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The Standard Celeration Society (SCS) publishes the *Journal of Precision Teaching and Celeration* (ISSN# 1088-484X) annually. SCS members receive the *Journal of Precision Teaching and Celeration*. To join the SCS fill out a membership application located at the back of the journal. Please send SCS membership to Nancy Hughes Lindsley, Standard Celeration Society, PO Box 3351, Kansas City, KS 66103. Membership dues: Student – 25.00 yearly membership includes one volume of the *Journal of Precision Teaching and Celeration* and reduced International Precision Teaching Conference rates; Regular – 50.00 yearly membership includes one issue of the *Journal of Precision Teaching and Celeration* and reduced International Precision Teaching Conference rates; Sustaining – 100.00 yearly membership includes one issue of the *Journal of Precision Teaching and Celeration*, an extra copy of the volume, and reduced International Precision Teaching Conference rates; Institutional – 90.00 yearly membership includes one issue of the *Journal of Precision Teaching and Celeration*. 

STATEMENT OF PURPOSE: As the official journal of the Standard Celeration Society the *Journal of Precision Teaching and Celeration* has dedicated itself to a science of human behavior founded on a technology of direct, continuous and standard measurement. This measurement technology includes: a standard unit of behavior measurement – frequency; a standard measure of change in behavior frequencies – celeration; a standard measure of the variability of behavior frequencies – bounce; and a Standard Celeration Chart to display frequency, celeration and bounce data. The Standard Celeration Chart enables chart based statistical procedures to determine changes in frequency-frequency jumps, changes in celeration – celeration turns and changes in bounce – bounce verge.
This volume, 21, marks a transition from Rick Kubina to Jesus Rosales-Ruiz as the Editor. Dr. Rosales-Ruiz, along with Associate Editors Clay Stalin and Alison Moors, shepherded the peer review process for all of the research articles and chart shares. Along with the editorial changes the journal will move from bi-annual to annual production.

Volume 21 shows the continued application of Precision Teaching for learners with autism. The first research article from Marlene Cohen examines how older learners with autism benefit from an instructional strategy. Clerical behaviors displayed on Standard Celeration Charts show acceleration while aggression and self-injury show a corresponding deceleration. Three chart shares also show how Precision Teaching has positively impacted younger students with autism. These chart shares show changes in reading, sound imitation, and asking for additional information. Another research article highlights Precision Teaching use with pre-service teachers. The results of the study by Koorland and MacLeod show that the use of an Accuracy Improvement Measure showed clear performance differences among the pre-service teachers.

This volume ends with a very touching tribute to Ogden Lindsley who recently passed away. Abigail Calkin recounts the influence and creativity Ogden, or Og as everyone who knew him, had on her life and that of many others. The Precision Teaching community mourns the lost of their father, advocate, and dear friend.
The Effect of Increasing the Rate of Clerical Skill Performance on Challenging Behavior

Marlene J. Cohen

Rutgers the State University of New Jersey

In the field of Applied Behavior Analysis, much focus is placed on the intense training needs of young children with autism. Many educators believe that adolescents and adults with autism are less likely to make significant strides than their younger counterparts. The present research looks at fluency-based instruction as an instructional strategy that is time efficient and has the potential to significantly improve the quality of life for older learners with autism by establishing competent performance that will prepare them for future job placements. The study examined the impact of fluency-based instruction on the rate of skill acquisition and the rate of challenging behavior of an adolescent with autism learning vocational skills. Results showed that increases in rate of performance of trifolding (folding paper into thirds) corresponded with decreases in rates of aggression and self-injury during performance of the task. Results were replicated with the introduction of fluency-based instruction for envelope stuffing and mail sorting. These findings yielded support for the effectiveness of fluency training in addressing challenging behavior and increasing competence in vocational skills. This has implications for increasing the potential employability of adults with autism.

DESCRIPTORS: Precision Teaching, frequency-building, Autism, challenging behavior


One of the most widely cited applications of Precision Teaching was a study implemented in Great Falls, Montana in the early 1970’s (in Binder 1996). Over the course of four years the Sacajawea Elementary School students “... advanced 19-40 percentile points higher on the Iowa Test of Basic Skills than students elsewhere in the district” (Beck, cited in Binder & Watkins, 1990). The success of this type of intervention has been documented in other areas as well. Binder and Bloom (1989) used fluency-based instruction to train new sales representatives, who later demonstrated a stronger knowledge base than more experienced sales representatives who did not receive such training. Johnson and Layng (1992) reported the success of this methodology for working adults learning to read. They found that the results of fluency-based instruction were superior to any other program funded by The Job Training Partnership Act. Clearly, the implementation of fluency-based instruction has widespread implications across a variety of applications.

Behavioral fluency is that combination of accuracy plus speed of responding that enables individuals to function efficiently and effectively in their natural environment” (Binder 1996 p. 164). Initial stages of implementation of fluency-based instruction at Adult and Transitional Services of the Douglass Developmental Disabilities Center demonstrated that this technology could have a significant impact on the efficiency of vocational skills training leading to increased potential for employment as well as decreases in escape driven disruptive behavior. More recent results have indicated that Precision Teaching with frequency-building procedures has increased independence in activities of daily living in a 30-year-old man with autism who was demonstrating unilateral motor neglect following a stroke. The staff of Adult and Transitional Services have determined that the majority of adolescents and adults with autism in our program are not fluent in simple motor movements (e.g., reach, point, touch, grasp, place, release). This has lead to the realization that the lack of progress students and adults with autism experience in daily living and other skills may be a direct result of dysfluent performance...
of component skills (smaller skills that comprise more complex behaviors). Binder (1996) notes that “Use of fluency-based instructional methods has led to unprecedented gains in educational cost effectiveness, and has the potential for significantly improving education and training in general” (p.163). There is a tremendous need for research that demonstrates effective methods of instruction for adolescents and adults who have an urgent need to demonstrate competency in employable skills in order to live productive and fulfilling lives.

Recent interest in Precision Teaching with frequency building procedures has led to its increased implementation in the field of applied behavior analysis for learners with autism and other developmental disabilities (Binder, 2003; Fabrizio & Schrimer, 2002; Fabrizio, Schrimer, & Vu, 2003; Zambolin, Fabrizio, & Isely, 2004). Specific research has found that Precision Teaching with frequency-building procedures with this population of children has achieved powerful results in many curricular areas, including: language (preposition use), social skills (joint attention), pre-academics (picture matching and pattern imitation), and academics (sight words) (Fabrizio & Schrimer, 2002; Fabrizio, Schrimer, Vu, Diakite, & Yao; 2003, Kerr, Campbell, & McGrory, 2002; and King, Moors, & Fabrizio, 2003). These findings have supported the need for teaching and measurement methods that ensure “true skill mastery” or “fluent performance,” (measured as performance frequencies or frequency ranges with “mastery” defined by the fluency outcomes indicated by RESA/SEAR and other acronyms) in contrast to more traditional teaching methods for this population which traditionally have focused solely on accuracy and percent correct as measurement and mastery criteria (Fabrizio & Moors, 2003).

The purpose of the present study was to determine effective and highly efficient instructional strategies that have a significant impact on the lives of the older learners with autism. This result would make a meaningful contribution in the Precision Teaching arena.

METHOD

Participant

The intervention was implemented with a 16-year-old student with autism. The subject had a history of aggression and self-injury associated with vocational training sessions. Aggression includes grabbing, pinching, scratching, digging fingernails into another’s skin, head butting, striking with a fist, and/or kicking. Self injury includes striking self with open hand or fist and pinching self with enough force to temporarily discolor skin.

The student is able to perform basic functional academics skills such as reading (at a Kindergarten to First grade level as tested by the Woodcock-Johnson III Tests of Achievement), phonics, number concepts to 100, and telling time with a digital clock. He uses an augmentative communication system, which contains various category levels appropriate for use in a number of environments (school, community, recreation, etc.).

Setting

The student receives educational services from the Transitional Services component of Adult and Transitional Services, a division of the Douglass Developmental Disabilities Center. The Center is a university-based day school/adult program at Rutgers University serving adolescents and adults with autism, ages 14 to 30 years. Adult and Transitional Services employs the techniques of applied behavior analysis in the education and treatment of individuals with autism. The Transitional Services unit was designed specifically to meet the unique needs of adolescents with autism and a long-standing history of challenging behavior. The goals of the unit include determining the function of challenging behavior, teaching the student skills that enable them to manage their own behavior, and transitioning the students into a variety of community environments for the purpose of daily living, recreation, and potential employment.

Design

A single case study was implemented and replicated across three instructional conditions using a multiple probe design. A multiple-probe design is a variant of the multiple baseline design (Baer, Wolf, & Risley, 1968), in which the independent variable is applied sequentially to each of three behaviors for the same participant. Baseline measurement of each participant’s frequency...
of performance of the target motor behavior was obtained. Baseline measurement of the frequency of each clerical skill was obtained. Precision teaching with frequency building procedures was implemented for the first skill (trifolding). Once the criterion has been met for trifolding, an additional probe of the performance of the second skill (envelope stuffing) was completed before initiating timed practice with this skill, and so on with the third skill (mail sorting). The multiple-probe design was selected to eliminate the need for continuous baseline measurement for the two participants remaining in the baseline phase in order to avoid unnecessary exposure to measurement in the absence of reinforcement and instruction to improve the target behavior. The multiple baseline/multiple probe designs demonstrate a functional relationship between the independent variable and the dependent measure when the participants’ response frequencies demonstrate the most improvement only when the intervention is applied (Baer, Wolf & Risley, 1968). Frequency building sessions were implemented five school days per week.

Materials

The instructional conditions selected for the intervention were as follows: Trifolding - trifold machine, paper, finished bin, Envelope stuffing - envelopes, trifolded paper, finished bin, Mail sorting - 24 slot mail-sorting bin, labeled envelopes (first and last name of staff members). Trifolding consisted of grasping a single paper from a stack of paper, placing the paper evenly into the top of the trifold machine, releasing the paper as it feeds into the machine, and placing the folded paper into a bin. Envelope stuffing consisted of grasping a single trifolded paper, grasping an envelope with the other hand, placing the paper into the envelope, and releasing the stuffed envelope. Mail sorting consisted of grasping an addressed stuffed envelope, placing it into the corresponding mail slot, and releasing the envelope. Frequency aims were determined utilizing a performance standard established by sampling the performance of three competent neurotypical performers. Progress was graphed on standard celeration charts.

Procedure.

Rate of performance was determined during a five-minute timing for trifolding and one minute timing for envelope stuffing and mailsorting. Rate per minute was calculated. Rate of aggression and self-injury (total combined behaviors) was collected during the baseline session. The baseline rates for the clerical skills and aggression and self-injury were plotted on the standard celeration chart. A line of celeration of 1.25 was plotted in order to determine daily goal rates. The decision to utilize a minimum celeration line at all was made on the basis that previous research demonstrated that the use of minimum celeration lines increased the likelihood of more timely decisions and higher learner progress than when minimum celeration lines were not utilized (Bohannon, 1975 & Mirkin, 1978; as cited in White, 2000). Further, previous clinical experience in the current setting suggested that use of the minimum celeration line was critical in helping to establish consistency in intervention across participant and staff. The aim (competent rate of performance) for trifolding and envelope stuffing was 13 per minute and for mail sorting was 11 per minute.

Precision Teaching with Frequency Building

Intervention began by exposing the learner to daily timed practice sessions, consisting of 1 to 10 timings at the specified interval (as determined by achieving the minimum celeration goal). The learner performed the skill with verbal encouragement from the instructor for the length of the timing, and the frequency of response will be charted. Daily goals for timed practice were determined by the intersection of the minimum celeration line and the frequency value on the y-axis of the Standard Celeration Chart. Timed practices (or sprints) were repeated until the daily goal is reached or until a maximum of 10 sprints have been completed. If the learner did not meet his daily goal for 3 days, individual modifications were made as suggested in White (2000). Modifications included more frequent practice, change in materials or specific response requirements, more opportunities for modeling and feedback, shorter timing duration, change in reinforcement, or other individualized strategies. As soon as the learner’s frequency met or exceeded the overall primary frequency aim for at least 2 days in one of the initial timings, the timing length increased to the next increment (e.g. from 10 seconds to 15
seconds). The learner then performed daily timed practice at the new timing length until he met or exceeded the frequency aim, at which time the timing length will be increased again. Timing lengths increased according to this strategy until a timing length of 30 seconds was reached. Once the learner achieved the frequency aim at a 30 second timing, fluency outcomes were evaluated (stability, endurance and retention).

The intervention was initiated for the first clerical skill, trifolding. Daily criterion-based instruction (instruction focused on accuracy, but without relation to rate of performance) continued for the other two skills. Once a frequency aim was reached at a one-minute timing and the stability check was met (performance at the fluent rate in the face of distraction), the intervention began for the second clerical skill, envelope stuffing with a baseline session of a one-minute timing. The same criteria were used to begin the intervention with the third skill, mail sorting. The intervention was initiated at a one-minute timing for trifolding; however due to lack of progress (failure to meet the daily goal for two to three consecutive timings), the timing length was reduced to 30 seconds, then to 20 seconds, then to 10 seconds. Intervention was initiated at a 10 second timing length for envelope stuffing, with increases made according to our research design. This included starting with short timings until the learner is performing at competent rates and increasing incrementally until the individual is able to perform at competent rates for one minute, demonstrating endurance (competent performance over a sufficient period of time). Current research indicates that competent performance for one-minute timings is sufficient in achieving competent performance. Baseline followed by the intervention was implemented at a ten second timing length for envelope stuffing, once fluent rates were achieved for envelope stuffing, baseline followed by intervention was implemented for mail sorting.

**Inter-observer Agreement and Treatment Integrity**

Inter-observer agreement was conducted on 20% of the scheduled sessions. Exact agreement for each completed behavior was implemented by an independent observer. In addition, treatment integrity data was collected by the independent observer for 20% of the sessions utilizing a 14-step checklist of the behaviors included in our frequency-based procedure. Reliability ratings ranging from 70-100% (94% average) and treatment integrity was 100% all sessions.

**RESULTS**

The rate per minute for trifolding and the rate per minute aggression and self-injury (total rate combined) shows the trifold rate increasing from 8.4 per minute to an average of 13 per minute and the rate of aggression and self-injury decreasing from 8 per minute to an average of .2 per minute over the course of 20 weeks (See Chart 1). In Chart 2, the trend of aggression and self-injury during routine retention checks is illustrated, showing the rate of trifolding remaining at 13 per minute and rate of aggression and self-injury decreasing to zero over the course of 9 weeks.

In Chart 3, the rate of envelope stuffing and decreasing trend for self-injury and aggression (total behaviors combined) is illustrated. The chart depicts the rate of envelope stuffing increasing from 4 per minute to an average of 13 per minute and rate of aggression and self-injury decreasing from 5 per minute to 0 per minute over the course of 11 weeks. This replicates the results achieved for trifolding.

Rate of celeration for mail sorting and the corresponding decreasing rate of self-injury and aggression (total behaviors combined) can be seen in Chart 4. The chart shows the rate of envelope stuffing increasing from 7 per minute to an average of 21 per minute and rate of self-injury and aggression decreasing from 2 per minute to 0 per minute over the course of 6 weeks. This replicates for a second time, the effect of decreased challenging behavior in response to achieving performance standard for a third clerical skill.

**DISCUSSION**

Most behavior reduction research has focused on functional assessment and the effectiveness of various interventions (Carr & Durand 1985, Cary & Bucher 1981, Iwata, Pace, Cowdery & Miltenberger 1994, and Vollmer, Iwata, Zarcone & Mazaleski 1993). The literature regarding vocational training as related to behavior reduction
SUCCESSIVE CALENDAR DAYS

COUNT PER MINUTE

SUCCESSIVE CALENDAR DAYS

CALENDAR WEEKS

LIKENESS OF DAILY PER MINUTE STANDARD CELERATION CHART
6 CYCLE - 140 DAYS (20 WEEKS)
BEHAVIOR RESEARCH CO WWW.BEHAVIORRESEARCHCOMPANY.COM
BOX 3351 - KANSAS CITY, KS 66103 VM: 913-362-5900
WWW.BEHAVIORRESEARCHCOMPANY.COM

29-Sep-02
27-Oct-02
24-Nov-02
22-Dec-02
19-Jan-03
16-Feb-03

2000 1500 1000 500

500 100 50 10 5

5

1

.5

.1

.01

.005

.001

0 7 14 21 28 35 42 49 56 63 70 77 84 91 98 105 112 119 126 133 140

Baseline
Absence
Endurance
Stability
Retention
Retention

Chart 1.

See-Do Trifolds Sheets of Paper • Aggression and Self-Injurious Behavior • Record Floor
See-Do Stuffs Envelopes  Aggression and Self-Injury  Record Floor
has focused on the effectiveness of such interventions as preference assessment and choice making (Parsons, Reid, Reynolds & Bumgarner 1990). This study expands the literature base for interventions that build desired competing behavior and increase skills that are related to employment. The data suggest that by increasing the rate of performance for clerical skills, one can decrease the rate of challenging behavior in older students with autism. This finding, first shown with the intervention of Precision Teaching with rate-building procedures of trifolding (using a trifold machine) is further strengthened by replication of the results for an additional two clerical skills, envelope stuffing and mail sorting. This suggests that competent performance and the occurrence of challenging behavior are incompatible. This result holds promise for other adolescents who present behavioral challenges. Precision Teaching with rate-building procedures has the added benefit of being time efficient. Each fluency instruction session took a maximum of 15 minutes and results were achieved in as little as six weeks.

One collateral effect noted was that the student demonstrated a more positive affect during the intervention once competence was established. This was noted through the observation of videotape recorded during the beginning sessions, middle sessions, and last sessions. The videotaped intervention sessions were viewed in random temporal order. Eight independent observers were asked to rate affect during each videotaped segment. The evaluation consisted of a five-point Likert scale with a rating of 1 being negative, 2 being somewhat negative, 3 being neutral, 4 being somewhat positive and 5 being positive. The mode for the first frequency-building session was compared to the mode from the final intervention session, with the mode for the first being 2 and for the last being 4. Future research should focus on further quantification this aspect of instruction as satisfaction with one’s own performance relates to improved quality of life.

Study Limitations. Implementation of the first phase of the study resulted in many challenges. The use of a mechanical device (trifold machine) lead to a procedural ceiling due to failure of the machine to operate consistently and correctly. Although implementation of the intervention for skills requiring the use of a machine might be of importance, it is recommended that future studies avoid this potential confound. The length of time necessary for the student to achieve competent performance for trifolding was significantly greater than for envelope stuffing or mail sorting. Rates of aggression and self-injury may have been impacted by the student’s frustration in using a device that malfunctioned on numerous occasions.

One additional confound in this study is the effects of practice on the reduction of challenging behavior. Although the student had been exposed to typical instruction for a year prior to fluency-based instruction, typical instruction was performed only a few times per week. We are unable to determine if similar results could be achieved if typical instruction were performed more frequently.

A single baseline was collected for each clerical skill targeted for intervention. There is the possibility that other variables may have contributed to the reduction in challenging behavior as multiple baseline measures were not collected to validate the skill performance as stable performance prior to intervention.

Research Recommendations. Further research holds much promise for a population of individuals that were previously considered to have reached a plateau in the educational/training process. Additional research could examine the effects of interventions meant to improve transitions from adolescence to early adulthood, particularly for vulnerable young people (i.e., learners with autism), and examine the changes to systems, organizations, and programs, with particular emphasis on results that are durable (longitudinal data collected in our future studies). Increasing the understanding and use of the behavioral sciences could influence change in educational practice.

REFERENCES


Zambolin, K., Fabrizio, M. & Isley, S. (2004). Teaching a child with autism to answer...
Four pre-service teachers trained, and one untrained, in Precision Teaching (PT) were compared employing the Accuracy Improvement Measure (AIM), as an outcome variable. All teachers taught elementary aged students. All five teachers participated in a university practicum. The teachers taught reading, math and related skills for one 3 hour meeting over 10 weeks. Pilot results showed that the AIM was measure suitable for detecting differences among teachers. Description of the AIM, its implications for accountability and examining teacher preparation programs are discussed.

DESCRIPTORS: Teacher preparation, accountability measures, Precision Teaching

The content of teacher training has become more important in the continuing call to reform instruction in the schools (Mathes & Torgesen, 1998; Moats, 1994; Darling-Hammond, 2000). Teacher training is viewed as an important variable that influences what teachers do and how their students learn (Wilson, Floden, & Ferrini-Mundy, 2002). Various methods have been employed to evaluate the effectiveness of teachers including direct observation of teacher practices, teacher responses to questionnaires, and learner change. These measures have been used alone or in combination. A few studies in special education serve to illustrate common quantitative methods of approaching the accountability challenges of teacher effectiveness.

Blackwell, (1972); Meisgeiger, (1965); Sindelar, Espin, Smith, & Harriman, (1990), and Westling, Koorland, & Rose, (1982) all sought to evaluate the relationships among teacher behaviors, teacher preparation, and teacher effectiveness. Various dependent measures were employed. Westling et al. (1981) compared demographic information and instructional practices of exceptional student educators designated as either superior or average. The designation of superior or average was obtained by querying the special educators’ district level administrators. Differences between the superior and average teachers on their instructional activities, characteristics, and degree of preparation and training were determined by examining teacher questionnaires. Results indicated superior teachers differed from their average counterparts in years of training, practicum experience, and certain classroom instructional practices.

The Sindelar et al. (1990) study employed teacher volunteers to examine teacher effectiveness via student achievement measures. Teachers were placed in higher or lower designated groups according to their students’ mean achievement gains. Teacher effectiveness was related to specific teacher skill repertoires that also have implications for teacher training. Results, however, did not point to teacher preparation as a factor in effectiveness.

Traditionally, direct measures in the form of celerations have not been employed as a learner outcome measure in published teacher effectiveness studies. Precision teaching (PT) and the use of the Standard Celeration Chart, however, permit measurement of change in learner responding over time. Change in frequencies over a week can be computed and the resulting measure, celeration, is defined as count per minute per week (Pennypacker, Gutierrez, & Lindsley, 2003). Producing change in learner achievement is often considered necessary if we wish to adequately evaluate the effectiveness of teacher preparation programs (Carlson, Hyunshik, & Scholl, 2004).

Pennypacker, et al., (2003) describe the accuracy improvement measure (AIM), a useful measure of change in two celerations simultaneously. The AIM results from describing, as a multiplier, the relationship between concurrent celer
ations of correct and incorrect learner responses. Specifically, incorrect celeration can be used as a reference celeration from which a multiplier is calculated to describe a comparison celeration, in this case, celeration of corrects. The result, a multiplier, is an indicator of the change per week in the accuracy (i.e., the number of correct responses for each incorrect response). Consequently, the greater the value of the AIM produced for a particular learner then the greater the change produced in accuracy per week. Since the AIM is independent of initial accuracy, it permits comparison of change in performance accuracy across learners performing at varied frequencies of correct and incorrect responding (Pennypacker, et al., 2003).

AIMs calculated from concurrent correct and incorrect celerations may be averaged to produce summary measures. For example, all teacher x’s charted data can be analyzed and an AIM (based on the learners’ correct celerations in relation to incorrect celerations) calculated for each pinpoint the teacher taught. The same calculations can be performed for the charted data of teacher y and a comparison of the average change in accuracy per week produced by each becomes possible. Pennypacker et al. (2003) state that the AIM is useful for comparing the relative effects of teachers, curricula, and programs, and point out that in program evaluations, the AIM has been used to compare learners under various service delivery models in order to determine the model that produces the greatest change relative to the cost of the program.

Our pilot study attempted to employ the AIM for examining the association between learner performance and their pre-service teacher’s preparation. Charted data and subsequent AIMs produced by pre-service teachers trained one way were compared to the AIMs produced by a teacher trained differently. Specifically, we noted pre-service training that included PT coursework versus training that did not include PT coursework as a programmatic variable, and examined, for each teacher, their charted data, and associated AIMs as an outcome variable.

METHOD

During practicum training for pre-service teachers enrolled in The Florida State University Special Education teacher preparation program, an opportunity arose to examine charted data of elementary-aged learners tutored by pre-service practicum students trained in PT (i.e., having taken a 45 contact hour university graduate course in Precision Teaching), and learners taught by one pre-service teacher who did not have the PT course. The non PT trained pre-service teacher received otherwise identical training to the other pre-service teachers. Three teachers taught among five different pupils one semester, and two student teachers taught among another five pupils during a subsequent semester. Each semester, the teachers enrolled in the practicum, taught and timed reading, math, and related skills with their pupils during an evening 3-hour practicum for 10 weeks.

Pre-service Teacher Participants

Pre-service participants were five female graduate students in special education, all with highly similar experience, demographics, and pre-service preparation, except for one teacher, Melody, who had not taken the graduate methods course in PT. The PT course had been taken by the other four teachers. All five pre-service teachers were enrolled in a state approved three year, junior, senior, master’s program resulting in exceptional student education licensure. The program required 90 semester credit hours across the three years. In this particular program, both the Master’s and Bachelor’s degree and were awarded at completion.

The pre-service teachers were enrolled in a graduate level practicum supervised by two practicum supervisors trained in PT. Three of the teachers enrolled in the practicum the first semester of the pilot, and two enrolled during the second semester. Taking the PT course was a prerequisite for enrollment in these particular field experiences. Melody, however, was admitted inadvertently to the second semester PT practicum without having taken the prerequisite PT course. Because of the administrative error, she was allowed to continue to participate. She received assistance from the practicum supervisors on site and fellow students in learning very basic pinpointing, probing, and charting skills as she worked through the practicum.
PT Training

The PT course available to the pre-service teachers addressed the nature of direct versus indirect measures, charting, chart based measures, chart interpretation, and use of the frequency finder. Other topics focused on constructing teacher made probes and using other available materials for obtaining performance samples, setting aims, and using decision rules to prompt instructional changes or adjustments while teaching. Additionally, the course included content about direct instruction. All students in the PT course were required during the 45 contact hours (i.e., 3 semester credit hours) to use PT with a learner (instructional strategies for each learner were determined by the pre-service teacher), write a report, and share charted results with classmates. Students took numerous timed probes in class as one of the course evaluation activities. The charted instructional project comprised the other major course activity.

Learners

Five elementary aged learners, CA 6 to 11, were available each semester (1 male and 4 females during the first semester, 3 males and 2 female during the second semester). The learners had been variously classified with mild learning and behavior disorders. One female during the first semester had undergone psychiatric hospitalization. The learners’ caregivers were enrolled in an evening parenting class that met once a week at a state office. That office served as the setting each semester, and contained adequate space for each teacher to work with students individually or in small groups.

Procedures

The pre-service teachers assessed each child’s current levels in reading and math. For the teachers trained in PT, aims were set for tool skills in reading and math. Instructional sessions were conducted interspersed with arts and crafts and games. A point system was employed by all the teachers for behavior management. Learners participated in 1 minute probes each session, and their performance was charted on a Standard Celeration Chart. Table 1 displays the teacher, their students, and each student's pinpoint. Students rotated among teachers, however, each teacher chose the pinpoints for their student, and determined the instructional activity for the student as well.

Analysis: Celerations and Improvement Measure

For each learner’s chart, correct and incorrect frequencies and associated celerations were recorded. Celerations were drawn using the method found in Graf & Lindsley (2002). Each teacher’s charts were analyzed in terms of celerations produced for concurrent correct and incorrect responses.

An overall AIM was calculated for each pre-service teacher. Each teacher’s charts were analyzed and an AIM was determined for each of their charted pinpoints. Next, all AIMGs for a particular teacher were averaged resulting in a mean or overall AIM for each teacher.

RESULTS

Because curricular choice and instructional actions originate with the teacher, then one may generally associate student gains with such choices. Clearly, it is difficult to say with confidence that the overall AIM produced by a teacher is solely the result of his or her training, especially since experience, supervision and other variables could be operating. However, if experiential, supervision and demographic variables are all generally similar across teachers and only their preparation differs, then one could perhaps suggest an approximate association between the teacher training and their instructional efforts in terms of charted progress of students. Without a more carefully designed and managed study than we describe here, only a pilot demonstration of how one might approach studying the relationship between teacher preparation and student outcomes is possible. As a teacher accountability model, the notion of associating summary measures derived AIMGs with teacher actions appears reasonable, and due to the properties of celeration and the AIM as an outcome measure, such a model appears feasible.

Comparing the AIMGs (Table 2 displays overall AIMGs by teacher) between the trained teachers and Melody illustrates this result quantitatively. Melody’s charts showed smaller changes in learner accuracy over time than those who were trained differently (i.e., taken the PT course). The overall AIMG’s in Table 2 were averaged (calculation of geometric means appropriate for ratios
Table 1.
Pre-service Teachers, Student, and Pinpoints

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Student (CA)</th>
<th>Pinpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melody</td>
<td>Katrina (7)</td>
<td>See/say words in context</td>
</tr>
<tr>
<td></td>
<td>Katrina (7)</td>
<td>See/say words</td>
</tr>
<tr>
<td></td>
<td>James (6)</td>
<td>See/say letter names</td>
</tr>
<tr>
<td></td>
<td>James (6)</td>
<td>See/say phonemic sounds</td>
</tr>
<tr>
<td></td>
<td>Helena (11)</td>
<td>See/say words in context</td>
</tr>
<tr>
<td></td>
<td>Kristen (6)</td>
<td>See/say words</td>
</tr>
<tr>
<td></td>
<td>Richard (8)</td>
<td>See/say words</td>
</tr>
<tr>
<td>Rachel</td>
<td>Helena (11)</td>
<td>See/say fractions</td>
</tr>
<tr>
<td></td>
<td>Helena (11)</td>
<td>See/write temperature</td>
</tr>
<tr>
<td></td>
<td>James (6)</td>
<td>Counts backwards</td>
</tr>
<tr>
<td></td>
<td>Katrina (7)</td>
<td>See/say numbers</td>
</tr>
<tr>
<td></td>
<td>Katrina (7)</td>
<td>See/write numbers</td>
</tr>
<tr>
<td></td>
<td>Richard (8)</td>
<td>See/write division</td>
</tr>
<tr>
<td></td>
<td>Kristen (6)</td>
<td>See/say numbers</td>
</tr>
<tr>
<td>Andrea</td>
<td>Jason (9)</td>
<td>See/say words (reading passage)</td>
</tr>
<tr>
<td></td>
<td>Zack (7)</td>
<td>See/say words (reading passage)</td>
</tr>
<tr>
<td></td>
<td>Susan (10)</td>
<td>See/say words (reading passage)</td>
</tr>
<tr>
<td></td>
<td>Melissa (9)</td>
<td>See/say words (reading passage)</td>
</tr>
<tr>
<td>Brenda</td>
<td>Zack (7)</td>
<td>See/say words</td>
</tr>
<tr>
<td></td>
<td>Susan (10)</td>
<td>See/say words</td>
</tr>
<tr>
<td></td>
<td>Melissa (9)</td>
<td>See/say words</td>
</tr>
<tr>
<td></td>
<td>Jennifer (7)</td>
<td>See/say words</td>
</tr>
<tr>
<td>April</td>
<td>Jennifer (7)</td>
<td>See/write one digit numerals</td>
</tr>
<tr>
<td></td>
<td>Zack (7)</td>
<td>See/write multiplication numerals (X2 Table)</td>
</tr>
<tr>
<td></td>
<td>Jason (9)</td>
<td>See/write multiplication numerals (X2 Table)</td>
</tr>
<tr>
<td></td>
<td>Susan (10)</td>
<td>See/write multiplication numerals (X2 Table)</td>
</tr>
<tr>
<td></td>
<td>Melissa (9)</td>
<td>See/write multiplication numerals (X2 Table)</td>
</tr>
</tbody>
</table>

Table 2.
Comparison of Accuracy Improvement Measures (AIM)

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Mean AIM by Teacher</th>
<th>Mean AIM By Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trained in PT</td>
<td></td>
<td>x2.00</td>
</tr>
<tr>
<td>Brenda</td>
<td>x2.31</td>
<td></td>
</tr>
<tr>
<td>Rachel</td>
<td>x2.29</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>x1.98</td>
<td></td>
</tr>
<tr>
<td>Andrea</td>
<td>x1.85</td>
<td></td>
</tr>
<tr>
<td>Untrained in PT</td>
<td></td>
<td>x1.47</td>
</tr>
<tr>
<td>Melody</td>
<td>x1.47</td>
<td></td>
</tr>
</tbody>
</table>
such as the AIM are described in Pennypacker et al., 2003) and produced a mean of x 2.0. Melody’s AIM value was x1.47. Melody’s mean AIM is the lowest among the five teachers, and represents a value that is approximately 74% of the mean AIM (1.47 /2.00 X 100) for the other four teachers.

DISCUSSION

In this pilot, we were able to note differences among teachers in learner growth in accuracy through examination of their AIMs. Further, differences between the PT trained and untrained pre-service teachers, while not attributable to their training with confidence, are nevertheless interesting to note. Unfortunately, an insufficient number of teachers untrained in PT, do not permit any clear association between training and differential learner growth. What particular component of the PT course or what combination of course components and other experiences that may have contributed to the findings are unknown. Ideally, if teachers could be assigned first to different training models and then their AIM’s examined, statements about the function of different teacher preparation strategies could be offered. Since this pilot does not meet the requirements necessary for determining causal relationships, its value may reside in providing a model for approaching teacher preparation program accountability. The method and results suggest a strategy for examining the usefulness of larger units (i.e., a course) of a particular teacher preparation curriculum.

The AIM should be explored further as an accountability measure that may be sensitive to independent variables such as instructor training. Accountability is now regularly sought and expected as an element in programs for learners in public education and other training venues. Additionally, university teacher preparation program accreditation agencies are seeking to obtain data about the effectiveness of teacher preparation programs in terms of outcomes for those who are taught by the programs graduates (Illinois State Board of Education, n.d.). This shift to outcome measures in accreditation presents new challenges to those colleges and schools that in the past needed only to provide curricular, human resource, and program descriptions to the accrediting agency.

What more powerful method to show the value of training for teachers than to demonstrate the outcomes associated with variously trained teachers? Typically, measures such as certification test passage rates, principal evaluations, and supervisor evaluations are employed to determine the fitness of a beginning teacher. Changes in any measure of learner performance, however, are rare as a tool to determine teacher preparation program efficacy. The AIM provides an easily computed efficacy measure, perhaps, useful in evaluation of a teacher’s preparation long before one enters the workforce where other measures, often less direct and sensitive, will prevail.

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The Role of Initial Frequencies in Evaluating Student Performance in Curricular Sequences with Infinite Ranges

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That a student’s performance reaches a certain frequency aim should not be the only criteria used to determine whether or not to end or change intervention with a particular skill. While frequency aims—especially aims empirically linked to important instructional outcomes like retention, endurance, stability, and application—certainly play central and important roles in Precision Teaching in determining when a student might have mastered a particular skill, clinicians and teachers should also consider other variables when trying to evaluate whether students have learned a given skill. In many situations, curricular complexity and skill agility are also very important considerations. By curricular complexity, we mean an adequate range of instructional items to delineate sufficient coverage of the subject matter; by skill agility, we mean the degree to which children’s data show “better and better responses” to increasing curricular demands, often through data patterns such as rises in initial frequencies across curricular changes (climbing bottoms) or steeper acceleration of correct responding across progressively more difficult curricular steps.

To better understand the importance of curricular complexity in instructional programming for children with disabilities, we discriminate between tasks with two different types of curricular ranges: infinite and finite. For some skills, the range of instructional stimuli that should come to occasion responding by students is inherently finite, or limited. Naming family members, saying the names of classmates, and repeating sounds of a language are all examples of skills with finite curricular ranges—the number of items to be taught for each skill is inherently restricted to a manageable, real number. For skills with finite curricular ranges, empirically-derived frequency aims can serve as signposts that help inform when frequency building may be stopped. As an example, when teaching a child to repeat sounds (Hear/Say Sounds), a teacher might consider ending instruction once their students could repeat all sounds in the English language (or whatever the child’s native language happened to be) at empirically-derived frequency aims (Fabrizio & Moors, 2003; Binder, 1996).

For other skills, however, the range of instructional stimuli that should come to occasion responding by the student is infinite—that is, there exists no finite, easily identifiable range of things to teach. Answering basic informational questions during conversations, repeating sentences, and reading words are all examples of skills whose range of instructional stimuli is either infinite or so large that it precludes easily including the full range within instructional programs. Who can say how many words a child needs to be able to repeat fluently? Students should be able to repeat any word containing sounds and sound combinations they have mastered—not just words directly taught to them. How many sentences should a student be able to repeat? A student should be able to repeat any sentence they hear.

Because we cannot easily specify the range of instructional materials across which we should measure a student’s frequency of responding to help us determine when a student might be ready to end timed practice for skills with infinite (or at least functionally infinite) curricular ranges, we must turn instead to other measures such as skill agility. As Lindsley (2001) as cited in Neely (2004) pointed out, in measuring skill agility, we may focus on two features of a child’s charted performance data: climbing bottoms and celeration.

The data we present here show an example of climbing bottoms in the word reading (See/Say Words) of a child with multiple disabilities. The curricular range of See/Say Words is functionally infinite in that clinicians and teachers would be hard pressed to recount the entire list of words that a child should be able to read quickly and easily. Such a list begins quite small in kindergarten, but grows geometrically larger with each year of schooling. It would prove a very difficult task for any piece of specially designed instruction to keep up with such growth demands. Accordingly, clinicians and teachers might set rapid and easy
acquisition of novel items from whatever curricular range they want the child to learn as the goal of instruction with this skill and other skills with infinite curricular ranges.

The chart we present here shows Tyler’s timed practice performance on See/Say Words across a 20-week period. Tyler, who was diagnosed with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) secondary to Pallister-Killian Mosaic Syndrome (a rare genetic disorder), was four years and two months old when he began practicing this skill. Tyler’s in-home instructional team began teaching him to read from the text Teach Your Child to Read in 100 Easy Lessons (Engleman, Haddox & Bruner, 1986). Once Tyler learned 10 new words from 100 Easy Lessons, those 10 words became a practice set for his daily See/Say Words frequency building. Each practice set contained words arranged on practice sheets with approximately 70 words per sheet that Tyler practiced until he could say the words at a frequency of 70 words per minute.

Cumulative slices (for example, “Cum 1-3,” “Cum 1-4”) consisted of words from each slice within the specified range. If the phase name was “Cum 1-3,” Tyler practiced the words he had previously practiced in sets one, two, and three. If the phase name was “Cum 1-10,” Tyler practiced the words he had previously practiced from sets one through ten.

The dots within each phase of the chart show Tyler’s frequency of correct responding on that day’s timed practice and the X symbols represent his error frequency. We have enlarged slightly Tyler’s initial correct frequencies during the first day of timed practice for each phase on the SCC to help the reader’s eye detect the climbing bottoms pattern in the data. Throughout the course of frequency building, Tyler practiced between one and four times each day until he reached a pre-determined daily improvement goal. The first day of each new phase, however, he practiced three times only without an improvement goal as a way of establishing baseline performance for that phase on the chart.

Across Tyler’s 16 weeks of timed practice on See/Say Words, the number of days of timed practice he required to reach the frequency aim of 70 words per minute, but the number of days to aim decreased steadily across sets of new words and cumulative slices, a result of the “climbing bottoms” seen in his data. When introduced to the new words for sets 14, 15, 16, and 17, he reached the 70 corrects per minute frequency aim during the first day of timed practice on each of these sets.

Especially when working in curricular areas with infinite instructional ranges, watching for climbing bottoms in students’ performance data can help inform instructional decisions; given the appearance of this pattern, teachers may elect to suspend frequency building on a skill or may elect to move children through curricula at a faster pace. In the example data we present here, after Tyler finished set 17 we began using sets comprised of 20 new words rather than 10. The wealth of decisions that teachers can make using the SCC goes well beyond decisions based solely on frequency of correct responding; as a comprehensive, self-contained, and highly flexible display for student performance data, the SCC offers us myriad levels of information about how our students are doing under the conditions of instruction that we arrange for them.

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Teaching Sound Frequency Imitation to a Child with Autism

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Learning to discriminate the number of parts contained in auditory stimuli is an important skill for any child, but especially for children whose spoken language lags behind their typically developing peers. Developing strong auditory discrimination skills may help children to hear syllables in words, words contained in sentences, and phrases in sentences as distinct movements. Later, these skills may help with their reading development as they learn to blend isolated sounds into words and segment words into their component sounds. The chart we present here shows the performance of a toddler with autism as he learned to repeat the number of auditory stimuli spoken to him.

Kion was 3-years and 2-months old when this chart began. He had a diagnosis of moderate autism and attended an integrated preschool as well as received intensive in-home behavior analytic intervention for approximately 16 hours each week. Each day, Kion’s therapists set a daily improvement goal for him on this skill. His therapists set his daily improvement goal by examining his Daily per Minute Chart for this skill and identifying a frequency of correct responding that represented significant growth in his performance over his previous highest frequency. Kion’s therapists worked with him on this skill each day for ten minutes or until he reached the daily improvement goal they set for him, whichever came first. If he reached his goal, he chose a preferred item from a reinforcer menu.

Kion began timed practice on this skill on January 20, 2003. The first practice phase consisted of Kion’s therapists repeating a sound one, two, or three times across the length of a thirty-second timing. Kion repeated the same number of sounds he heard back to his therapist. The sounds Kion practiced included single sounds, consonant-vowel blends, vowel-consonant blends, and consonant-vowel-consonant blends. The dots in the first phase of the chart represent Kion’s frequency of sounds repeated correctly. Discriminating between one, two, or three sounds proved not very difficult for Kion; because of his steep acceleration in corrects and low error frequency, we moved on after three days from asking Kion to repeat one to three sounds to asking him to repeat sequences of three to five sounds—the second phase on the chart.

While the timing interval and the sounds remained the same as in the first phase, the movement cycle changed. Rather than counting each single sound as either correct or incorrect, we counted each sequence of sounds as correct or incorrect. Kion’s therapists counted a correct sequence for each string of sounds Kion repeated correctly. As an example, if Kion heard two sounds (“ab-ab’) and said the same two (“ab-ab), his therapists counted one correct. If Kion heard two sounds (“ab-ab”) and instead said three sounds (“ab-ab-ab”), his therapists counted one error.

Repeating sequences of three to five sounds proved a bit more challenging than repeating sequences of one to three sounds for Kion. While on the first day of timed practice on this slice, Kion had higher errors than corrects, his performance crossed over the next day and his corrects continued to accelerate at X2.4 with a bounce of X1.8. His rate of sequences repeated correctly during this phase began at six correct sequences and ended the phase at 18 correct sequences per minute, with low and high values of 6 and 24 respectively, and a median frequency value of 12. His frequency of sequences repeated incorrectly (an “X”) began at eight per minute, ended at six per minute, and had a median frequency value of eight per minute. His errors during the phase of sequences of three to five accelerated at X3.2 across the course of the phase with a bounce value of X3.0. Kion completed one to three practices per day during the phase, with a median of two practices.

Because hearing and saying three to five sounds took more time than saying only one to three sounds, and because past experience taught us that Kion’s performance would likely show retention, endurance, stability, and application (RESA) at frequency of 40-60 correct syllables per minute on Hear/Say learning channels, we started
counting the number of syllables as well in the next phase of the chart. In the next phase, a closed circle still represents the rate of correct strings of frequencies and an “X” still represents the rate of incorrect strings. His rate of correctly repeating strings of sounds jumped down (/5) from the previous phase. While repeating sequences of three to five sounds, Kion’s rate of sequences repeated correctly began at eight correct sequences per minute and ended at ten corrects per minute, with a low value of eight per minute, a high value of 28 per minute, and a median frequency of 16 per minute. His corrects bounced at X1.6 (a crease—a proportional change in bounce from one phase to another—of /1.1) and accelerated at X1.4 across the course of the phase, which represented a turn down of /1.7 from the previous phase.

During the three to five sound phase of the chart, Kion’s errors jumped down (/2.4) from the previous phase. His errors during this phase began at 22 per minute, ended at eight per minute, and had a low frequency of one, a high frequency of ten, and a median frequency of eight per minute. His errors decelerated during this phase at /1.8 with a bounce of X5—a crease in his error bounce of X1.6 from the previous phase.

While we began counting and charting the number of syllables he repeated, we continued to set Kion’s daily improvement goal based on the number of correct strings, but we counted and charted the number of correct syllables. As Kion approached 60 correct syllables per minute, his number of practices per day began to accelerate. We interpreted this change in the number of practices he completed per day as suggesting that he may have reached the frequency aim that predicted RESA—despite our best efforts and his completing more and more daily practices, his frequency performance was not changing.

In the next phase, we combined one to three sounds with three to five sounds to ensure that Kion could perform across a full range of syllables. He did a beautiful job! Both his syllable and string frequencies remained very high, while his errors remained low. The number of practices he completed also remained low (three per day) for each of the two days in this slice.

Because Kion performed so strongly under these more complex conditions, and because repeating strings of between one and five syllables represented a functional and appropriate instructional set for a child of his age, we next began to test systematically each outcome of fluent performance (RESA). We started by assessing the stability of Kion’s performance to evaluate whether he could maintain his high levels of performance in the presence of distraction. For Kion, the distractions we used consisted of completing the stability check timing while his favorite musical toy played. Kion’s performance dropped only slightly on the first stability check timing, so we moved on to evaluate whether his performance would endure across long, untaught lengths of practice (Endurance Check). To test Kion’s performance for endurance, we tripled the timing interval from thirty seconds to 90 seconds, and presented him with the same sounds and frequencies he practiced previously. Again Kion maintained his frequency of correct and incorrect performance, so we proceeded next with an application check. For the application check, we selected words that Kion had not previously practiced (for example, “banana”) and divided the words into between one syllable (ba) and five syllables (bananana). Kion matched his previous best performance on his first timing, so we moved on to evaluate Kion’s retention of the skill. To do so, we stopped all practice of this skill for four weeks. After four weeks, we presented Kion with the same sounds and frequencies from the final slice of timed practice. He passed his retention check at a slightly higher rate of sound strings. Having demonstrated that Kion’s imitation of sound frequencies displayed retention, endurance, stability, and application—the primary outcomes of fluency—we stopped this chart and continued teaching Kion more advanced speaking skills.
Teaching a Child with Autism to Respond to Unfamiliar Stimuli by Asking for Additional Information

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Teaching children with autism to label items in their environment is often a daunting task. However, even more daunting is teaching them to identify when they do not know something and then ask for additional information. Many intervention programs for children with autism do not teach this critical skill, resulting in child responding that is heavily reliant on prompting. The same difficulties arise when teaching children to answer unfamiliar questions. Unless the answer to the question has been specifically taught in the past, many children will either not respond or attempt to answer by guessing when a speaker asks them an unfamiliar question. The chart we present here displays teaching a child with autism to respond to unfamiliar stimuli (items and questions) and ask for additional information through the See/Say and Hear/Say learning channels.

When the chart began, Jonathan was three years and three months old. He had a diagnosis of mild autism, and received in-home behavior analytic intervention for 15 hours per week. He was a fluent reader and imitator, and an avid labeler, but did not respond in the presence of unfamiliar stimuli. When presented with an item that he had not previously been taught explicitly, rather than ask what the item was, he simply did not respond at all.

We began this chart on November 4, 2003. The learning channel and pinpoint during the first slice was “See known or unknown item/Say item, ‘I don’t know, or ‘What is it?’” The dot in the upper cycles of the Chart represent the frequencies of either correctly saying the names of items he knew or correctly saying “I don’t know” or “What is it?” when his therapist showed him an item that he did not know. An “X” on the Standard Celereation Chart represents the frequency of Jonathan incorrectly labeling a known item, or saying, “I don’t know” or “What is it?” when he did know the item. The dots in the lower cycle of the Chart show the number of timings per day Jonathan completed.

We mixed the items (pictures) so that about half of them would be ‘known’ and half would be ‘unknown’ items. We tested responses to items by probing them before each teaching session. During these probes, Jonathan’s therapist (the third author) asked Jonathan to label each item; if he responded correctly, that item went into the ‘known’ pile. If he did not label them correctly, that item went into the ‘unknown’ pile. During each ten-second timing, the therapist asked Jonathan to say the names of the items he saw. Upon seeing each picture, Jonathan either said the name of the item or said “I don’t know” or “What is it?” The items used changed for each session because once Jonathan asked for more information about an unknown item, he learned that item’s label. This rapid learning of new labels, while certainly advantageous for Jonathan in his daily life meant that the picture was no longer unknown, and needed to be replaced for the purposes of this chart so that he could encounter an appropriate mix of known and unknown pictures.

Jonathan’s performance grew rapidly, reaching the frequency aim of 50 correct responses per minute within only six days of practice. We therefore changed the task to make the program more difficult. The next phase was “Hear item/Say category.” In this learning channel, the therapist asked Jonathan to name the categories to which known and unknown items belonged. We categorized ‘known’ and ‘unknown’ items just as we had in the previous phase. During this phase and from this point forward, the movement cycle changed such that a dot on the Standard Celereation Chart represents a correct category name or a response of “I don’t know” or “What is it?” while an “X” represents either an incorrect category name, or a response of “I don’t know” or “What is it?” when the response was known. Jonathan’s answer phrases such as “I don’t know” or “What is it?” all counted as one correct movement rather than as three correct movements.

It only took two days of practice for Jonathan to reach the Hear/Say frequency aim of 20 correct responses per minute and to generalize.
this skill from the See/Say to the Hear/Say learning channels, so we then moved to the next phase: “Hear item/Say features.” In this phase, the therapist asked Jonathan to label features of known items and say “I don’t know” or “What is it?” if his therapist said the name of an unknown item. He reached the frequency aim within three days of practice.

The next phase (“Hear item/Say function”) involved the therapist asking Jonathan to label functions of known and unknown items. Although he did not reach the frequency aim during this particular phase, his errors remained low, so we moved on to a cumulative review phase. This cumulative review phase involved Jonathan saying items’ features, functions, and classes upon hearing a series of items. After two days of practice with low error frequencies, we lengthened the timing to 20 seconds to allow Jonathan to respond to a wider range of examples during each timing. Within two days, his performance matched that of the previous two phases.

The next phase was “Hear personal question/Say answer.” In this phase, the therapist asked Jonathan personal questions—some of which he knew the answer to and some which he had not been taught. Jonathan either said the correct answer, or said “I don’t know” when he heard an unknown question. This phase proved more difficult for him as witnessed by the slower acceleration of correct frequencies and the higher number of timings needed to reach his daily improvement goals. However, he did attain a frequency of 30 correct responses per minute after seven days of practice. The week-long period of time in the middle of this slice containing no data denotes Jonathan’s holiday break from therapy.

After working on personal questions with Jonathan, he moved on to “Hear general information question/Say answer” as the next phase. Jonathan’s performance grew to 27 correct responses per minute after five days of practice. The next phase involved cumulative questions from all previous phases on the Chart: items’ names, features, functions, classes, personal questions, and general information questions. Jonathan matched his performance from the previous slice of 27 correct responses per minute within two days of timed practice.

Next, we evaluated the outcomes associated with fluent performance (stability, endurance, and retention) following procedures described by Fabrizio & Moors (2003). We did not conduct an application check for this particular chart because stimuli used in all previous slices changed daily, thereby providing application checks throughout the program. We tested skill retention, stability, and endurance in the Hear/Say learning channel. For the stability check, Jonathan needed to match his performance in the previous slice within one timing in the presence of significant distraction. After passing this outcome check, we moved to evaluation of endurance. To test Jonathan’s performance for endurance, we tripled the last timing interval of 20 seconds and presented the same questions used during timed practice. Jonathan’s performance passed the endurance check as well, and so we proceeded with the retention check where we stopped all timed practice on this skill for four weeks. After four weeks, we presented the same questions to Jonathan as in the previous slices, but at the original timing interval of 20 seconds. During the retention check, his performance actually improved from the previous outcome checks. Having thus demonstrated that Jonathan’s performance showed the features of fluency, we discontinued data collection.

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Before the intervention described on this chart, Jake, an eight-year-old boy with autism, frequently used incorrect verb tenses in conversation. To help remedy this, we designed a program called Hear Statement/Say “Right” or “Wrong” and Correct If Wrong. This SCC shows the data from that program. We designed this program to help Jake discriminate when to: (a) use the present, past, and future tense of regular and irregular verbs in a sentence; and (b) how to position prepositions and linking verbs in sentences.

Each session, Jake’s therapists wrote 20 different statements, 10 grammatically correct and 10 grammatically incorrect, on separate note cards and put the cards in random order. In the first slice of the chart, the therapists read a statement, and Jake said “right” or “wrong” depending on whether the verb in the statement was used correctly or incorrectly in the present tense. In all the following phases, Jake not only discriminated whether the statement was correct or incorrect by saying “right” or “wrong”, but also corrected the error by saying the sentence correctly when the therapist presented him with an incorrectly used verb in a sentence.

In the second phase, we presented Jake with incorrect and correct statements containing regular verbs in the present tense. In the third phase, we presented incorrect and correct statements containing regular verbs in the past tense. After presenting Jake with present and past tense verbs together in one phase (phase 6, labeled “cum present and past” as a shorthand notation for “cumulatively present past and present tense verbs together” on the SCC), in the seventh phase, we presented incorrect and correct statements containing regular verbs in the future tense.

After Jake’s second family summer vacation, in the tenth and eleventh phase, we presented correct and incorrect statements containing “to,” “at,” “go,” and “went”; for example, Jake might hear, “I flew at Boise on the airplane.” and need to say that the statements was incorrect and provide a correct version of the statement such as, “I flew to Boise on the airplane.” In the twelfth phase, we presented statements where we placed the linking verb “is” in different positions within the statement. As an example of an incorrectly structured sentence containing the word “is,” Jake might hear, “Where my new Nintendo game is?” In the fifteenth phase, we presented correct and incorrect statements containing compound subjects and/or compound predicates. For example, Jake might hear, “They went to the ballpark and ate to Wendy’s.” as an example of an incorrect sentence. In the sixteenth phase (shown on the second SCC), we presented incorrect statements in which the position of the person and the place in the statement were switched. For example, “The dog house put Maggy in there.”

In phases 19 through 22, we presented two different sets of incorrect and correct statements containing temporal word indicators and regular verbs in either present, past and future tense. For example, “He will played the hockey game tomorrow.” or “Yesterday, I will dress up for my cousin’s wedding.” This phase required that Jake use the temporal word indicator in the statement to discriminate if the tense of the regular verb was correct or incorrect.

Phases 24 through 27 were identical to phases 19 through 22, except that the statements contained irregular verbs. In the endurance, stability, and retention checks for this program (shown on the SCC), we presented correct and incorrect statements that he had previously used during timed practice, which contained temporal word indicators and regular or irregular verbs in past, present, and future tenses. In the application check, we presented Jake with all new correct and incorrect statements that contained temporal word indicators and regular or irregular verbs in present, past, and future tenses. Jake’s frequency of correct responding was above or at aim in two or fewer timings for all the outcomes checks.

Before we began this chart, when we conversed with Jake we often had to look to his mother for clarification because the syntax of his speech made it difficult to understand him.
Now, we are able to have meaningful conversations with Jake without relying on others to interpret what he says. Both his immediate and extended family members have noted significant improvement in Jake’s syntax.
Og was the first person to take Skinner’s methods into the field of human behavior, initially with his daughter, Kathy. According to a May 1952 Newsweek article, although about 250 infants had grown up in the Aircrib, “Kathy is the first of the crowd to undertake a precise scientific experiment.”

By the mid 1960s, Og had combined his engineering training using log-log graphs, Skinner’s use of frequency to measure animal behavior, and his work with people to develop the Standard Behavior Chart. He also started counting his reaches and urges for cigarettes and had his graduate students take the chart into special education classrooms. Thus began what has become known as Precision Teaching. By 1970, precision teaching was using the two most powerful methods for measuring and changing behavior—frequency of performance and its growth across time, celeration.

I, like so many other precision teachers and learners, can list a host of ideas, information, and practices learned from him. My greatest ones have included the Standard Celeration Chart itself and the ability to change inner behavior because using the chart forces us to count behaviors (outer or inner) and look at their frequency. He always told me never to publish unless I included a chart. While I don’t always follow that, I offer two here, as much of a tribute to Og as any words I can say.

In Figure 1, Seth is the behaver, I the manager, and Og the supervisor. While I threw balls at Seth, he caught them, and Og filmed us. I had a box of about 40 or 60 tennis balls and threw them at him. The green dots are his catches, the red xes are his misses; he used colored Vis-à-Vis pens to chart because we were making a film. The first 10 days shows catches and misses have steep celerations. When the next two weeks showed little continued growth, we changed to a 2-min timing. The errors continued to decelerate and the corrects accelerated some, enough so they no longer overlapped. In addition to doing his own charting, note how Seth claimed the chart as his own. Through this charted project and Og’s patient inductive teaching, and not a textbook, I learned about free and controlled operant behavior. This was Og’s way of teaching.

The second chart is one of inner behavior: Thinks about writing. I counted this behavior all day, thus the floor is at .001. “Accident” at the top refers to the working title of the chapter I was writing at the time. It was during the first phase that I learned Og had cancer, my sister-in-law had cancer, and Og died. I perceived that any count below 50 was due to the grief I felt. In the fifth phase, a count below 50 meant that I did something other than write that day. Solid celeration lines are just that—celeration lines. The dashed one of x2 is the trend line across a phase line that made it clear to me my inner behavior, i.e., thinks about writing, was returning to its normal level. RIS is Riverside Indian School where I consulted. In addition to the notes of impending loss or the loss of Og, there is also a note “talked to Shultz & MacGillis,” two of the Coast Guardsmen I interviewed that week for the chapter I was working on at the time.

I miss him immensely—his creativity, energy, wit and humor, and oh that wonderful resonant laugh of his. For years, decades for some, we have dedicated our lives to ensuring his excellent work spreads and continues.

Og’s amazing creativity brought about the tools for changing human behavior. Rather than causing the education system to turn upside down and inside out to improve itself, Og received what had to be one of his greatest heartbreaks: the chart that can help change people’s lives for the better has not been recognized widely.

But he never gave up. Not even the day he died. He has left a legacy and our job is to continue his work. What we do see however, is what Og saw: changes in individual lives. “Little steps for little feet,” he used to say as he followed his principles of “Each one teach one.” Og understood the significance of what he had developed. If we understand its significance, then we must chart and teach others to do the same.

The first time I met him, he wore a seersucker jacket (my mother used to wear seersucker suits), a bow tie (my father often wore bow ties), and spoke in his cultured New England accent (I grew up in New England). I liked him and the clarity and analysis of his thinking and work immediately. I treasure those familiar and comfortable elements he had.
is a personal In Memoriam, an unusual one to publish in a professional journal. I could have written about his contributions to learning and the measurement of human behavior with a more academic tone, but I offer those by the charts I share—both of which represent important aspects of what I learned from him. He was a personal friend, a brilliant and creative person, and a mentor.

Thank you, Og, for being such a great teacher and friend—to me, to all the colleagues, teachers, and students whose lives you have touched.
Journal Description

The Standard Celeration Society publishes the Journal of Precision Teaching and Celeration (JPTC) two times a year. JPTC provides a forum for research, practical applications and discussions of Precision Teaching and Celeration technology. JPTC has dedicated itself to the promotion and diffusion of Precision Teaching and Standard Celeration technologies.

Journal Sections:

Authors may submit their original contributions to one of five sections of JPTC:

I. Application Articles: “Application articles” require:
(1) Use of Standard Celeration Charts;
(2) Use of basic charting conventions;
(3) Description of variables or procedures supporting the interpretation of the data.

“Application articles” usually represent data from applied settings such as schools, clinics, human service agencies.

II. Research Articles: “Research articles” require:
(1) The use of Standard Celeration Charts;
(2) Descriptions of the collection and analysis of data;
(3) Use of basic and advanced charting conventions and analysis;
(4) Description of variables or procedures supporting the interpretation of the data;
(5) Control for extraneous variables or report of their influence.

III. Discussion Articles: “Discussion articles” offer explanations, reviews, and extensions of Precision Teaching and Standard Celeration concepts.

IV. Chart Shares: “Chart shares” contain data displayed on Standard Celeration Charts along with brief descriptions of the performer, what occurred, and other relevant observations. [Note: We encourage performers (e.g. students, clients, patients) to submit their own charts to the chart share section.]

V. Technical Notes: Brief technical descriptions clarifying, elaborating, or reporting upon Precision Teaching and Standard Celeration concepts.

Submission Guidelines:

To submit a manuscript authors must conform to the following guidelines:
(1) Submit three (3) typewritten, doubled spaced copies of the manuscript without author’s names or affiliations;
(2) Follow the format outlined in the Publication Manual of the American Psychological Association (5th edition, 2001);
(3) Do not exceed 20 words in the article title;
(4) Include an abstract and do not exceed 250 words in the abstract (Technical Notes do not require an abstract);
(5) Select 3 to 5 key words that describe the manuscript;
(6) Secure permission for use of copyrighted materials;
(7) Send submissions to: Dr. Richard M. Kubina Jr., The Pennsylvania State University, Department of Educational and School Psychology and Special Education, 231 CEDAR Building, University Park, PA 16802-3109

Editors reserve the right to edit all material accepted for publication.
# BASIC CHARTING CONVENTIONS for the DAILY STANDARD CELEBRATION CHART

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
<th>CONVENTION</th>
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| 1. CHARTED DAY | A day on which the behavior is recorded and charted. | 1. Chart the behavior frequency on the chart on the appropriate day line.  
2. Connect charted days except across phase change lines, no chance days and ignored days. |
| a) ACCELERATION TARGET FREQUENCY | Responses of the performer intended to accelerate. | Chart a dot (•) on the appropriate day line. |
| b) DECELERATION TARGET FREQUENCY | Responses of the performer intended to decelerate. | Chart an (x) on the appropriate day line. |
| 2. NO CHANCE DAY | A day on which the behavior had no chance to occur. | Skip day on daily chart. |
| 3. IGNORED DAY | A day on which the behavior could have occurred but no one recorded it. | Skip day on daily chart.  
(Connect data across ignored days.) |
<p>| 4. COUNTING-TIME BAR (aka Record Floor) | Designates on the chart the performer’s lowest possible performance (other than zero) in a counting time. Always designated as “once per counting time.” | Draw solid horizontal line from the Tuesday to Thursday day lines on the chart at the “counting-time bar.” |
| 5. ZERO PERFORMANCE | No performance recorded during the recording period. | Chart on the line directly below the “counting-time bar.” |
| 6. PHASE CHANGE LINE | A line drawn in the space between the last charted day of one intervention phase and the first charted day of a new intervention phase. | Draw a vertical line between the intervention phases. Draw the line from the top of the data to the “counting-time bar.” |</p>
<table>
<thead>
<tr>
<th>7. CHANGE INDICATOR</th>
<th>Words, symbols or phrases written on the chart in the appropriate phase to indicate changes during that phase.</th>
<th>Write word, symbol and/or phrase. An arrow (➡) may be used to indicate the continuance of a change into a new phase.</th>
</tr>
</thead>
</table>
| 8. AIM STAR          | A symbol used to represent: (a) the desired frequency, and (b) the desired date to achieve the frequency. | Place the point of the caret... ^ for acceleration data  
v for deceleration data  
...on the desired aim date. Place the horizontal bar - on the desired frequency. The caret and horizontal line will create a "star." |
| 9. CALENDAR SYNCHRONIZE | A standard time for starting all charts. | It requires three charts to cover a full year. The Sunday before Labor Day begins the first week of the first chart. The twenty-first week after Labor day begins the second chart. The forty-first week after Labor day begins the third chart. |
| 10. CELERATION LINE  | A straight line drawn through 7-9 or more charted days. This line indicates the amount of improvement that has taken place in a given period of time. A new line is drawn for each phase for both acceleration and deceleration targets. (Note: For non-research projects it is acceptable to draw free-hand celeration lines.) | ![Diagram of celeration line with acceleration and deceleration targets.](attachment:image.png) |
SUCCESSIVE CALENDAR DAYS

COUNT PER MINUTE

0 4 8 12 16 20

0 100 1000

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<table>
<thead>
<tr>
<th>TERM</th>
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<th>CONVENTION</th>
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<tbody>
<tr>
<td>Frequency:</td>
<td></td>
<td></td>
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<tr>
<td><strong>1. FREQUENCY CHANGE (FC)</strong> (aka frequency jump up or jump down)</td>
<td>The multiply &quot;x&quot; or divide &quot;÷&quot; value that compares the final frequency of one phase to the beginning frequency in the next phase. Compute this by comparing: (1) the frequency where the celeration line crosses the <strong>last</strong> day of one phase -to- (2) the frequency where the celeration line crosses the <strong>first</strong> day of the next phase. (e.g. a frequency jump from 6/minute to 18/minute. FC = x 3.0)</td>
<td>Place an &quot;FC =&quot; in the upper left cell of the analysis matrix. Indicate the value with an &quot;x&quot; or &quot;÷&quot; sign (e.g. FC = x 3.0)</td>
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<td></td>
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<tr>
<td>Celeration:</td>
<td></td>
<td></td>
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<tr>
<td><strong>2. Celeration Calculation (Quarter-Intersect Method)</strong></td>
<td>The process for <strong>graphically</strong> determining a celeration line (aka &quot;the line of best fit.&quot;) (1) Divide the frequencies for each phase into four equal quarters (include ignored and no chance days), (2) Locate the median frequency for each half, (3) draw a celeration line connecting the quarter intersect points.</td>
<td>See advanced charting conventions sample chart.</td>
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<tr>
<td><strong>3. Celeration Finder</strong></td>
<td>A piece of mylar with standard celeration lines which can be used to compute celeration line values.</td>
<td>Buy commercially or copy and cut out part of the vertical axis on the Standard Celeration Chart.</td>
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<td><strong>4. Projection Line</strong></td>
<td>A dashed line extending to the future from the celeration line. The projection offers a forecast that enables the calculation of the celeration change value.</td>
<td>See advanced charting conventions sample chart.</td>
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<tr>
<td><strong>5. Celeration Change (CC)</strong> (aka celeration turn up or turn down)</td>
<td>The multiply &quot;x&quot; or divide &quot;÷&quot; value that compares the celeration of one phase to the celeration in the next phase (e.g. a celeration turn down from x1.3 to 1.3. CC= 1.7)</td>
<td>Place an &quot;CC =&quot; in the upper middle cell of the analysis matrix with the value indicated with a x or sign. (e.g., CC = 1.7).</td>
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<td><strong>6. CELERATION COLLECTION</strong></td>
<td>A group of three or more celerations for different performers relating to the same behavior over approximately the same time period.</td>
<td>Numerically identify the high, middle and low celeration in the celeration collection and indicate the total number of celerations in the collection.</td>
</tr>
<tr>
<td><strong>7. BOUNCE CHANGE (BC)</strong></td>
<td>The multiply &quot;x&quot; or divide &quot;÷&quot; value that compares the bounce of one phase to the bounce in the next phase. Computed by comparing: (1) the total bounce of one phase -to- (2) the total bounce of the next phase. (e.g., a bounce change from x 5.0 to x 1.4, BC = 3.6)</td>
<td>Place a &quot;BC=&quot; in the upper right cell of the analysis matrix with the value indicated with a multiply &quot;x&quot; or divide &quot;÷&quot; symbol (e.g., BC = 3.6)</td>
</tr>
<tr>
<td><strong>8. ANALYSIS MATRIX</strong></td>
<td>The analysis matrix provides the numeric change information regarding the effects of the independent variable(s) on frequency, celeration and bounce between two phases.</td>
<td>Place the analysis matrix between the two phases being compared. For acceleration targets place the matrix above the data. For deceleration targets place the matrix below the data.</td>
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<tr>
<td><strong>Optional:</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>9. FREQUENCY CHANGE P-VALUE (FCP)</strong></td>
<td>The frequency change p-value is the probability that the noted change in frequency would have occurred by chance. (Use the Fisher exact probability formula to compute the p-value.)</td>
<td>Use &quot;FCP =&quot; and indicate the p value in the lower left cell on the analysis matrix (e.g., FCP = .0001).</td>
</tr>
<tr>
<td><strong>10. CELERATION CHANGE P-VALUE (CCP)</strong></td>
<td>The celeration change p-value is the probability that the change noted in celeration would have occurred by chance. (Use the Fisher exact probability formula to compute the p-value.)</td>
<td>Use &quot;CCP =&quot; and indicate the p value in the lower middle cell of the matrix (e.g., CCP = .0001).</td>
</tr>
<tr>
<td><strong>11. BOUNCE CHANGE P-VALUE (BCP)</strong></td>
<td>The bounce change p-value is the probability that the change noted in bounce would have occurred by chance. (Use the Fisher exact probability formula to compute the p-value.)</td>
<td>Use &quot;BCP =&quot; and indicate the p value in the lower right cell of the analysis matrix (e.g., BCP = .0001).</td>
</tr>
</tbody>
</table>

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1. Frequency change = x 3.0

2. Celeration calculation (Quarter-intersect method)

3. Celeration change calculation

4. Projection lines

5. Celeration collection

6. Celerations

7. Analysis Matrix

8. Analysis Matrix

Advanced Charting Conventions

- Frequency change = x 3.0
- Celeration change calculation
- Projection lines
- Celerations
- Analysis Matrix
- Analysis Matrix

Acceleration Target
- FC = x 2.8
- CC = x 2.3
- BC = x 1.8
- FCP = .001
- CCP = .003
- BCP = .005

Deceleration Target
- FC = ÷ 2.8
- CC = ÷ 1.6
- BC = ÷ 1.1
- FCP = .005
- CCP = .0001
- BCP = .01

Total bounce = x 1.96
Total bounce = x 2.25
Total bounce = x 3.6
Total bounce = x 1.69

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