In Search of Charts of Fluent Behavior

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Precision Teachers have attempted to define fluent behavior in several ways. We are a charting community, so where are the exemplar charts? In this article, the author presents sets of possible exemplar charts in Keyboarding and Reading. He also presents some Arithmetic charts that do not yield clear indicators of fluency.

This article was originally delivered at a symposium at the Twenty-First Annual International Precision Teaching and Celeration Conference held at Penn State University in October 2009, and it benefits from the discussion among the participants there. It is hoped that this presentation can become part of a community-wide compendium of charts that assist us in making data-based decisions on what constitutes fluent behavior.

In this article, I am defining fluent behaviors as a set of actions that an organism can carry out smoothly and effortlessly while thinking about something else. Examples are walking, running, talking, and swimming. For accomplished musicians, it is sight-reading music—the fingers automatically arrange themselves to play the notes and the bow arm or mouth/breathing just “happens” while the mind is actively engaged in reading the notations. Of course, there are many examples in sports.

In the academic area, a competent reader is absorbed in the story that the collection of words is expressing and wastes no effort figuring out each word. A competent math student follows the teacher’s explanation and performs the arithmetic operations mentally, jumping to the next step without hesitation. The competent writer writes or types his or her thoughts without worrying about hand or finger movements. In all of these examples, the student is fluent in a set of underlying skills.

Fluent behavior, or “true mastery” (Binder, 1988), has been the topic of many discussions among Precision Teachers. Haughton (1980) postulated that fluency is demonstrated not only by accuracy, but also by retention (exhibiting the skill after a period of nonpractice), endurance, (maintaining high rates for several minutes), and application performance standards (the ease with which component fluent behaviors are combined or become integrated into a composite behavior).

While an underlying tenet of Precision Teaching is that each individual is unique and may acquire proficiency at a different rate than other individuals, practitioners have dared suggest some ballpark rates of behavior in some skills. Kubina (2002) summarized these aims in a list and distributed it on the Internet.

As Precision Teachers, we say that we prefer a visual medium (the Chart) to assist us in making decisions. Flat lines and high errors indicate that some kind of intervention is necessary. Change lines and Celeration lines tell us that an intervention is succeeding or failing. Charts of fluent behavior often do not have such clear indicators. We sometimes have a student continue to practice a skill when he or she has already mastered it sufficiently.

Figure 1. Students have access to their Fluency exercises at school and home through the Internet.

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to move on to a more complex task. Is this a waste of student time? Can we collect charts that show us optimal times to change?

This article is a first attempt on my part to put together some charts that I believe show the acquisition of fluency, and some that show a need for more research.

The Setting

Ben Bronz Academy (BBA) is a state-approved private school for learning-disabled students, Grades 2 through 12. Our students come to us with severe deficits. In reading, most are dyslexic and at the time of admission they are not reading at or near grade level, or they read slowly or haltingly. The majority do not know their arithmetic facts. Most have labored handwriting. Only 2 (of 190) students had previously learned a systematic approach to keyboarding.

The charts presented here have been generated by students who have been introduced to fluency through a computer-based program that we named CyberSlate. In 1989 we began to automate several component fluency tasks into computer programs to make both the exercises and the data tracking as efficient as possible. This program provides all of our students with a fluency regimen in which they practice selected 1-minute timings daily. CyberSlate manages all the fluency activities, provides domains and slices of skills, keeps track of scores, and automatically produces and updates charts of progress.

We designed CyberSlate to work through the Internet, so that students can have access to the same exercises at home and at school, or wherever they may be visiting (Figure 1). Each student has an individualized menu of twelve or more 1-minute fluencies (Figure 2). The individualized menu is changed as students master skill sets.

Figure 2. Each student has an individualized menu of one-minute fluency exercises.
The three-cycle standard celeration charts produced by CyberSlate provide profiles of progress. In this article, I will present a selection of these charts that show what a chart of fluent behavior looks like. Three areas are examined: keyboarding, reading, and arithmetic.

**Keyboarding**

We insist that all of our students learn to touch-type. Most of our students come to us as non-writers. Some cannot formulate complete sentences. Most block when asked to write a coherent narrative. All have atrocious spelling and punctuation. None have smooth, flowing handwriting. Our first step with all of the students is to teach keyboarding skills. Students begin learning the touch-typing fingering on a practice exercise called Keyboard Finger Trainer (Figure 3). They work on building up the ability to type words (Figure 4), practice finger stretches from the home position (Figure 5), and, finally, practice putting together these discrete skills in a Typing Sentences Fluency. They keep Finger Guides (Figure 6) on their keypads to remind their fingers to stretch up and down rather than move laterally.

In each Typing program, we have sliced one aspect of the skill of typing into several sub-skills. In Finger Trainer, beginners (“novices”) learn the stretches of the first six letters (three for each hand in alphabetical order). When they reach a criterion speed, two or three more letters are added. In Typing Words, Home Stretch, and Typing Sentences, novices usually begin with home-row keys and then add one or two stretches per level. The passing criterion is set at 35 wpm in Typing Words and Sentences, (Figure 7) and 120 keystrokes per minute in Keyboard Finger Trainer and Home Stretch. When the students master all of

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2. The Chart produced by CyberSlate meets the following standards: The left scale (y Axis) is Multiply-Divide. The horizontal scale is divided evenly into 140 days, with a stronger mark for the Sunday line. The aspect of the chart will produce a 33 degree x² Acceleration line. The chart is Calendar Synchronized so that the first chart begins on the Sunday before Labor Day. A dot is used to indicate a pinpoint that you wish to accelerate. “x” is used to indicate Learning Opportunities or behaviors that you wish to decelerate. Vertical lines indicate phase changes. Celeration lines are calculated using a quarter intersect. An optional grid can be applied to the chart. No-chance and ignored days are plotted. The chart can be printed to size so that it will overlay correctly on a chart mylar.

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**Figure 6.** Finger Guides are placed on the keypad to help students keep the correct hand position.

**Figure 7.** As a novice, the student attempts to reach the criterion speed of 35 wpm before passing each subskill.

**Figure 8.** Students earn an AlphaSmart when they become fluent typists.
the slices as Novices, they graduate to the “rank” of User and go through all of the slices once more at a higher passing criterion. They can continue to pass through six ranks, but most apply to take a competency test when they reach the rank of Pro, which demands 55 wpm with fewer than five learning opportunities (errors).

The competency test is taken on a keyboard from which the letter symbols have been removed, and if the student uses the correct fingering and is twice able to type 100 letters in a minute with four or fewer errors without looking at his fingers, he is awarded a laptop keypad called an AlphaSmart (Figure 8), which is his to keep when he leaves the Academy to go to his next school. Students learn to take notes in class on their AlphaSmart, and they also use it for rough drafts, homework, etc. And they are no longer required to use the Finger Guides.

Finger Trainer, Typing Words, and Home Stretch were designed to teach specific component skills that lead to fluent typing. Typing Sentences represents the end product: smooth typing of sentences using the acquired component skills. The Typing Sentences Chart in Figure 9 indicates fluency in keyboarding. Words Correct is in a bandwidth of 12 to 35, and most students pass a skill level within a week. Learning opportunities

Figure 9. Upon passing into the User Rank, Ryan maintains 45 wpm with two learning opportunities, and passes skill levels rapidly. This is an indicator of fluency in keyboarding.

Figure 10. David completes a paragraph of over 60 words in just over 1 minute, with an average of less than 1 learning opportunity.
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Figure 11. The words from a selected passage are presented in random order for one minute. The student reads them aloud to a coach who marks each word. If the student has said the word incorrectly, an “X” appears and the student tries again. After the second try, the word is presented phonetically, and the timer stops while the student decodes the word.

Figure 12. The computer provides information about the passage to be read, and a one-minute timer.
average around one.

Of 129 students who completed the Competency test over the past 5 years, the median time taken to complete Typing Sentences was 328 days, 672 sessions in Typing Sentences, or 1.86 sessions per day. More than 70% of the students passed their test in their first two tries. Those who didn’t had developed wandering finger habits that took a few weeks to correct. We informally checked these students in intervals after they earned the AlphaSmart. There was no regression to using other fingering, or looking at their fingers. Endurance was checked through their next fluency program, Typing Paragraphs, in which a paragraph of about 65 words appears on the screen, and the student must type it exactly, correcting errors while typing. Once the complete paragraph is typed, the student presses the enter key, and the computer issues a score of number of correct words per minute. Figure 10

TIM ASKED QUESTIONS

Tim asked a lot of questions. His dad told him to go to the store for milk. Tim asked, “Which store?”

When his mom told him to set the cups on the shelf, he asked, “Which shelf?”

His sister said, “Give me a hand.”

Tim said, “Which hand?”

Last week, Tim was at a ranch. The rancher told him, “Get on a horse and go down that path.”

Tim asked 2 questions. What questions do you think he asked?
shows David’s performance on the paragraphs. All of the students use their keyboarding skills both in taking notes on their AlphaSmarts in classes and in composing all of their assignments directly on the word processor.

Reading

Most BBA and CyberSlate students enter the Academy several years behind in reading. Some who are chronologically in Grades 4 to 11 test at a Grade 1 level. Our comprehensive reading program is individualized for each student and can include phonemic awareness, phonics, linguistics (Let’s Read at Ben Bronz), SRA Decoding and Comprehension, Visualize/Verbalize, and a fluency component that again uses the CyberSlate fluency engine. All students have at least two reading fluencies called “Words” and “Passages.” In Reading Words, the student reads words to a listener/coach. The words are taken from the passage and presented in random order for 1 minute (Figure 11). Then the student reads the passage aloud to the coach, beginning at the start of the passage each time, and repeats reading that passage until he or she attains a criterion of 150 words per minute. Differing from some reading fluency practitioners, we have the coach point to a learning opportunity when it occurs, and the reader decodes/corrects it immediately. This of course slows the reader’s performance so his or her score is lower. We count the words read and the learning opportunities and enter the scores into the computer by hand (Figures 12 and 13).

Students enter the Reading Fluencies at their present level of competence as tested by the San Diego Quick Test (LaPray, 1969) and read from a
Figure 18. The Digit Pad fluency has students practice the correct fingering. In this figure, the numbers are all home row keys.

Figure 19. Three arithmetic facts are presented in the first level, and one new fact in each successive level. There are 54 levels in the Addition and Subtraction series.
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Figure 20. As a Novice, (passing rate 30 correct facts per minute) Nicole’s scores varied widely, with high error rates. When she repeated the facts as a User (passing criterion 40 facts per minute) and Pro (50 facts per minute), she became much faster with fewer learning opportunities. At what point can she be considered fluent?

Figure 21. Spencer is a Grade 8 student, and an example of the “fluent” group. He passes all 55 levels at the rank of User in ten weeks, passing one level every day that he does the fluency. His learning opportunities average 3. There is a large gap between corrects and learning opportunities.

We compared charts for two groups of students. For “fluent” charts, we chose students who tested at grade level (Standard Scores 96 or above) on three standardized tests, the Woodcock Johnson III Reading Fluencies (Woodcock, McGrew, & Mather, 2001), WRAT-4 Decoding (Jastak & Wilkinson, 1984), and Gates-MacGinitie Comprehension (MacGinitie, 1978). Those students had all completed Reading Fluencies to above grade level, passed each passage within 3 days, had a “first read” (cold read) consistently above 100 wpm, and averaged no errors (Figure 16).

For the group that was not “fluent” (scoring between 80 and 90 on the three standardized tests), there were three chart indicators of nonfluency. The most consistent indicator was first reads below...
100 wpm. Two less consistent indicators were that the students were not yet in grade level fluency materials, and some took a few more days to pass from one passage to the next.

There were some outliers in both groups. Figure 17 is an example of the scores of a student with a “Fluent” chart who did not score well on one or more of the standardized tests.

Figure 22. Leah is a Grade 5 student, also in the “competent” group. Her struggle with some levels indicates that she has not mastered some specific facts. Her corrects vary widely, and at one point the corrects and learning opportunities cross over.

Figure 23. Spencer, Grade 8, sails through Multiplication at the rate of several levels per day.

Figure 24. Gavin, who is in Grade 4 and considered “competent”, is still learning his Multiplication facts, reflected in the variance on his chart.
Arithmetic

We first have the students learn the correct fingering on the Digit Pad, using the 4, 5, and 6 keys as home keys for the index, middle, and ring fingers of the right hand, and the pinky on the Enter key. The index finger moves up to the 7 and down to 1. Similarly, the other two fingers move up and down, and never sideways. Some students use their index finger for the 0 key, and others use their thumb. The digit pad fluency (Figure 18) begins with the home row numbers in combination, and then introduces one or two stretches per level. Students have no difficulty reaching 120 digits per minute within a few weeks.

The students then proceed to work on becoming fluent in all of the facts. CyberSlate presents two simple fact combinations in random presentation, and the student types the answer and presses the Enter key. If the answer is incorrect, an “x” appears and the student makes a second and/or third attempt. If the answer is still incorrect, the student is shown the correct answer, and the cursor moves on to the next fact. The student tries to complete as many correct facts as possible in a minute.

As is the case in the Keyboarding program, the student passes to the next level when he or she has reached a criterion of 30 correct facts per minute with fewer than 10 learning opportunities. Each skill level presents one new fact. The first level has only...
three facts. In addition, this includes 2+1, 1+1, and 2+2 (Figure 19). Unlike flashcards, the computer can and will repeat the same fact combination several times in a row during the learning phase. Once a fact is mastered, it randomly appears again for review. In each successive level, one more fact is added. In Addition and Subtraction there are 55 skill levels, while in Multiplication and Division there are 44. Once the student has mastered all of the combinations at 30 correct in a minute, he or she graduates from being a Novice to the rank of User in which he or she repeats all of the levels again at 40 facts per minute. This repetition through ranks continues through Expert, Pro, Master, and Champion.

This Arithmetic regimen does not yield a clean set of charts, especially in the lower ranks. There is a high bounce in both corrects and learning opportunities. Figure 20 shows how Nicole’s corrects and learning opportunities varied widely while she was a novice. Upon repeating the skills as a User and a Pro, she became much more accurate, generally passing at 80 facts per minute with around two learning opportunities.

To examine whether there is a distinctive chart of fluent behavior in Arithmetic, we selected two groups of 10 students, matched for grade level, but differing based on their scores in standardized testing.

Figure 27. Spencer, Grade 8, is passing Division rapidly, but at about half the speed he passed his Multiplication fluencies.

Figure 28. Mac, Grade 6, does not demonstrate competency on this chart or in independent testing. His range of Corrects and Learning Opportunities continuously overlap. This overlap does not occur on the charts of the “competent” group.
yearly testing. The “competent” group consisted of students whose scores on the Woodcock
Johnson Math Fluency (standard score) measure, Calculation, and Applied Problems were all greater
than 99. This group was contrasted with a group that was “not yet” competent, having an average
standard score in the 80s. Like Spencer in Figure 21, most of the students in the competent group passed
from level to level in half the time it took students in the noncompetent group. Younger students in
each group stalled at some levels because they had not yet mastered particular facts (Figure 22). Both
groups varied in the tightness of the bandwidth of corrects and errors, and a few of the lower group
had crossovers in which errors were sometimes more numerous than corrects.

The different operations account for some variance. Students pass levels quicker in Addition
and Multiplication, with tighter bounce in both corrects and learning opportunities. Some older
students “catch on” to Multiplication and pass those levels rapidly (Figure 23). As is the case
in Addition, younger students have much more variance because they are still learning the facts
(Figure 24). In Subtraction, all students take three times longer to pass levels, with greater variance
in both corrects and learning opportunities (Figure 25). In Division, students take about twice as long
to pass as they do in Multiplication, but far less time than in Subtraction (Figures 26 and 27).

In arithmetic, there is only one distinction between the “competent” and the “not-competent”
group charts. Charts with frequently overlapping Corrects and Learning Opportunities, like
Mac’s Addition (Figure 28), do not occur in the “competent” group. But not all “non-competent”
group students have the overlapping Corrects and Learning Opportunities. While Sarra scored in the
“non-competent” range, her Addition Chart (Figure 29) has many features in common with those of the
“competent” group.

Summary

The CyberSlate Keyboarding Charts have clear indicators of fluency. When a student attains
Pro status using the correct fingering, the student is able to pass a keyboard fingering test, in two tries,
and does not lose this skill after the test. The student is able to maintain a speed of 35 words correct per
minute when typing a paragraph that takes two or more minutes to complete.

CyberSlate Reading Charts also have clear indicators of fluency. The student has passed
through books of passages until he or she is one or more years ahead of grade, and the First Read is
almost always above 100 wpm.

The CyberSlate Arithmetic Charts do not yield as clear indicators. Some competent students pass
rapidly through the skill levels with few errors. Others have a greater mix in their results, including
a higher rate of learning opportunities, but they still score high on yearly testing.

Discussion

In Keyboarding and Reading, the CyberSlate Charts are more useful because they show clearly
when a student has achieved a fluent rate. The charts have greater utility than the yearly probes because
they yield a daily report and decisions can be made when fluent rates are achieved, rather than after the
yearly test has taken place. Because he reads the charts, the behaver can predict for himself when he
will become fluent. He can change the outcome by increasing his practice schedule and adding specific
component skill exercises.

The CyberSlate Arithmetic charts do not yield distinctive differences between groups of students
who test well in yearly probes and those who do not. Our discussion at the symposium yielded
many paths to explore:

- There may be some underlying components that students must master before tackling the arithmetic
  fluencies, such as saying, writing, and typing numbers in order or randomly. Once those components are mastered,
  we might try raising the passing criterion on each of the operations fluencies and see if it results in a tighter bounce
  of corrects and learning opportunities.
- The CyberSlate Arithmetic fluencies present skill practice in each operation separately. The Woodcock-
  Johnson III Arithmetic fluency presents three operations (+, −, ×) on the same page in random order. A number
  of the student errors are because of the use of the wrong operation. We will design a fluency skillset with mixed
  operations to address that weakness.
- The CyberSlate Daily Chart selects the best score each day, or the best score of a skill level. An artifact of
  this selection is that students who pass a level daily appear to flatline because their scores do not increase from day
to day. Merbitz (2009) suggests that this is an occasion on which to replot the available data, either on a Sessions
Chart that would reveal the steep acceleration within each level, or a One Year Chart, in which the count is levels passed per week, or sessions required per level.

Starling (2009) observed that “Science is messy” and some skill sets may not yield a collection of distinctive charts. This does not diminish the usefulness of the exercises. It just requires us to continue to look at many indicators to determine fluent behavior.

One of the first obstacles to overcome in Precision Teaching is to help the behaver establish daily practice routines. But once these routines are established, our greatest failure is to have students practice skills for days or weeks after they have become fluent. One reason to identify charts of Fluent Behavior is to make us more aware of when it is time for a student to move on to more useful exercises. Merbitz (2009) suggests that a “Fluent Chart” should trigger a situation in which the behaver is invited to drop the exercise in which he has demonstrated proficiency, and pick a new challenge from the available fluency exercises, or invent his own.

This article is a beginning. Kent Johnson and Elizabeth Haughton have several charts of fluent behavior that they hope to share in a future Symposium. It is hoped that others will bring charts and observations to these Chart Shares, and that we might build a compendium of charts that either support or change the fluency benchmarks compiled by Kubina. Perhaps then we can publish the charts with links so our whole charting community can participate and share their wisdom toward our collective greater insight into the science of building fluency.

REFERENCES


