problem probe sheet as they used during their one minute time trial. Daily, the students performed the warm up one minute timing as previously demonstrated in the baseline phase. The students counted and charted their answers after the warm up timing. Immediately following the warm up timing, the students did another one-minute time trial using the same minute probe. The students also counted and charted their progress after the second one minute timed trial.

RESULTS
The data in Table 1 indicate improvement in 5 out of the 6 students in single digit addition calculations with the use of one minute warm up timings prior to their daily one-minute addition fluency timing. During the 13 baseline sessions, the mean performance of the 6 students was 24.13 with a range of means from 18.50 to 36.80.
Means and Ranges for Baseline and Intervention Conditions

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline Mean</th>
<th>Range</th>
<th>Intervention Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elizabeth</td>
<td>20.20</td>
<td>17-28</td>
<td>25.80</td>
<td>15-38</td>
</tr>
<tr>
<td>Jessenia</td>
<td>25.15</td>
<td>25-33</td>
<td>29.71</td>
<td>28-46</td>
</tr>
<tr>
<td>Jessica</td>
<td>36.80</td>
<td>32-50</td>
<td>29.78</td>
<td>29-48</td>
</tr>
<tr>
<td>Samantha</td>
<td>23.46</td>
<td>16-28</td>
<td>18.92</td>
<td>20-36</td>
</tr>
<tr>
<td>Kim</td>
<td>20.69</td>
<td>16-30</td>
<td>27.28</td>
<td>25-35</td>
</tr>
<tr>
<td>Aaron</td>
<td>18.50</td>
<td>18-28</td>
<td>22.92</td>
<td>23-30</td>
</tr>
</tbody>
</table>

Table 2
Celerations and Performance Changes for Baselines and Intervention Conditions

<table>
<thead>
<tr>
<th>Student</th>
<th>Baseline Celeration</th>
<th>Performance Change</th>
<th>Intervention Celeration</th>
<th>Performance Change*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elizabeth</td>
<td>x1.01</td>
<td>x1.9</td>
<td>x1.80</td>
<td>x2.4</td>
</tr>
<tr>
<td>Jessenia</td>
<td>x1.01</td>
<td>x1.3</td>
<td>x1.01</td>
<td>x1.6</td>
</tr>
<tr>
<td>Jessica</td>
<td>x1.01</td>
<td>x1.6</td>
<td>x1.25</td>
<td>x1.4</td>
</tr>
<tr>
<td>Samantha</td>
<td>x1.01</td>
<td>x2.0</td>
<td>x1.01</td>
<td>x1.7</td>
</tr>
<tr>
<td>Kim</td>
<td>x1.01</td>
<td>x2.0</td>
<td>x1.25</td>
<td>x1.5</td>
</tr>
<tr>
<td>Aaron</td>
<td>x1.01</td>
<td>x1.5</td>
<td>x1.25</td>
<td>x1.8</td>
</tr>
</tbody>
</table>

* Lowest to highest performance

This is compared with the 14 sessions conducted during the warm up intervention procedure resulting in the average mean performance of the 6 students of 27.40 with a range of 18.92 to 39.78. During both baseline and intervention, the learning opportunities remained below the record floor (i.e., no errors). Charts 2, 3, and 5 show an improvement during intervention in terms of a slight level changes (i.e., higher overall trends in the data during intervention when compared to baseline) and less apparent overall bounce (i.e., less overall variability in the scores during the intervention when compared to baseline).

Chart 1 shows important improvement as indicated by the steeper slope of the trend during the intervention when compared to the baseline measures. Chart 1 reveals an accelerating data path multiplying at x1.80 during the intervention as compared to a flat trend during baseline that multiplied at x1.01.

Data from Charts 4 and 6, respectively, appear flat or slightly decelerating during intervention when compared to baseline data. Although the student in Chart 6 appears to show a slight improvement in his overall mean during intervention, the trend did not appear to indicate an appreciable improvement with the introduction of the warm up procedure.

Table 2 shows the celerations of the learning pictures and the overall performance changes during baseline and intervention.

**DISCUSSION**

Although the results are not as dramatic as the first author had originally
Chart 3
SUCCESSIVE CALENDAR DAYS

COUNT PER MINUTE

SUCCESSIVE CALENDAR DAYS

COUNTING PERIOD FLOORS

MIN

HRS

SUPERVISOR

ADVISER

MANAGER

BEHAVIOR

AGE

LABEL

COUNTER

CHARTER
anticipated, the data indicate improvement in 5 of the 6 students when a warm up procedure is used prior to a one-minute time trial for addition math facts fluency. Three of the 6 students showed increases in overall level during the intervention condition when compared to the original baseline. It appears that the warm up procedure may increase overall addition fact fluency as well as reducing the overall variability (i.e., bounce) in the data in a given learning picture. Further improvements are shown by the steeper slope of the trends among several students during the intervention condition.

This research builds upon previous research on the use of time trials to enhance fluency in math facts (Whalen et al., 1993). Similar to the Whalen et al. (1993) study, the current study shows the potential use of one-minute timings combined with math probes to evaluate the fluency of basic computational skills with students in the classroom. The authors also firmly believe and agree with the assumptions made by Miller and Heward (1992) regarding the importance of using one-minute timings to evaluate the fluency levels of students’ math performance.

There are two potential reasons for some of the results in this study not being as dramatic as initially hoped. First, all of the students in this study had initially been taught math calculations by using a touch point system. Students were dependent upon using touch points in counting to calculate their math answers. The touching of number points may have acted as a fluency blocker. The first author observed that all of the students continued to use the imaginary touch points on numbers to count up the second number in all of the math problems, even though the touch points no longer existed on their work sheets. This continued use of the touch points limited their ability to respond to addition facts correctly and without hesitation. Secondly, Samantha and Aaron experienced repeated health problems, attendance difficulties, the loss of one’s glasses for several days, and unstable and volatile conditions at home. These variables may have interfered with Samantha and Aaron’s progress and success at building fluency with addition facts.

Several implications of this research are indicated. Warm up procedures may improve students’ performance in developing fluency with math facts. Warm up procedures may be an essential component to effective curricular programming; however, more research needs to be conducted in this area to validate this assumption. Finally, future research in the area of utilizing warm up procedures should also evaluate other curricular areas, such as spelling, oral reading, writing composition, and content in specific areas.

The authors hope that this study encourages other researchers to evaluate the effectiveness of using warm up procedures to help increase students’ fluency in content area studies. These procedures will hopefully be used by other educators as a means of improving the academic fluency levels of a wide variety of students, while maximizing the learning potential for all students.
REFERENCES


Learning Rates with Direct Instruction, Precision Teaching and the Corrective Reading Series

Anick Legault, Michael Maloney, and Normand Giroux

The QLC Educational Services located in Belleville (Ontario, Canada) has been tutoring students of all ages since 1979. The QLC teaching model, which was derived by Michael Maloney, is an amalgam of existing behavioral technologies. These include: Behavioral objectives for goal setting; 2. Behavior analysis and behavior management to bring the student under instructional control; 3. Direct Instruction to teach effectively at a faster than normal rate; 4. Precision Teaching to measure progress daily; 5. Directed and independent practice to reach fluent performance levels (Maloney, 1998). Although the Center provides instruction in all areas of basic curriculum for both elementary and secondary levels, the largest number of its students need remedial reading instruction to learn decoding skills. As a result, the program most commonly applied is Engelmann's Corrective Reading (Decoding) Series. Of this series, Decoding Strategies level B1 (Engelmann, Johnson, Carnine, Meyer, Becker, & Eisele, 1988) and level B2 (Engelmann, Meyers, Carnine, Becker, Eisele, & Johnson, 1988) are the most frequently used entry level programs. While there are some data regarding the efficacy of these programs in themselves (Carnine, Silbert, & Kameenui, 1997), there is almost no information about learning rates attained with this material, as charted on the Standard Celeration Chart. The purpose of this study was to make a portrait of the celeration rates of attending students between the age of 7 and 17 years old engaged in the Corrective Reading programs, level B1 (Engelmann, et al., 1988), and level B2 (Engelmann, et al., 1988). The study was conducted during winter 2000. An attempt is made to predict the amount of time required to reach fluency levels, based on the acceleration rates of the students. Relationships to the reading program level and to sex were examined.

**METHOD**

**Participants and setting**
The participants of this study were 49 boys (31 in level B1, and 18 in level B2) aged between 7 and 15 years old, and 11 girls (7 in level B1, and 4 in level B2) between 8 and 17 years old. They all live in or around Belleville. Each student attends for two one-hour tutoring sessions per week before or after school, or on week-ends. Most have been labeled "learning disabled": some have been diagnosed as having also conduct disorders according to their school files or parent interview reports.

**Measurement procedures**
The pinpointed behavior was the number of words read correctly in a one-minute timed reading test; results were charted on the Standard Celeration Chart (SCC). The data collected were the celeration rates, on successively more complex stories, for each student involved in either levels of the Corrective Reading series, for the year 1998-1999. Then, the median of these celeration rates for both boys and for girls was computed.
RESULTS

As expected, more boys than girls attending the QLC Educational Services have reading disabilities. According to DSM-IV (1994), 60% to 80% of diagnosed learning disabled students are boys in the general population. This trend was evident at the QLC Center (registration indicates more than 4 boys for 1 girl). This result is consistent with other sources where a proportion of 3 boys for 1 girl having learning disabilities is reported (Anderson, 1997; Badian, 1999).

It was also found that there are significant higher number of 8-year old boys involved in this remedial reading program. This result is consistent with literature where learning disabled third graders have the highest ratio between boys and girls (Badian, 1999).

Each story was read by the student (one-minute readings) until the level of fluency was attained. For boys, data were collected on a total of 150 completed stories in level B1, and 59 completed stories in level B2. For girls, data were collected on 15 completed stories in level B1, and 6 completed stories in level B2. According to the Precision Teaching literature, the minimal rate increase requested for a significant celeration is x1.25 per week (Beck, Conrad, & Anderson, 1995; White & Haring, 1976). In this sample, the median celeration rates were x1.5, and x1.6 for boys in B1 and B2 level, and x1.5 and x1.25 for girls in B1 and B2 level respectively.

Moreover, as illustrated in Figure 1, the number of days required to attain fluency is typically small, fluency being defined as reading 200-250 words per minute with 2 or fewer errors (Binder, 1996; Johnson & Layng, 1996). All students reached fluent reading levels before moving to a subsequent more challenging story.

DISCUSSION

The data review shows that all rates were significantly superior compared to the minimal celeration rates expected in the Precision Teaching literature (Beck, Conrad, & Anderson, 1995; White & Haring, 1976). It was also observed that a relatively short period of time was required to reach a level of fluency. When combining the short time to attain fluency and the superior celeration rates that were obtained, it seems clear that the students at QLC Educational Services are effectively learning to decode increasingly difficult stories. Unfortunately, due to the small number of girls enrolled in these reading programs, it is difficult to extrapolate a reliable celeration rate for girls. Some indirect support can be drawn from the fact that there are no significant sex difference effects in comparison between celeration rates of boys and girls.

Direct Instruction may be enhanced in remediating reading deficits when paired with one-minute timed reading in which the student is held to a firm fluency criterion of 200-250 words per minute with 0-2 errors. More information is needed on female students than is provided by these data.
REFERENCES


Fluency Research: An Example From History

Warren S. Barnes and Henry S. Pennypacker

A thorough review of the literature concerning the development of frequency aims and fluency criteria reveals a common thread running throughout. Responding to stimuli at high rates, or frequencies, improves performance in the following areas: Retention, Endurance, Application, and Performance Stability which have been declared the products of fluency. While there are numerous definitions for fluency, Binder (1988, 1990, 1996) described it as “the fluid combination of accuracy plus speed that characterizes competent performance.” (For a more thorough treatment, see the issue of The Behavior Analyst, Fall, 1996). Many of these claims are supported by copious amounts of data (Binder, 1996); unfortunately, space restrictions preclude their inclusion here.

One set of data is conspicuous by its absence from this body of literature. These data were collected by an individual whom we shall refer to only by his initials. The data were collected before the advent of the Standard Celeration Chart, so we have taken the liberty of replotting for this audience.

METHOD

Participant
The male participant, H.E., was approximately 79 years of age at the time of the experiment. Prior to the experiment, his history included extensive training in philosophy that eventually led to the acquisition of a doctoral degree.

Apparatus
The experiment was conducted in the study of the participant’s home. Approximately 2,300 novel letter combinations (consonant-vowel-consonant) were created, mixed together, and randomly selected to create lists of sixteen combinations each (H.E., p.22). These tests were to be later learned via the See/Say learning channel as subsequently described by Haughton (1980). A timing device was used to record response times as well as trial durations.

PROCEDURE

Each test was constructed in the following manner. The lists of 16 different 3 letter (CVC) combinations were compiled into sets of six, with one set serving as both test and retest for a given set of 96 syllables. Overall, the experiment consisted of 10 such test-retest trials for each of seven conditions. A condition was defined by the number (8,16,24,32,42,53,0r 64) of times the participant was required to read aloud the set of 96 syllables. The first reading of a particular test was therefore repeated 8,16,24,32,42,53, or 64 times for a total of seven conditions. Twenty four hours later, the same test materials were relearned up to the point of “first possible errorless production” (H.E., p.56).

During each of the first tests, H.E. was required to read and/or recite the
material to an arbitrarily set of frequency aim of 150 per minute. The separate lists were always read/recited from beginning to end; they could not be learned as separate pieces, and based on his verbal report, the harder portions were not repeated more frequently. H.E. then reread the list a required number of times for the experimental condition. This was repeated 10 times within each condition. For each of the ten different repetitions per condition, first test frequencies and durations remained constant.

During each second test, H.E. read and/or recited the same test series presented 24 hours earlier to the set frequency aim of 150 items per minute. Whenever a probe for the first possible errorless production was conducted, upon hesitation the rest of the list was read through to the end before H.E. began again. All probes were initiated by the participant. After reciting each list, a pause of 15 seconds occurred to allow for scoring and was followed immediately by the next list in the test series. First possible errorless production "...was considered attained when, the initial syllable being given, a series could be recited at the first attempt, without hesitation, at a certain rate, and with the consciousness of being correct." (H.E., p. 23) During each test-retest trial, distractions were kept to a minimum, and an attempt was made to keep the history of the participant constant throughout the course of the experiment.

RESULTS

The original experimenter's presentation of the data did not allow for easy plotting in the Standard Celeration Chart. It was necessary to recalculate the data to derive actual response times per item and hence response duration for each test. These items appear to be fairly constant across conditions and tests due to the frequency aim, the number of responses per test, as well as the individual overall test and retest durations. The scoring and hesitation times were not included in calculating test durations.

Prior to contemporary presentation and interpretation of these data, one important point had to be accommodated: Due to the constant rate of responding for each of the first tests (ten per condition), the frequencies and durations for each of the first tests were plotted as rotated Aim Stars (Journal of Precision Teaching and Celeration, 1993) at the beginning of each condition to allow for comparison to the subsequent retest conditions. This permitted all of the resultant data to be displayed on one piece of chart paper. This procedure appears to be sufficient to permit accurate analysis of the data.

The data for the first two conditions, 8 and 16 repetitions, clearly show that relearning the six lists of 16 syllables to the point of first errorless reproduction required more time than the initial recitations. These changes in duration measures, 1/d, (Pennypacker, et al. 1972) are approximately +4 frequency multiplier (F.M.) in the 8x condition and a +2 F.M. in the 16x condition. The durations for the 24x test and retest conditions appear to be stable at x1.0. As displayed on the Chart, the frequency data showed very little deviation from the set frequency aim of 150 responses per minute across conditions. The variability was explained by the original author as being a result of slight changes in the "inner conditions" at the time of
“first fluent reproduction”. Beginning with the 32x condition, and continuing in subsequent conditions, the steadily increasing median duration measures to achieve first possible errorless reproductions, ranging from a x1.5 F.M. to a x5 F.M., are clearly revealed. The Chart thus shows the systematic benefit of increased practice on attainment of fluency. These data also offer support for the contemporary procedure of starting acquisition at high frequency, letting accuracy emerge with practice (Lindsley, 1992).

In the 64x condition, first test durations lasted approximately 45 minutes. The participant’s verbal reports during this condition included complaints of headaches, exhaustion, and other symptoms, which may have complicated the conditions of the test if the number of repetitions had been increased. In this condition, the participant was emitting strings of 6,144 responses at the frequency aim of 150 per minute! As originally interpreted, these data suggest that an endurance ceiling for this type of performance had been approximated.

These data were drawn from a series of experiments conducted by an individual who has been hailed as “...One of psychology’s foremost pioneers, ranking with (if not ahead of) others from his time who are remembered more favorably today” (Roediger, 1985, p 519). When H.E. began his experiments, the prevailing zeitgeist was that, in principle, an experimental science of higher mental processes was impossible. When Memory: A Contribution to Experimental Psychology was first published in 1885, the direction of psychology was significantly altered — perhaps signaling the beginning of a paradigm shift. H.E. had arguably shown that higher mental processes were no longer exempt from scientific investigation.

Today, the work of Hermann Ebbinghaus continues to serve as a fundamental underpinning of experimental psychology. Herr Ebbinghaus selected the following quotation as the epigram for his volume, “From the most ancient subject we shall produce the newest science,” (as translated by E.G. Boring, according to Hilgard, 1964). We take the liberty to suggest that the reinterpretation of these data can now be used as foundational support for continued fluency research, or as Binder (1996) has claimed, “...The Evolution of a New Paradigm”.

REFERENCES


Warren Barnes and Hank Pennypacker are affiliated with the University of Florida, Gainesville.
Chart Share: Steffi Graf's Pro Tennis Career

Stephen A. Graf
Youngstown State University

Chart Description

Type of Chart
- Full size Standard Celeration Chart
- Data: Yearly per year frequencies
- Professional tennis tour singles matches played by Steffi Graf per year with dots as "wins per year" and Xs as "losses per year"

Celerations
Four Trend-following celerations show:

<table>
<thead>
<tr>
<th>Celeration values per 5 years</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>dots (wins): x6 acceleration</td>
<td>1982-1989</td>
</tr>
<tr>
<td>Xs (losses): /6 deceleration</td>
<td></td>
</tr>
<tr>
<td>dots (wins): /2 deceleration</td>
<td>1990-1999</td>
</tr>
<tr>
<td>Xs (losses): &gt; /2 deceleration</td>
<td></td>
</tr>
</tbody>
</table>

Bounce
Bounce within each celeration course:

<table>
<thead>
<tr>
<th>Bounce values</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>dots (wins): &lt; x2</td>
<td>1982-1989</td>
</tr>
<tr>
<td>Xs (losses): x3</td>
<td></td>
</tr>
<tr>
<td>dots (wins): &lt; x2</td>
<td>1990-1999</td>
</tr>
<tr>
<td>Xs (losses): &gt; x2</td>
<td></td>
</tr>
</tbody>
</table>

Jump Turn Combos
Change effects shown by Jump Turn Combinations:

<table>
<thead>
<tr>
<th>Celerations and Combos</th>
<th>Jump Turn values</th>
</tr>
</thead>
<tbody>
<tr>
<td>dots (wins): No Jump Turn Down</td>
<td>Jump x1 Turn /12</td>
</tr>
<tr>
<td>Xs (losses): Jump Up Turn Up</td>
<td>Jump x8 Turn x3</td>
</tr>
</tbody>
</table>

Outliers
Unusual frequency instances beyond the celeration courses:

<table>
<thead>
<tr>
<th>Outliers</th>
<th>Reason</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xs (losses): 1 peach (1 loss in 1982)</td>
<td>1 match played as 13-yr-old</td>
<td>1982-1989</td>
</tr>
<tr>
<td>Xs (losses): 2 lemons (9 losses in '98 &amp; '99)</td>
<td>Injuries</td>
<td></td>
</tr>
</tbody>
</table>

Learning Pictures
Dots and Xs together form the following two-line Learning Pictures:
- "Jaws" from 1982-1989
- "Downhill" from 1990-1999
Steffi Graf’s Pro Tennis Career

Background

Sometime in the early ‘80s I read about a German teenage tennis player whose name was the same as mine—just a gender variation. When my wife gave birth to our third daughter in 1986, she voiced no objection to naming her “Steffi.” The fantasy? That when the original Steffi was ready to retire, I would have fluency trained another Steffi to take her place. The reality? When Steffi Graf announced her retirement at age 30 in 1999, the younger Steffi, now 13, was indeed on her way to becoming a fine athlete, but in the team sports of softball, basketball and volleyball rather than tennis.

Comment

Steffi Graf played her first professional tournament in 1982 at 13. Over the next six years, her wins accelerated and her losses decelerated in a “Jaws” Learning Picture. In the last three of those years she won 233 matches while losing only seven. From that point, we see a No Jump /12 Turn Down in wins as the win deceleration changes from x6 to /2 while the loss deceleration undergoes a x8 Jump Up with a x9 Turn Up. The last 11 years produced a “Downhill” Learning Picture with the wins decelerating by /2 every five years, but she also decelerated her losses by /2 every five years. After injuries produced a lemony year for wins in 1997, she suffered back to back outlier years in losses in 1998 and 1999. Steffi ended her professional tennis career with 902 wins and 115 losses, a winning ratio of 8 to 1.
Do Times Two, Then Go for Four, Or More: Precision Teaching Aims for the 21st Century.

Ogden R. Lindsley

Here follows a brief historical outline of our major 20th century discoveries and the even more exciting challenges facing us in the first half of the 21st century. We have the knowledge, the energy and the tools to accomplish amazing progress in learning in the next 25 years.

We are poised on the threshold of amazing progress. Our knowledge, skills, position and timing are excellent... LET'S GO!

We started with rate of response and “pinpoint, record, and consequeate,” which Nancy Johnson put to music.

We proved all behaviors multiply with the Behavior Bank.

We proved corrects and errors, positive and negative feelings, and feelings and their related behaviors accelerate and decelerate independently. This required using counting and charting pairs from then on.

We designed and tested in practice a full line of daily, weekly, monthly, and yearly Standard Celeration Charts, covering weekly, monthly, 6 monthly, and 5 yearly celerations.

We developed a system of plain English words to describe changes in frequencies and celeration, along with graphical descriptive and interpretive statistics.

We developed practical, inexpensive classroom Precision Teaching and saw it multiply and then be ignored by the educational establishment.

We joined with our brethren in Direct Instruction and combined our effective educational procedures.

We built and grew to understand fluency, and its producers, blockers and products.

One of our popular workshop songs was “Are you charting,” written by Hank Pennypacker in 1975 to the tune of Frere Jacques.

Our slogans were “The child knows best,” and “Care enough to chart!”
Sprints
1974 Eric Haughton and Mary Kovacs used 30 and then 15 second practice sessions working with Dominick at St. Catherine’s Developmental Center, Hamilton, Ontario.

1979 Harold Kunzelmann and Carl Koenig used 15 second practice and 20 second screening for referral of preschool and kindergarten children in REFER.

1990 10 second sprints (8 to 10 per day) used for establishing new skills at Morningside Academy by Kent Johnson, Hollind Kevo, and Jim Peters.

Celeration fans
1938 the diagram numbering the slope of cumulative records was called “coordinates” by Skinner, and by Ferster and Skinner 1957.

1953 to 1993 I called them “grids” and put them on my cumulative records.

1993 I renamed them “fans” and put them on journal published Standard Celeration Charts (Lindsley, 1996).

1996 Behavior Research Company first put celeration fans on paper SCCs.

It has taken us decades to directly use, describe, and be comfortable with our unique product - celeration. No one else has it.

Weekly Celeration Aims
1972 - Lindsley describes the celeration aim star. The arms of the star were tipped at the celeration aim angle. (Frequency aim star had horizontal arms).

1975 x 1.25 - Kathleen Liberty took middle aim from 600 projects. (53% greater than x1.25 and 66% less than x1.25.

1976 x1.25 - White and Haring suggested 6 different celeration aim methods.
1. Set aim date and aim rate.
2. Catch up slope to join peers.
3. Child can do 75% of the time from prior celerations.
4. Similar movement, similar slope. best can do for similar movement.
5. Teacher can do slope for amount of progress that teacher can provide for.
6. x 1.25 Standard Celeration taken from Kathleen Liberty’s median.

1979 -x1.9 +2.5 Marilyn Chapel leapt her class of 15 second graders from add to multiply facts without instruction and accomplished X2 celerations. Ever since then I urged precision teachers to set x2 high celeration aims.

1991 Times two per week aims for all daily practice at Morningside Academy.
Daily Sprint
Celeration aims

1992 (Summer) x2 aims set for ten sprints within one day at Morningside Academy by Kent Johnson, Hollind Kevo, and Jim Peters.

1992 (Fall and Spring, 1993) x2 per day aims for sprints and x 2 per week aims for daily practice repeated with success at Malcolm X College by Joe Layng, Angela Boone, and Hube Dure.

The Morningside Curriculum

The power of the Morningside curriculum is attributed to its fluency generating. No doubt this is important, but I feel that Morningside's real power is that it is the first program to set and demand realistically high celeration (x2) aims for both repeated 10 second sprints on one day and weekly x2 aims for one minute daily practice sessions.

In published articles, the effect and the need for these celeration aims is not mentioned. The whole effect is attributed to fluency with no mention of Morninside's even more powerful and unique use of distinguished (x2) daily and weekly celeration aims (Johnson and Layng, 1992).

Performance
(frequency)
ladder

The performance (frequency) ladder has one direction with fluency at its top.

Learning
(Celeration)
fan

The learning (celeration) fan has two directions.

An agile person will be able to change direction - to learn new skills and to unlearn old skills rapidly adjusting to the more and more rapid information age changes.

Keynote Address, International Precision Teaching and Celeration Conference.
Seattle, WA - 10 October 1996
We will build and grow to understand agility, and its producers, blockers and products.

We will focus and add knowledge and experience of celeration. just as we learned the products of aiming at high fluency.
We will learn the benefits of aiming at high agility.

If we build tool skills at higher accelerations (agility), will we get super high deceleration's (degility) for future tasks?

What are the practical limits to celeration? Will there be different limits for different channels? Is it possible that the hear-say channel, which tends to be our most fluent channel, prove to be our most agile channel as well?

Just as we got fluency generativity from building component tool skills to high frequency, will we get agility generativity from building component tool skills at high celerations?

Our large scale applications at Morningside, Malcolm X, Chicago Public Schools, Haughton Learning Center, Cache Valley Learning Center, and Ben Bronz Academy provide unique opportunities to examine what Harry Harlow called “Learning to Learn” fifty years ago. Harlow tried to study it using percent of trials correct as his measure. We have the advantage of having learning in 3 dimensions - number per minute per week, and of having learning to learn in 4 dimensions - number per minute per week per year.

A popular workshop song will be “We all promise, we will do times two!”

And our slogan will be “Do times two, then go for four, or more!”

Thank you for joining me in this grand adventure!

References


Keynote Address, International Precision Teaching and Celeration Conference, Seattle, WA - 10 October 1996
Our 5 Number Worlds™: Measurement Scales Made Clear- Ogden Lindsley

Fear not to Focus
In 1953 I focused my research and reading on human, free operant performance frequencies charted on standard charts (Lindsley, 1956). Following research and teaching leads expanded this focus so far that in 1970 I redesigned S. S. Stevens' scale system to simplify it for primary grade school children. Only short plain English words were used (Lindsley, 1991). This redesign has been shared with my students, but never before publicly presented.

Stevens' NOIR Ladder
In 1946 S. S. Stevens organized measurement scales - a system of how we use numbers (Stevens, 1946). His ladder, started with Nominal on the bottom, Ordinal on the second rung, Interval on the third, and Ratio on the top rung (the king of scales to Stevens). Reading up the ladder, students abbreviated Stevens' scale ladder NOIR, the French word for black, as a memory aid.

<table>
<thead>
<tr>
<th>R</th>
<th>Ratio</th>
<th>Multiply interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Interval</td>
<td>Add interval</td>
</tr>
<tr>
<td>O</td>
<td>Ordinal</td>
<td>Order number</td>
</tr>
<tr>
<td>N</td>
<td>Nominal</td>
<td>Name number</td>
</tr>
</tbody>
</table>

Widely covered in the statistical chapters of most psychology textbooks, NOIR has been accepted for organizing measurement scales for over 50 years - a half century!

NOIR Zero Problem
We faced two major problems teaching Stevens' NOIR scale ladder. The first was the Zero point.

On an interval scale Stevens said the zero point is arbitrary, as in temperature. Zero on the centigrade scale and zero on the fahrenheit scale are different and set by convention.

On a ratio scale Stevens said an absolute zero is always implied, even though it may never be reached.

The problem: If temperature is an interval scale how is it that there is an absolute zero temperature? According to Stevens an absolute zero would make temperature a Ratio scale. Student CONFUSION!

NOIR Ladder Problem
The second problem faced when teaching NOIR was the ladder problem.

If NOIR is a true hierarchy, as you go up the ladder each scale should include all the properties of the scales on rungs on the ladder below it. The statistics that may be used with nominal and ordinal scales should be all right to use with interval scales. This is correct.

But, the statistics correctly used with interval scales are NOT correct to use with Ratio scales on the rung above. The arithmetic mean, standard deviation, and product-moment correlation of interval scale data are not correct to use with ratio scale data. In fact the arithmetic average does not give a middle score on a ratio scaled set of numbers. You must use a multiply (geometric) average. Therefore, Nominal, Ordinal, and Interval are a ladder, but Interval and Ratio do not ladder. All the Interval procedures cannot be used correctly with a ratio scale. Student CONFUSION!

Lindsley's NO/AMP T Solution to NOIR Ladder Problem
Our solution keeps the ladder of Name and Order numbers. There is no constant distance between numbers on these two scales.

Above Name and Order the distances (intervals) between the numbers on the scales have meaning - a constant add, multiply, or power.

Constant Distance (Interval) Scales

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>20</td>
<td>1024</td>
</tr>
<tr>
<td>18</td>
<td>512</td>
</tr>
<tr>
<td>16</td>
<td>256</td>
</tr>
<tr>
<td>14</td>
<td>126</td>
</tr>
<tr>
<td>12</td>
<td>64</td>
</tr>
<tr>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Add Multiply Power

\[ +2 \times 2 \times ^2 \]

Plus 2 Times 2 Times self

©™ 1999 Ogden Lindsley. Distinguished Service Award Acceptance Opening Event, ABA Conference, Chicago, IL, 27 May 1999

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Our 5 Number Worlds™: Measurement Scales Made Clear- Ogden Lindsley

On our Add scale the distances are a constant: added going up or subtracted coming down the scale. A +2 add scale has numbers 0, 2, 4, 6, 8, 10, 12, 14 ...

On our Multiply scale the distances are a constant: multiplied going up or divided coming down. A x2 multiply scale has numbers 1, 2, 4, 8, 16, 32, 64, 128, 256, 512 ...

On our Power scale the distances are a constant: power going up or root coming down. A ^2 power scale has numbers 2, 4, 16, 256, 65,536, 4,294,967,296 ... With first graders we call this a "times self" scale. Each constant distance is the number times itself.

We diagram the relationship between these 5 number worlds™ of Name, Order, Add, Multiply, and Power in a T form.

Add Multiply Power Order Name

We also diagram their initials as a T.

AMP ON

This diagram is written from its bottom up as NO/AMP and pronounced in English as "No amp."

The three rungs up this T ladder are a true hierarchy because statistics used on the Name rung can be used on the Order rung. The statistics from the Order rung can be used in all three scales on the AMP rung. Order world statistics can be used in the Add world, the Multiply world and in the Power world.

However, Add statistics are not correct to use in the Multiply world or Power world. Multiply world statistics (geometric mean) are not correct to use in the Add world where the add (arithmetic) mean must be used to give correct central values.

Solution to NOIR Zéro Problem
The solution to the zero problem is found in the nature of the mathematics of our three constant distance (equal interval) number worlds.

Zero exists in our Add world. It is the operation for identity. You add zero to a number and it stays the same. You can start with zero and add 10 and you end up with 10.

Zero does not exist in our Multiply world. It is not a multiply number. When you multiply zero by a number, no matter how big it is, you can't get out of zero. You need a number bigger than zero to multiply from. That is why in solving factorials, if you run into a zero, the rule is to put the number 1 in zero's place. That is also why we cannot build behavior from zero frequency. We need at least one response to multiply by our reinforcers.

The number 1 is to our multiply world as zero is to our Add world - an identity operation. When you add zero or multiply by 1 the number stays the same.

Neither Zero nor 1 exist in our Power world. If we start with a number 1, no matter how big the power we raise it to, we can not get out of 1. So we need a number larger than 1 to raise to any power.

Separate 3 Things in Scale Thinking
When diagramming or thinking about scales and number worlds we must keep 3 things clearly separate. We must think of:
1) the scale Distances between the numbers,
2) the Numbers on the scale, and
3) how the thing being scaled Lives (grows, spreads, or is distributed).

Pure Scales
For clearest presentation, scale a thing with intervals, and scale numbers from the world in which it lives. If the thing grows by adding a constant, then it should be charted on an pure add scale with constant add intervals and add numbers. On a chart with time in an add scale across the bottom and the values in an add scale up the left, constant add growth forms a straight line.

Thermometers, rulers, and bathroom scales have pure add scales.

If the thing grows by multiplying by a constant (as do all living and behaving things) it should be charted on a pure multiply scale with both multiply distances and multiply numbers.
Mixed Scales
The common practice of putting add numbers on multiply distances confuses us. The logarithmic scale itself has add numbers (the characteristic) on the basic multiply distances (mantissa), as do the Decibels sound intensity, and Richter earthquake scales.

Statistical Formulas Between A, M, and P
Useful statistical rules occur between the Add, Multiply, and Power worlds. For example the general rule for finding an average or central value is:
1) put all the numbers together by the math of their world.
2) Bring it back to the size of one by borrowing the reducer from the next world to the right on the arm of the T.
3) Reduce using the number of numbers (N).

Example: To get an Add world mean (arithmetic mean):
1) Add all numbers together to get their sum.
2) Borrow the reducer divide from the multiply world to the right.
3) Divide the sum by N.

Example: To get a Multiply world mean (geometric mean):
1) Multiply all numbers together to get their product,
2) Borrow the reducer root from the power world to the right.
3) Root the product by N.

Real World Examples of Our 5 Number Worlds
The scales we have discussed above are subclasses of Our 5 Number Worlds. We have students sort cards with pictures of the following real world numbers into five boxes. Examples of the five different ways that we use numbers follow:

Name World Numbers
Sports jerseys
Telephone numbers
Automobile plates
Social Security numbers
Flight numbers

Order World Numbers
Sports seeds and rankings
IQ and Achievement Test scores
Course grades

Multiply World Numbers
(model are mixed scales)
Sports team and player improvement
Log, Decibel and Richter scale
Population and Disease
Percent
Interest and Dividends
Discount
Cost of living and Inflation
Performance and Learning
C and D scales on slide rule
All growth. All Decay

Power World Numbers
None so far

5 Number World Song
(Tune: Three Blind Mice)
Five number worlds,
Five number worlds.
Name, Order, Add,
Multiply and Power,
We label our things in
our Name world.
We test ourselves in
our Order world.
We count everything in
our Add world.
Everything grows in
our multiply world.
And nothing yet lives in
our Power world.
Our Five number worlds.
Mixed Scale Example - Richter +1 number x39 distance Earthquake Scale
Richter numbers tell the reader that a quake of 8 is about as much bigger than a 7, as a 4 (disturb objects) is of a 3 (felt indoors) - both +1 apart. Actually an 8 is the size of the 1906 San Francisco, and a 7 only collapses weak buildings. The energy in an 8 quake is 35 times greater than a 7 (Gere & Shah, 1984).
Our school children learn earthquakes live in the multiply world, so the +1 numbers don’t fool them.

<table>
<thead>
<tr>
<th>Myth</th>
<th>Multiply</th>
<th>Add</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log10</td>
<td>distance</td>
<td>numbers</td>
</tr>
<tr>
<td></td>
<td>Energy</td>
<td>Richter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>x39</td>
<td>+1</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td>x31</td>
</tr>
<tr>
<td>x100</td>
<td>x10</td>
<td>x35</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td>x39</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td>x43</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td>x48</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td></td>
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</tbody>
</table>

x2 Time Series on Add, Multiply, and Power Charts
These three charts show x2 multiplying data set projecting easily in a straight line when charted on a multiply scale with multiply numbers. On an add scale it curves concave upwards like a cup. On a power scale it curves concave downwards like a dome. Moral: chart data the way they live.

REFERENCES
Celeration and Agility for the 2000’s
Ogden Lindsley *

Frequency
- The number of times something happens divided by the counting time.
- Has two dimensions: count, count time. (Number per minute)
- Scale up the left side of our standard celeration chart (SCC).
- Given us by Fred Skinner, 1938, 1950 “Rate is a universal datum.”
- You can count and chart anything you can think of including your thoughts.
- SCC covers all human performance from 1 a day to 1000 a minute.

(Rate focused song: “Pinpoint, Record, Consequate” Nancy Johnson 1967)

Fluency
- Charting hit and miss frequencies guarantees both accuracy and fluency
- Performed without effort or thought, fluent skills become second nature.
- Think of fluency as fast, smooth, accurate, automatic skilled performance.
- Fluent performances are very high dots on our standard chart.
- A fluent person is a fast, accurate, performer.

Celeration
- How much a frequency multiplies over a standard time period.
- Has three dimensions: count, count time, celeration period.
- Slope of charted frequencies on our standard celeration chart. Lower left to upper right corner is $x^2$. That is a 34 degree angle on all SCCs.
- Standard charters can read the values on our celeration fan blades of $x^1, x^1.4, x^2, x^4, x^{16}$ and $+1.4, +2, +4, +16$.
- Those angles and their meanings are what is standard on our chart.
- Given us by no one. We discovered, measured, and named it our selves.
- SCC covers all human learning from $x^{100}$ to $+100$ per learning period.

Agility
- A celeration high enough to guarantee high celerations on future learning.
- Agility is to celeration as fluency is to frequency.
- Our SCC shows agility growing by steeper and steeper slopes.
- Once agile (steep celeration) a learner feels ready for any learning challenge.
- Think of agility as fast, smooth, accurate, automatic, skilled learning.
- Agile performances are steep slopes on our standard chart.
- An agile person is a fast, accurate learner.

(PT Teacher focused song: “Are You Charting?” Hank Pennypacker 1973)

Keynote Address, International Precision Teaching and Standard Celeration Conference, Provo, UT, 4 November 1999
<table>
<thead>
<tr>
<th>Early research: Frequency and celeration found independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1965-1974 Behavior Bank, Behavior Research Company</td>
</tr>
<tr>
<td>Lindsley, Koenig, Kantor, Nichol, &amp; Young, 1971.</td>
</tr>
<tr>
<td>Proved frequency and celeration were independent.</td>
</tr>
<tr>
<td>Divided 12,000 performances into 18 frequency bands from 1 to 3 per day up to 100 to 300 per minute.</td>
</tr>
<tr>
<td>All 18 frequency bands had the same median celeration of x1.3 per wk.</td>
</tr>
<tr>
<td>• 1975-1980 Learning Bank, International Management Systems</td>
</tr>
<tr>
<td>Koenig &amp; Kunzelmann, 1980.</td>
</tr>
<tr>
<td>Proved frequency and celeration were independent.</td>
</tr>
<tr>
<td>Studied 8,868 school children in grades 1 to 6 finding no correlation between frequency and celeration.</td>
</tr>
<tr>
<td>Frequency was minority class related, but celeration was not. Combining both frequency and celeration more accurately predicted later special education assignment than did either alone.</td>
</tr>
<tr>
<td>• Frequency and celeration describe different dimensions of performance and both must always be reported and researched.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Later research: Fluency cult ignores celeration</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Every chart ever charted has frequency, celeration, and bounce.</td>
</tr>
<tr>
<td>• Every precision teacher and precision learner tracks frequency, celeration and bounce every day. These are the three crucial dimensions of performance.</td>
</tr>
<tr>
<td>• We must look at length, width, and height to know how to improve a box.</td>
</tr>
<tr>
<td>• We must look at frequency, celeration, and bounce to improve performance.</td>
</tr>
<tr>
<td>• Most of our research publications since 1980 ignored celeration and bounce.</td>
</tr>
<tr>
<td>• Morningside Academy's high gains were attributed to fluency.</td>
</tr>
<tr>
<td>• Yet Morningside was the first to set school-wide x2 celeration aims in 1992.</td>
</tr>
<tr>
<td>• Fluency makes REAPS? How do we know it was not also celeration, or only celeration, if we don't report the celeration?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teachers and learners set both frequency and celeration aims</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Many of our private schools and learning centers now set three aims: Acquisition celeration aims above x2 per 10 timings on a Timings chart, and fluency building celeration aims above x2 per week on a Daily chart, and tool skill frequency aims above 100 per minute on the Daily chart.</td>
</tr>
<tr>
<td>• When your curriculum steps are so small that you get no jump down, you have no celeration to show learning. You can not estimate learning from the complex curriculum content. So leap over steps to get steep celerations!</td>
</tr>
</tbody>
</table>

(PT discoveries song: “How Does Performance Grow?” Og Lindsley 1999)

<table>
<thead>
<tr>
<th>Research suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Researchers should no longer ignore celeration, but should look at Retention, Endurance, Application, and Stability for these performance combinations: High Cel / High Freq</td>
</tr>
<tr>
<td>High Cel / Low Freq</td>
</tr>
<tr>
<td>Low Cel / High Freq</td>
</tr>
<tr>
<td>Low Cel / Low Freq</td>
</tr>
<tr>
<td>• Michael Fabrizio has recently run such a pilot study with 4 middle school children at Morningside Academy. Frabrizio, 1999 He found:</td>
</tr>
<tr>
<td>1) Celeration is at least as good a predictor of skill retention as frequency.</td>
</tr>
<tr>
<td>2) Celeration is a better predictor of endurance than frequency.</td>
</tr>
<tr>
<td>• Finally, we have someone researching celeration! Congratulations, Michael!</td>
</tr>
</tbody>
</table>

Keynote Address, International Precision Teaching and Standard Celeration Conference. Provo, UT, 4 November 1999
**Teaching suggestions.**

- Leap up your public school curriculum in giant steps.
  The small step curricula were built for learners without charts to motivate them and dispel their fear of low correct and high error frequencies.
  

- Look for climbing bottoms and climbing tops showing fluency growth.
- Look for steeper slopes showing agility growth.

**Og Quote 1999**

You have not described performance until you have described its frequency, its celeration, and its bounce.

(Celeration aim focused song: “We Will Do Times Two!” Og Lindsley 1996)

**REFERENCES**


**PRECISION TEACHING SONGS**

**Pinpoint, Record, and Consequate 1967**

Words and music © by Nancy Julia Ann Johnson for Precision Teaching workshops, Operation Upgrade, Kansas City, MO.

Pinpoint, Record, and Consequate.
  Be specific, get that rate,
  Aim at the target, then consequate!

Pinpoint, Record, and Consequate.

Keynote Address, International Precision Teaching and Standard Celeration Conference, Provo, UT, 4 November 1999
Are You Charting?
1973

Words © by Hank Pennypacker, sung to the folk tune of “Frere Jacques,” for Precision Teaching of Florida workshops.

Are you charting? Are you charting?
Yes we are! Yes we are!
Chart a little movement. Look at the improvement!
Every day, In every way.

Are you changing? Are you changing?
Yes I am! Yes I am!
Changing my procedures. Helping little creatures,
Learn to grow. See them grow!

Are we teaching? Are we teaching?
Yes we are! Yes we are!
Teaching with Precision, making each decision,
with our charts. From our hearts!
From our hearts!

How Does Performance Grow? 1999

Words © by Og Lindsley, sung to the tune of “Jingle Bells,” for industrial standard charting workshops.

1st Verse
How does performance grow?
As we count it day by day.
To chart it we must know.
To change it we must say:

Chorus
Multiply, multiply,
multiply each week.
That's how our performance grows
To the fluency we seek.

2nd Verse
Start with zero? No!
To that there's no debate.
We need one to grow,
Two, then four, then eight!

3rd Verse
Do errors go away,
when corrects go up each day?
It's not as you think.
They go their own way!

4th Verse
Middle guy does ten.
And our bottom guy does two.
Will top guy do eighteen?
No! Top guy does fifty!

Keynote Address, International Precision Teaching and Standard Celeration Conference,
Provo, UT, 4 November 1999
We Will Do Times two! 1996

Words © by Og Lindsley, sung to tune of union song, "We Shall Not Be Moved," for summer workshop and institute in Seattle.

We all promise - we will do times two.
    We all promise - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Kent is our designer - we will do times two.
    Kent is our designer - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Og’s our chart inventor - we will do times two.
    Og’s are chart inventor - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Ray’s our teacher trainer - we will do times two.
    Ray’s are teacher trainer - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Chuck is our President - we will do times two.
    Chuck is our President - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Bruce set up our meeting - we will do times two.
    Bruce set up our meeting - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Tracy did the hard work - we will do times two.
    Tracy did the hard work - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

We all promise - we will do times two.
    We all promise - we will do times two.
Just like our friends who shared and learned at Provo,
    We will do times two!

Keynote Address, International Precision Teaching and Standard Celeration Conference, Provo, UT, 4 November 1999
Does Autism Involve Excess Will and Control: Can this Control be Shared using Free Operants? - Ogden Lindsley

Let's Hear From Some Mothers
“A teacher told me Willy had been trying for 15 minutes to open a locked closet door.”

“Francis flopped on the classroom floor and would not get up. He is so heavy the teachers had to call the fire department to get him up.”

“Bobby wanted out of his car seat while I was driving on the LA freeway. He kicked me so much, my bad driving caused a cop to pull us over. The cop saw my bleeding, felt sorry, and escorted us to UCLA.”

Should We Teach Him Who's Boss?
The conventional approach to teaching such willful children is to be extremely structured, firm and not yield to any of their demands. The wilder they get, the firmer we get. They must learn compliance. The teacher controls each and every part of the carefully scripted learning task. Eventually the learner yields to control as do most children.

Should We Teach Slower?
SLOBS - Conventional Wisdom
In the late 1960’s, while struggling to get my special education teachers to teach rapidly, using free operants, I found their entrenched conventional wisdom went in exactly the opposite direction. When they ran into teaching problems they slowed down, spoke louder, did things one at a time, made things bigger, and simpler. I coined the acronym SLOBS for this conventional wisdom that guided teaching in the wrong directions.

S Slow
L Louder
O One at a time
B Bigger
S Simpler

Our charts showed us that we often got steeper learning going faster, speaking softer, teaching full compounds, making things smaller, and teaching the complete final action. (Large primary pencils are too big for those little hands to draw fast.)

For most students SLOBS were steps in the wrong direction. Making things slower, louder, bigger, and simpler bored them to tears and did not improve their learning.

Or, Should We Share Free Operants.

Every learning task has at least nine parts that learners could do. If the teacher does all except respond, it is a controlled operant. The more parts the learner does, the more free the operant.

Nine Operant Task Freedoms
Most teaching tasks have the following nine parts that can be shared.
Schedule their task. Learner decides which learning task we do first today. The learner can choose by reaching for it.

Present all stimuli. Learner holds and turns flash cards, book pages, or moves to next section of practice sheet.

Form their responses. Learner holds hand in the position they find most productive. Dick Fosbury went over high jump bar head first, against tradition, and coaches advice. Dick became a champion high jumper and most follow his style today.

Record their responses. Learner makes a tally mark, puts a bead in cup, or presses a counter button after each response. At high end learners chart their own performance on a standard chart.
Repeat and self correct responses. Learner repeats and corrects a wrong response just as soon as he sees his error.

Speed without limit. Learner goes as fast as she can. Nothing comes between her responses to limit her speed.

Select their reward. Learner selects the reward for each response. Tokens cashed for a variety of things, and different flavor candies in a reward box, provide selection.

Deliver their reward. Learner reaches into the box and delivers their own reward.

Invent and try new changes. At the high end, learners make suggestions for going faster, or changing materials to learn faster. An example, learner in sheltered workshop said he could collate papers faster if he had a his own full table to work on. He was right!
Does Autism Involve Excess Will and Control:  
Can this Control be Shared using Free Operants?  
- Ogden Lindsley

Free Operant Teaching is Very Fast.  
The following description of the Big 6 plus 6 makes clear how very fast free operant teaching goes - 20 in 5 seconds!

Big 6 plus 6 elements isolated  
Eric Haughton and Ann Desjardins in 1980 developed six pinpoints for extremely fast practice of fine motor skills.

<table>
<thead>
<tr>
<th>Their big 6:</th>
<th>Their Plus 6:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach</td>
<td>Pull-Push</td>
</tr>
<tr>
<td>Point</td>
<td>Shake</td>
</tr>
<tr>
<td>Touch</td>
<td>Squeeze</td>
</tr>
<tr>
<td>Grasp-Release</td>
<td>Tap</td>
</tr>
<tr>
<td>Place</td>
<td>Twist</td>
</tr>
</tbody>
</table>

These component skills should be at 20-25 in 5 seconds. They worked with both hands and charted each hand separately.

Big 6 Compound  
Here child reaches for an object, touches it, grasps it, places it over a can and releases it. Marbles, coins, blocks, clothes pins can be used. Practice 30 or 60 seconds, count objects in can and chart frequency. Aim for 100 to 120 per minute (15-20 in 10 sec).

Learning Channels  
Not only do we teach both hands, but also in as many channels as we can on the same day. The learner must get to performance aim on each channel. A channel sequence for Reach in Big 6 flows like this:

<table>
<thead>
<tr>
<th>In</th>
<th>Out</th>
<th>Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide</td>
<td>Reach</td>
<td>G/Reach</td>
</tr>
<tr>
<td>Touch</td>
<td>Reach</td>
<td>To/Reach</td>
</tr>
<tr>
<td>Hear-Touch</td>
<td>Reach</td>
<td>H-To/Reach</td>
</tr>
<tr>
<td>Hear</td>
<td>Reach</td>
<td>H/Reach</td>
</tr>
<tr>
<td>See</td>
<td>Reach</td>
<td>Se/Reach</td>
</tr>
<tr>
<td>Think</td>
<td>Reach</td>
<td>Th/Reach</td>
</tr>
</tbody>
</table>

We do not work on one channel at a time. A learner may be working on Guide/Reach, Touch/Reach, and Hear-Touch/Reach on the same day. Work with both hands at once and chart each hand separately.

Details of Teaching Reach By Itself  
- Hold object for the child to reach toward.  
- Give assistance your channel stipulates.  
- As soon as the child moves toward the object, move the object in another direction so the child tracks the object with their hand.  
- Do not let the child make contact with the object after each reach. You want the movement to be repeated over and over again. Since grasping and manipulating the object is a natural reinforcer you may want to build up the ratio of reaches to reinforcement when you first begin.  
- Practice the reaching for a few minutes then time the child for 15 or 30 seconds counting the number of reaches.  
- Chart the frequency information.  
- Always give assistance at normal levels of performance. If guiding, you should be guiding at 20-25 reaches in 5 seconds (200-300 reaches per minute).

Maxi-guiding  
Eric and Ann did not name their super fast guiding. Conventional educators guide at about 1 per second, or 10 in 10 seconds, or 60 per minute. Even Precision Teachers who know of the Big 6 plus 6 work guide at low inadequate rates. Maxi-guiding moves as fast as the tutor can move. That’s why we call it maxi. Make those little hands blur! The word maxi-guide points out that the real difference between Eric and Ann’s Big 6 plus 6 and the conventional methods is maximum SPEED - 5 to 10 times faster!

Elizabeth Haughton, Eric’s widow, uses these methods in her learning center in Napa, CA. Giordana Malabello in Australia, and Alison Moors and Michael Fabrizio in Seattle, use charted free operants in home tutoring programs for toddlers with autism.

Precision Teaching  
Applying Skinner’s laboratory developed self charting of performance frequency to classroom teaching we find four parts.  
Heart of Precision Learning is self recording on our standard chart.  
Slogan: “Care enough to chart.”  
Head of Precision Learning is our learner. Ideally, each learner does all teaching acts and decisions - a goal constantly strived for.  
Slogan: “Child knows best.”
Hands of Precision Learning are daily, timed, charted, fast, aimed practice sessions. Ten second, within day, timings build skills. One minute daily timings build fluency. Slogan: “Daily practice builds fluency.”

Health of Precision Learning is weekly standard chart sharing with other learners. Slogan: “Share a brag and help each week.”

PT’s Chart Heart is Multiply
The important thing about our Standard Celeration Chart is that it has a standard multiply scale up the left for performance. This permits teachers and learners to project learning with a straight line and tell on what day they will reach their aim.

Learn Chart Performance Lines in See+Hear/Say+Do Channel
Stand, follow leader and point and say to frequency lines on walls of standard chart room. Leader corrects point positions.

1000 per minute
100 per minute
10 per minute
1 per minute
1000 per day
100 per day
10 per day
1 per day

(When we have more time we have learners draw their own standard chart on a blank white sheet of paper.)

Learn Chart Learning Lines in See+Hear/Say+Do Channel
Stand: Follow leader and rotate left arm at correct angle (slopes) of learning lines. Leader corrects arm angles.

x16
x4
x2
x1.4
x1
/1.4
/2
/16

Learners describe their learning with these values. Most aim at x2 per day in their acquisition sprints and at x2 per week in their daily practice to fluency.

How Does Performance Grow
Each verse of the lyrics to the tune of Jingle Bells describes a different thing we learned about performance from our learner’s charts.

1 - Performance multiples.
2 - You must start with at least one to learn.
3 - Learning corrects is independent from learning not to make errors.
4 - Performance of different students spreads equally on a multiply scale.

How Does Performance Grow Jingle Bells
1 How does performance grow?
   As we chart it day by day.
   To change it we must know.
   To forecast we must say:

   Chorus: Multiply, multiply, multiply each week.
   That’s how our performance grows to the fluency we seek.

2 Start with zero? No!
   To that there’s no debate.
   We need 1 to grow,
   to 2, then 4, then 8!

3 Do errors go away,
   when corrects go up each day?
   It’s not as you think.
   They go their own way!

4 Middle guy does 10.
   and our bottom guy does 2.
   Will top guy do 18?
   No! Top guy does 50!

Head Strong, Fast, Narrow Focused Theory
After researching the behavior of children with autism from 1953 to 1965 in my Harvard Medical School Laboratory in Metropolitan State Hospital, Waltham, MA, and teaching parents from 1965 to 1972 at KU Medical Center in Kansas City, Bernie Rimland asked me what my theory of autism was. I answered, “They are very head strong, fast, and narrow focused young people.” Bernie laughed and said, “That is not a theory, that is a description.” And so it is. Lindsley’s descriptive theory of autism.


File code WrdD39 ABA 00 AutExWill - Free Op
Does Autism Involve Excess Will and Control:
Can this Control be Shared using Free Operants? - Ogden Lindsley

Free Operants Share Control
The nine free operant freedoms share control of the learning task with these head strong youngsters. This may be one reason that free operants produce more learning than more controlling teaching methods.

Free Operants Give Faster Practice
As Carl Binder has pointed out, the absence of fluency blocking trials permits fast unlimited practice which may fit better with some children's need for faster stimulation and action.

Free Operants Give More Practice
Using free operants gives 10 to 30 times more practice a day in each skill than when the tutoring is done with discrete trials.

Discrete Trials or Free Operants. Which?
Obviously we should try both with each learner and chart how fast each approach teaches. Shahla Ala'i Rosales and Jesus Rosales, Alison Moors and Michael Fabrizio, and Giordana Malabello have independently made such comparisons. All three studies found the high speed, high volume free operants produce much faster learning than the slower deliberate discrete trials. These research results will be shared in our Symposium #268 at this conference on Monday, May 29, 2000.

Earlier the Intervention The Better
We owe my good friend, Ivar Lovaas and his students, enduring gratitude for demonstrating that massive early intervention can arrest and prevent later autistic behaviors (Lovaas, 1987). Their creativity, determination and clear cut, systematic research that has continued over the ensuing years, provided a solid platform for our free operant methods to stand on.

Mary Had a Real Tough Child
New Lyrics to “Mary had a little lamb” written by Og Lindsley for CalABA 2000.

Mary had a little lamb,
little lamb, little lamb.
Mary had a little lamb, its fleece was white as snow.
Mary had a real tough child,
real tough child, real tough child.
Mary had a real tough child, she could not teach or guide.

Then one week she raced his hands
raced his hands, raced his hands. Then one week she raced his hands at 20 in 5 seconds.

That turned the trick, he’s on his own,
on his own, on his own. And doubling every week.

He’s learning all his big 6 tools,
big 6 tools, big 6 tools.
He’s learning all his big 6 tools soon his fluency will peak!

References

File code WrdD39 ABA.00 AutExWill - Free Op