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Developing Behavioral Fluency for Students With Autism

A Guide for Parents and Teachers

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With the increase of students with autism in public schools, alternative schools, and in-home programming, attention to effective learning procedures has increased. A general model based on precision teaching for practicing behavior to fluency is presented as a guide for teachers and parents. This model applies to a wide variety of skills and can be tailored for individual students. The procedure for conducting efficient practice fall into four broad categories: (a) planning the practice routine, (b) developing the practice routine, (c) implementing the practice methods, and (d) analysis of data.

Keywords: *intervention; academic methods; instructional methods; precision teaching; fluency*

Developing Behavioral Fluency for Students With Autism: A Guide for Parents and Teachers

Many people know the famous saying, "How do I get to Carnegie Hall? Practice. Practice. Practice." Equally memorable, Vince Lombardi once said, "Practice does not make perfect. Only perfect practice makes perfect." Such aphorisms pay homage to the power and value of practice. Additionally, both quotations implicitly point to the desired outcome of practice, a state of fluency or automaticity. Although sometimes described slightly differently, both fluency and automaticity functionally refer to a similar outcome, a behavior performed with a high degree of accuracy and speed (Dougherty & Johnston, 1996).

The research base for fluency and automaticity shows pronounced effects. For instance, Bloom (1986) surveyed experts from six fields varying from research neurologists and Olympic athletes to concert pianists and sculptors. Bloom discovered that to achieve such high levels of automatic performance the experts took approximately 12 years of practice with individuals practicing the skill anywhere from 25 to 50 hours a week. The theory of deliberate practice suggests that expert performance in elite performers results from a minimum of 10 years of intensive practice (Ericsson, Krampe, & Tesch-Römer, 1993).

That practice results in automaticity for elite/expert performers may not surprise many readers. Indeed, the link between active engagement/practice and subsequent improvement within many fields like education appears well documented (Ellis & Worthington, 1994; Heward, 1994; Rosenshine, 1997). Practice techniques for developing fluency efficiently, however, have recently received attention. As a method for measuring student behavior and facilitating decision making, precision teaching offers teachers a means for developing and evaluating practice procedures leading to fluency.

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White (2005) defined precision teaching as a system for "defining instructional targets, monitoring daily performance, and organizing and presenting performance data in a uniform manner to facilitated timely and effective instructional decisions" (p. 1433). As a result of monitoring performance daily and focusing on variables that affect learning, precision teachers have produced specific and efficient methods that lead to fluency.

Why Autism?

A recent Centers for Disease Control and Prevention report estimates the prevalence of autism spectrum disorders as 1 child per every 150 (Centers for Disease Control and Prevention, 2007). The influx of vast numbers of children with autism in the school systems will pose a number of challenges for teachers. These problems stem from how the core deficits of autism affect a student's ability to access traditional learning environments. These deficits

> . . . involve a distinct constellation of behavior symptoms, incorporating impairments in three developmental domains: (a) impairment of reciprocal social interactions, (b) impairment in verbal and nonverbal communication, including problems in imaginative activity, and (c) impairment in behavior, including a markedly restricted repertoire of activities and interests. (Gabriels & Hill, 2002, p. 26)

Because of the degree of heterogeneity among students with autism, teachers cannot rely on one uniform curriculum for all students. Some students need more help with communication whereas others require greater assistance with social development. Although students with autism have unique sets of strengths and weaknesses, all would benefit from a variety of research-based educational practices. One such practice, precision teaching, offers a method for monitoring student progress across any skill repertoire such as play, academics, or functional communication. Furthermore, precision teaching fosters the development of fluency which aids in the generalization and maintenance of skills. As Scott, Clark, and Brady (2000) stated, "Given the acknowledged generalization problems facing students with autism, developing fluent performances should be considered absolutely essential" (p. 312).

With the emergence of applications of precision teaching for students with autism (Cauley, Brian, & Snider, 2003; Cohen, 2005; Fabrizio & Moors, 2003; Kerr, Smyth, & McDowell, 2003; Kubina, Morrison, & Lee, 2002; Kubina & Wolfe, 2005; Zambolin, Fabrizio, & Isley, 2004) a general model for efficiently building fluency for students with autism can be described.

Furthermore, the general model provides a practical guide for teachers and parents. By creating this guide, existing precision teaching research and methods can be translated so that teachers and parents may more readily apply the method for students with autism. As indicated by Heward (2003), a gap exists between the exposition of researched-based methods and their use in special education.

The general model uses a systematic practice procedure derived from precision teaching and other sources of researched methods aimed at promoting successful learning (Binder, 1996, 2003; Ellis & Worthington, 1994; Haughton, 1972; 1980; Kubina, 2005; Kubina & Morrison, 2000; Lindsley, 1995, 1997; Maloney, 1998). The procedures for conducting efficient practice fall into four broad categories: (a) planning the practice routine, (b) developing the practice routine, (c) implementing the practice methods, and (d) analysis of data.

Planning the Practice Routine

Allocate and schedule time for practice routines. In their research review, Ellis and Worthington (1994) listed engaged time as the first principle of effective teaching. To maximize students' time engaged with learning, Ellis and Worthington wrote, "When planning instructional activities, time should be considered as an important instructional principle" (p. 15). Allocating time for practice ensures students will have direct engagement with the selected skill. The following example of scheduling time for practice routines comes from a behaviorally based school for children with autism. As shown in Figure 1, each student's schedule illustrates their planned activities across a school day. Within the school day, students participate in a variety of academic and non-academic activities. Subjects may include math, reading, gym class, social skills groups, and community-based instruction. Also, students have time allocated for practicing their fluency targets. Specifically, referencing Student A's 10:10 a.m. time block, the teacher has allocated 10 minutes for practicing gross motor fluency. Within this 10-minute allocation the teacher will not only implement the practice routine but also set up practice materials, analyze performance, provide feedback to the student, and provide reinforcement.

Selecting a behavior for practice. Three considerations affect the selection of behavior for practice. The first consideration advises teachers to choose behavior beyond the acquisition stage of learning. The levels of learning include acquisition, fluency, maintenance, and

TIME	STUDENT A	STUDENT B	STUDENT C	STUDENT D
9:00-9:15	Entry Routine			
9:15-9:30	Group: Calendar/Orientation			
9:30-10:00	Group math instruction	**1:1 Math facts fluency**	Group math instruction	**1:1 Math facts fluency**
10:00-10:10	**Dressing fluency (Shirt)**	Change for gym class		
10:10-10:20	**Group – Gross Motor fluency practice (in gym)**			
10:20-11:00	Gym Class – small group sport activities			
11:00-11:15	Change clothes and bathing			
11:15-11:45	**Group: Reading fluency (10 min)** Group reading activity		Reading group	
11:45-12:15	LUNCH			
12:15-12:45	Recess			
12:45-1:15	**Fine motor fluency (10 minutes)**		Thematic Art Activity	
1:15-1:45	Occupational therapy	Cooking activity	**Articulation therapy fluency (10 min); Speech therapy**	Cooking activity
1:45-2:00	Cooking activity	**Word imitation fluency (CVC, VC, CVCC); Speech therapy**	Cooking activity	Occupational therapy
2:00-2:20	Independent activities; School store OPEN			
2:20-2:40	**Answering personal information questions fluency (10 min);** Social skills group			
2:40-3:00	Pack up and complete exit routine			

Figure 1. A classroom schedule showing daily instruction and practice activities for four students.

generalization (Alberto & Troutman, 2003). Acquisition refers to the quality of a response. Teachers measure acquisition by the accuracy of the behavior (e.g., percentage correct). Student behavior during the acquisition level may include frequent errors and occur at a slow or irregular rate. Therefore, teachers must decide what level of accuracy (e.g., 80%, 90%, 100%) the student must reach before moving the behavior to a practice routine leading to the fluency level. As an example, when a student can correctly identify numerals 1 to 10 with a 90% or greater accuracy, a teacher may consider this skill acquired. Selecting a behavior with which the student continues to make frequent errors may result in a frustrating situation where the student may practice errors or continue inconsistent performance.

The second consideration asks teachers to examine a behavior in regard to element/compound relations. Behavioral elements, sometimes referred to as component behaviors, can combine to form a behavioral compound, also referred to as a composite behavior (Binder, 1996; Haughton, 1972, 1980; Kubina, Young, & Kilwein, 2004). For example, a fluent pincer grasp constitutes an element of the following compound behaviors: picking up a pencil, using a toothbrush, or manipulating clothing fasteners.

The third factor involves selecting behaviors that have far-reaching effects. Rosales-Ruiz and Baer (1997) call these behaviors, which facilitate increased opportunities for new learning experiences, behavioral cusps. Bosch and Fuqua (2001) proposed a set of five criteria for identifying behaviors that may serve as behavioral cusps.

1. Behaviors should allow the student to access new environments and reinforcers. Making eye contact could allow a student to initiate communication or engage in social interactions.

| Sound Fluency |
| m, s, t, e |

t	s	e	t	m	m	(6)
s	t	e	m	e	s	(12)
t	m	t	e	s	e	(18)
e	s	m	t	e	m	(24)
s	t	e	m	t	s	(30)

Figure 2. A letter-sound practice sheet illustrating features conducive for building fluency.

2. Selected behaviors promote generative learning. For instance, writing vertical, horizontal and diagonal lines and drawing circles results in a student being able to write an entire uppercase and lowercase manuscript letters (Zaner-Bloser, 1999).
3. Behaviors may compete with inappropriate behavior. Responding to an instructional signal from a teacher competes with calling out answers.
4. Chosen behaviors may affect people who control consequences for the student. For example, a student is taught to recruit positive teacher attention (Alber & Heward, 2000) from a teacher by asking, "Did I do that right?"
5. Behaviors should have social validity for the student. A student who raises his hand in school has social validity whereas a therapist may deem this behavior as not socially valid for her one-to-one teaching sessions.

Determining the range of behavior included in the practice set. When practicing any skill, a range of behaviors will exist defining the scope of that particular skill. For instance, reading consists of a number of decoding and comprehension skills that must co-occur for efficient and fluent reading (Carnine, Silbert, Kame'enui, & Tarver, 2004). Within decoding, a student might practice saying sounds represented by letters. In the SRA program *Reading Mastery I Classic Edition* (Engelmann & Bruner, 1993) students learn 40 distinct letter sounds. When practicing letter sounds, a teacher must decide what range of sounds to include in the practice set. Figure 2 shows a practice sheet with 4 of the 40 possible letter sounds.

A number of factors may impact selection of the range of behaviors included in various practice sets. First, starting with a limited slice of the fluency target (e.g., 4 letter sounds out of 40) may potentially reduce frustration because the learner has fewer behaviors to master within the practice set. Furthermore, the learner may subsequently reach the fluency aim faster when compared to practice with a large slice (e.g., 20 letter sounds out of 40).

Second, a student may practice cumulative sets of behaviors. In the letter sound example the ultimate set came to 40 letter sounds. Therefore, the student may practice the first 4 letter sounds and on achieving fluency begin a new practice sheet with an additional 4 letter sounds. Following this pattern, the student will eventually practice 10 iterations of the practice sheet (i.e., 4, 8, 12, 16, 20 . . . 40). However, when practicing vocabulary a student could potentially practice 1,000 words and still not meet the ultimate practice set. When selecting behaviors that do not lend themselves to cumulative practice such as vocabulary, teachers may decide what behaviors to include based on functional, curricular, or individual considerations.

Developing the Practice Routine

Materials. When practicing any type of skill the materials used become vital to the success of that practice. For example, a piano player needs a piano to practice. The materials required depend on the skill to be practiced. When gathering materials for practice routines, teachers should look for fluency builders, factors that promote fluency, and fluency blockers, factors that prevent fluency. Binder (1996) defined fluency builders as materials with "many examples, easy to manipulate or use, efficient use of paper, space and movement; succinct worksheets and directions; easy-to read and comprehend" (p. 189). Subsequently, fluency blockers would include materials with "Too few examples; materials that are difficult to use, waste paper, movement, etc; unnecessarily wordy worksheets and directions; difficult-to-read and comprehend" (Binder, p. 189). Figure 2 shows a practice material constructed with features that promote fluency such as having more examples than can be responded to during the counting time, landscape setup facilitating optimal responding, and appropriate spacing between letters.

Data collection sheets. Teachers collect data by monitoring student performance and counting correct and incorrect responses. Then the teacher records data for each practice trial on some type of data collection sheet. Figure 3 shows a generic data sheet for recording practice data. There are locations for student name, teacher name or initials, date, timing interval, number of correct and incorrect responses, a general comments section, and the fluency target.

Student Name: _____   **Fluency Target:** _____

Date & Initials	Timing interval	Aim	General Comments	Timing #1 Corrects / Incorrects	Timing #2 Corrects / Incorrects	Timing #3 Corrects / Incorrects	Timing #4 Corrects / Incorrects	Timing #5 Corrects / Incorrects
				/	/	/	/	/
				/	/	/	/	/
				/	/	/	/	/
				/	/	/	/	/
				/	/	/	/	/
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				/	/	/	/	/
				/	/	/	/	/

Figure 3. Generic data sheet used for recording practice data.

Selecting a fluency aim. A teacher sets a fluency aim as a goal for determining when the student has met the criteria for fluency. Measuring students' performance in relation to the fluency aim helps the teacher make informed decisions regarding student progress. Fluency aims show current performance level and its relation to the aim. By comparing student performance to the fluency aim, the teacher can quickly identify if the student has met the terminal goal or if additional practice is required.

A fluency aim represents the terminal goal of practice. When students reach the fluency aim, they can begin practicing new skills in a set (e.g., practicing sums 6–18 after sums 0–5) or begin practicing a new skill (e.g., practicing double-digit addition after single-digit addition). Precision teaching research has shown three critical learning outcomes: (a) long-term retention, (b) endurance or resistance to fatigue and environmental distraction, and (c) application or skill elements combining to form a skill compound, associated with the achievement association with the attainment of fluency aims. Additional information regarding fluency research is available (see Binder, 1996, 2003; Haughton, 1972, 1980; Johnson & Layng, 1992; Kubina & Morrison, 2000).

Although a number of fluency aims exist for academic behaviors (Beck & Clement, 1991), fluency aims specific to designing instruction for students with autism have only started to emerge (Kubina & Wolfe, 2005). With these aims not currently available in the professional literature regarding students with autism, a user-friendly method for teachers to determine aims is necessary. Koorland, Keel, and Ueberhorst (1990) offered a straightforward method for setting aims.

Teachers use peer data from students without disabilities to set aims according to Koorland et al. (1990). To create the aim, the teacher would select a group of peers who have mastered or appeared to have obtained fluency with the target skill. The teacher samples the peer's performance for 3 days and selects the median correct rate among the frequency scores. This score becomes the fluency aim. This procedure does not involve attaining a normative sample of average performance. "An average regular education student could be chosen, but average performance poses potential difficulties since it may represent mediocre achievement" (Koorland et al., 1990, p. 65). Other methods exist for generating fluency aims. For example, teachers can use an adult/child proportional formula (Eaton, 1978), or adult aims as described by Binder (1996). Currently, research does not indicate a favored method for setting student aims.

Selecting a counting time. A counting time refers to the time designated for recording a targeted behavior (Kubina, 2005). Stated differently, the counting time reports the exact amount of time one spends counting a behavior of interest. A teacher who records how many numerals a student points to during 1 minute has used a 1-minute counting time. Emerging research may guide teachers in selecting the best counting times. There are two practical guidelines that may assist in the selection of appropriate counting times. The duration of the counting time interval must capture a representative sample of the targeted behavior. For instance, a student practicing answers to *wh* questions should have a counting time long enough to allow multiple answers. A 30-second counting time would permit a teacher to count sufficient examples of the target behavior. Additionally, the duration of the counting time should not burden the student's ability to repeatedly practice the skill. A student with articulation problems should not practice sound production for a 2-minute counting time. This duration of practice could cause the student to become fatigued and evoke more errors.

Implementing the Practice Routine

When implementing a practice routine, specific steps will help facilitate an efficient application of a structured practice routine (see Figure 4). The first step of implementation involves positioning the learner appropriately with regard to the target skill. Target skills may vary from motoric skills such as gross motor imitation and utensil use to academic skills such as orally reading

Practice Routine Implementation Checklist		
Teacher Implementation Steps	**Integrity Check**	**Notes/Observations**
1. Position learner appropriately with regards to the target skill.	(Yes) - No	
2. Arrange necessary materials within easy reach of both student and teacher.	(Yes) - No	*Great organization of materials, you started the trial very quickly!*
3. Set timer for selected counting time.	(Yes) - No	
4. Gain learner's attention.	(Yes) - No	*Loved the way you interacted with Jessie just prior to starting the trial, really got her attention!*
5. Signal the learner to initiate responding using specific instructions.	(Yes) - No	
6. Start timer upon initial student response.	Yes - (No)	*Timer started too early on practice trial one.*
7. *Following the timed practice trial*, deliver appropriate reinforcement for participation and record performance on data sheet.	(Yes) - No	
8. Provide feedback to the learner for errors that occurred within timed practice trial.	(Yes) - No	
9. Document relevant variables that may have significantly affected learner performance or teacher implementation of the timed practice trial.	(Yes) - No	*Excellent job noticing how a classmate's disruptive behavior affected Jessie's performance on the 3rd trial.*
For subsequent timed practice trials, repeat steps one through eight.		

Learner: *Jessie Keckler*   Date: *10-22-06*

Teacher: *Ms. Stacey*   Behavior: *Letter sounds*

Observer: *Ms. Cowher*

Performance Review:
Ms. Stacey did a good job following her practice routine steps for Jessie. On the first practice trial Ms. Stacey started the timer before Jessie began to say the first letter sound. Following feedback, Ms. Stacey corrected this error on subsequent practice trials.

Figure 4. Steps to facilitate an efficient application of a structured practice routine.

text and mathematical computations. Therefore the target skill will dictate proper placement of learner and teacher. For instance, a teacher implementing one-to-one gross motor imitation practice would sit 2 to 4 ft in front of the learner. Conversely, a teacher applying a basic addition math fact practice routine for a small group of three students would need to have visual access to all three students throughout the timing.

The second step of the implementation checklist involves the efficient arrangement of materials. Given the target skill and the materials involved, both the teacher and student must have ready access to all practice items. For example, a learner practicing letter sound identification would require a practice sheet, as shown in Figure 2, placed on the table directly in front of her. Eliminating distracting items in the practice environment (e.g., toys removed from the table area) reduces the likelihood of interrupted performance while enhancing attention toward the practice materials (Scheuermann & Webber, 2002).

The third step of the implementation checklist entails the use of a timing device. The timing device signals the beginning and end of the practice trial given the selected counting time. Setting the timer will depend on the type of timing device used. An array of

timing devices exists such as wall clocks, wristwatches, and stopwatches. Precision teachers, however, tend to use countdown timers (Scott et al., 2000). Wall clocks, wristwatches, stopwatches put the teacher at a disadvantage because they generally count up toward the terminal timing thereby requiring the teacher to continually attend to the timing device. Electronic countdown timers provide two obvious advantages for timings: (a) most have buttons permitting the entry of specific timings and (b) they present auditory and sometimes tactile signals.

In the fourth and fifth steps of the implementation checklist the teacher gains the learner's attention and then provides the specific instructions related to the practice activity. A teacher may gain the attention of a learner by saying his name, tapping an object (e.g., practice materials), or touching the learner's hand or arm. Once the teacher has the learner's attention, instructions are given to start the practice trial (e.g., "When I say begin you start saying the letter sounds. Ready?" Please begin). As soon as the learner begins to respond (i.e., says the first letter sound) the teacher starts the timer, the sixth step of the implementation checklist.

The seventh step of the implementation checklist has the teacher monitoring the learner's performance and

keeping track of correct and incorrect responses. The teacher may use tick marks, clickers, or a personal digital assistant to form a record of the learner's performance during the practice trial. For instance, a teacher tracking letter sounds may circle mispronounced sounds on her own copy and draw a line after the last sound said within the counting time. At the sound of the timer the teacher delivers appropriate reinforcement for participation and records the learner's performance on a data sheet (see Figure 3), thus completing the eighth step of the implementation checklist.

In the ninth step of the implementation checklist the teacher provides feedback to the learner for all errors that occurred within the timed practice trial. Contingent on the specific skill, feedback for errors may involve (a) the teacher modeling the correct response, (b) having the learner imitate the correct response, or (c) asking the learner to independently produce the correct response. Error correction used during practice differs from error correction used during acquisition. Although all forms of error correction serve the same purpose (i.e., decrease the repetition of errors), the error correction/feedback procedure occurs at a different level of learning. Namely, practicing to fluency occurs during the proficiency level, whereas acquiring new information occurs during the acquisition level (Alberto & Troutman, 2003).

Analysis of Visual Display of Student Performance and Decision Making

The link between visually displaying student performance and making responsive decisions has an empirical foundation. Fuchs and Fuchs' (1986) meta-analysis of systematic formative evaluation demonstrated that students with disabilities had significantly greater results when teachers regularly used decision rules to analyze student data. Also, Fuchs and Fuchs noted, "when data were graphed, effect sizes were higher than when data simply were recorded" (p. 205).

A hallmark of precision teaching involves the daily collection and display of data. This rapid flow of information allows teachers to effectively monitor progress and make fast, responsive decisions (Maloney, 1998). Furthermore, the specially designed standard *celeration* chart increases the efficiency of reading data because of its standard nature (White, 2005). Although a full description of benefits of using the standard celeration chart fall beyond the scope of this article, interested readers may consult the following sources for more information: Graf and Lindsley, 2002; Lindsley, 2005; McGreevy, 1983; Pennypacker, Gutierrez, and Lindsley, 2003.

Conclusion

Research shows that attaining fluency results in greater retention or recall, better attention and less fatigue, and the ability to apply previously learned behaviors to more advanced skills (Binder, 1996). Because students with autism can have deficits with social skills, communication, and language usage and other learning problems, practicing selected skills to fluency may foster positive outcomes. Although the research has yet to determine how significant fluency outcomes may be, emerging studies suggest favorable outcomes. Furthermore, the history of education and human performance shows a powerful, direct link between practice and subsequent performance. A general model for practicing efficiently is derived from precision teaching. Here teachers and parents can thoughtfully plan or analyze a practice routine specific to the needs of the student. Then, the practice methods are implemented and carefully monitored. Finally, the analysis of data through visual displays permits a full view of student progress and shows the effects of adjustments and modifications, if necessary, to the practice routine. The ultimate goal of this practice routine is a well-practiced, fluent behavior.

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