CHAPTER 4

Blending Precision Teaching Technology with the Response-to-Intervention Framework

MR. TSENG'S DILEMMA

Mr. Tseng is the third-grade teacher at Sandy Lake Elementary School in Jasper, Michigan.* He has been teaching for 10 years and has become increasingly concerned about the number of his students who seem to be floating through the curriculum without learning it at all, or learning it until a high-stakes test is given but never truly mastering it. These aren't just the students who start out behind their peers; the same can be said for students who are in the middle of the pack and even for some of his "best" students. He's discouraged when he hears the fourth-grade teachers talking about all of the parts of the third-grade curriculum they spend "half the year reteaching!" Although they never say anything about him to his face, he gets the feeling that they blame him more than they do the kids. In a way, he blames himself, but he recognizes that it's not for lack of trying. He incorporates the latest and most evidence-based and learner-verified curriculum; he incorporates project-based inquiry to engage students. He's been employing the RTI approach for several years now. Still, he knows that by the beginning of the next school year, many of his students won't remember the skills that they and he have worked so hard on. It's the same way when students come into third grade; he spends a great deal of time solidifying skills they were "supposed to have learned" in second grade.

That's why learning about the benefits of PT at a workshop has Mr. Tseng so excited. He likes the systematic and efficient PT practice strategies. But most of all, he gets the MESsAGe! He's beginning to see his students differently. There's Manuel, who remembers most of what he has learned but can't seem to apply it. There's Teresa, who can read at about 200 wpm with few if any errors for the first minute, but who needs to build her endurance so she can read an entire 1,000-word passage at that same speed and accuracy. Maxim can do math facts with the best students in the class so long as there is no distraction, but his accuracy fails when other students in the room are making noise around him. And Mr. Tseng is absolutely sure that Rachel, Nathan, and Jerome can make tremendous curriculum leaps once he assesses their ability to recruit existing skills to learn new component and composite skills. He's pretty sure he knows now what to do to get them where they need to be.

He's also intrigued by the notion that PT can improve a teacher's ability to predict how long it'll take for *individual* students to acquire new skills. He's always known there were differences, but the ability to predict would allow him to plan instruction and practice accordingly. One of the first things he's going to do this fall is to change his assessment protocols, so that he can see not only *what* students know, but also *how quickly* they can learn a new skill.

Mr. Tseng knows there will be a steep learning curve to put this new assessment and practice protocol in place, but he's motivated. He wants his students to be successful . . . and he also wants those fourth-grade teachers to see him in a different light.

*The teacher, students, school, and locale in this story are fictitious. The story is an amalgam of those we've heard and seen during our 30-plus years of working in schools.

We are persuaded by the evidence that the instructional technology of PT ideally complements the aims of the RTI framework. Our goal in this chapter is to explain this evidence. We will:

- Describe the increased interest among educators in fluency in key academic tool and component skills.
- Identify ways in which PT technology can enhance the effectiveness of the RTI framework.
- Provide examples of the ways in which the learning pictures that emerge from the data recorded on a Standard Celeration Chart inform interventions.
- Discuss the critical importance of providing practice in the correct curricular elements.
- Provide examples of prototypic PT practice sets.
- Show how speedier resolutions accompany a change from the quarterly or even biweekly data-based decision making that characterizes many RTI implementations to the daily decision making that characterizes PT implementations.

FOCUS ON FLUENCY

Interest in performance fluency—particularly fluency related to literacy and numeracy—has blossomed in recent years. For example, the 2001 report of the National Institute for Literacy (Armbruster, Lehr, & Osborn, 2001) lists fluency instruction as one of five key elements of good reading instruction. The report offers the following discussion of fluency:

> Fluency is the ability to read a text accurately and quickly. When fluent readers read silently, they recognize words automatically. They group words quickly to help them gain meaning from what they read. Fluent readers read aloud effortlessly and with expression. Their

> reading sounds natural, as if they are speaking. Readers who have not yet developed fluency read slowly, word by word. Their oral reading is choppy and plodding.
>
> Fluency is important because it provides a bridge between word recognition and comprehension. Because fluent readers do not have to concentrate on decoding the words, they can focus their attention on what the text means. They can make connections among the ideas in the text and between the text and their background knowledge. In other words, fluent readers recognize words and comprehend at the same time. Less fluent readers, however, must focus their attention on figuring out the words, leaving them little attention for understanding the text. (p. 19)

Similarly, the final report of the National Mathematics Advisory Panel (NMAP, 2008) recommends fluency with whole numbers and fractions as important preparation for the study of algebra. Specifically in regard to fluency with whole numbers, the NMAP advises:

> By the end of Grade 5 or 6, children should have a robust sense of number. This sense of number must include an understanding of place value and the ability to compose and decompose whole numbers. It must clearly include a grasp of the meaning of the basic operations of addition, subtraction, multiplication, and division. It must also include use of the commutative, associative, and distributive properties; computational facility; and the knowledge of how to apply the operations to problem solving. Computational facility requires the automatic recall of addition and related subtraction facts, and of multiplication and related division facts. It also requires fluency with the standard algorithms for addition, subtraction, multiplication, and division. Fluent use of the algorithms not only depends on the automatic recall of number facts but also reinforces it. (pp. 17–18)

Later in the same report, the NMAP notes that "to prepare students for Algebra, the curriculum must simultaneously develop conceptual understanding, computational fluency, and problem-solving skills. These three aspects of learning are mutually reinforcing and should not be seen as competing for class time" (p. 19).

The terms *automaticity* and *fluency* appear in this passage to have the same meaning. However, Armbuster et al. (2001) differentiate between these terms. They suggest that fluency should be reserved for more complex repertoires, whereas automaticity refers to the learner's capacity with foundational elements:

> Although the terms automaticity and fluency often are used interchangeably, they are not the same thing. Automaticity is the fast, effortless word recognition that comes with a great deal of reading practice. In the early stages of learning to read, readers may be accurate but slow and inefficient at recognizing words. Continued reading practice helps word recognition become more automatic, rapid, and effortless. Automaticity refers only to accurate, speedy word recognition, not to reading with expression. Therefore, automaticity (or automatic word recognition) is necessary, but not sufficient, for fluency. (p. 21)

Both reports also note that both reading comprehension and mathematics computational facility depend on automatic or fluent performance of tool skills.

The RTI framework embraces a similar perspective. In the two curricular areas where RTI is most commonly applied—reading and mathematics—virtually all of the progress-monitoring tools have a frequency aim. That is, number correct per unit of time is the metric used to evaluate performance. CBM (see Chapter 1), a commonly employed progress-monitoring tool, provides a good example. CBM chooses metrics that predict performance on high-stakes macro-level assessment, using speed as well as accuracy as a critical component of the prediction. Hosp et al. (2007) say about different measures of reading mastery that each assessment provides a different score, but all scores are based on the number of items correct in a set amount of time, reflecting the student's accuracy and fluency on the task. Stanley Deno (2003) concurs:

> All CBM scores are obtained by counting the number of correct and incorrect responses in a fixed time period. In reading, for example, the most commonly used measure requires a student to read aloud from a text for 1 minute and have an observer count the number of correctly and incorrectly pronounced words. (p. 185)

Deno also notes the evidence that performance on rate-based measures predicts success on high-stakes assessment:

> Students reading at least 40 words correctly in 1 minute by the end of first grade are on a trajectory to succeed in learning to read, and students reading more than 110 words correctly in 1 minute by the beginning of third grade are most likely to pass their state assessments in Oregon. . . . Eighth grade students who can read at least 145 words from local newspaper passages correctly in 1 minute are almost certain to pass the Minnesota Basic Skills Test in reading. . . . (p. 189)

Despite mounting evidence about the importance of fluent repertoires, neither CBM nor the RTI framework offers teachers guidance about how to facilitate their acquisition. Furthermore, the terms *fluency* and *frequency* are often used interchangeably, with little expressed interest in the other by-products of performance that constitute fluency. Third, much of the literature on building frequency or fluency doesn't take into account methods that achieve the best performance trajectories or celerations.

A MATCH MADE IN HEAVEN

PT is ideally suited to be a partner in the RTI movement, for several reasons: its development of effective practice strategies, its use of rate as the measure of performance, its interest in other by-products of fluency as well as frequency, and its emphasis on changes in rate over time (celerations) as an important indicator of learning. Current performance levels and learning trajectories are fundamental to the purpose and current use of RTI in classrooms and schools. In addition, PT's effective and efficient practice strategies provide the "how-to" that the RTI framework doesn't address. Last, its provision of strategies to assess the other important by-products of high-frequency performance that characterize everyday definitions of mastery (see the section on "getting the MESsAGe" in Chapter 2) make it a particularly useful companion. In the remainder of this chapter, we first describe a number of ways that PT can benefit the RTI framework. We then briefly review the history of the use of PT in the K–12 system. Finally, we relate PT to six key elements of the RTI framework: screening, Tier 1, Tier 2, Tier 3, progress monitoring, and data-based decision making.

PT Benefits RTI as a Screening and Placement Tool

The ease with which learning celerations can be depicted in standardized charts in the PT technology facilitates placement decisions. Although rate of performance at a given point in time is a useful measure, celerations, which track changes in rate over time, are much more helpful in determining *learning ability or tendency.* Typical RTI assessments measure snapshots of performance in a given moment. However, snapshots often misrepresent the true current level of performance. PT can be used to assess performance over 3–5 days until performance stabilizes, revealing a more accurate measure of present performance. It's for this reason that a Seattle-based neuropsychologist placed her clients at Morningside Academy for several days during her assessment process: to determine both her clients' true performance levels and their growth or learning potential.

Let's examine a prototypic example of the types of cases that have raised placement concerns and that have, in part, fueled the interest in RTI. José is the child of an immigrant family. His primary language is not English, and his family is a non-English-speaking monolingual family. It is likely that in the early grades or shortly after the family immigrated to the United States, José's rate of correct responding on tasks that require reading or speaking English words was considerably below that of same-age peers. However, using that information alone to classify José as in need of special education may disadvantage him. A better measure of his need for special services might be the speed with which he is able to acquire reading and speaking-related skills. The celeration feature of PT provides exactly that kind of information in an efficient way. It reveals José's learning trajectory by looking across a number of tasks on which he is building rate, to estimate how quickly he can acquire new skills. Regardless of his entering competency on critical skills, should José prove to be a speedy learner, this provides additional evidence that the placement team can and should consider in a placement decision.

Although the initial screening instruments that are applied to all children must necessarily be time-efficient, secondary screening of learners whose performance is below that of same-age peers may allow the district to avoid unnecessary special education placement. For learners whose initial screening suggests that they are lagging behind, districts can use the celeration feature of the Standard Celeration Chart to assess their probable learning trajectories and the type and level of instruction that will be required for them to catch up to and benefit from the core curriculum. For example, a paraprofessional might provide José with minimal instruction in a skill on which he showed a deficiency during screening, and then conduct several timings over several days to judge his growth trajectory. If José shows rapid acquisition, the paraprofessional may decide to maintain him in the Tier 1 classroom for the majority of the reading period, but to assign him and other learners with similar growth trajectories to a learner-verified Tier 2 intervention that is known to improve the reading skills of second-language learners for a portion of the reading period. As José masters skills in the specialized program, he may continue to do one or more daily timings on skills in the core curriculum as a way to determine when full-time reentry into Tier 1 is defensible. This empirical approach takes much of the guesswork out of placement decisions and benefits both teachers and learners.

PT Benefits RTI through Fine-Grained Assessment of Skill Acquisition

Some learners lag behind peers for reasons that aren't entirely obvious. A "smart" child may struggle in reading because he or she lacks tool skills that other learners have acquired but that are not directly assessed in the core curriculum. For such learners, PT can be used to diagnose elements of the deficits, provide interventions, and then assess benefits to the learner's performance on tool and component skills that *are* included in the core curriculum. For example, a traditional assessment in grade 6 reading may include reading a list of multisyllable nonsense words but may not assess the learner's fluency on a list of single-syllable nonsense words. Similarly, a traditional assessment in grade 6 math might ask a learner to add fractions with unknown denominators but may not include math facts assessment directly. In both cases, if the learner does not have facility with the lower-level skill, efforts to teach the higher-level one may fail. Because PT assessments can be done quickly, the focus can be on teaching the skills that are missing which, in turn, provides the support these smart learners need to catch up to grade level.

PT Benefits RTI by Providing Efficient Interventions

Many learners struggle in the core curriculum not because of an accuracy problem, but because of a frequency problem. For example, Macy may struggle with problems involving decimals because she isn't up to speed with place values less than 1 (10ths, 100ths, 1,000ths, etc.). She can name the place value correctly, but only after she thinks about it. PT program slices provide opportunities for practice and speedy movement toward fluency. Since this isn't an uncommon problem in the intermediate grades, several learners may benefit from a quick Tier 2 intervention that would get them back on track to benefit from the Tier 1 curriculum.

PT Benefits RTI by Providing Comprehensive, Predetermined Pinpoints for Tool and Component Skills

PT has benefited from expert instructional designers (see, e.g., Markle, 1990; Tiemann & Markle, 1990) over the last half century who have analyzed key academic tasks and identified the tool or component skills that underpin success. Precision teachers have turned these pinpoints into banks of practice slices related to tool and component skills that align, most commonly, with reading, mathematics, and writing curricula. Furthermore, as we have discussed in Chapter 2, they have identified aims that predict that the entire set of by-products of frequency—maintenance, endurance, stability, application, and generativity—will emerge. This saves substantial time and guesswork for teachers, whose days are already stretched to oversee the progress of more than 30 students in some classrooms.

Precision-targeted skill-building slices are typically not provided among the suite of options available from publishers of core curricula. Although virtually all publishers provide practice materials, these materials often lack the calibration that lends itself to efficient practice. Furthermore, only rarely have publishers incorporated the level of analysis needed to uncover the entire range of tool and component skills that, when built to fluency, result in improved performance on the components or composites of which each skill is a part. Access to both the analyses and the finely calibrated practice sets can benefit both teachers and learners, and, when used as prescribed, can result in the kind of performance growth that districts and parents desire.

PT Benefits RTI through Visual Analysis and Problem Solving with the Standard Celeration Chart

Another important feature of a fully adopted PT model is the Standard Celeration Chart. As we have discussed in Chapter 2, the chart is a ratio or multiply–divide chart instead of an equal-interval or add–subtract chart. This means, among other things, that it reveals learning trajectory or growth as more data points are plotted on the chart. This feature allows users to project the trajectory forward in time to estimate when a skill will reach rates that have been associated with fluency. Let's say a teacher knows that for learners to stay on track with the math curriculum, they need to have developed automaticity with multiplication and division facts by the end of the year. However, several learners' December learning trajectories suggest that they won't reach that goal. For those learners, the teacher can provide additional practice opportunities to change the slope of the trajectory and get them back on track.

PT Benefits RTI through Decision Rules That Accompany Standardized Learning Pictures

Among the other advantages of the Standard Celeration Chart, its standardization results in *learning pictures*—visual representations of the relation of correct and error celerations—that are easy to "read." These learning pictures assist teachers in the data-based decision making that is a key feature of RTI. The chart provides incontrovertible evidence to both a teacher and a learner about the learner's progress, and lets both know when the learner is ready to move on to a different skill because the desired aim has been achieved or to move out of an intervention entirely.

The chart may also reveal when the number of errors is so high that the best course of action is to build either accuracy or rate on a subset of items in the current practice set or even on a prerequisite skill. Sometimes learning pictures suggest that additional instruction is required to prepare for successful practice, or that *tips and quips* may be sufficient to get the learner on the right trajectory. Tips and quips (Johnson & Street, 2004) are quick reminders to the learner to apply a rule or to attend to particular characteristics of the problem. Often used in the pacing or individual-turns pieces in direct instruction boardwork, they also can improve responding during practice.

Figure 4.1 provides five examples that illustrate how the learning picture provided by the graph informs the teacher about the best course of action. Here's a story to accompany each of the five.

> *Example 1:* This is Jasper's learning picture. Jasper's corrects are increasing and his errors are decreasing, just as they should with appropriate practice and feedback. In fact, his performance looks so good that the teacher may choose to make no

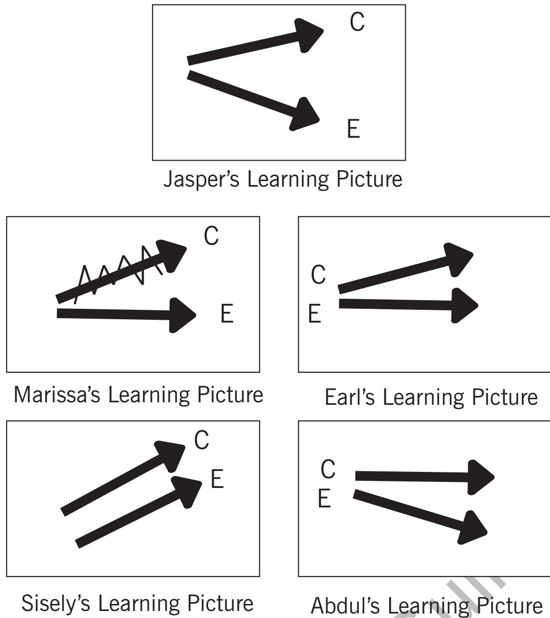

FIGURE 4.1. Five prototypic Standard Celeration Chart learning pictures. Adapted from Haring, N. G., Liberty, K. A., and White, O. R. (1980). Rules for data-based strategy decisions in instructional programs: Current research and instructional implications. In W. Sailor, B. Wilcox, and L. Brown (Eds.), *Methods of instruction with severely handicapped students* (pp. 159–192). Baltimore: Brookes. Copyright 1980 by Paul H. Brookes Publishing Co., Inc. Adapted with permission. Pseudonyms of learners have been added to correspond to stories in the text.

changes. Alternatively, she may decide that his progress warrants intervening to produce an even steeper celeration. Overall, though, this is the ideal learning picture.

Example 2: Marissa's corrects are increasing and her errors are holding steady, but her performance is highly variable from day to day. This pattern suggests that the teacher needs to identify circumstances that account for the variability. For instance, Marissa may need to be seated with her back to other students who may be distracting her until she improves her focus on the task at hand.

Example 3: Earl's corrects aren't increasing, but his errors are. This suggests that he is becoming increasingly confused about the task. A good solution might be to ensure that he is making the proper discrimination, in keeping with the PT adage *Discriminate before you generate.* For example, if the task is to say the place value of a number in a five-number figure, providing a mini-lesson on each place value name and giving Earl think time before he signals a response might be called for. When Earl's corrects stabilize, the teacher would then pace an increase in speed, ensuring that the error rate doesn't creep back up.

Example 4: Sisely's corrects are increasing at a good celeration, but her errors are also increasing. This may indicate that she is moving so quickly that she isn't attending to important instructional cues. For example, in a mixed addition–subtraction practice set, Sisely may need to be reminded to focus more on the addition or subtraction sign before responding. In other words, Sisely may need to be encouraged to slow down a bit and get her errors under control, and then build rate from there. The mantra that precision teachers use in such cases is this: *Fluency is not about a race, it's about a pace.*

Example 5: Abdul's learning picture reveals that although his corrects per minute are increasing and his errors are remaining quite low, the celeration or rate of increase is also very low. In this case, the teacher might use brief sprints of 15 seconds until Abdul's frequency for that period is a little more than one-fourth of the frequency that would put him on the right growth trajectory, and then build back up to the 1-minute timing from there. Alternatively, the teacher may note that he covers the next item while responding to the previous item, and may suggest a way he can follow along without losing the important "looking ahead" advantage.

Table 4.1 summarizes the most common learning pictures and recommends modifications to instruction or practice that may resolve those pictures where change is recommended. Of course, the test of any modification is a learner's progress. Should the next data point on the chart following an instructional or practice modification reveal that the learner's performance isn't improving or is heading in the wrong direction, the teacher should look even more carefully for potential sources of error or poor celeration.

PT Benefits RTI through Enhanced Support for Frequent, Time-Based Measurement

PT brings progress monitoring on key skills or its tools or components from a weekly, monthly, or (most typically) quarterly basis into the classroom's daily routine. Just as the RTI framework's addition of the meta-level assessment (CBM or CBA) reduced the wait time from annual (macro-level) assessment for a reliable indicator of performance growth, PT provides an even finer-grained opportunity to assess each student's learning trajectory. Most importantly, it provides information that enables teachers to make midcourse corrections even earlier than they are currently able to do with meta-level assessment. Just as the RTI process of quarterly assessment and interventions results in improved learning compared to annual assessment and intervention, daily assessment and decision making speed up progress even more. If a primary goal of RTI is to arrange circumstances that set the stage for the large majority of learners to benefit from the evidence-based core curriculum, then PT technology is well positioned to assist in meeting the goal.

PT Benefits RTI by Addressing the Roots of Problems

PT practice typically focuses on *tool* and *component* skill learning, which has been correlated with improvements on *composite* skills, giving it the added bonus of addressing the root of a struggling learner's problem. Let's look at some examples.

TABLE 4.1. Suggested Interventions for Six Types of Learning Pictures on a Standard Celeration Chart

Characteristics of the learning picture	Name for the intervention	Types of intervention most likely to work
Corrects are increasing at a reasonable celeration, and errors are decreasing or stable.	No change	• Leave it alone!
Correct rates are not getting better or are increasing more slowly than error rates (White & Haring, 1980).	Slice back (White & Haring, 1980)	• Select a practice set that isolates the part of the current skill on which the learner is *not* making errors, and build rate to aim on these parts before adding complexity (White & Haring, 1980). • Select a practice set that isolates the skill within the practice set on which errors are made; use tips and quips to remind the learner of important discriminations or associations; and build rate to meet the frequency aim on this skill before returning to the original practice set. • In both scenarios above, it may be helpful to introduce 10- to 15-second sprints until the learner shows improved performance (accurate and fluent). Then build up to 1-minute timings before returning to the component or composite skill.
Corrects are staying the same or going down and are lower than the error rate (White & Haring, 1980).	Step back (White & Haring, 1980)	• Move back to a slightly more elementary skill that is a prerequisite for the current material (White & Haring, 1980). • Step back to instruction in order to firm up responses. For example, provide more explicit direction in multiple modes; move back to a model/demonstrate if errors occur at the "lead" phase or back to "lead" if errors occur at the "test" phase; rethink types of prompts; modify materials; etc.
Errors are low, stable, or decreasing, and corrects are higher than errors but increasing slowly.	Sprint	• Introduce 10- to 15-second sprints to give the learner the feeling of going faster, and then build back up to 1-minute timings. • Increase positive consequences for improved rate. • Observe the learner to determine ceilings he or she may be placing on performance. Suggest ways in which item-to-item movement can be improved.
Corrects are decreasing or very unstable, and errors are decreasing or remaining level; or corrects are less than chance; or corrects decelerate after a promising start.	Monitor distractions and reinforcers	• Remove distractions at least until improvements appear, and then reintroduce appropriate levels of distraction. • Ensure that reinforcers are appropriate in quality and schedule, and contract for points related to improvement and stability. • Ensure that poor performance isn't resulting in greater payoff than appropriate performance.
Corrects and errors are both flat, or errors are increasing and corrects are decreasing or flat.	Provide guided practice and pace performance	• Review both antecedent and consequent variables. If the learner is not making correct responses during independent turns in instruction, he or she may need more guided practice. • If the learner is going faster than his or her prompts might be expected to drop out, thus producing a high error rate, you may wish to pace the learner's performance. • If the learner's performance is jerky, you may wish to do 10-second sprints with prompts to move smoothly from item to item until the performance evens out.

Example 1: Johnna is struggling with sound–symbol associations, the basis of decoding. Rather than automatically assigning more practice on that skill, a precision teacher might assess Johnna's phonological coding to determine whether her problem arises from weaknesses at the auditory level—sound discrimination. Should that prove to be the case, Johnna would be provided the opportunity to practice phonological coding. Depending on the severity of the deficit, practice on sound–symbol association might be interrupted during the phonological coding practice, or the teacher might decide to continue the sound–symbol work and look for changes in accuracy and fluency that correspond to improvements in phonological coding.

Example 2: Herschel is struggling with oral reading fluency and, despite repeated practice on passages, shows minimal improvement. Again, rather than practicing that skill in which errors are not only frustrating Herschel but also interfering with his comprehension, a precision teacher would assign practice on the word parts that an analysis revealed were creating the problem. So, for example, if Herschel's errors were related to discrimination of short versus long vowels, practice sessions would focus on that skill.

Example 3: Miranda's progress in mathematics stalls when she reaches long division. It would not be uncommon for her teacher to assume that she doesn't understand the long-division process. A precision teacher might instead focus on tool or component skills that are sufficiently weak to interfere with Miranda's proficiency with the long-division algorithm. The teacher may determine that Miranda needs greater fluency on add–subtract or multiply–divide number families, in order to succeed in the "divide–multiply–subtract–bring down" algorithm that characterizes long division. Alternatively, the teacher may determine that Miranda needs more practice in estimating.

Example 4: Darby's compositions are choppy and lack the kind of flow her teacher prefers. The teacher's first action is to provide additional opportunities to practice compositional writing, but the additional practice doesn't improve Darby's skills. Upon further investigation, the teacher discovers that Darby doesn't know how to use connecting words to combine several short thoughts into a unified whole. The teacher decides to assign Darby to practice sentence-combining exercises, and tracks improvements in her compositions during the time that this intervention is in place.

Example 5: Let's say that Sergio's reading rate is quite slow. Further investigation reveals that the disruption arises because he hasn't mastered the final-*e* rule. The teacher continues to pursue the case in order to institute a plan that will solve the problem in the least amount of time. Sergio might benefit from a direct instruction lesson that focuses on discriminating the presence or absence of the final *e* or on assigning the correct sound (long or short) to its presence or absence. Or if the assessment suggests that Sergio can correctly read the final-*e* words but does so very deliberately or slowly, the intervention might be limited to building rate on the skill.

These are just a few examples that support this PT adage: *The problem that a learner presents is not necessarily the problem to solve.* In each of these cases, a tool or component skill on which mastery of the composite skill hinges is the problem, even though it appears that the deficit is in a composite skill. In general, the more thorough the task analysis on which the core curriculum is built, the more adequate the instructional procedures will be. In addition, the greater the degree to which learners achieve frequency aims on tools and component skills, the more likely the majority of them will be able to progress through the curriculum without interruption.

Experienced teachers may recognize the roots of learners' problems, but they may not have easy access to calibrated and well-sequenced practice sets to address these. Simply put, the practice sets and standardized routines involved in the PT technology are preventive and allow for quicker and more enduring fixes.

HISTORY OF PRECISION TEACHING IN THE K–12 SYSTEM

PT evolved out of the need to provide additional support for struggling learners. As a result, it came to be associated with remedial programs, including Title I programs, academic tutoring, language therapy, and special education. The PT technology now is better developed and has been used more frequently in the K–5 system than in middle school, high school, or college instruction.

Many current applications of PT occur in 1:1 "clinical" interactions between a single teacher and a single learner. Learners may be meeting with an academic or behavioral therapist for academic tutoring or language therapy. Children with developmental disabilities and autism may also receive 1:1 PT. In a 1:1 arrangement, progress in both instruction and practice can be charted. It is relatively easy to keep data while teaching one person.

In classrooms and with groups, PT is used for practicing skills and concepts that a teacher has taught to the whole group. Each student then practices with a timer and works with at least one other peer in correcting and charting performance. It is not practical for teachers to provide 1:1 instruction with each member of a class, so other teaching methods must be employed. PT can reasonably be aligned with virtually any instructional method that specifies and calibrates learner outcomes. In fact, many core curricula and specialized interventions that are evidence-based and learner-verified already employ a form of frequency building in their activities. For example, after students achieve accuracy on elemental or basic skills, authors and publishers often recommend picking up the pace to ensure that the performance is not only accurate, but sharp. In a small group or with the entire class, this pacing is a preparatory step toward building frequencies with PT that will meet real-world requirements.

That PT has only rarely been associated with general education is due in part to its inclusion in preservice programs and professional development activities for special educators, and its exclusion from similar programs for general educators. However, there are exceptions that point to its utility in general education. According to Carl Binder (1988),

> Perhaps the most widely cited demonstration of this technology was the Precision Teaching Project in the Great Falls, Montana school district, accepted by the Office of Education Joint Dissemination Review Panel as an exemplary educational model for both regular and special education. . . . Teachers engaged elementary school students in 20 to 30 minutes per day

> of timed practice, charting, and decision-making in a range of basic skills over a period of four years. The results were *improvements between 19 and 44 percentile points* on subtests of the Iowa Test of Basic Skills, as compared with children in control group classrooms elsewhere in the same school district. These are exceptionally large improvements with a comparatively small expenditure of time and effort. In addition, original copies of the materials used for these practice and measurement sessions were available at very low cost from the Precision Teaching Project for unlimited duplication by teachers. (p. 13; emphasis in original)

A replication of the original Great Falls study was conducted in 1996–1997 at Chief Joseph School in Great Falls, Montana. As Figure 4.2 reveals, it produced growth almost identical to that described by Binder (1988).

Morningside Academy in Seattle, Washington, and the Roger Bacon Academy in Leland and Whiteville, North Carolina, are also notable PT implementations in general education. Both have employed PT successfully with students who are progressing through the curriculum at typical or even accelerated rates. Although many students first enrolling at Morningside Academy are behind same-age peers in reading, mathematics, and writing, only about 40% of them arrive with a special education diagnosis. Morningside attributes its outstanding outcomes in large part to the focus on PT practice technology (Johnson & Street, 2004). Roger Bacon Academy, which enrolls 900 students at its Leland site and 500 at its Whiteville site, conducts reading fluency trials 3 days per week in every K–5 classroom, and math facts timings occur daily (A. Calkin, personal communication, May 16, 2011).

MasterMind Prep, an online tutoring and test prep service that prepares students to master academic skills for school, college, and life, also employs PT in its work with

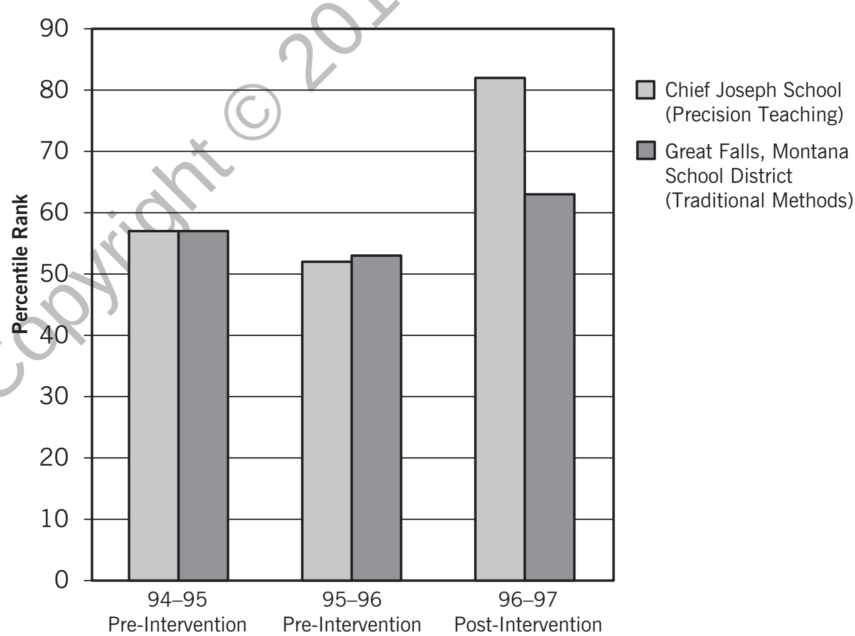

FIGURE 4.2. Percentile rank data from the Great Falls, Montana, PT replication in 1996–1997.

students in general education who want to improve their performance and in its SAT-Prep classes. MasterMind Prep says that PT

> uses a student's own performance data (some call it "the learner knows best") to set specific baseline skill levels and goals and to accelerate skill fluency, which is defined as accuracy plus speed. [As] in medicine ([e.g.,] measuring a heartbeat), Precision Teaching provides numerical performance fluency standards, frequent practice and a consistent method of recording, analyzing and making decisions based on student performance data. . . . Students chart progress that compares current with past performance and shows trend lines toward individual fluency goals and errors. ("Precision Teaching," n.d.)

In his 1985 doctoral dissertation, Binder described a series of classroom studies that revealed improved performance levels and learning rates as a result of adding brief, timed practice periods to the class day. Commenting on this evidence in his 1988 article in *Youth Policy,* he concluded that "explicitly timed practice, independent of any other instructional intervention, may be among the most cost-effective educational methods available" (p. 13).

RTI provides an opportunity to bring the benefits of PT to all students, regardless of their placement. PT holds promise for improving the number of students who thrive in Tier 1 settings, for speeding up the progress of students who require Tier 2 intervention, and for providing specialized skills training for students who require the individual instruction characterizing Tier 3.

FROM SCREENING TO DATA-BASED DECISION MAKING

PT has the potential to enhance the effectiveness of RTI in measuring and ensuring student progress, particularly in six key areas:

- Screening—to identify students at risk.
- Tier 1—as a systematic whole-class method to build core skills or supplement core skills instruction.
- Tier 2—to speed progress of learners who require instruction in small-group interventions.
- Tier 3—to benefit learners whose skill deficits are extreme or sufficiently unique that they require highly specialized individualized intervention.
- Progress monitoring—to assess growth and to project performance on annual standardized tests.
- Data-based decision making—to assist teachers in prescribing changes in programs or placements.

Screening

As we have noted in the earlier example with José, rate of performance at a given point in time is only one indicator that a learner is progressing well or failing to progress. Here's another example: Imagine that Anna has been diagnosed with developmental delays, and her parents have spared no expense to provide educational support. During screening, Anna's rate on specific skills—oral reading or math facts—may be at grade level, but a tool that looks at anticipated growth in a novel skill without special intervention may reveal the need for extra support. Recognizing the importance of keeping screening brief, improved diagnosis and prescription results when an "assessment classroom" approach is used to determine not only current rate of performance, but also typical growth trajectory with and without additional support.

PT and the Standard Celeration Chart can provide a fine-grained analysis of a learner's ability to thrive, and can reduce frustration and stigmatizing if educators provide appropriate Tier 1 support from the beginning instead of waiting for poor performance to trigger a review. For example, knowing that José is behind his classmates but is a fast learner, the placement team may plan for him to use some of his seatwork time to build vocabulary and rate on conventions of the English phonetic code. In Anna's case, the team could arrange for a teacher aide or even Anna's parents to work on building rate on tools and components that will allow her to match the progress of the rest of the class.

The chart can also be used to confirm placements. If, for example, José's case were to reveal that he is not only behind his same-age peers but also has a relatively slow learning trajectory, the team might begin the year by having José work in small-group instruction with other students whose screening reveals similar deficits, or might even decide that intensive individualized instruction holds the best promise to bring his skills to a level that he could thrive in the Tier 1 environment. Similarly, in Anna's case, the chart would reveal whether the provision of additional support would make it possible for her to keep pace with her Tier 1 classroom peers, and could thus be used either to confirm or to rethink her placement.

The advantage of estimating learning trajectory during screening is that interventions—whole-class, small-group, or individualized—can prevent performance failures down the road and reduce or even eliminate the emotional impact that can accompany them. PT can be used to confirm placements based on both learning status and trajectory.

Tier I

PT holds particular promise for learners who are in Tier 1, because of the speed with which it can assist them in developing fluency with tool and component skills, which will free them to focus on composite skills in the curriculum. In virtually any curriculum and particularly in K–5 classrooms, teachers recognize the importance of practice, and most core curricular materials in these grades provide opportunities for practice. However, the kinds of practice sets that are available and the way they are employed may not produce the most effective results and may even increase the chances that able students will require Tier 2 services. The well-known football coach of the Green Bay Packers, Vince Lombardi, was quoted as saying, "Practice doesn't make perfect; only perfect practice makes perfect." We agree, and offer the following critique of traditional (mostly imperfect) practice.

Only occasionally is practice timed, and when it is, the time available to complete the assignment often exceeds the time it would take an expert to do the work. This extra time allows learners to achieve correct responses by depending on prompts to complete the assignment. For example, they may count on their fingers or draw marks on the page to complete a math facts page. Or they may recall that *a* says "æ" as in *apple*, as a way to correctly read words with the short-*a* sound. Although such prompts may be useful during initial acquisition, they interfere with fluent performance during composite activities, such as reading with prosody or using math facts in math computation. However, when students reach expert-level performance rates on the tools and components, the likelihood that they'll be able to concentrate more fully on composite skills is greatly enhanced. Figure 4.3 provides a prototypic example of a publisher-provided seatwork or homework assignment in mathematics. It is not uncommon for teachers to set aside up to 25 minutes for an exercise of this sort, which should easily be accomplished in 1 minute by fluent performers. This not only creates an opportunity for off-task behavior; it also loses classroom time that could be spent on instruction or more focused practice.

Much of the practice that is prescribed by publishers is not sufficiently calibrated to allow rate-based comparisons from assignment to assignment. In Figure 4.3, for

Adding Three-Column and Two-Column Numbers with and without Regrouping

In this exercise, you'll be adding two- and three-column numbers just like these. Remember to regroup if you need to.

423 + 42 465	1 1 176 + 97 273

Find the total for each problem.

253 + 63	728 + 43	478 + 21	369 + 50	514 + 71
462 + 17	928 + 33	174 + 67	823 + 46	681 + 19

Write the answer on the line.

623 + 79 = ______ 843 + 86 = ______ 265 + 34 = ______ 517 + 81 = ______

Write in the missing numbers in these problems.

242 + 29 2_1	93_ + 47 982	783 + 1_ 795	377 + 65 _42

Find the answers to these problems. Use the space below to solve.

Marty had saved $465 to buy a guitar. He worked for his dad for one weekend and earned $38 more. How much does Marty have altogether?

Serena needed 23 more flowers to complete her project. She already had 277. How many did she need altogether?

FIGURE 4.3. Prototypic mathematics seatwork practice exercise.

example, learners move between different types of problems in which they add three- and two-digit numbers with and without regrouping. This makes it challenging for the learners to get into the flow of the task and interrupts overall performance rate. The teacher is left with accuracy as the only available measure of mastery. As we've noted earlier, however, accurate performance and fluent performance aren't the same thing. The kind of practice illustrated in Figure 4.3 may be appropriate at the end of a lesson in which the focus is responding correctly to different formats for adding three- and two-digit numbers with and without regrouping. However, it's not a good exercise for building frequency on the individual elements or on their combination.

PT practice sets and routines are arranged to make practice efficient and effective. Using these efficiencies, a Tier 1 classroom teacher could select practice sets for key curricular elements and establish a period of time in each curricular area during which all students would complete daily or three-times-weekly timings. In reading, for example, the ability to read nonsense words at prescribed rates predicts overall reading ability (Fien et al., 2008), and once readers have mastered the sounds of letters, the ability to read multisyllable words benefits oral reading passage fluency. Therefore, frequency-building exercises in reading might include basic decoding of single-syllable nonsense words in grade 1 (Figure 4.4) or multisyllable word reading in grade 2 (Figure 4.5). Reading comprehension is aided not only by the ability to read at conversational rates, but also by fluency with the vocabulary included in the passage (Tucci & Johnson, 2012). The practice cards in Figure 4.6 exemplify one way learners can build rate on vocabulary.

Good writing, as we have mentioned earlier, depends on a number of skills that can be practiced in isolation. One such example is sentence combining (Figure 4.7). Examples in math might include math facts (Figure 4.8) and simple computations (Figure 4.9).

Although some teachers do not subscribe to the tenet that rate or frequency is a necessary component of fluency, most would agree that practice to automaticity is important. PT provides a time-sensitive way to encourage a great deal of practice in a short period of time and to build the kind of automaticity that facilitates performance on more complex skills. Furthermore, the similarity between timed daily practice and timed meta-level assessment (e.g., CBM probes) reduces the learner's apprehension about the timed components of high-stakes assessment.

Another weakness of traditional practice is that there commonly is only one version of a practice set. This either assumes that the learner will meet criterion in one practice, or doesn't account for the possibility that learners will memorize the order of answers. Strange as it may seem, students who are struggling in a content area may find it easier to memorize the order in which answers appear than to learn the discriminations necessary to respond to an individual problem. Most PT practice sets provide several versions of each curriculum slice. Morningside Press's *Morningside Phonics Fluency: Basic Elements* (Johnson, Casson, Street, Kevo, & Melroe, 2005) provides four versions of each practice sheet. Multiple versions are also provided in *Morningside Mathematics Fluency* (Johnson, 2005, 2008a; Johnson & Casson, 2005a, 2005b) and in *Teaching Computation Skills: A Diagnostic and Prescriptive Instructional Sequence*[1] (Johnson & Melroe, 2006a,

[1]This program is made up of two volumes for addition and subtraction, two volumes for multiplication and division, three volumes for fractions, and two volumes for decimals.

CCVC				BASIC ELEMENTS					Slice 16	
brip	flit	plox	skib	smix	shiv	thux	shan	grez	prab	10
drot	fron	snil	smot	wrub	wres	plat	whap	glin	glup	20
gran	skot	brub	fleb	thim	swem	drod	scog	slub	drus	30
wheg	snup	spip	whin	frug	blos	frag	chot	blap	crod	40
wrub	grez	tros	wrab	creb	prem	clav	scog	shum	plat	50
snup	spip	glin	swem	prut	sced	fleb	gran	trub	sten	60
flit	frug	slub	shan	drod	frag	whap	brip	trix	chot	70
snil	brub	skot	slan	shiv	drus	swip	glup	crod	thux	80
blos	plox	wres	skib	spof	whin	smot	prab	smix	thed	90
cran	drot	fron	plen	clom	blap	thim	chux	stad	wheg	100
Aim: 100 - 80 Corrects per Minute									Version 3 of 4	

FIGURE 4.4. Frequency-building practice sheet for single-syllable nonsense word decoding. From Johnson, Casson, Street, Kevo, and Melroe (2005).

Word Workout Fluency		lessons 14-15 Version 1		-al, -ous, -ent/-ant, -ence/-ance, -ency/-ancy ization, fication, already a word		
perpendicular	Mexican	Alaskan	aromatization	victimize	hypnotize	6
certification	seminar	capatalist	cellular	sanitization	rectangular	12
ratification	personalize	ratification	spectacular	metropolitan	modification	18
cosmopolitan	qualification	catamaran	modernization	republican	certification	24
qualification	molecular	immunization	equalize	cosmopolitan	globular	30
artisan	popular	cosmopolitan	nullification	spectacular	globular	36
vocalization	cosmopolitan	geneticist	cardigan	monopolization	mannerism	42
putification	victimize	secular	energize	samarian	cynicism	48
colonization	catagorization	pollenize	patronize	fortification	hypnotize	54
sanitization	popularize	mystification	veteran	sensitization	ratification	60
aromatization	nationalist	clarification	fantasize	summarization	sanitize	66
seminar	cardigan	apologize	economist	normalize	dramatization	72
consumerism	simplficaton	fertilize	terrorist	monopolization	exemplar	78
catamaran	pessimism	qualification	muscular	consumerism	qualification	84
generalize	monopolist	qualification	hypnotize	fertilize	energize	90

FIGURE 4.5. Frequency-building practice sheet for multisyllable words. Unpublished sheets created by Morningside Press to accompany Lewkowicz (1994). Reprinted with permission of Morningside Press.

2006b, 2009, 2011). Many other publishers of PT practice sets also provide multiple versions of each practice sheet.

Because protocols for practice and charting performance are routinized, both teachers and students can complete this work easily and often in less time than curriculum-based practice sets require. They also provide the added bonus of allowing teachers to project performance on meta- and macro-level assessments and to intervene as soon as needed. For example, if several learners are not meeting rate aims that predict success on meta- and macro-level assessments, an analysis of errors may suggest additional instruction or specific practice on a curriculum slice. Because these interventions can occur as problems emerge in real time, they have the advantage of correcting errors before they become entrenched or before they frustrate learners.

FRONT	Insatiable	BACK	Unable to be satisfied
FRONT	Predominant	BACK	Having superior strength or influence
FRONT	Sublime	BACK	Majestic, grand
FRONT	Laborious	BACK	Difficult; demanding great effort and hard work
FRONT	Nefarious	BACK	Very wicked, vicious
FRONT	Clamor	BACK	Loud noise, uproar, shouting

FIGURE 4.6. Sample SAFMEDS (an acronym for *Say All Fast, a Minute Each Day, Shuffled*) cards for vocabulary practice. See also Tucci and Johnson (2012).

Name______________ Date ______	Slice 13	**Aim: 320-360** letters *written* in three minutes

Chapter 8: Combining Three or More Sentences with the Same Subject (Continued)

Following the patterns you learned in Chapter 8, combine these sentences using commas and the word AND. Repeat words when you think it makes a sentence sound or communicate better. Write your answers on loose-leaf paper.

9. Every child can tell of his ominous presence.
   Every child can tell of his ruthless temper.
   Every child can tell of the fate of his wives.
   Every child can tell of his own fate.

10. The woman felt her heart ache with sorrow.
    The woman cried bitterly.
    The woman could not believe what they had done.

11. The grave gentleman led the way to the coach.
    The grave gentleman opened the door.
    The grave gentleman helped the children in.
    The grave gentleman quietly shut the door behind them.

12. One afternoon, Master No-book skipped school.
    One afternoon, Master No-book sprawled on the sofa.
    One afternoon, Master No-book ate potato chips.
    One afternoon, Master No-book played Nintendo all day.

13. The stranger was a man of the world.
    The stranger was kind and gentle.
    The stranger was easily trusted.

14. Sandra and Jamie sat on the swings.
    Sandra and Jamie gathered up speed.
    Sandra and Jamie spun themselves around.

15. The King of the Golden River uttered his final speech.
    The King of the Golden River turned away.
    The King of the Golden River walked into the center of the flames.

FIGURE 4.7. Frequency-building practice sheets created by Morningside Press for sentence combining. Reprinted with permission of Morningside Press.

___ Name	Morningside Math Facts Fluency Add-Subtract ALL FACTS		Review 1 - 16 Missing Numbers
0 9 ___	5 5 ___	___ 9 13	___ 2 11
3 ___ 12	___ 5 10	3 ___ 6	3 2 ___
9 ___ 14	9 5 ___	4 ___ 10	5 ___ 7
5 ___ 7	7 8 ___	8 4 ___	4 ___ 11
___ 9 18	8 ___ 13	6 ___ 9	___ 4 7
8 2 ___	___ 4 9	___ 9 18	___ 4 7
9 ___ 17	___ 7 10	___ 5 11	4 ___ 6
9 ___ 13	___ 7 13	2 ___ 2	3 3 ___
6 ___ 12	___ 9 14	2 5 ___	2 ___ 10
___ 3 12	8 ___ 10	6 ___ 8	8 ___ 16
7 8 ___	___ 4 11	6 2 ___	___ 9 18
5 ___ 9	7 6 ___	2 7 ___	8 4 ___
___ 2 3	___ 2 9	7 ___ 14	7 ___ 9
___ 9 17	3 ___ 8	5 ___ 12	8 ___ 12
6 ___ 13	4 4 ___	8 6 ___	2 5 ___
8 3 ___	___ 9 14	7 7 ___	___ 4 8
___ 7 14	3 6 ___	1 5 ___	9 ___ 16
8 ___ 17	___ 8 17	___ 5 9	9 3 ___
7 4 ___	3 8 ___	___ 5 7	9 9 ___
8 ___ 13	6 ___ 13	___ 8 17	4 ___ 9
3 2 ___	0 0 ___	___ 5 11	___ 4
3 4 ___	___ 7 14	___ 8 12	9 9 ___
7 5 ___	6 5 ___	___ 2 11	3 ___ 9
___ 10 11	3 3 ___	6 6 ___	6 ___ 15
5 5 ___	2 2 ___	6 2 ___	___ 3 6
25	*25*	*25*	*25*

FIGURE 4.8. Frequency-building practice sheet for all math facts (1–16). From Johnson (2008a). Copyright 2008 by Morningside Press. Reprinted with permission.

Morningside Math Fluency:
Computation with Whole Numbers
Subtraction

Version: **9** Facts: **1 – 16**

60,000 – 57,410	120,082 – 88,047	1,308 – 654	689 – 233	50,045 – 34,771	20/20
6,002 – 455	104,240 – 76,845	706 – 166	663 – 316	108,804 – 74,647	20/40
750 – 120	120,208 – 77,468	50,181 – 44,808	3,064 – 1,564	8,504 – 1,463	20/60
905 – 660	603 – 223	7,600 – 7,130	104,000 – 77,456	10,370 – 2,074	18/78
7,070 – 5,228	20,742 – 4,300	702 – 61	440 – 225	360 – 124	1 /96

FIGURE 4.9. Frequency-building practice sheet for simple computation. From Johnson and Melroe (2006a). Copyright 2006 by Morningside Press. Reprinted with permission.

Tier 2

Including PT as an intervention in Tier 2 holds promise for producing speedier results and enabling a quicker return to full inclusion in Tier 1 activities. That, of course, is the primary purpose of Tier 2 interventions. Typically, schools are encouraged to avoid individualized instruction in favor of standard teaching and practice protocols in Tier 2. The assumption here is that the 10–15% of students who aren't progressing in the core curriculum reflect deficiencies in the instructional protocols; therefore, a standard intervention should result in improved learning for all students. Ideally, teachers would have at their disposal a number of mini-curricula that are capable of responding to the most common curricular weaknesses. These may include both additional instruction and well-calibrated practice.

Tier 2 interventions typically focus on building tool and component skills that are critical to success in the composite skills that predict improved performance on meta- and macro-level assessment. Two examples of skills that are often overlooked in math curricula or for which many publishers provide limited practice are "See/say or hear/write whole numbers" and "See/say place value." For some learners, the typical coverage results in limited mastery. Figures 4.10 and 4.11 are drawn from *Morningside Mathematics Fluency: Basic Number Skills* (Johnson, 2005) and represent the last in a series of increasingly challenging practice sets that build up to these terminal levels. Well-designed practice sets like these that focus on building frequency on the tool skill certainly improve performance on the skill itself, but they also lead to improvements on components and composites in which it is embedded. For example, students who struggle with place value or with hearing and writing whole numbers that include a zero may not only improve their performance on these two skills, but also reduce errors on problems they are to write as the teacher reads them.

Similarly, practice sets such as those exemplified in Figures 4.4–4.7 may prove too challenging for some learners, who may need a slower progression to apply rules (e.g., discriminating when a long or short vowel is appropriate) effectively. For another example, learners who struggle with the cumulative set of all add–subtract math facts reflected in Figure 4.8 may benefit from a few minutes of practice daily on component sets that include only a portion of the number families[2] (Figure 4.12). Depending on the number of students who fail to progress on the cumulative sheet (more than or less than 20% of all students in the class), the teacher might introduce subsets of the cumulative number family practice sets for all students in Tier 1 or might assign them as a Tier 2 intervention.

As we've indicated earlier, many students struggle with subsequent or composite skills because they still depend on prompts to ensure that they respond correctly. Practice gradually reduces the need for prompts and moves a task from accuracy to fluency. However, some students require additional instruction to make progress on a skill set or pinpoint. Another major benefit of the fine-grained task analysis and calibration of many PT practice sets for mathematics and reading is that they make any additional instruction on the skill to be practiced fairly straightforward.

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[2]Morningside Academy uses a *number families* approach to teaching both add–subtract and multiply–divide facts, because it embeds math facts in the reciprocal properties of the two sets of operations, and also reduces the number of individual facts to be learned by 75%. Thus students learn the add–subtract number family 4, 3, 7, from which they can derive two addition and two subtraction facts: $4 + 3 = 7$; $3 + 4 = 7$; $7 - 3 = 4$; and $7 - 4 = 3$. Chapter 8 discusses number families in more detail.

Morningside Math Fluency: Tool Skills

See/Say, Hear/Write Numbers

Cumulative Whole Numbers with Zeroes

Version: **5** Number of Digits: **9**

1.	**3,000,004**	26.	**70,008**	51.	**50,900,003**	76.	**104,812,600**
2.	**739,070,700**	27.	**600**	52.	**29,000**	77.	**420,620,500**
3.	**109**	28.	**219,000,700**	53.	**800**	78.	**6**
4.	**80,050**	29.	**203,100**	54.	**10,061,120**	79.	**8,004,028**
5.	**80**	30.	**90,000,400**	55.	**8,069,002**	80.	**570,807,000**
6.	**70,000**	31.	**510,050,740**	56.	**83,000**	81.	**903**
7.	**508,018**	32.	**2,068**	57.	**80**	82.	**5,400,958**
8.	**1,908**	33.	**50**	58.	**700**	83.	**820,292,060**
9.	**402,497,020**	34.	**2,070,033**	59.	**10**	84.	**109,200,010**
10.	**88,080**	35.	**1,000,038**	60.	**80**	85.	**20**
11.	**40,300,030**	36.	**60,200**	61.	**90,041,290**	86.	**7,000**
12.	**307**	37.	**700**	62.	**967**	87.	**882,605,300**
13.	**4,191**	38.	**70**	63.	**10,070,010**	88.	**800,050**
14.	**7,202,103**	39.	**900,050,090**	64.	**7,108**	89.	**80,030**
15.	**4**	40.	**6,004,057**	65.	**6**	90.	**500**
16.	**35**	41.	**73,030,600**	66.	**1**	91.	**5,007**
17.	**300,612**	42.	**862,404**	67.	**207,806,000**	92.	**6,000,070**
18.	**68,700**	43.	**360,000**	68.	**5,030**	93.	**800,000,060**
19.	**76**	44.	**70,000**	69.	**896,001,050**	94.	**5,009**
20.	**410**	45.	**80,400**	70.	**916**	95.	**20**
21.	**400,008,000**	46.	**14**	71.	**200**	96.	**78,800,700**
22.	**465,100**	47.	**5**	72.	**5,905**	97.	**1,395,130**
23.	**5,000,042**	48.	**29**	73.	**614,002,000**	98.	**6,771,060**
24.	**2**	49.	**20**	74.	**4,005**	99.	**10,000**
25.	**60,000**	50.	**50,006,880**	75.	**500,104**	100.	**109,008,000**
	124 : 5.0		131 : 5.2		121 : 4.8		154 : 6.2

(Total Digits : Average Digits per Entry)

FIGURE 4.10. Frequency-building practice sheet for "See/say or hear/write whole numbers" (cumulative whole numbers with zeroes). From Johnson (2005). Copyright 2005 by Morningside Press. Reprinted with permission.

Morningside Math Fluency: Tool Skills

Sheet Number: 4
Place Value & Rounding

Digits in Whole: 9
Digits in Fraction: 0

1. 1 35,073,767	16. 20 6 ,980,096	31. 4 89,917,592
2. 2 8 8,480,375	17. 309,98 9 ,486	32. 163,503, 0 44
3. 746,91 0 ,967	18. 868, 5 71,982	33. 3 5 8,730,041
4. 416,8 9 5,582	19. 5 8 1,281,457	34. 52 1 ,579,920
5. 8 5 7,376,422	20. 551,3 6 7,462	35. 820,99 6 ,720
6. 895,602, 2 55	21. 530,6 0 4,315	36. 414,537,2 7 7
7. 389,0 4 4,500	22. 375, 0 84,125	37. 4 7 3,845,735
8. 156, 5 49,602	23. 397,3 8 9,051	38. 171,6 4 5,283
9. 996,597, 2 71	24. 712,709,56 7	39. 478,74 2 ,647
10. 1 5 3,147,694	25. 509,65 2 ,408	40. 34 1 ,194,840
11. 221,7 3 3,294	26. 851,4 3 8,986	41. 38 6 ,691,424
12. 744, 2 65,795	27. 7 68,582,107	42. 385,073, 7 77
13. 5 20,966,124	28. 5 8 5,947,658	43. 925,71 3 ,120
14. 9 8 7,765,599	29. 5 22,891,568	44. 5 30,410,622
15. 2 3 6,438,971	30. 14 1 ,385,964	45. 5 2 1,133,537

FIGURE 4.11. Frequency-building practice sheet for "See/say place value." From Johnson (2005). Copyright 2005 by Morningside Press. Reprinted with permission.

Name ____________

Morningside Math Facts Fluency

Add-Subtract

Cum 1 - 5

Missing Number

0 1 (All digits), 2 2 4, 2 3 5, 2 4 6, 2 5 7, 2 6 8, 2 7 9, 2 8 10

2 7 __	__ 6 8	__ 2 10	7 __ 9
8 2 __	5 2 __	2 __ 9	3 2 __
0 0 __	6 2 __	__ 2 4	3 2 __
8 __ 10	2 __ 6	__ 7 9	2 8 __
__ 6 8	__ 2 9	8 2 __	7 2 __
2 __ 5	2 7 __	2 __ 5	3 __ 5
8 2 __	5 2 __	__ 7 9	1 6 __
__ 2 9	2 2 __	2 __ 4	2 __ 4
__ 2 7	2 __ 8	2 __ 4	6 2 __
3 2 __	2 8 __	__ 7 9	2 8 __
1 2 __	2 __ 4	8 __ 10	__ 2 9
2 __ 4	2 4 __	5 __ 7	2 __ 4
2 __ 6	6 __ 8	4 2 __	2 __ 6
3 2 __	0 1 __	__ 2 9	2 5 __
2 2 __	7 __ 9	4 __ 6	2 7 __
6 __ 8	__ 2 9	__ 8 10	2 __ 8
__ 2 9	2 __ 4	2 __ 7	2 __ 4
__ 2 10	__ 2 8	2 5 __	2 __ 8
__ 2 9	6 2 __	2 4 __	2 __ 4
7 2 __	__ 6 8	3 2 __	4 2 __
4 1 __	__ 8 10	2 8 __	4 __ 6
2 6 __	2 __ 5	2 2 __	2 5 __
8 __ 10	__ 2 8	2 2 __	2 __ 7
6 __ 8	__ 7 9	6 __ 8	8 __ 8
7 __ 9	__ 8 10	__ 5 7	__ 2 10
25	25	25	5

FIGURE 4.12. Frequency-building practice sheet for a subset of math facts. From Johnson (2008a). Copyright 2008 by Morningside Press. Reprinted with permission.

This is particularly true for teachers who have access to two outstanding guides for teaching these content areas: *Designing Effective Mathematics Instruction: A Direct Instruction Approach* (Stein, Kinder, Silbert, & Carnine, 2006) and *Direct Instruction Reading* (Carnine, Silbert, Kame'enui, & Tarver, 2003). Each provides more and less structured scripts that communicate in unambiguous terms how a learner is to respond and the conditions under which different responses are appropriate. Figure 4.13 provides an example of a script for reading numbers from the Stein et al. (2006) text. Note that this script has both a structured and an unstructured board presentation. These scripts are designed for use with small groups of learners who respond chorally to a teacher's instructions. Once learners have responded correctly to several examples, the teacher may provide some additional independent practice opportunities and then have learners work in pairs to practice using PT practice sets like those illustrated in Figure 4.10. We provide guidelines for peer coaching in Chapter 5.

Tier 3

PT is well positioned to improve the performance of Tier 3 learners as well. If a teacher employs the evidence-based Tier 1 curriculum and Tier 2 interventions with fidelity, fewer than 10% of students in a classroom should require individualized instruction to make progress in the curriculum. Although instruction in Tier 3 is based on a careful analysis of an individual learner's skill and process deficits, learners may or may not work alone. If two learners present a similar learning challenge, the same instructional protocol may be appropriate for both, and working as a pair may have some advantages. However, as we note in Chapter 5, peer coaching may not be appropriate if neither learner is well positioned to assess, provide feedback on, or recommend interventions for a peer's performance. Those whose learning trajectories show particularly slow celeration may require individualized support or individualized contracts to meet their performance goals.

Students in Tier 3 may vary considerably in the instructional, practice, and management tasks and protocols that they will require to make adequate progress relative to their current performance. Some may be sufficiently behind their peers that they need to acquire a fairly large repertoire of academic skills to be able to work with their classmates. Others may have achieved 100% accuracy on skills being taught in the Tier 1 curriculum, but may be struggling with rate building in all curricular areas. Some may require a schedule or type of reinforcement to maintain and accelerate their progress that is not available in Tier 1 and Tier 2 programs. Still others may present behavior management challenges that have slowed their progress. However, even in these situations, practice is an essential ingredient. PT technology can facilitate performance gains on a wide array of academic goals and remove many of the occasions for misbehavior.

For many Tier 3 students, it is often necessary to build tool skills that are not within the scope of the typical general education classroom. Some learners that are placed in Tier 3 will spend the majority of their time working on preacademic tasks, for which PT provides practice activities that correspond to evidence-based teaching programs. In most cases, these will be learners whose overall learning trajectories are well below those of the typical learner. However, other learners who will require individualized Tier 3 instruction may have skill deficits because they have not received the kind of naturalistic instruction on skills that are prerequisite to reading or math. For example,

FORMAT 5.9 Reading Numbers 100–999

TEACHER	STUDENTS
PART A: STRUCTURED BOARD PRESENTATION	
1. *(Write the following chart on the board.)*	
hundreds | tens | ones — 5 | 4 | 8	
(Point to appropriate column as you say the following.)	
This is the hundreds column.	
This is the tens column.	
This is the ones column.	
Tell me the names of these columns.	
(Point to the columns, starting with hundreds; repeat until students are firm.)	hundreds, tens, ones
2. The first thing we do when we read a number is identify the column the number starts in. *(Point to 5 in 548.)*	
What column does this number start in?	hundreds
How many hundreds do we have?	5
What do five hundreds equal?	500
3. *(Point to 4.)* What column is this?	tens
How many tens do we have?	4
What do four tens equal?	40
4. *(Point to 8.)* What column is this?	ones
How many ones do we have?	8
What do we say?	8
5. Let's read the whole number. When I touch a numeral, you tell me what it says.	
(Point to 5, pause a second, touch 5.)	500
(Point to 4, pause a second, touch 4.)	40
(Point to 8, pause a second, touch 8.)	8
6. Say the whole number.	548
7. *(Repeat steps 2–6 with 697, 351, 874, 932, all written in place value charts.)*	
Note: When presenting examples with a 1 in the tens column, present the following steps instead of steps 3, 4, and 5 in the format. The following example shows how to teach the number 514.	
8. What column is this?	tens
How many tens do we have?	1

(cont.)

FIGURE 4.13. Direct instruction script for reading numbers 100–999. From Stein, M., Kinder, D., Silbert, J., and Carnine, D. W. (2006). *Designing effective mathematics instruction: A direct instruction approach* (4th ed.). Upper Saddle River, NJ: Prentice Hall. Printed and electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.

TEACHER	STUDENTS
9. How many ones do we have?	4
We have one 10 and four ones, so what do we say?	14
10. Let's read the whole number. *(Point to 5.)* What do we say for this?	500
(Points to 14.) What do we say for these?	14

PART B: LESS STRUCTURED BOARD PRESENTATION

1. *(Write the following chart on the board.)*

hundreds	tens	ones
4	4	6

2. Now we are going to read the numbers without saying the parts first.
   This time when I point, you are going to tell me the whole number.
   (*Point to 446 and then pause 2–3 seconds.*)
3. (*Repeat step 1 with 249, 713, 321, 81, 720, 740.*)
4. (*Give individual turns to several students.*)

FIGURE 4.13. *(cont.)*

prior to working on "See/say sounds or words," teachers may need to build frequency in phonological coding—a skill that the majority of learners have at the time they enter kindergarten—for children whose life experiences haven't provided the instruction. For a good number of them, intensive individualized instruction may bring them into line with their peers very quickly, and they may be able to rejoin Tier 2 or Tier 1 curricular or program activities. Once again, the teacher should keep a watchful eye on learning celeration: Learners who acquire the skill quickly are likely not to have encountered it before in any systematic way. On the other hand, those whose celerations are low or for whom progress stalls may continue to require intensive individualized instruction on each newly encountered academic skill.

Progress Monitoring

The Daily per minute Standard Celeration Chart is the ideal tool for progress monitoring, because it displays not only current performance levels but also shows growth trajectories or celerations. Let's say, for example, that Figure 4.14 provides a picture of Abeer's performance on "See/say nonsense words," a skill that predicts oral reading fluency. The aim for this skill is 100 words per minute (wpm), and Abeer is currently at 80 wpm. However, the chart also reveals a fairly steep learning curve or celeration. Her rate grew from 40 to 80 wpm in the last week, a celeration of ×2. In other words, her rate doubled in the last week. By extending Abeer's celeration line, the teacher can project that Abeer will get to the prescribed rate of 100 wpm with another 2 days of practice. She is also tracking Abeer's oral reading rate and sees that they parallel each other. That

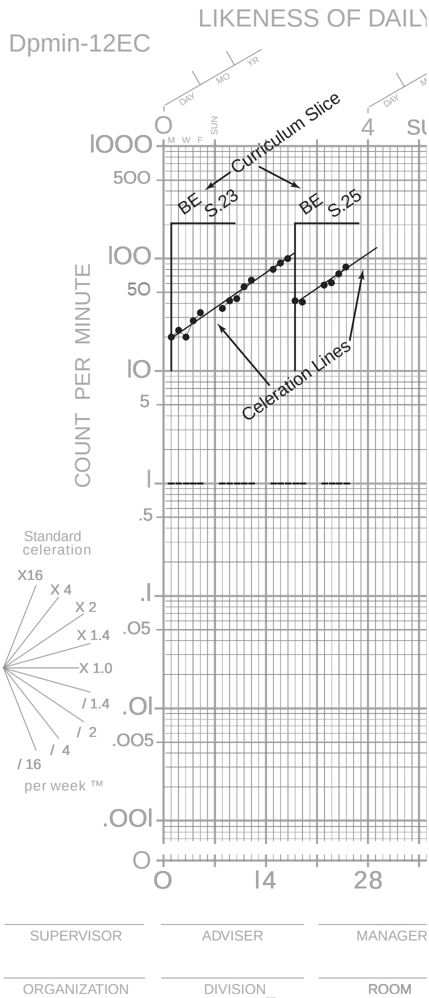

FIGURE 4.14. A likeness of a Daily per minute Standard Celeration Chart showing data and celeration lines for Abeer on "See/say nonsense words." Used with permission of the Behavior Research Company.

is, as her rate of reading nonsense words increases, her celeration for oral reading rate is also doubling.

The chart can also reveal when low celerations are specific to one or a few areas of the curriculum or are generic to all areas. Let's say, for example, that Grace's celerations in reading are at ×1.25, but that in math her "See/say place values" rate is doubling every week (a ×2 celeration) while her errors remain low. This scenario suggests that Grace can work quickly; that is, building rate on a see/say task itself is not a challenge for her.[3] However, the two pictures suggest that additional interventions in reading may improve her progress.

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[3]It's important to make judgments about overall fluency potential within each learning channel. Had the math worksheet required a written response (e.g., "See/write missing elements from number families"), it wouldn't have necessarily revealed frequency-building potential for "See/say words" (Fabrizio & Moors, 2003).

Data-Based Decision Making

An advantage of combining PT technology with the RTI framework is that it provides the opportunity for more frequent performance feedback and, as needed, interventions. As we have noted in Chapter 1, Ysseldyke (2006) has presented preliminary evidence suggesting that data from students' daily performance predicted their performance on annual high-stakes state tests. Similarly, teachers at Morningside Academy have a long history of tracking daily celerations on the Standard Celeration Chart and accurately projecting performance on meta-level assessments. When daily performance suggests that learners are below the trajectory required to meet the meta-level assessment benchmarks, teachers intervene immediately. Even for our expert precision teachers, the first intervention isn't always successful. But because they are monitoring and making decisions daily, the probability that they'll solve the problem is greatly increased. Furthermore, when performance on meta-level assessments such as the SRI (see Chapter 1) project lower-than-anticipated performance on annual tests, the first line of defense is to intervene to improve daily celerations. The benefit of using PT technology to gauge learning progress is that when daily practice sets are similar to the meta-level assessments, teachers can intervene each day to improve corrects over errors and can take actions that have a good track record of increasing celerations. The end result is smoother progress toward improved end-of-year performance.

SUMMARY

In this chapter, we have:

- Described educators' growing interest in fluency in important academic tool and component skills.
- Identified ways in which PT can increase the effectiveness of RTI.
- Provided examples of the ways in which the data-based learning pictures that emerge from recordings on a Standard Celeration Chart inform interventions.
- Discussed the major importance of providing practice in the correct curricular elements.
- Provided examples of prototypic PT practice sets.
- Showed how faster resolutions accompany a change from quarterly or even biweekly data-based decision making (which characterizes many RTI implementations) to daily decision making (which characterizes PT implementations).

In Chapter 5, we describe how to implement the five steps of the pure case of PT, and we describe the complementary roles of teachers and peer coaches in achieving efficiencies in implementation. In fact, teachers who combine the Timings Chart and peer coaching approach we describe there with the Daily per minute Standard Celeration Chart avoid many of the faulty learning pictures that are depicted in Table 4.1!

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