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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.

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The Standard Celeration Society (SCS) publishes the *Journal of Precision Teaching and Celeration* (ISSN# 1088-484X) annually. To join the SCS visit www.celeration.org or send SCS membership to SCS Administration, PO Box 3351, Kansas City, KS 66103. Membership dues: Student – 25.00 yearly membership includes reduced International Precision Teaching Conference rates; Regular – 50.00 yearly membership includes reduced International Precision Teaching Conference rates; Sustaining – 100.00 yearly membership includes reduced International Precision Teaching Conference rates; Institutional – 90.00 yearly membership includes one issue of the *Journal of Precision Teaching and Celeration*. 
The Journal of Precision Teaching and Celeration showcases a wide range of articles from research to teacher driven projects. In Volume 26 readers will find one research article, one chart share, and a series of Ogden Lindsley’s handouts. The article by Mason provides a timely take on the relationship between effect sizes and celeration. As the stakes rise on educational outcomes, researchers look for methods to compare and summarize the effects of studies. Within the domain of single case design studies current techniques used for summarizing data have received scrutiny. Mason offers a novel approach to the problem and recharted data on the Standard Celeration Chart. Mason suggests how the SCC can augment the process of determining the significance of research findings.

Ogden Lindsley (1922-2004), the founder of Precision Teaching, always had a wealth of creative ideas he would share with teachers, practitioners and researchers urging them all to push the envelope to help learners reach their potential. Clay Starlin reviewed some of the last handouts Lindsley used and discusses the issues and thoughts Ogden (Og as he would have people call him) had. The information provided by Lindsley demonstrates how Og never stopped learning and never stopped pursuing better ways for understanding and acting on the world to create better outcomes for humanity.

The chart share by Stockwell and Eshleman contains a great deal of information demonstrating how SAFMEDS promote fluency with important information, namely verbal behavior terms. SAFMEDS stands for Say All fast Minute Every Day Shuffled, and offers a unique way to present information and allow learners to build fluency, not the same thing as flashcards which many people wrongly call SAFMEDS. Stockwell and Eshleman’s chart share showcases how we should use SAFMEDS and what they can accomplish.

This Volume marks the last for my tenure as Editor. On behalf of my Associate Editors Clay Starlin and Alison Moors I welcome the new Editor Douglas Kostewicz. The time spent reading manuscripts and shepherding the peer review process has taught me a great deal about the Precision Teaching field and how science operates. Not all submissions turn into publications and almost all of the original manuscripts undergo revisions contingent on reviewer comments. The peer review process does not result in perfect articles and the process has flaws, but it forms a vital part of science and serves the scientific community well. The volumes I have edited serve as a learning process for me and I look forward to my successor also learning the important lessons we all learn from the application of science to the applied field of Precision Teaching.

Richard M. Kubina, Jr., PhD, BCBA-D

Editor, Journal of Precision Teaching & Celeration
The Use of Judgmental Aids in Single-Subject Research

Recent legislation, such as the No Child Left Behind Act of 2001 and the Individuals with Disabilities Education Improvement Act of 2004, calls for the use of evidence-based practices to make curricular and instructional decision in the classroom. Underlying this legislation is the assumption that educators will select interventions that would provide the strongest benefit for their student population. Evidence-based practices are research-validated instructional techniques that have met rigorous standards for research design, methodological quality, and the magnitude of the effect. Randomized controlled trials and meta-analyses, which rely on statistical evaluation, typically identify evidence-based practices by examining effect sizes that measure the magnitude of the effect of an intervention (Cohen, 2001). On the other hand, single-subject research relies on the use of visual analysis in “reaching a judgment about the reliability or consistency of intervention effects by visually examining graphed data” (Kazdin, 1982, p. 232). As a result, comparisons across studies become somewhat more subjective. Furthermore, rather than determining effect sizes across groups of participants, single-subject designs compare the effect of an intervention with an alternative treatment or an adjoining phase.

Parker, Vannest, and Brown (2009) note that even the best visual analyses are commonly supported by simple statistical heuristics. According to Michael (1974), who preferred the plain English term “judgmental aids” rather than “statistics,” these numbers are simply stimuli that more easily elicit responses from researchers and practitioners than raw data alone. For instance, oral reading fluency has been shown to be sensitive to instructional changes (Good & Kaminski, 2003; Shinn, 1989), and it is frequently used as a measure.
to evaluate the effects of reading interventions. However, sequential assessments with a single individual typically show some random variability or “bounce” in addition to the actual changes in reading skill. This variability in oral reading rate can reduce the measure’s sensitivity to changes in reading skill, thereby hindering its effectiveness for monitoring progress in reading. In such cases, judgmental aids may be more helpful in describing the overall efficacy of the intervention.

Over the years, researchers have offered many suggestions for summarizing and synthesizing single-subject research in terms of trend, slope, and variability. Some of the many examples are the percentage of non-overlapping data (PND; Scruggs, Mastropieri, & Castro, 1987), the percentage of zero data (PZD; Scotti, Evans, Meyer, & Walker, 1991), the mean baseline reduction (MBLR; Kahng, Iwata, & Lewin, 2002), the C statistic (Nourbakhsh & Ottenbacher, 1994), the percentage of all non-overlapping data (PAND; Parker, Hagan-Burke & Vannest, 2007), Kruskal-Wallis W, and the improvement rate difference (IRD; Parker et al., 2009).

Campbell (2003; 2004) synthesized the literature for reducing problem behavior in persons with autism by quantifying 117 single-subject research articles and comparing the effect sizes for the PND, PZD, MBLR, and regression-based d metrics. Pearson’s product-moment correlations between all four were found to be statistically significant, except for PZD and d. This finding suggests that each effect size provides a similar interpretation of the data, so that multiple measures (i.e., both PND and PZD) are unnecessary. Campbell (2004) calls for future research to continue comparing and contrasting additional effect sizes so as to better understand their use in summarizing single-subject research.

One measure of single-subject research, which has long been used to measure change in frequency over time, is celeration (Graf & Lindsley, 2002; McGreevy, 1983; White & Haring, 1980). A celeration line is a trend line, drawn through multiple behavioral frequencies on a standard celeration chart (SCC), which quantifies the amount of learning over a given period of time. A frequent criticism of visual analysis in single-subject research is the lack of formal decision rules for analyzing data (Nourbakhsh & Ottenbacher, 1994). However, with standard displays such as the SCC, multiple practitioners interpret the same data in a more consistent manner: They bring the viewer’s reaction under control of the data, rather than the less pertinent features of the graph (e.g., scale; Johnson & Pennypacker, 1993).

Using the SCC, a specific value is computed for each celeration line, thereby providing a judgmental aid for comparing celerations. Celeration offers the rate of behavior over time as the measure of effect. Clearly, a reading intervention designed to increase words correct per minute with a celeration of x2.0 has a greater effect than a similar intervention with a celeration of x1.4. Even though celerations are frequently compared with one another to measure the effects of behavioral interventions, celeration has not yet been systematically compared with other types of single-subject effect sizes. The purpose of this study is therefore to examine the extent to which celeration and celeration change relate to PND, PZD, and MBLR. Specifically, this research sought to answer the following question: To what extent does celeration offer a unique effect size for single-subject research?

METHOD

Selection of Studies

Campbell (2003; 2004) identified the 117 articles used in this research. According to an a priori power analysis, this sample size was sufficient for computing a Pearson product-moment coefficient (r; Faul, Erdfelder, Lang, & Buchner, 2007) to examine the correlation between celeration and other measures of single-subject effect size. Individual data sets were selected, based on four criteria:

1. Only single-subject research was included to ensure that behavioral data for each participant were readily available.
2. Baseline and treatment phases in each single-subject design had to be presented as repeated measures.
3. Treatment targeted the reduction of problem behavior (e.g., self-injurious behavior, stereotypy, aggression, or property destruction).
4. At least one participant was diagnosed with autism.
If the article included multiple participants, only the behavers who fit these criteria were included in this analysis.

**Single-Subject Effect Sizes**

As noted, a variety of methods can be used to summarize single-subject data. Three of the more common methods found throughout single-subject literature are the percentage of non-overlapping data (PND), the percentage of zero data (PZD), and the mean baseline reduction (MBLR). The PND summarizes the effects of treatment by counting the number of data points in the intervention phase that do not overlap with the highest or lowest data points in the baseline phase, dividing by the total number of data points in the treatment phase, and multiplying by 100 (Scruggs et al, 1987; Scruggs, Mastropieri, Cook, & Escobar, 1986). Figure 1 shows hypothetical data on an intervention designed to reduce self-injurious behavior (SIB). The circled data point in the baseline phase represents the lowest level of SIB observed during baseline. A dashed line has been extended from this point into the intervention phase. The three data points circled in the intervention phase are those overlapping with the lowest data point in the baseline phase. The PND for this data set is 70%.

**Figure 1. Hypothetical data demonstrating the calculation of percentage of non-overlapping data (PND).**
The PZD measures behavior reduction by locating the first data point in an intervention based on a count of zero; for the remainder of the phase, the percentage of data points remaining at zero is calculated (Scotti et al., 1991). Figure 2 presents the same hypothetical data. In this figure, the three data points that reach zero are circled, and a dashed line is drawn at the first zero data point. The PZD is calculated from this point forward and equals 50%.

Figure 2. Hypothetical data demonstrating the calculation of percentage of zero data (PZD).

The MBLR is found by subtracting the mean treatment value from the mean baseline value, next dividing by the mean baseline value, and then multiplying the result by 100 (Kahng et al., 2005). Figure 3 shows the hypothetical data set once again. The average count of the 5 observations in the baseline is 7, whereas the average of the 10 observations in treatment is 2.3. These are calculated to give a MBLR of 67%.
This analysis also examined the celeration line of the first treatment phase and the celeration change between the baseline and the intervention. To calculate the celeration lines and the MBLR, the graphically presented data were converted to raw numbers. Using a drafting divider, the distance between the horizontal axis and each data point was measured in millimeters and rounded to the nearest half-millimeter (Huitema, 1985). An approximate value was then produced by measuring this distance against the vertical axis of the same graph. This data-conversion procedure has been used with a high degree of reliability (Allison, Faith, & Franklin, 1995; Kahng et al., 2005; Skiba, Casey, & Center, 1985-86).

Recharting on the Standard Celeration Chart

To compare celeration with the above-listed effect sizes, the data in each article were recharted on the SCC. The only graphs considered were those with a behavior or product of a behavior on the vertical axes and a unit of time on the horizontal axes. Using the guidelines Porter (1985) provided, each of the 117 articles was screened and recharted. A summary of these procedures follows.

The Dpmin-11EC SCC was used to replot data from each article. This chart consists of calendar days along the horizontal axis, allowing for a comparison of studies that use various observation schedules (e.g., daily versus twice weekly). Additionally, the SCC measures frequency on the vertical axis, so that studies using different...
measures or interval lengths (e.g., number versus percent-interval) could be compared. Therefore, all the original details from the research are preserved on the SCC.

The frequencies were charted on the Microsoft Excel Standard Celeration Chart Template (Harder, 2008). A new chart was used for each data set from each study. In some cases, as with multi-element designs, the same baseline was used with multiple intervention phases — each replotted on its own chart. Record floors and ceilings were marked with dashes, and data points were placed between. Frequencies based on a count of zero were plotted ÷2 below the record floor (White & Neely, 2004).

Separate celeration lines were drawn for both the initial baseline and the first intervention phase. For the purposes of comparing effect sizes, both the celeration of the first intervention phase and the celeration change between the baseline and intervention phases were recorded for every chart. Celeration lines were automatically computed for each phase by the Excel Standard Chart Template, using the median slope method (White, 2005). The median slope is found by drawing lines passing through all possible pairs of data points, then selecting the line that falls in the middle of that array. If all the slopes in the distribution are arranged in numerical order and there is an odd number of scores, the median slope would be the score in the middle. With an even number of slopes, either the line representing the most conservative slope can be selected, or the two middle slopes can be averaged. White (2005) notes that the median slope is generally more useful in predicting future performance than other methods of calculating trend lines.

Celeration changes were determined by comparing the celeration of the baseline phase to the celeration of the intervention phase. Using the same hypothetical data as above, Figure 4 displays a celeration turn down from x1.3 to ÷3.1. This yields a celeration change of ÷4.03.

Figure 4. Hypothetical data demonstrating the calculation of celeration and celeration change.
Celeration lines were not calculated for any phase that had fewer than five daily frequencies. In cases where the intervention had fewer than five data points, the data set was excluded. If the baseline phase contained fewer than five data points but the intervention phase had at least five points, the intervention celeration was calculated, but the celeration change could not be determined.

Each article was closely examined to determine the frequency of observation. When this information was not provided, an assumption was made of once daily excluding weekends. When an article listed multiple sessions per day, only the initial daily data point was recharted. For example, if an article stated that two sessions were run each day, only the sequentially odd-numbered data points were replotted. Articles that listed a variety of sessions (i.e., between 3 and 5 sessions run daily) were excluded.

Additional information was required to rechart percent-interval data, including the total observation time and the interval length. Articles that did not include this information could not be recharted. Recharting percent-interval data requires converting each data point to an assumed frequency. However, three factors must be determined first: (a) the record floor, (b) the record ceiling, and (c) the total number of intervals observed in each session.

The minimum frequency that can be recorded during a session is called the record floor. In percent-interval graphs, this is the total observation time. For most articles, the observation time remained constant throughout the study. If observation time was given as a range (e.g., sessions ranging from 10 to 15 minutes), the shorter observation time was used as the record floor. When interrupted-interval recording procedures were used (e.g., a 5-second observe, a 5-second record cycle used for 10 minutes), only the actual observation time was used as the record floor.

The maximum frequency that can be recorded during a session is called the record ceiling. This is directly defined by the interval length used in each study. To find the record ceiling, divide 60 by the interval length (e.g., 60 divided by 6-second intervals yields a record ceiling of 10).

For converting a percentage of intervals to a frequency estimate, the total number of intervals observed in each session is needed. This can be found by multiplying the record floor by the record ceiling (e.g., a record floor of 10 multiplied by a record ceiling of 10 equals 100 intervals). A percentage of intervals can then be converted to the number of intervals by multiplying the percentage by the number of intervals observed (e.g., 75% of 100 intervals equals 75 intervals scored). Finally, dividing the number of intervals observed by the observation time yields a frequency estimate (Porter, 1985). This number can now be recharted on the SCC.

RESULTS

This study examined the extent to which celeration offers an independent effect size for single subject research. Of the original 117 articles Campbell (2003) identified, 75 fit the criteria for eligibility in this study. The data sets for two articles could not be located and were therefore not included in this analysis. The remaining articles examined 112 behavers, and a total of 176 behaviors that were recharted and included in this review. Interestingly, out of initial 117 articles, only two (Bierly & Billingsley, 1983; Sugai & White, 1986) originally plotted their data on standard celeration charts.

Correlation coefficients were computed among the five single-subject effect sizes by using the R statistical computing environment. The Bonferroni approach to control for Type 1 error was used across the 10 correlations, thereby requiring a p value of less than 0.005 to show statistical significance (0.05÷10 = 0.005; Green & Salkind, 2008). Table 1 shows that 4 out of the 10 correlations were statistically significant and were greater than or equal to 0.23. The largest correlation occurred between the celeration of the intervention phase and the celeration change of $r = 0.54$, $p < 0.001$. This is understandable since the intervention celeration is used to determine the celeration change.

A moderate correlation was found between the celeration of the intervention phase and the mean baseline reduction of $r = -0.33$, $p < 0.001$, and a small correlation was found between celeration change and MBLR, $r = -0.26$, $p = 0.002$. These negative coefficients can be explained by examining the manner in which each effect size was determined. For example, imagine the data set in which problem
behavior was high during baseline and immediately dropped to zero at the start of the intervention, where it remained. This would result in a high MBLR (e.g., 100%) and a low intervention celeration (e.g., x1.00). Conversely, a data set in which the baseline numbers were high, but gradually decreased over several intervention sessions, would result in a lower MBLR (e.g., 50%) and a greater celeration value (e.g., x4.00).

Another small correlation was found between MBLR and PzD, r = 0.23, p = 0.001. This is consistent with Campbell (2003, 2004), suggesting that these two effect sizes are measuring somewhat similar aspects of the effects of treatment. Conversely, no significant correlations were found between the intervention celeration or the celeration change and PND or PzD, indicating that these statistics measure different aspects of effectiveness.

**DISCUSSION**

Single-subject research has always relied on the graphical analysis of data to determine the effects of an intervention. This is primarily done by comparing level, trend, or variability across phases. Although several researchers have attempted to convert these effects into numbers that can be compared across studies, no single statistic appears to account for all methods of visual analysis. The data presented here suggest that celeration and celeration change are independent evaluations of single-subject research, which measure an effect that is entirely unrelated to PND and PZD. One reason for this may be because celeration measures slope, whereas the other statistics measure level or variability.

An interim step in determining effect size may be to select the appropriate statistic based on visual analysis. That is, multiple graphs demonstrating a change in level may then be compared using PND or PZD, whereas celeration or an improvement rate difference may be used to compare graphs showing a change in slope. What is important to note in the present study is that the mean baseline reduction did show some amount of correlation with both celeration and celeration change. Therefore, the effect sizes measuring level and slope are not mutually exclusive. To date, there has been no consensus on which effect sizes best represent raw data.

This research has other limitations that must be addressed. Most notably, recharting data does not result in a true frequency. Interval recording produces only an estimate of the actual frequency of behavior. Additionally, converting intervals to a percentage and back again results in some error (Porter, 1985). As a result, many of the charts included in this study were not precise.

Although the number of publications about individuals with autism continues to rise, there is an obvious dearth of data being presented on standard charts. Whether this is due to the multiply/divide scale on the SCC or the inability to manipulate axes is unclear. However, the ease with which it allows users to calculate a celeration line and compare data across charts makes a compelling argument for an increase in standard celeration charting. While the results of this study demonstrate that both celeration and celeration change are related to other single-subject effect sizes, future researchers are strongly encouraged to use a variety of methods to determine the effects of their interventions.
urged to continue examining and comparing additional methods for synthesizing single-subject designs.

Salzberg, Strain, and Baer (1987), as well as Michael (1974), note that the idiosyncrasies and familiarity accompanying prolonged and intense interaction with time-series data do not occur in a one-number summary. The experimenter is forced to rely on theory and other people’s research, and then attempt to draw conclusions about the relative merits of broad categories of intervention. Although Michael suggests that the use of these judgmental aids may produce a stimulus the teacher or behavior analyst can more easily react to, he cautions that these statistics may be worthwhile only when the time spent learning how to use such techniques and the effort in determining which one to use is relatively small compared with the simplifying effect achieved.

The term “effect size” has been used here to talk about comparing the effectiveness of interventions across single-subject research; however, other methods, such as metacharting, may also function to compare celerations. Lindsley, Calkin, and White (1993) emphasize the importance of analyzing chart collections, and Cooper, Kubina, and Malanga (1998) provide a variety of ways in which collections of standard celeration charts can be synchronized and displayed. Charting repeated measures not only helps users to stay connected with the data, but metacharting also allows them to make instructional or intervention decisions based on multiple sources of data (thereby also acting as a judgmental aid).

For celeration to truly function as a measure of the magnitude of effect for single-case interventions, future research should address the classification of large, medium, and small celeration effect sizes. Green and Salkind (2008) note that “as with all effect size indices, there is no good answer to the question ‘What value indicates a strong relationship between two variables?’” (p. 259). Effect size is dictated by the discipline within which the research is conducted. For celeration charting, each SCC includes a celeration fan ranging from x16 to ÷16 that may act as a guideline for talking about the magnitude of a celeration (e.g., 1.4, 2.0, and 4.0 – irrespective of sign – can be interpreted as small, medium, and large effect sizes, respectively).

For years, educators and researchers have been using data, or practice-based evidence, to make instructional decisions in their classrooms and clinics. These measures help to demonstrate that adequate progress is being made towards a specified goal. Recent educational policy may have just begun mandating the use of evidence in the classroom, but the practice is hardly new. Many practitioners have argued that the prescription of evidence-based practices results in the loss of autonomy. However, the specific educational gains of each student are more important than the generalization of practices across settings and participants. Cook, Tankersley, and Landrum (2010) conclude that evidence-based practices “will not and should not ever take the place of professional judgment but can be used to inform and enhance the decision making of special education teachers” (p. 380). Ultimately, effect size and other statistics are simply additional judgmental aids to help practitioners make data-based decisions.

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Note: Asterisks denote articles that were included in the synthesis.


AN ANALYSIS OF EFFECT SIZES FOR SINGLE SUBJECT RESEARCH


Effects of a verbal warning and overcorrection on stereotyped and appropriate behaviors. *Journal of Abnormal Child Psychology, 5*, 387-403.


Four of Ogden Lindsley’s Unpublished Presentation Summaries

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As one might expect from the founder of Precision Teaching, Ogden Lindsley was precise in creating the summaries of his presentations. Ogden took the opportunity to share his latest thinking on a topic in his presentations. However, because the presentation summaries have not been published, many people have missed the advantage of this knowledge. At the request of Rick Kubina, JPTC editor, I agreed to write my reaction to four of Og’s presentations. These summaries cover presentations between May 1999 and October 2001. One summary discusses the connection between the Suzuki music teaching system and Precision Teaching, four summaries are related to autism, and the last summary addresses the role of Precision Teaching in decision making.

Gifts From Precision Teachers to Suzuki Teachers.

(Lindsley, 1999a - See Appendix A) The Suzuki Method is a music education system established in the 1940s by the Japanese educator and musician Dr. Shinichi Suzuki. It emphasizes listening, imitation, and repetition in building skill, knowledge, and character.

Og’s presentation summary suggests some commonalities between Precision Teaching and the Suzuki Method and the benefit Precision Teaching might offer to the Suzuki Method students. Pitch notation is particularly noteworthy since it is represented on a multiply-divide frequency scale and aligns with the Standard Celeration Chart. As a result the SCC is a good fit for monitoring the progress of students of the Suzuki Method or any other music education system.

Another highlight for me in this summary is that both Precision Teaching and the Suzuki Method emphasize fluent performance. Music and athletics are two fields that understand the importance of moving beyond 100% correct performance to fluent, accurate performance. In school settings, asking music teachers and coaches to share their understanding and practices on fluency development with classroom teachers could be the “aha breakthrough” that would support the teachers’ willingness to incorporate fluency-focused measurement and instruction into their classrooms.

Two Related Presentations on Autism

(Lindsley, 2000 & 2001 - See Appendices B & C) The two autism presentation summaries have a good deal of redundancy, since they had been presented at state and international ABA events in 2000 and 2001. Og emphasizes the need to avoid SLOBS (i.e. Slower, Louder, One at a Time, Bigger, Simpler) teaching procedures; the importance of what he called the “free operant freedoms”; the importance of foundation motor skills (aka Big 6 + 6); the critical importance of early intervention; and the power of shaping through clicker training.

For children with autism (and all other children), Og suggests instruction emphasizing a pattern that is more likely to be effective: Faster, Softer, Many, Smaller and Full Complexity’ The SLOBS discussions re-emphasize the importance of viewing frequent, direct records of performance instead of relying on logic or conventional practice.
Education continues to be largely a methodically driven profession. Teachers are trained to employ particular methods and to follow prescribed curricula rather than monitoring student learning and using this to guide decisions on adjusting the program.

The “free operant freedoms” highlight the significance of student choice/interest (The Child Knows Best) in promoting student participation. We individuals tend to choose events that they expect to be reinforcing and/or have a previous history of reinforcement. This relates to the matching law that people make choices related to the rates of reinforcement (see Fantino, 2008).

The emphasis on the Big 6 (reach, point, touch, grasp & release, place) + 6 (push, pull, shake, squeeze, tap, twist) reminds us of the importance of these foundational motor skills. For many children with autism, the lack of mastery of Big 6 + 6 skills is a major impediment to their progress in higher-level skills.

Og recounts the power and critical need for early intervention, as Ivar Lovaas’s work showed. Lovaas demonstrated that with early intervention, autistic symptoms can be reversed for some children and their impact mitigated for others. Recent work related to brain development and plasticity (see Neville, 2009) documents the importance of critical early stages in creating cognitively competent brains.

Og also reminds us of the importance of shaping (aka Clicker Training, TAGteaching), particularly with children who have significant cognitive difficulties. The click is a “sharp response definer” that does not require elaborate cognitive engagement.

Novel Teaching With Session and Across Session Decisions

(Lindsley, 1999b - See Appendix D) In this summary, Og mentions his current method of teaching the SCC. Two points are important to note. One relates to using multiple channels in learning the chart (e.g., See + Hear/Say + Point). The multi-sensory, multi-response format provides good modeling for supporting student learning in other areas. Second, the experience of learning a skill/concept with a kinesthetic dimension creates a nice mind-body connection. People can intellectually understand frequency and celeration; but adding the body sensation of different frequencies and celerations, as well as “feeling” the differences between the two measures, seems to deepen our understanding and retention.

Og also reminds us that using celeration aims not just frequency (fluency) aims, is central to decision making. The emphasis on at least \( \times 2 \) (or \( \div 2 \)) change within a session (on timings charts) and across sessions (on the daily charts) ensures significant growth. In fact, \( \times 2 \) growth consistency corresponds with our subjective perceptions of improvement. (i.e., without data, we perceive, see, and hear differences in performance) (see Starlin, 2009). The complementary nature of such subjective and objective information provides a “social validity” to learning outcomes.

As is true of many great thinkers, Ogden continued to be productive throughout his life. These six presentation summaries provide a glimpse into areas that Og emphasized near the end of his career.

REFERENCES


Gifts from Precision Teachers to Suzuki Teachers

Ogden Lindsley

Things we share

• Accentuate the Positive,
• Eliminate the Negative,
  **Latch on to the Affirmative**
• Don't mess with Mr. In between (% )
  "Celerate then Celebrate"
• Daily practice
• Proceed up curriculum at own pace
• Coaching
• Choral responding led by teacher
• Perform at own pace and rhythm
• Perform well beyond accuracy to speed (Fluency)
• Fluency gives learners confidence

PT gifts to Suzuki teachers

• Multiply world view (Music scale)
  | 32  | 64  | 128 | 256 | 512 | 1024 | 2042 |
  | C   | C   | C   | C   | C   | C    | C    |
  | mid C |  |  |  |  |  |  |

• bass       • tenor    • soprano
• baritone   • contralto

• Because music lives in the multiply world it would be good to chart practice and performance on a multiply chart
• Suzuki approach has standard performance skills, standard practice materials, standard methods, and standard music. Standard performance charts will save Suzuki learners and teachers even more time

PT gifts to Suzuki center directors

• Compare charts of different teaching methods to research their effects and maintain quality
• Collect charts to summarize a center's teaching effectiveness
• Track a center's growth on standard weekly and monthly charts

PT gifts to Suzuki teacher trainers

• Don't mess with Mr. In Between ( % )
  "Percent is the worst thing that ever happened to Education!"
  (Holzschuh, 1967)

• Chart teacher's Suzuki teaching skill by counting correct and incorrect Suzuki coaching acts and chart them on standard charts instead of using teacher skill rating scales and percent of time spent on skill

PT gifts to Suzuki learners

• When you have difficulty with a selection, practice only one minute timings of the troublesome part
• If you still have problems practice brief 10 second sprints
• Record your own correct and error counts right after each performance
• Divide your counts by the performance time taken to get your frequency

© 1999 Ogden Lindsley - Presented in symposium at 25th ABA Convention, Chicago, IL 29 May 1999
File code: WrdD41-Gifts Pt to Suzuki
OGDEN LINDSLEY’S UNPUBLISHED PRESENTATION SUMMARIES
APPENDIX A (CONT.)

• Chart your daily frequency on Standard Celeration Chart to track learning
• Share your chart progress with other students, your parents and teacher
• Celebrate when you reach each fluency aim

© 1999 Ogden Lindsley - Presented in symposium at 25th ABA Convention, Chicago, IL 29 May 1999
File code: WrdD41-Gifts Pt to Suzuki
Engage Autism at Maximum Speed: Stamp Out SLOBS!
Ogden Lindsley, University of Kansas

SLOBS - Conventional Wisdom
In the late 1960’s, while struggling to get special education teachers to use free operants to teach rapidly, I found their teaching wisdom led them in the wrong direction. When facing poor learning they slowed down, spoke louder, did things one at a time, made things bigger, and simpler. I coined the acronym SLOBS to describe these poor misguided souls.
S Slower? No! Faster.
L Louder? No! Softer.
O One a time? No! Many.
B Bigger? No! Smaller.
S Simpler? No! Full cycle.
Most student’s charts showed SLOBS were steps in the wrong direction. SLOBS bored students and did not improve their learning. Students with autism may need speed more than others, after all they self stim above 120 per minute.

Seven Free Operant Freedoms
We can speed our teaching and student practice by letting students:
Choose their task
Present all cues
Form their responses
Repeat and self correct responses
Speed without limit
Select their reward
Invent and try new changes
Most toddlers, and older handicapped learners do not invent and try new improvement changes, but we can give them the other six freedoms. Free operants share control and give more and faster practice than discrete trials. They are more efficient and more effective

Precision Teaching PT
Applying Skinner’s laboratory developed self-charting of response rate to classroom teaching we find four PT parts.
PT Heart is self record on standard chart.
Slogan: “Care enough to chart.”
PT Head is our learner. Ideally, each learner does all teaching acts and decisions - a goal we constantly strive for.
Slogan: “Child knows best.”
PT Hands are daily, timed, charted, fast, aimed practice sessions.
Ten second within day timings build skills.
One minute daily timings build fluency.
Slogan: “Fast 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
Our Standard Celeration Chart has a multiply scale up the left for performance. Learners can project their learning aims with straight lines and adjust curriculum to keep their learning on track.

Learn Chart Performance Lines in See+Hear/Say+Point Channel
Stand. Follow leader and say and point to frequency lines on wall 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
Fluency practice is in the top cycle above 100 per minute. Conventional discrete trial practice is in the cycle below that between 1 and 10 per minute.
Engage Autism at Maximum Speed: Stamp Out SLOBS!
Ogden Lindsley, University of Kansas

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

\[
x_{16} \quad x_{4} \quad x_{2} \quad x_{1.4} \quad x_{1} \quad x_{0.14} \quad x_{0.25} \quad x_{0.5} \quad x_{1}
\]

Learners describe their learning with these values. Most aim at \(x_2\) per day in their acquisition sprints on Timings Charts, and at \(x_2\) per week in their daily practice to fluency on Daily Charts.

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

Big 6 Plus 6 Elements Isolated
Eric Haughton and Ann Desjardins in 1980 developed 12 pinpoints for extremely fast practice of fine motor skills.

Their big 6: Their Plus 6:
Reach Push-Pull
Point Shake
Touch Squeeze
Grasp & Release Tap
Place Twist

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

Videos Of Therapists Teaching
Here we share videos of timed practice of children with early autism in a home based program managed by Fabrizio/Moors Consulting. I love reach-point following a laser dot. CDROM available from F/MC.

Maxi Guiding at 200 per minute
Conventional educators guide around 1 per second, or 60 per minute. Even precision teachers who know the Big 6 plus 6 guide at low inadequate rates. Maxi guides as fast as the tutor can go. Make those little hands blur at 200 to 300 a minute (50 in 10 secs)!

Earlier The Intervention The Better
We owe Ivar Lovaas and his students enduring gratitude for demonstrating that massive early intervention can arrest and prevent autistic behaviors (Lovaas, 1987).

Child reaches for an object, touches it, grasps it, places it over a can and releases it. Use marbles, coins, blocks, or clothes pins. Practice 60 seconds, count objects in can and chart frequency. Aim at 120 per min.
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 day she raced his hands
   raced his hands, raced his hands.
Then one day she raced his hands
   two hundred maxi guide.

That turned the trick, he’s on his own,
   on his own, on his own.
That turned the trick, he’s 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 fluency will peak!

References

File code WrdD40 NYSABA 01 EnAuAMaxSpd
OGDEN LINDSLEY’S UNPUBLISHED PRESENTATION SUMMARIES
APPENDIX C

1

Fast, and Narrow Focused Toddlers With Autism - Ogden Lindsley

Where we start
First we will find out what we know before we start. We will tell a neighbor what we know about precision teaching free operants. Our listening neighbor will count out loud for each fact heard. I will start us and stop us after one minute.

Then I call for the numbers counted and share them at the overhead projector. Our group chart will give a rough idea of what we knew coming in.

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 learners to project their own learning with straight lines 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

x16 /16

x4 /4

x2 /2

x1.4 /1.4

x1

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.

Seven Free Operant Freedoms
Four years ago I listed four free operant freedoms (Lindsley, 1996). I overlooked the learner’s freedom to choose their task, to select their reward, and to invent and try new task improvement changes. This brings our operant freedoms to seven:

Choose their task
Present all cues
Form their responses
Repeat and self correct responses
Speed without limit

Precision Teaching Free Operants to Head Strong,

Fast, and Narrow Focused Toddlers With Autism - Ogden Lindsley

Select their reward
Invent and try new changes

We strive for these seven freedoms to put our learners in charge of their own learning. Sharing the teaching acts and decisions often overcomes resistance from willful, head strong learners. Most toddlers, and older handicapped learners do not invent and try new improvement changes, but we usually can give them all of the other six freedoms.

These seven freedoms also permit each learner to work at their own fastest maximum speed. The freedoms remove what Carl Binder calls fluency blockers put in by discrete trials.

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 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.

Jingle Bells
1 Dashing through the snow,
In a one horse open sleigh.
O’er the fields we go,
Laughing all the way.

Chorus: Jingle bells, Jingle bells,
Jingle all the way.
Oh what fun it is to ride
In a one horse open sleigh.

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

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

Their big 6:
Reach
Point
Touch
Grasp & Release
Place
Their Plus 6:
Pull-Push
Shake
Squeeze
Tap
Twist

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.
Precision Teaching Free Operants to Head Strong,

3

Fast, and Narrow Focused Toddlers With Autism - Ogden Lindsley

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.

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>Abbreviation</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 G/Reach, To/Reach, and H-To/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 towards.
- Give assistance your channel stipulates.
- As soon as the child moves towards 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 you are guiding, you should be guiding at 20-25 reaches per second (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.

Details of Teaching Point Element
- Have objects in front of the child, on the wall, etc.
- Have child point, preferably with an outstretched finger, to each object one after another.
- Keep repeating the sequence.
- Practice for a few minutes then time for 15 or 30 seconds counting how many points.
- Chart the frequency for that hand.

SLOBS - Conventional Wisdom
In the late 1960’s, while struggling to get special education teachers to teach rapidly and use 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 to describe this conventional wisdom that guided teaching in the wrong directions.

Precision Teaching Free Operants to Head Strong, Fast, and Narrow Focused Toddlers With Autism - Ogden Lindsley

S Slow Slower
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.

Head Strong
From 1965 through 1972 I taught fathers of children with retardation and autism to improve their children’s behavior in their homes and community. I developed a sort of theory describing these youngsters with autism. Unusually head strong, they often demand their way to the point of demanding to sit in one seat at a restaurant table rather than any other table or seat. It is this seat right here, or you get a tantrum!

King Floppo The First
An example of head strong was a boy we called “King Floppo the First.” He had eaten until he weighed close to 200 pounds. He threw himself on the floor of his home or his school corridor when he did not get his way. Teachers had to call the fire department to move him.

Fast
I also noticed that they self-stimulated themselves at very high frequencies - usually above 120 per minute. If finger flicking, they flicked as fast as they could in front of their eyes. I never saw a slow finger flicker. The rockers rocked as fast as they could move their bodies. When we offered them stimuli, they picked the fastest moving ones.

Narrow Focused
Many children with autism focused on a narrow band of colors, objects, numbers, or sounds. Telephone numbers but not street numbers. All things turquoise - no other color will do.

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.

Free Operants Share Control
The seven free operant freedoms share control of the learning with these head strong youngsters. Because of this free operants may produce more learning than the discrete trial 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.
Earlier the Intervention The Better
We owe Ivar Lovaas and his students enduring gratitude for demonstrating that massive early intervention can arrest and prevent later autistic behaviors (Lovaas, 1987). Without their clear cut, systematic research that has continued over the ensuing years, our free operant would be impossible.

How much did we learn?
Now tell your neighbor what you know about precision teaching free operants. Our listening neighbor will count out loud for each fact heard. I will start us and stop us after one minute. Then I call for the numbers counted and chart them at the overhead projector. Comparing with our starting frequencies shows what we learned.

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 day she raced his hands
raced his hands, raced his hands.
Then one day she raced his hands
at 200 maxi guide.

That turned the trick, he’s on his own,
on his own, on his own.
That turned the trick, he’s 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
Precision Teaching Free Operants to Head Strong,

Fast, and Narrow Focused Toddlers With Autism - Ogden Lindsley


Using Sprints and Dashes in Your Corporate Projects*

Ogden Lindsley**

Sprints

- Timed 10, 20, or 30 second practice sprints held within one class period to build accuracy and speed.
- Frequency converted to number per minute and charted on standard timings chart after each timing.
- Usually learners aim to keep performance above a times 2 celeration (doubling) line drawn on chart.
- Once there are no errors in sprints speed practice can be moved to daily one minute practice dashes.

Dashes

- Timed 1 to 2 minute practice dashes held daily to build fluency.
- Frequency per minute correct and incorrect are charted each and every day on daily standard change charts.
- A fluency aim is marked on the chart which will guarantee Retention, Endurance, Application, and Stability. (REAPS).
- If the slope of the charts flattens before the fluency aim is reached, the learner makes changes to improve their learning slope.

Welcome your Standard Charts

- Point to the parts of our chart room.
- Draw your own chart.
- Sing “Big number on the left” as we walk up our standard charts.

Learning channels

- Free/say, free/abbreviate, free/write...
- See/say, see/abbreviate, see/write. See/mark, see/do...
- Hear/say, hear/abbreviate, hear/write, hear/mark, hear/do...
- Hear+see/say+do, hear+see/say+abbreviate, hear+see/say+write....

Practice sheets

- Right to left.
- 100 problems on sheet.
- Answer sheet for timing partner’s use.
- Totals at right of each row to make counting easy.
- Usually 10 rows of 10 in each row on sheet.

Practice cards SAFMEDS

- SAFMEDS = Say All Fast a Minute Each Day Shuffled.
- Commercial decks of 100 3x5 inch index cards work well.
- Learners can make their own, or company prints some up.
- Commercial preprinted flash cards have too much info on each side. This distracts and blocks fluency if learner tries to say it.
- Instructions for making SAFMEDS available from Zero Brothers at ZeroBros@aol.com

* Presented at KCISPI monthly meeting, Yellow Freight, 7 September 1999
** Behavior Research Company, www.onlearn.com/brco.html, Olindsley@aol.com
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A Case Study Using SAFMEDS to Promote Fluency with Skinner’s Verbal Behavior Terms

Fawna Stockwell & John Eshleman
The Chicago School of Professional Psychology
Chicago, IL

Using a deck of 60 Say All Fast a Minute Every Day Shuffled (SAFMEDS) cards, a learner established a fluent verbal repertoire related to the key terms of Skinner’s (1957) analysis of verbal behavior. This learner was required to see the phrase printed on the front of the card and to say the term printed on the back. Regular timings were recorded over the course of 3 weeks. Results showed an improving learning picture over time – an increase in correct responses and a decrease in incorrect, or “not yet” responses. During the 3rd week of practicing the SAFMEDS set, the learner achieved the fluency aim of 40 cards correct and 2 or fewer not yet responses in a 1-minute timing. Follow-up timings, conducted 3, 4, and 11 weeks after the learner achieved the fluency aim, showed a general maintenance of the performance in both speed and accuracy in the absence of daily practice.

One of the primary components of Precision Teaching learning is behavioral fluency, a performance characterized by both speed and accuracy (Binder, 1988). One of the tools used in Precision Teaching to achieve a fluent performance with some verbal repertoires is Say All Fast a Minute Every Day Shuffled (SAFMEDS). During the 1970s, Ogden Lindsley developed and promoted SAFMEDS as a tool to promote behavioral fluency (Eshleman, 2000). They incorporate behavioral principles, and they also include frequency as the primary datum of interest, which Skinner considered one of his major contributions to the field of behavior analysis (Graf & Lindsley, 2002; Skinner, 1976). SAFMEDS also permit free-operant responding, where the learner is able to respond at his or her own pace, unencumbered by artificial ceilings (Binder, 1996; Lindsley, 1996a). By employing SAFMEDS to reach a fluent performance in a specific content area, specific products of fluency may be achieved, such as the retention of information, endurance over extended amounts of time, stable responding in the face of distractors, application of material to novel situations, and the ability to meet performance standards (Lindsley, 1992; Lindsley, 1996b).

The acronym SAFMEDS outlines the task’s main procedural guidelines. The word Say specifies that the learner should make an overt, audible response for each card. Unlike flashcards, a learner is instructed to begin working with the deck as a whole (Say All), rather than with only a few cards at a time. When using SAFMEDS (Fast), learners should respond as quickly as possible during a timing that is typically brief in duration (e.g., a Minute). Learners should practice Every Day rather than attempt to “cram” before a deadline, and they should Shuffle the deck before each timing to prevent a serial learning effect in which responding is dependent on the order of the cards (Eshleman, 2000).

Responding during SAFMEDS timings is measured by a count of the number of “corrects” and “not yets” the learner produces during a brief timing (see Vargas, 2009, p. 135, for use of “not yet” referring to incorrect responses). If the learner says the correct word or phrase on the back of a card, he or she places that card into a “corrects” pile; if the learner emits an incorrect or incomplete response, or no response at all (a “skip”), he or she places the card in a “not yets” pile. This process continues throughout the timing; once the timing ends, the learner or another individual counts the
number of cards in both the “corrects” and “not yet” piles. Each timing results in a total count of correct responses and a total count of not yet responses. This count is divided by the length of the timing, and it is then converted into a standard frequency of corrects and not yet responses per minute.

Learning channels were an important development in the field of Precision Teaching. Eric Haughton created a taxonomy of learning channels, such as SeeSay, SeeWrite, and HearDo (Graf & Lindsley, 2002). These can be viewed as behavioral “throughputs” in which a learner contacts the environment through one or more of the five senses (i.e., See, Hear, Taste, Touch, or Sniff) and then operates on the environment (e.g., Say, Do, Write, Touch, etc.).

SeeSay is the learning channel typically used with SAFMEDS (Eshleman, 2000). The learner sees the text or picture on the front of the card, and then says the word(s) written on the back (without looking at them). Although the back of the card contains printed text, the stimuli on the front of the card may vary by deck and may include a graphical representation or other picture, a term or phrase, or a full definition. In this project, the pinpointed learning channel for the verbal behavior SAFMEDS was “See phrase, Say term.” Typically, the text displayed on the front of the card had a greater number of words than the response printed on the back, which the learner was required to say.

According to Skinner’s (1957) analysis of verbal behavior, a SAFMEDS response can be considered an intraverbal if the display text on the front of the card and the performer’s response do not have point-to-point correspondence: in other words, a paired associate. With SAFMEDS, the goal is to establish a fluent intraverbal repertoire for the learner that is related to the subject matter on the cards—the current topic being Skinner’s terminology related to his analysis of verbal behavior.

METHOD

Participant

The learner was a 28-year-old female graduate student enrolled in an Applied Behavior Analysis PhD program whose previous experience using SAFMEDS was that she had been assigned sets of SAFMEDS for other courses. She had also independently constructed and used two sets for other academic purposes. For the present study, the learner was required to use a set of SAFMEDS to fulfill one requirement of a graduate-level course on Skinner’s (1957) Verbal Behavior. She conducted SAFMEDS timings independently and charted her ongoing progress by plotting frequency data on a Standard Celeration Chart (Figure 1).

Setting, Apparatus, and Materials

Practice timings typically occurred in the learner’s home, either in the living room area while she sat on a couch, or in the bedroom while she sat on the bed. No other individuals were present. Following the test-out date when the fluency aim was achieved, all follow-up timings occurred either in the learner’s home or at a desk in a small office. During these follow-up timings, either the learner was alone or one or two other individuals were also in the office. One 60-card set of verbal behavior SAFMEDS was used for this project (see Figure 2), as well as a small battery-operated timer, a data sheet, and a Daily per Minute Standard Celeration Chart (displayed in Figure 1).

Independent and Dependent Variables

The dependent variables were the number of correct and not yet responses the learner emitted during a 1-minute timing. A correct response was defined as an occasion when the learner said the term out loud as it was listed on the back of a SAFMEDS card. A not yet response was defined as an occasion when the learner laid down a card without stating an answer, or an occasion when the

Figure 1. Daily per Minute Standard Celeration Chart indicating the learner’s performance with the Verbal Behavior SAFMEDS over time. At the one minute line, dots indicate the frequency of correct responses per minute and Xs indicate the frequency of not yets per minute. Dots at the bottom portion of the chart show the total number of SAFMEDS timings conducted per day.
learner stated a response that did not closely match what was printed on the back of the card.

The principal independent variable, present up to the date the learner met the aim, was the performance aim of 40 or more correct responses and 2 or fewer not yets during a 1-minute timing. This response requirement was not present during follow-up timings. The course instructor set the fluency aim. To determine that 40 correct responses per minute was a reasonable aim for students enrolled in the course, the instructor conducted and charted a series of timings on 1 day while using the same set of SAFMEDS (Eshleman, personal communication, September 9, 2009).

Once the number of not yet responses reached a frequency of 2 or fewer per minute and the number of corrects remained below the fluency aim of 40-per-minute correct, the learner added an additional step to the pre-timing preparation. While studying the cards in an untimed fashion before the timing began, the learner made a separate pile for the cards which she responded to correctly, but took longer than approximately 1 second to say. After cycling through all the cards in this untimed fashion, the learner conducted a 1-minute timing with only the cards in the “long latency” pile. These data were not recorded on the data sheet. Immediately following the unrecorded practice timing with the cards that required more than 1 second to respond to, the learner used the entire deck of cards in one or more other practice timings. The exact date of this intervention was not recorded.

**Procedure**

Preparation. SAFMEDS timings began during the 2nd week of the learner’s course entitled “Critical Analysis of Verbal Behavior Research.”

---

**Figure 2. Sample SAFMEDS used during timings.** The learner read the text on the left and said the term on the right out loud.

<table>
<thead>
<tr>
<th><strong>FRONT</strong></th>
<th><strong>BACK</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Responding reinforced through mediation of another person</td>
<td>Verbal behavior</td>
</tr>
<tr>
<td>Persons who shape a listener’s repertoire</td>
<td>Verbal community</td>
</tr>
<tr>
<td>Mediator who delivers S^r+</td>
<td>Listener</td>
</tr>
<tr>
<td>Vocalization produces same sound pattern as S^d</td>
<td>Echoic</td>
</tr>
<tr>
<td>Verbal operants under functional control of nonverbal stimuli</td>
<td>Tacts</td>
</tr>
<tr>
<td>Response under EO control and reinforced by characteristic consequence</td>
<td>Mand</td>
</tr>
</tbody>
</table>
Before each timing, the learner engaged in untimed study of the SAFMEDS by looking at the front of each card individually and producing the answer on the back of the card, either overtly or subvocally. For all not yet responses, she placed the corresponding card in a pile separate from the corrects and reviewed them an additional time before the start of the timing. Before the start of each timing, the learner shuffled the cards and then pressed the “START” button on the timer with her right hand.

Timing. During each practice timing, the learner sat in an upright position and held the cards in her left hand. For each card visible at the top of the pile, she made a vocal response, and then she flipped the card over with her right hand and set it down on the nearby flat surface. She placed cards corresponding to correct responses in a “corrects” pile and cards that were skipped or responded to incorrectly in the “not yets” pile. This procedure continued for the 1-minute duration of the timing. The learner again pressed the “START” button on the timer when it began to beep, signaling the end of the 1-minute timing. A dot on the bottom portion of the chart (Figure 1) shows the number of timings completed each day. Timings occurred on 10 of the 14 days the learner was in possession of the SAFMEDS before the test-out with the course instructor. During these 10 days when timings occurred, the learner completed between 1 and 6 timings each day.

Data recording and charting. After turning off the beeping timer, the learner set down the pile of unused SAFMEDS (those not responded to during the timing) and counted the cards in the pile of corrects. She wrote this total count on the data sheet, in the column labeled “# Corrects.” Next, the learner counted the number of cards in the pile of not yets and wrote the total count in the column labeled “# Not Yets.” On the same row of the data sheet, she also recorded the date, length, and location of the timing, as well as the total number of responses and percent correct for that timing. The learner then plotted the number of correct and not yet responses for that timing on the corresponding day line of a Daily per Minute Standard Celeration Chart. If multiple timings were conducted on that date, she selected the best timing and charted it. The “best timing” was defined as that with the highest number of corrects, regardless of the number of not yets (Fabrizio, 2003; White, 1984). If multiple timings resulted in the same number of correct responses, she charted the timing with the lowest number of not yets. To indicate a frequency of 0 occurrences for either corrects or not yets, she drew a question mark on the chart, just below the counting time floor (Pennypacker, Gutierrez, & Lindsley, 2003).

Follow-up timings. During the follow-up timings, the learner conducted only 1 timing on each of these 4 days. Before the timing, the learner reviewed each card in an untimed manner and rehearsed subvocally; then she conducted a 1 timing and charted the data in a manner identical to the timings described above.

RESULTS

Throughout the course of the timings for this project, the data on the Standard Celeration Chart showed a “jaws” learning picture, indicating an improvement in performance – an increase in corrects over time and a decrease in not yets over time (Graf & Lindsley, 2002). The number of corrects achieved during timings ranged from 16 per minute to 44 per minute. The number of not yets observed during timings ranged from 0 per minute to 4 per minute. The frequency of correct responses over time showed a X1.5 celeration and a bounce of approximately X2. The frequency of not yet responses over time showed a /1.7 celeration and a bounce of approximately X3. No outliers occurred in these data.

Subsequently, 4 follow-up timings were conducted to assess the maintenance of responding: Their frequencies were 32 correct and 1 not yet per minute; 40 correct and 0 not yets; 42 correct and 0 not yets; and 34 correct and 1 not yet, respectively. Data showed that the aim for this project (40 or more corrects and 2 or fewer not yets in 1 minute) was achieved 3 weeks before the test-out date, as indicated by the “Aim” symbol on the chart (Figure 1).

DISCUSSION

Through the use of SAFMEDS, the learner acquired a fluent SeeSay intraverbal repertoire on the terminology of Skinner’s analysis of verbal behavior. The 1-minute daily SAFMEDS timings occurred over the course of 3 weeks and during 4
follow-up timings; correct and not yet responses were plotted on a Daily per Minute Standard Celeration Chart. The data showed a favorable pattern of learning over time (an increase in corrects and a decrease in not yets), and the learner successfully met the aim the instructor had set: To emit at least 40 correct responses and 2 or fewer not yet responses in 1 minute. Follow-up data collected 3 weeks, 4 weeks, and 11 weeks after the test-out date showed that the level of performance generally maintained over time in the absence of daily practice.

It is uncertain whether an equally favorable outcome would have resulted with other types of SAFMEDS sets; potential variables affecting follow-up performance may include differences in SAFMEDS characteristics, such as the number of words read or spoken for each card or whether the front of the cards display pictures or printed text. In addition, the continued use of the terms and their definitions within and outside the academic course, as well as novel applications of the information, may have contributed to the maintenance of correct responding. One prominent issue of stimulus control for this set of SAFMEDS relates to the required learning channel of “See phrase, Say term.” Although correct responding in this specific learning channel occurred at high rates, there is no guarantee that fluent responding in the reverse learning channel “See term, Say phrase” was established. Performing a “See term, Say phrase” learning channel may be just as important to using the information learned in the learner’s environment, if not more so.

SAFMEDS are a key component of Precision Teaching, and they are also compatible with the practices most common in the rest of the field of Precision Teaching. Fluency is the goal of SAFMEDS timings as well as for other Precision Teaching-based interventions. During SAFMEDS timings, the behavior of the learner is directly observed in situ and recorded; the frequency of a behavior as it occurs in real-time is the primary phenomenon of interest, and timings are typically brief (Barrett, 2002). Data from SAFMEDS timings are charted on a Standard Celeration Chart so the instructor and/or the learner can make data-based instructional decisions by viewing the learner’s charted progress and resulting learning picture. Finally, the emphasis of Precision Teaching on training component skills is consistent with the use of SAFMEDS to promote fluency with basic terminology, including those outlined in Skinner’s (1957) analysis of verbal behavior.

REFERENCES


# APPENDIX A

FAWNA STOCKWELL & JOHN ESHLEMAN

## VB Course, Sec A  SAFMEDS Set 1  Aim: 40/min  Start: 10 Sep 2009  Stop: 10 Dec 2009

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th># Corrects</th>
<th># Not Yets</th>
<th>Total Responses</th>
<th>% Correct</th>
<th>Observer</th>
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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; (See the JPTC guidelines for guidance on the “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;
   (See the JPTC guidelines for guidance on the “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) If submitting by postal mail*, submit three typewritten, doubled spaced copies of the manuscript without author’s names or affiliations. If submitting by e-mail, send to rmk11@psu.edu.

(2) If submitting electronic manuscripts, we recommend OpenOffice Writer (v3 or higher), Word Perfect (v4), Apple iWork, or Microsoft Office 2003. We discourage Microsoft Office 2007 and will not accept pdfs.

(3) Follow the format outlined in the Publication Manual of the American Psychological Association (5th edition, 2001);

(4) Do not exceed 20 words in the article title;

(5) Include an abstract and do not exceed 250 words in the abstract (Technical Notes do not require an abstract);

(6) Select 3 to 5 key words that describe the manuscript;

(7) Secure permission for use of copyrighted materials;

(8) Send all charts and graphics in vector format or as 600 dpi bitmapped images, uncompressed;

*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 Celeration Chart

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<tr>
<th>TERM</th>
<th>DEFINITION</th>
<th>CONVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CALENDAR SYNCHRONIZATION</td>
<td>A standard date for starting all charts.</td>
<td>The synchronization date begins on the first Sunday before Labor Day. The second chart begins 20 weeks after the synchronization date. The third chart begins 40 weeks after synchronization date. Three charts cover a full year.</td>
</tr>
<tr>
<td>2. CHARTED DAY</td>
<td>A day the charter records and charts a behavior.</td>
<td>1. Chart the behavior frequency on the chart on the appropriate day line.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Connect charted days.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. <em>Do not connect charted days across phase change lines or no chance days.</em></td>
</tr>
<tr>
<td>a) ACCELERATION TARGET FREQUENCY</td>
<td>Responses of the performer intended to accelerate.</td>
<td>Chart a dot (●) on the appropriate day line.</td>
</tr>
<tr>
<td>b) DECELERATION TARGET FREQUENCY</td>
<td>Responses of the performer intended to decelerate.</td>
<td>Chart an (x) on the appropriate day line.</td>
</tr>
<tr>
<td>3. NO CHANCE DAY</td>
<td>A day on which the behavior had <em>no chance</em> to occur.</td>
<td>Skip day on daily chart. (Do not connect data across no chance days).</td>
</tr>
<tr>
<td>4. IGNORED DAY</td>
<td>A day on which the behavior could have occurred but no one recorded it.</td>
<td>Skip day on daily chart. (Connect data across ignored days).</td>
</tr>
<tr>
<td>5. COUNTING-TIME BAR (aka Record Floor)</td>
<td>Designates on the chart the performer's lowest possible performance (other than zero) in a counting time. Always designated as &quot;once per counting time.&quot;</td>
<td>Draw solid horizontal line from the Tuesday to Thursday day lines on the chart at the &quot;counting-time bar.&quot;</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
<th>CONVENTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. ZERO PERFORMANCE</td>
<td>No performance occurred during the recording period.</td>
<td>Chart on the line directly below the &quot;counting-time bar.&quot;</td>
</tr>
<tr>
<td>7. PHASE CHANGE LINE</td>
<td>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.</td>
<td>Draw a vertical line between the intervention phases. Draw the line from the top of the data to the &quot;counting-time bar.&quot;</td>
</tr>
<tr>
<td>8. CHANGE INDICATOR</td>
<td>Words, symbols or phrases written on the chart in the appropriate phase to indicate changes during that phase.</td>
<td>Write word, symbol and/or phrase. An arrow (➔) may be used to indicate the continuance of a change into a new phase.</td>
</tr>
<tr>
<td>9. AIM STAR</td>
<td>A symbol used to represent: (a) the desired frequency, and (b) the desired date to achieve the frequency.</td>
<td>Place the point of the caret... A for acceleration data C for deceleration data On the desired aim date. Place the horizontal bar - on the desired frequency. The caret and horizontal line will create a &quot;star.&quot;</td>
</tr>
<tr>
<td>10. CELERATION LINE</td>
<td>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.)</td>
<td><img src="image1.png" alt="Acceleration Target" /> <img src="image2.png" alt="Deceleration Target" /></td>
</tr>
</tbody>
</table>
LIKENESS OF DAILY per minute CHART™

BASIC CHARTING CONVENTIONS

1. Calendar synchronization

2. Charted days

2a. Acceleration target frequency

2b. Deceleration target frequency

3. No-chance day

4. Ignored days

5. Counting-time bar or Record Floor

6. Zero performance

7. Phase change line

8. Change indicator

9. Aim star

10. Celeration line

The name of the person who works with the performer on a daily basis.

The name of the person who advises the manager or performer on a weekly basis.

The name of the person who sees the performer's chart on a monthly basis. The person may give advice to the Adviser or Manager.

The name of the person who times the performer.

The name of the person who counts the performer's behavior.

The name of the person who charts the performer's counted behavior.

OPTIONAL: The age of the performer when the chart begins. If not filled in, draw a line through the space.

A clear description of the performer's counted behavior. Use a learning channel and active verb and noun (e.g., SeeSays counts block).

The name of the division of the organization.

The name of the organization where the counted behavior takes place.

The name of the person who works with the performer on a daily basis.

The room where the counting occurs.

The name of the person who times the performer.

The name of the person who counts the performer's behavior.

The name of the person who charts the performer's counted behavior.

OPTIONAL: Any additional information relevant to the performer or chart. If not filled in, draw a line through the space.
## ADVANCED CHARTING CONVENTIONS for the DAILY STANDARD CELERATION CHART

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<td><strong>Tools:</strong></td>
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<tr>
<td>Celeration Finder</td>
<td>A translucent tool (often Mylar) with celeration lines or calibration lines used for computing celeration line values. One edge of the celeration finder has the vertical axis of a Standard Celeration Chart, called a frequency finder, to assist in plotting frequencies and other common charting practices, including alternate techniques to compute celeration line values.</td>
<td>Bought commercially. For a frequency finder, one can copy and cut out part of the vertical axis on the Standard Celeration Chart.</td>
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<tr>
<td><strong>Calculations:</strong></td>
<td></td>
<td></td>
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<tr>
<td>1. Celeration Calculation (Quarter-Intersect Method)</td>
<td>The process for graphically determining a celeration line (aka &quot;the line of best fit&quot;). Divide the frequencies for each phase into four equal quarters (include ignored and no chance days), locate the median frequency for each half, and then draw a celeration line connecting the quarter intersect points.</td>
<td>See advanced charting conventions sample chart.</td>
</tr>
<tr>
<td><strong>Frequency:</strong></td>
<td></td>
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<tr>
<td>2. Frequency Change (FC) (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 the frequency where the celeration line crosses the last day of one phase to the frequency where the celeration line crosses the first 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><strong>Celeration:</strong></td>
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<tr>
<td>3. Celeration Change (CC) (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 a &quot;CC =&quot; in the upper middle cell of the analysis matrix with the value indicated with an &quot;x&quot; or &quot;÷&quot; sign. (e.g., CC = ÷ 1.7).</td>
</tr>
<tr>
<td>TERM</td>
<td>DEFINITION</td>
<td>CONVENTION</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>4. PROJECTION LINE</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>
</tr>
<tr>
<td>5. BOUNCE CHANGE (BC)</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 the total bounce of one phase to the total bounce of the next phase. (e.g., a bounce change from x 5.0 to x 1.4, BC = ( \div 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 = ( \div 3.6 )).</td>
</tr>
<tr>
<td>(aka bounce diverge or converge)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Celeration Collection</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>7. Celeration Fan</td>
<td>The nine-blade celeration fan shows nine reference celerations used to quickly provide a visual estimate of any celeration value by using modifiers of &quot;equal to,&quot; &quot;greater than,&quot; or &quot;less than.&quot;</td>
<td>Celeration fans are printed on all commercial standard celeration charts.</td>
</tr>
<tr>
<td>8. ANALYSIS MATRIX</td>
<td>The analysis matrix provides the numeric change information regarding the effects of the intervention(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>
</tr>
</tbody>
</table>
Celeration Calculation
Quarterly intersect method

Frequency Change (FC)
Frequency change = \( \frac{14}{8.5} = 1.65 \)

Celeration Change (CC)
Celeration change from \( x \) 1.15 to \( x \) 3.25
\( \frac{3.25}{1.15} = 2.82 \)

Bounce Change (BC)
Bounce change from \( x \) 1.9 to \( x \) 3.1
\( \frac{3.1}{1.9} = 1.63 \)

Celeration Line
\( x \) 2.35 (per week)

Celeration Collection
Low = \( x \) 1.05
Middle = \( x \) 1.45
High = \( x \) 2.35

Cluster celerations collections at their actual frequencies.

Analysis Matrix
Accelerations Target
FC = \( x \) 1.65
CC = \( x \) 2.82
BC = \( x \) 1.63

Deceleration Target
FC = \( \frac{1}{1.22} \)
CC = \( \frac{1}{2.22} \)
BC = \( \frac{1}{1.15} \)

The orders of celerations are independent of frequency.