Building Fluent Performance: Measuring Response Rate and Multiplying Response Opportunities

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Abstract

Precision teaching emerged from O.R. Lindsley's pristine application of Skinner's natural science of behavior, with a focus on response rate measurement and free operant procedures. When applied with human learners in instructional settings, these first principles led to a series of developments framed in this paper as four kinds of ceilings that constrain or limit performance. Measurement-defined ceilings are the limits imposed on measurement sensitivity by use of percent correct and absence/presence methods of evaluation that lack standard units of measurement and ignore the time dimension. Removing measurement-ceilings by using time-based measures leads to discovery of limitations imposed by procedures or materials that limit the pace at which behavior can occur, referred to in this article as procedure-imposed (or teacher-imposed) ceilings. By changing materials and procedures to allow more self-paced, unconstrained behavior, teachers encountered limits on the pace at which learners could perform, below those count per minute levels shown by people judged to be competent in the particular behavior being measured. These deficit-imposed ceilings were remediated by identifying and building the frequencies of behavior components that must be combined and applied in more complex repertoires. Finally, the history of precision teaching has been, to a large degree, a search for behavior components which, if accelerated, could enable learners to break through what have been called handicap-imposed ceilings to achieve competent levels of count per minute performance. This article suggests a shift in the discussion among applied behavior analysts about precision teaching and fluency-based instruction from a focus on specific instructional procedures and recipes to the issue of measurement sensitivity and adherence to the underlying characteristics of Skinner's natural science, including response-rate measurement and free operant procedures.
Keywords: precision teaching, behavioral fluency, fluency-based instruction, rate of response, behavior frequency, free operant conditioning, instructional design, behavioral education, instructional measurement, educational research

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Other articles in this special issue describe state-of-the-art measurement and instructional methodologies that use the tools of precision teaching and specific strategies that have evolved in its application with particular learner populations. The present author has participated in this work from the early 1970's and can cite examples of successful instruction using these methods with learners that span the range from students suffering from severe developmental disabilities in now-defunct institutions to 21st century corporate training with senior sales executives and customer service personnel.

Rather than focusing on one or more populations, or on the specific instructional strategies associated with them, the purpose of this article is two-fold: 1) to describe a framework originally articulated in the 1970's for the evolution of precision teaching and "fluency-based instruction" (Binder, 1978, 1993) that provides a larger context for understanding other contributions in this field, and 2) to illustrate the elements of that framework with examples of measurement and instructional strategies from a range of different populations. Particularly at this time, when many of our colleagues in behavior analysis have not made contact with the work that led to precision teaching, or with early publications that emerged from that work, it seems worthwhile to establish a broader understanding of what precision teaching and its derivatives have brought to our field, and why.

A Framework for Evolving Instructional Technology

In the late 1960's and early 1970's, precision teaching involved a small and vibrant community of dedicated Skinnerian behavior analysts, led by Ogden Lindsley, Eric Haughton, and a handful of their colleagues and students. Lindsley (1964,1972) was committed to bringing the power of Skinner's "method of free operant conditioning" into the field of education, and this commitment drove the research and development of the time. It was the most pristine translation among behavioral educators and applied behavior analysts of Skinner's methodology and discoveries into education because it preserved without compromise Skinner's sensitive measure of behavior ("response strength"), rate of response or behavior frequency As the impact of measuring response rates in instructional procedures with freely emitted behavior became clear (Lindsley, 1992), precision teachers saw that discrete trial procedures coupled with percentage correct evaluation had the effect of leaving behind what Skinner (Evans, 1968) and others considered to be his most important contribution. With under the influence of Eric Haughton, who referred to "performance blocks" of various kinds that prevent acceleration of learned behavior, Binder (1978) framed the evolution of instructional methods in precision teaching as a process of removing "ceilings" that obstruct the acceleration of behavior toward useful levels of performance supported by natural contingencies.

Four Kinds of Ceilings that Prevent Growth of Skill

The four ceilings originally named during the 1970's offer a framework for understanding how using response rate measures in instructional settings led to development of a new technology of teaching. The ceilings are:

1. Measurement-defined ceilings
2. Procedure-imposed ceilings (also called Teacher-imposed ceilings)
3. Deficit-imposed ceilings
4. Handicap-defined ceilings

As Binder and his colleagues working in B.H. Barrett's laboratory classroom (Barrett, 1977) removed each ceiling, the next ceiling appeared as a flat data line on standard celeration charts above which students' performance would not accelerate. As each ceiling appeared, the need for changes in materials, procedures and behavior pinpoints become clear. The remainder of this section describes each ceiling with examples from different populations to illustrate underlying principles that drove the evolution of more effective and efficient performance development strategies.

Measurement-defined ceilings. Skinner's (1938) discovery that rate of response, or what precision teachers call behavior frequency, is the most sensitive indicator we have of the probability or strength of a response is the foundation of precision teaching and fluency-based instruction, just as it had been the foundation of Skinner's science. In free operant procedures, the count per unit of time (precision teachers prefer count per minute) at which a response occurs best reflects the strength or probability of that response. The ratio comparing the frequency of one response with that of any other response (e.g., rate of correct responses and rate of incorrect responses) reflects the *relative* probability of each response class. Definitions in behavior science of reinforcement, stimulus control, and other functional relations all stem from measuring rate of response in free operant procedures.

When we first began to compare graphs showing count per minute of target academic behavior with percentage correct graphs, which ignore the time dimension, it became clear that there was a big difference, for example, between a performance of 9 correct math facts per minute with 1 error and a performance of 45 correct with 5 errors – both the equivalent of 90% correct. However, in the absence of information about the temporal dimension of behavior, our ability to develop instructional strategies was limited because it was impossible to decide whether we should attempt to accelerate correct responding, decelerate errors, or both. Our decisions about whether or not students had mastered skills, or needed more work on those skills before moving on, were limited if we relied on percentage correct, the "dimensionless quantity" subsequently criticized by Johnson and Pennypacker (1980), among others, as insensitive and failing to meet the criterion of standard units of measurement used in natural science.

The *measurement-defined ceiling* that emerged from this investigation was the limitation of measurement to percent correct (or worse, to absence/presence of the behavior) where the best one can achieve is 100% correct

– a flat line at the top of a graph -- and where the accuracy-based definition of "mastery" lacks sufficient information to determine whether or not the behavior being evaluated is likely to make contact with available reinforcement in the natural environment. Barrett's (1979) often-cited data contrasting the different behavior frequency ranges shown by institutionalized students, young public school students, and professional adults – all of whom performed with perfect accuracy -- made the point most clearly. In the absence of the time dimension, instructional decision-making is relatively blind for the behavior analyst.

Classroom observations illustrate the limitations that hide behind accuracy-only measurement. For example, when teaching institutionalized students how to read, we recognized that discrete trial procedures could, at most, present between 10 and 20 opportunities to respond per minute. Even when students achieved 100% accuracy in such procedures, they remained far below the performance levels generally assumed to be competent reading fluency, e.g., 150 or more words per minute. We would not have recognized this difference in the absence of frequency measures. With corporate sales people, traditional training procedures prompt trainees to identify the names of product solutions in response to statements about customer needs. Such procedures, managed either by classroom trainers or in computer-assisted programs, allow students to respond to perhaps 5 items per minute. In real-world sales performance, however, it is clear that sales people who require 12 seconds (the equivalent of 5 per minute) to respond to a customer question or comment will be left in the dust, unable to engage in a fluent sales discussions. Perhaps the most wrenching discoveries in this respect emerged as precision teachers observed elementary school children struggling to complete long division or story problems when their basic addition, subtraction, and multiplication skills were in the 10-20 problems per minute range. When students and teachers use time-based assessments, they see the clear differences in basic math skills capability between 20 per minute and 60 per minute or higher rates of problem solving. When performance is measured only with percentage correct, teachers miss this difference between beginning and mastery levels of basic academic skills. Yet, with the addition of time-based measurement in learning programs, the data enable teachers to recognize the real-world contingencies of performance in which *time matters*, and where performing within a certain range of count-per minute frequencies can make the difference between contacting the natural reinforcement available for behavior, or failing to do so, resulting in a lack of application or maintenance after instruction.

For some reason, critics in the behavior analysis community of precision teaching and frequency-based instructional assessment (e.g., Doughty, Chase & O'Shields, 2004) seem to misunderstand this basic point. While one might argue and present evidence about the relative advantages and disadvantages of reinforcing quick responding at different stages in the learning process, rejecting Skinner's fundamental measure of response strength – rate of response – is hard to understand when it occurs among behavior analysts (Binder, 2004). Without attention to the time dimension, we relinquish the historic advantage that our science and its application inherited from Skinner and his experimental analysis of behavior.

With an understanding that percent-correct evaluation imposes a ceiling (or blinders) on the sensitivity of instructional decisions, precision teachers and practitioners of fluency-based instruction choose count per minute of correct and incorrect responses as their key measure. With this foundation, they can also observe and make decisions based on *celeration* – the rate of change in count per minute performance that quantifies *learning* – depicted as angles or multiplicative data trends on the standard celeration chart (Pennypacker, Gutierrez, and Lindsley, 2003). By including the time dimension in instructional measurement, teachers improve their ability to make informed decisions about curriculum and instructional methods. They remove the measurement-defined ceiling.

Procedure-imposed ceilings. Also called *teacher-imposed ceilings*, these limitations on the acceleration of behavior occur when teaching procedures, materials, or devices impose limits on the number of responses that a learner can make per unit of time. Recall that precision teaching was based on Lindsley's application of "free operant conditioning" methods with humans (Lindsley, 1991,1996). The free operant is a response that may be emitted at any time, without limitations, under prevailing contingencies of reinforcement. While not all precision teaching procedures use freely emitted behavior, the usual goal is to achieve a relatively uninterrupted, self-paced stream of behavior in the terminal performance. Instructional procedures toward the beginning of a learning process *might* require carefully sequenced procedural steps that, as a side-effect slow, can slow down responding as the teacher engages in response shaping and fading of stimulus control. (Although with procedures such as TagTeaching (www.tagteach.com), this might not even be needed during acquisition.) But the ongoing stream of behavior that characterizes "real life" does not present response opportunities one-at-a-time. And even when response opportunities *do* occur as discrete events, multi-tasking and concurrent responding are often part of ongoing human performance, so being able to respond as part of an ongoing stream is important.

With this in mind, and armed with frequency measures, early precision teachers noticed that many procedures limit the pace of behavior in artificial, and potentially deleterious ways. Again, 15 per minute discrete trials are nowhere near the 150 per minute or higher levels of behavior required for functional reading, as an example. Perhaps more importantly, if we assume (as do proponents of the "learn unit" such as Greer and McDonough, 1999) that the response opportunity is a basic unit of analysis, then it seems clear that instructional efficiency is best served by procedures that enable the learner to experience as many opportunities to respond per unit time as possible.

Precision teachers shifted procedures from discrete trials to those in which students received as many opportunities to respond as possible within a period of time. Calculation of the "opportunity multiplier" (Binder, 1989) as the ratio of opportunities per minute allowed by a revised procedure compared with opportunities per minute afforded by the original procedure became a guideline for improving instructional efficiency.

Consider a few examples. Multiplying opportunities to acquire activities of daily living might include shifting from a procedure in which the student puts on and takes off the same t-shirt to one in which the student puts on 5 or more shirts in a row without interruption, using a series of increasingly baggy shirts – in the same period of time. Shoe-tying would benefit from having multiple shoes lined up in a row. Teaching students to count objects might shift from a discrete trials procedure in which the teacher shows the student a numeral and prompts her to "count out this many," to one in which an array of paper cups, each labeled with a different numeral, prompts the student to count objects into as many cups as possible, interrupted only if necessary for correction, in a continuous stream of behavior. In effect, the removal of teacher-imposed ceilings involves "getting out of the way" as rapidly as possible, and shifting from constraining prompts and trials to continuous prompts with *coaching and cheerleading* (Binder, 1996) enabling students to perform at their own pace.

Such shifts from discrete trials to continuous performance often raised new issues, as an example with students whose behavior had been so controlled by teacher prompting that they did not know how to "do another one" without elaborate prompting and reinforcement. This occasioned problem-solving ways of enabling students to achieve greater levels of independence and the ability to work continuously, learning to approximate the continuous streams of activity that characterize everyday life. Some critics of precision teaching argue that efforts to encourage quick, self-paced behavior can be disruptive for certain learner populations, even encouraging unwanted behavioral outbursts or other problem behavior, and therefore should be avoided. While this might be true in some cases, and can certainly be managed with changes in procedure, as often as not we noticed just the opposite. Students who had been taught entirely in discrete trials were resistant to performing on their own without prompts, but that when they were enabled to become more self-paced and continuous in their performance, without interruption by the teacher, many undesirable behavior patterns dropped away.

This shift toward more response opportunities per minute and greater independence for students raised issues about instructional materials. It was a common problem that teachers ran out of materials and would have to obtain or create multiple sets of stimuli, manipulables, and so on. This was perhaps annoying in the beginning, but as teachers observed that their students were, in fact, capable of performing more quickly and with greater levels of independence from prompts, they approached materials design in new ways. Shifting from flashcards to work sheets when teaching and practicing skills such as sight vocabulary, naming pictures, and doing mental math by saying answers to math problems without writing, was an obvious strategy for multiplying response opportunities. For adult corporate learners there were comparable shifts, for example using self-paced flashcards to prompt responses to technical questions for computer help line technicians, compared to the more traditional training methods. The use of "fluency builders" – posters or projected diagrams with labels to which salespeople or customer service representatives were prompted to speak about different aspects of the pictures without interruption – multiplied opportunities per minute as compared with traditional question and answer classroom activities.

The indicators of success for such efforts to multiply response opportunities per minute included more rapid acceleration of correct responding and deceleration of errors; higher count per minute response rates more closely resembling the ranges of response required in the natural environment; and more rapid movement through curriculum. If these changes in procedures and materials did *not* accomplish more in the same amount of time, they were judged no better than the original more constrained methods. In many instances, for example where regular elementary students were able to master basic addition or subtraction facts with just a few minutes per day of timed practice on practice sheets as compared to more complicated and lengthy procedures of the past, the pursuit of opportunity multipliers bore fruit. In corporate training applications, the ability to achieve equal or greater levels of performance with less training time had obvious economic benefits (e.g., Binder & Bloom, 1989; Binder & Sweeney, 2002).

It is a hallmark of precision teaching and fluency-based instruction that teachers and instructional designers seek instructional efficiency by arranging as many opportunities as possible for students to respond per unit time. They prompt and reinforce students' behavior to accelerate responding, rather than continuing to constrain performance with teacher-controlled trials past the point when students demonstrate the ability for more self-paced performance.

An additional discovery that came from efforts to multiply response opportunities reflected back on the measurement-defined ceilings that gave rise to changes in procedure. In some cases, after repeated discrete trials with materials that limited rate of response, with stringent accuracy criteria such as 3 sets of trials in a row at 100% correct performance, teachers experimented by changing procedures to allow more opportunities per minute. The discovery that convinced many precision teachers to seek opportunity multipliers and use frequency measures earlier rather than later in the instructional sequence is that many students would, with a change in materials and light prompting, double or triple their response frequencies without any additional contingencies. For example, a procedure that prompted severely handicapped students to select and then name sight vocabulary words on flash cards one-at-a-time, occurred at a frequency of 12 opportunities per minute. The materials and procedures determined this frequency so that the teacher could not present response opportunities more quickly. When the teacher switched students from a discrete trials procedure to one in which they were prompted to say words presented in rows on a worksheet, several students immediately jumped from 12 per minute to 35 per minute or faster, and then continued to accelerate their oral reading rates on subsequent days. While the transition from one procedure to the other required a certain amount of behavior management in several cases, once it occurred, students were freed from the constraints of discrete trials. For many such students and teachers, first encountering the opportunity for student self-pacing can be disruptive to normal routine. However, with careful planning and instruction, the removal of procedure-imposed ceilings represents a major step-up toward more "normal" and natural learning procedures and materials. Perhaps more importantly, it allows the application of frequency-based measurement as a sensitive way of assessing learners' response strength.

Prior to changes in procedures and materials that allow learners to respond at their own pace, the count per minute measure provides a way of comparing response opportunities per minute for different materials and procedures. After the change, count per minute provides a sensitive measure of response strength. In either case it offers a useful guide for instructional decision-making that is more sensitive than percent correct or absence/presence evaluation.

Deficit-imposed Ceilings: What happens to behavior frequencies when we remove procedure-imposed ceilings? Does rate of responding accelerate or not? The answer is that "it depends."

Removal of procedure-imposed ceilings allows many learners to immediately jump-up in frequency by factors of x2 or more, and then accelerate with continued practice. For some, the jump-up might not be this large, and errors might intrude, requiring additional correction procedures or a more gradual shift from one arrangement to the other. For others, after a jump-up and acceleration, performance "tops out" at another flat line or ceiling. So what happens depends on some other factor that differs among individuals and levels of development.

Early precision teachers (e.g., C. Starlin, 1971; Haughton, 1972) discovered that smaller units of behavior variously labeled tool skills, elements, or components often constrain larger units (basic skills, compounds, or composites) when they cannot be performed at certain prerequisite frequencies. This is what we came to call a *deficit-imposed ceiling* – a flat learning line caused by the inability to perform a smaller unit of behavior with sufficient fluency to acquire or accelerate a larger form of response. Early precision teachers discovered these component-composite relationships by measuring frequencies of different response classes and determining the impact of raising the frequency of behavior components on the frequency of the behavior composites. This became an ongoing empirical investigation with each student and each area of curriculum, mostly in clinical rather than experimental settings, resulting in shared generalizations about what behavior components are important.

The pursuit of behavior components became the mission of many precision teachers, instructional designers, and researchers (Haughton, 1972; A. Starlin, 1972). The first and most obvious component-composite relations that were identified with frequency ranges to serve as "aims" were components of elementary arithmetic such as writing and reading numbers; and components of elementary reading such as saying sounds. The search continued for elements of gross and fine motor behavior, for components of more complex verbal and cognitive behavior, and for components of professional behavior such as sales knowledge, use of computer systems, and components of on-the-job analysis and decision-making.

These curriculum developments merged with other sources of instructional design expertise, as in the Morningside Model of Generative Instruction (Johnson and Street, 2004) that incorporated elements of Direct Instruction, mathetics (Gilbert, 1962), and a range of other strategies for analyzing and developing complex cognitive behavior. Binder (1989) extended this work in the FluencyBuilding™ methodology for instructional design and delivery in corporate training.

Discovery of deficit-imposed ceilings created new demands on the design of materials and procedures. Now teachers needed to create materials and procedures for teaching and practicing more elementary components of behavior than originally planned. This demand led to tremendous innovation, from the early efforts to find objects in toy stores and supermarkets that by their physical design and operation allow teachers to practice fine motor components such as squeeze (squirt guns, squeeze bottles, tennis balls), twist (dials, knobs, tops), or pull (ropes, string toys, rubber bands); to procedures for developing elementary factoid fluency with corporate sales people practicing with job aids and call-and-response activities. Headsprout.com's (Layng, Twyman and Stikeleather, 2003) online reading program is a descendent of this effort and represents a masterful job of identifying, teaching and combining components of reading that can be taught with a web-based application. Analyses of behavior components for sales and customer service training (Binder and Bloom, 1989; Binder and Sweeney, 2002) focused not so much on "deficits" as on opportunities to accelerate desired behavior beyond average by accelerating behavior components and providing opportunities to combine them into larger repertoires.

In some respects the history of addressing handicaps or learning disabilities in precision teaching has been the history of removing deficit-imposed ceilings. Early work with learning disabled children identified deficient components of basic academic skills and created materials to practice them. Work with students suffering from motor handicaps led to identification and practice of fine and gross motor components (Desjardins, 1980). Elizabeth Haughton (Freeman & Haughton, 1997) has remediated auditory processing deficits by identifying and accelerating sound-symbol manipulations of various kinds. Much of the most creative and largely unpublished work by precision teachers over the decades has been related to design and implementation of procedures and materials for assessing and accelerating the frequency of deficient behavior components. Many of the articles in this special issue, and in the precision teaching literature as a whole, discuss specific curriculum and material designs aimed at accelerating and combining behavior components.

Handicap-defined ceilings: The final type of flat lines that appear on charts below frequency ranges needed for effective and efficient interaction with the natural environment is commonly attributed to some form of "handicap." In the precision teaching and fluency-based instructional communities, this represents a teaching failure or at least a challenge as-yet unmet. Instruction using Skinner's measure and Lindsey's charts has proceeded for nearly 50 years to address handicap after handicap, raising the ceilings on what had previously been thought to be fixed limitations on behavior frequency. As in many applications of science in the development of technology, the most ardent proponents and developers never say never.

Barrett's (1979) famous data make the challenge obvious: students with labeled learning challenges performed important behavior components less quickly than much younger children in regular classrooms, and far less quickly than adult professionals. Precision teachers defined such deficits in behavior frequency as *handicaps* (although current culture might discourage use of this politically incorrect term). Precision teaching and fluency-based instruction, because they use Skinner's response rate measurement of freely emitted behavior, have the potential for producing important evolutionary developments (Binder, 2005a) in the habilitation and rehabilitation of such deficits. Pressing for the eradication of the first three types of ceilings described in this article, the handicap-defined ceiling reminds us that we have more challenges to address in designing efficient and effective performance development strategies.

Corporate Training Applications Illustrating Removal of Ceilings

Other articles in this special issue address various educational and clinical populations and the application of precision teaching and fluency-based instruction in a range of settings. Previous sections in this article have mentioned examples from a range of learner types. The remainder of this chapter summarizes developments in corporate training and instructional design grounded in the same heritage, but less familiar to many readers.

Early applications of fluency-based instruction in corporations occurred during the 1980's in banks (Binder & Bloom, 1989). After deregulation, banks needed to transform loan officers who typically waited for customers to apply for loans into sales people capable of proactively selling a range of new products and services. An analysis of the required performance indicated that sales people needed to speak with their customers about their business problems and financial needs, and be able propose solutions to those needs offered by the banks. This finding led to identification of behavior components such as talking about customer cash flows, linking financial solutions to business needs, and talking about how those solutions addressed the needs.

These components turned out to be required by nearly all types of sales people in any industry. Creation of fluency-based instructional strategies for accelerating these behavior components and synthesizing composite repertoires led to the founding of a consulting and training firm, Product Knowledge Systems, Inc., that served Fortune 500 sales and marketing organizations with fluency-based sales training. Further developments emerged from similar work with customer service representatives, first in the cellular telephone industry and subsequently in other industries. In addition to the verbal repertoires required of sales people, customer service representatives must master the operation of software (Binder, 1987) and be able to enter, retrieve, and talk about information on multiple online systems while asking questions and applying customer service skills (Binder and Sweeney, 2002). Successful implementation of fluency-based training and coaching for this population extended the generality of previous findings that achieving higher frequencies of behavior components could accelerate composite repertoires.

Corporate training, like regular education, seldom if ever uses timed measurement procedures. Combinations of lectures, workbooks, online instruction and coaching virtually never impose time constraints or attempt to multiply response opportunities. The greatest challenge in applying these methods to corporate training was cultural, persuading sales and service training organizations to use timed practice activities and multiply overall response opportunities (e.g., by factors of 1,000 or more over the course of a multi-week program).

For those organizations that took that risk, the rewards were substantial. Newly hired sales people in banks, trained with fluency-based methods, were often several times more knowledgeable as measured by conventional testing and timed assessment, than sales representatives with years of experience (Binder & Bloom, 1989). By choosing to overcome the measurement-defined ceilings, they opened new avenues for performance development. Reports of trainees practicing on their own time to achieve higher rates of performance on specific exercises were common, since with time-based practice goals and measurement tools, learners could take charge of their own progress (Binder and Sweeney, 2002). In addition, trainees and supervisors developed new approaches to coaching based on the idea that "fluency" is the hallmark of true mastery. It helped that in customer service environments existing measures of productivity include calls handled per hour (in addition to qualitative behavioral checklists pinpointing desired customer service behavior). Consequently, time-based measurement during training seemed more natural and acceptable in call centers than in many other areas of corporate training.

With measurement-defined ceilings removed, trainers recognized the need to transform materials and procedures to eliminate procedure-imposed ceilings and build critical components of on-the-job performance to address gaps between existing and desired performance. Classroom and self-managed learning came to include timed practice with flashcards, rapid question and answer practice between pairs, talking about graphic displays and posters that prompt verbal repertoires, blurting out ideas as quickly as possible, slowing down to speak confidently and at an appropriate pace when synthesizing components, and completing timed "races" to find or enter information in online systems. These training formats were entirely new to corporate trainers, without exception, and demanded that they become coaches not lecturers. The results were often impressive. At one customer service organization (Binder & Sweeney, 2002), fluency-based training for new hires took 1/3 less time, enabled graduates to surpass by 60% call center productivity benchmarks within two weeks of being on the job, ramping up to performance goals 4 times faster than with previous training and supervision methods. The financial and operational impact of these results required no statistical analysis to recognize – they were obvious by observing performers -- and managers became enthusiastic about the methods. Observers in call centers noticed "pumped up" customer service reps more than able to take on their challenging, high-paced job in a fast-moving industry.

The Need for New Performance Management Strategies

An interesting implication of applying the principles and strategies suggested in this article is that most instructional environments require new forms of performance management for effective implementation. In 1:1 settings teachers must learn to use new kinds of materials and procedures, to measure and make new kinds of decisions about performance and learning, and manage the portfolios of many individuals. In larger group instruction, teachers must learn to manage measurement and decision-making in ways that enable individual learners to share the logistical load and become more involved in their own learning, goal-setting, and instructional decision-making. In corporate settings, where achieving goals in fluency-based programs may require self-managed practice outside of scheduled classroom sessions, learners must be given new expectations, feedback, tools, and reinforcement to complete daily practice, measurement, and progress-reporting. In other words, whole new repertoires are required of teachers and learners, some demanding new skills and all needing new tools and contingencies of reinforcement.

While this topic deserves an article of its own, suffice it to say that the need to manage performance surrounding fluency-based programs in corporate settings led to initial applications of Gilbert's (1978) Behavior Engineering Model, and subsequent development of the Six Boxes® Approach to performance management

(Binder, 1998, 2005b). The latter emerged as instructional designers and implementation teams recognized the need to work with managers to whom trainees would report after training, to ensure that the contingencies and enablers on the job would support self-managed practice during training and application of new repertoires after training, on the job.

This approach, now commercialized by The Performance Thinking Network (http://www.sixboxes.com), offers a plain English framework that can be applied to management of performance surrounding and during fluency-based performance development programs.

Summary and Conclusion

The evolution of precision teaching and fluency-based instruction was founded on pristine application of Skinner's rate of response measurement and a mission to translate free operant conditioning methods into classroom procedures. The cascading impact of this starting-place included changes in conventional educational procedures and materials to allow time-based measurement and remove constraints as much as possible from learners' behavior, with the goal of establishing self-paced repertoires suited to natural contingencies and the multi-tasking streams of behavior that occur in daily life and work.

With the modification of materials to allow self-paced responding and time-based measurement, teachers saw that some repertoires failed to accelerate because key behavior components occurred at lower than optimal frequencies. Procedures for developing more "fluent" behavior components sometimes ran into ceilings that many would characterize as handicaps or learning disabilities. Much of the history of precision teaching and fluency-based instruction has been driven by the search for key behavior components and the means of accelerating them to within competent ranges of behavior frequency in order to remove ceilings from learning; and for methods to encourage application of those components in fluent composite repertoires. This approach to measurement, instructional design and instructional delivery has proven effective with many populations, including corporate trainees.

In pursuing this path, precision teaching and fluency-based instruction have been true to the original natural science of behavior as formulated in Skinner's laboratory. Those applied behavior analysts who object to this approach need to explain why their own practices have strayed from the original measurement and designs of the experimental analysis of behavior toward an approach that more resembles the measurement and designs of pre-Skinnerian learning theorists and developmental psychologists. Even the approaches to instructional research and development that they enforce – including hypothesis testing and use of non-standard units of measurement – more resemble traditional educational and developmental research than the inductive approach to discovery and empirical generalization pioneered in Skinner's experimental analysis of behavior and Lindsley's precision teaching.

The focus of ongoing discussion among behavior analysts about precision teaching and fluency-based instruction should shift from arguments about specific formats and instructional methods to investigation of the relative sensitivity of measurement procedures and the potential value of applying Skinner's measure of response probability to the development of repertoires traditionally referred to as "skills and knowledge." Such a shift in the discussion might increase the likelihood of returning applied behavior analysis to its roots in Skinner's science, and could accelerate constructive dialog about behavior measurement, which was the area in which Skinner's contributions were most profound. That, at least, is a long-held hope of the current author.

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