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APPLIED BEHAVIOR ANALYSIS: BEYOND DISCRETE TRIAL TEACHING

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We discuss the problem of autism-specific special education programs representing themselves as Applied Behavior Analysis (ABA) programs when the only ABA intervention employed is Discrete Trial Teaching (DTT), and often for limited portions of the school day. Although DTT has many advantages to recommend its use, it is not well suited to teach the full range of cognitive, social, academic, leisure, and functional living skills children with autism and related disorders need to develop and generalize to varied natural environments. DTT also does not address the treatment of behaviors that can interfere with instruction and the acquisition, generalization, and maintenance of skills many children with autism bring to instructional situations. We describe a comprehensive program of ABA services for children with autism and briefly discuss the various interventions and their applications and combinations to achieve broad improvement in many different skill areas. In our view, "true" ABA programs are comprised of multiple assessment and intervention methods used individually and dynamically to achieve the best results. © 2007 Wiley Periodicals, Inc.

Over the past decade, there has been a marked increase in the number of students identified with autism in the United States. For example, in the state of Maine, special education identification of students with autism has increased steadily from 158 in 1995 to 1,255 in 2004, representing a nearly 800% increase over the past decade (Maine Department of Education, 2005). By comparison, the school-age population in Maine has decreased by approximately 6% during the same time period. Paralleling the increased numbers of students has been the growth of autism-specific special education programs, many of which utilize applied behavior analysis (ABA) methodologies. Although comprehensive ABA-based special education programs were a rarity only a few years ago, scores of programs and practitioners claiming to offer ABA methodologies have recently emerged. Observations of many of these programs by the authors indicate one consistent finding; namely, there is considerable variation in the types of assessments and interventions used among school-based programs that purport to be an "ABA program." Many of these school-based ABA programs appear to be limited in scope, and relatively few programs appear to offer a full array of methodologies shown to be effective with students with autism and related developmental disorders.

A recent observation by the first author of a third grader with autism is illustrative of this narrow application of ABA methodologies. The student was placed in a self-contained special education classroom comprised of six students with autism, one special education teacher, and four educational technicians. The special education program was described as an "ABA classroom." Posted on the wall of the classroom was a daily schedule that listed in chronological order the tasks and activities that students would participate in throughout the school day. What was striking about this schedule was the minimum amount of time devoted to ABA intervention, which was limited to one 45-min session in the morning and another session in the afternoon. Further inquiry revealed that students' Individual Education Plans (IEPs) were dominated by instructional objectives that focused on the acquisition of pre-academic skills (e.g., imitation of gross motor movements; pointing to body parts; labeling objects; receptive and expressive identification of letters, shapes, numbers, and colors; matching words to objects). The instructional methodology used to teach these skills was Discrete Trial Teaching (DTT). DTT was offered in a highly prescribed

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fashion. Most of the time, it consisted of one-to-one instruction with the student seated at a table across from the teacher. Classroom observations over several school days confirmed that systematic instruction procedures were used only during the two 45-min sessions per day, administered by only one educational technician who was assigned to "run ABA programs." In addition, the only ABA method used was DTT, and the only data collected on student performance throughout the school day occurred during the two sessions.

This is problematic for several reasons. First, intensive and systematic instruction was limited to 1.5 hr per day, or approximately 7.5 hr per week. This is far short of the recommended 25 to 40 hr of instructional services (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; National Research Council, 2001). Second, although DTT may be a very effective method for teaching specific skills, it is not applicable to teaching sequential or chained responses (e.g., self-help, recreation-leisure, vocational skills, etc.). Third, other ABA instructional methods (e.g., incidental teaching; task analysis with prompting) that have been shown to be effective with persons with autism were not being used. Fourth, conducting instruction within a narrow range of settings and staff reduces the probability of generalization of skills to more natural aspects of the school day and to home and community settings. Fifth, multiple opportunities are missed throughout the school day to teach and reinforce skills within natural settings. Finally, behavior analytic procedures for assessing, treating, and recording interfering behaviors such as self-injury, aggression, tantrums, and stereotypy were not being used.

The purpose of this article is to offer a definition of ABA, to identify the components of comprehensive and effective ABA services for students with autism and related disorders, and to discuss the broad range of ABA-based intervention procedures that have been found to be effective in teaching and treating students with autism.

What Is ABA?

ABA is the technology side of a scientific discipline known as Behavior Analysis.[1] It involves the process of systematically applying interventions based upon empirically derived principles of behavior to improve socially meaningful behaviors, and to demonstrate that the interventions employed are responsible for the improvement in behavior (Baer, Wolf, & Risley, 1968). Simply put, ABA is sound educational practice. Over the past 50 years, thousands of published research studies have documented the effectiveness of ABA across a wide range of populations (e.g., children and adults with mental illness, autism, developmental disabilities, and learning disorders), interventionists, (e.g., parents, teachers, staff, administrators), settings (e.g., schools, homes, institutions, group homes, hospitals, business offices, sports venues, roadways), and behaviors (e.g., academic, social, leisure, and functional life skills).

ABA methods are used to support persons with autism and related developmental disabilities in at least five ways: (a) to teach new skills (e.g., systematic instruction and reinforcement procedures to teach functional life skills, communication skills, or social skills), (b) to reinforce and maintain previously acquired skills, (c) to generalize behavior from one situation to another (e.g., teaching and transferring social skills to natural settings), (d) to restrict or narrow conditions under which interfering behaviors occur (e.g., modifying the learning environment; antecedent modification), and (e) to reduce interfering behaviors by discontinuing their reinforcement and reinforcing

[1]As is the case for many scientific disciplines, two branches of the discipline emerge. The first is the basic science branch that is aimed at describing the fundamental nature of the subject matter. The second is the technological branch that uses the findings from basic research to develop technologies that have practical benefits for society. For Behavior Analysis, these two branches are the Experimental Analysis of Behavior (basic science) and Applied Behavior Analysis (technology).

competing replacement behaviors. These methods are incorporated into ABA educational programs and are comprised of two major components. The first is assessment of behavior in the educational context, and the second is intervention based upon the assessment to improve academic, vocational, life-skills, and social behavior.

Assessment

Measurement of behavior in various environmental contexts is an ongoing process that is integral to ABA programs. Assessment can be said to drive the design and modification of interventions. Assessment *before* intervention involves identification of the unique behaviors, needs, and characteristics of the individual, evaluation of the environment (including resources of caregivers and staff), and description of the complex interactions between the individual and his or her environment. The results of assessment are used to design individualized intervention plans and procedures. Assessments are conducted *during* the delivery of interventions to monitor progress. Analyzing performance data on a regular basis allows the intervention team to clearly evaluate the efficacy of interventions and, when necessary, to make modifications to programs to enhance their effectiveness or to begin to withdraw intervention components that are no longer needed. The methodology for objectively evaluating the effectiveness of interventions within the field of ABA is the use of single-case experimental designs.

Intervention

Interventions are those treatments, instructional procedures, and therapies that are implemented with the purpose of increasing adaptive, prosocial behavior and decreasing interfering behaviors. ABA programs are characterized by the use of interventions that have been empirically demonstrated to be effective with a given population in a particular context. This practice is widely known as evidence-based treatment (Brown-Chidsey & Steege, 2005; Kazdin & Weisz, 2003). ABA interventions have been subjected to thorough review and analysis, and their use has been demonstrated to produce meaningful behavior change that is not the result of extraneous or unrelated variables. The ABA research literature includes a vast array of evidence-based interventions. When interventions are matched to the unique characteristics of the learner, the effectiveness and efficiency of interventions are maximized. Effective ABA practitioners consider a broad range of interventions in designing individualized programs for persons with autism and related developmental disabilities.

Components of Comprehensive and Effective ABA Programs

In reviewing the literature on best-practices methodologies for students with autism, several themes emerge. The consistent finding from several decades of treatment research for children with autism is that the intervention of choice is ABA (Green, 1996). The National Research Council (2001) identified the following characteristics of effective interventions for young children with autism: early intervention; intensive instructional programming (defined as 5 days per week, 25 hr per week, and 12 months per year); the use of systematic instruction (e.g., DTT, incidental teaching); one-to-one and small-group instruction; instructional objectives addressing social, communication, adaptive living, recreation-leisure, cognitive, and academic skills; ongoing monitoring of the effectiveness of interventions; an emphasis on the generalization of skills; and opportunities for supported interaction with typically developing students.

Intensive and comprehensive ABA-based interventions have been described by numerous authors who have recommended intervention in multiple settings (i.e., home, school, and community), 35 to 40 hr per week of intervention for children over 3 years of age, 50 to 100 learning opportunities per hour, procedures to address problem behavior (e.g., functional behavioral

assessments and behavioral support plans), data-based decision making and analysis (i.e., accurate collection *and* analysis of relevant data), and ongoing supervision and evaluation of staff to ensure treatment integrity and promote ongoing professional development (Baer, 2005; Howard et al., 2005; Maurice & Taylor, 2005; Wilczynski et al., 2003). In short, best-practice services for children with autism are multifaceted and include a wide range of ABA methodologies to realize broad and durable behavior change in this population.

Beyond DTT

Many special education programs serving students with autism equate ABA with DTT. Although DTT is an important instructional component of ABA programs, DTT in isolation does not constitute comprehensive ABA services for children with autism and fails to provide the range of interventions needed to produce broad improvement.

Definition of DTT

DTT is an orderly and intensive instructional methodology that involves four components: (a) presentation of a discriminative stimulus (SD), (b) occurrence or approximation of the targeted response, (c) delivery of a reinforcing consequence, and (d) a specified intertrial interval (Brown-Chidsey & Steege, 2004; Koegel, Russo, & Rincover, 1977). DTT is the oldest and most ubiquitous of ABA teaching methods and is used in numerous variations ranging from rote memorization to abstract forms of Socratic dialogue (Baer, 2005). Anderson, Taras, and Cannon (1996) and Taylor and McDonough (1996) provided numerous examples of DTT interventions and described each step involved in using it. For example, in teaching a student to identify objects (e.g., cup, bowl, spoon), one instructional trial might involve the following sequence of steps: (a) The teacher and student sit in chairs at a table facing one another; (b) the teacher engages the child's attention; (c) the teacher says "Touch the _____;" (d) social and edible reinforcement is provided following a correct response; (e) if the child does not offer the correct response in 3 to 5 s, the teacher offers an instructional prompt (e.g., a gesture prompt by pointing to the correct object, a physical prompt by guiding the students hand to the correct object, or both); and (e) the teacher records data, thereby providing an intertrial "break." There are several variations that could be used to teach this one skill, including errorless learning procedures, modifying the number of stimuli in the instructional field, providing differential and intermittent reinforcement, and teaching these skills within mealtime situations.

It is important to recognize that DTT in itself is not a good or a bad method, and like any teaching method, it may be implemented on a continuum from very well to very poorly (Baer, 2005). Common mistakes made by individuals using DTT include not varying the content and timing of trials when acquisition is slow, providing inadequate positive reinforcement for correct responses (e.g., an edible reward; a special, brief activity; a hug; a song), and using unnecessarily harsh consequences when the child does not respond or responds incorrectly (Baer, 2005).

Misapplications of DTT

The authors have conducted numerous functional behavioral assessments (FBAs) of students with autism and related disorders who exhibited a wide range of interfering behaviors (e.g., aggression, self-injury, tantrums) during instructional programming. In several cases, when a student was presented with a typical DTT instructional environment (i.e., desk, chair, clipboard, instructional materials, reinforcers, and one-to-one instruction), the student immediately engaged in interfering behaviors or reacted negatively to frequently misdirected and incorrect implementation of DTT instruction. On numerous occasions, the FBAs revealed that these students had a history of

receiving inflexible DTT (i.e., a fixed number of learning trials per instructional objective with a rigid expectation that all trials must be completed before the student may "take a break").

The misapplication of DTT procedures may lead to students with autism engaging in low levels of escape-motivated behavior (e.g., turning away from the instructor, pushing materials away, signing "break," verbalizing "no") during the initial trials, followed by more extreme escape-motivated behaviors (e.g., self-injury, aggression) during subsequent trials. Eventually, the interfering behavior may escalate to a point where instruction will be interrupted. In many cases, the instructional assistant may inadvertently signal the termination of the teaching session by removing materials, backing away from the student, and/or removing the child from the immediate instructional environment.

Over time, these students may learn to be very efficient with their presentation of extreme interfering behaviors by exhibiting such behaviors during the initial stages of DTT or merely at the sight of a typical DTT instructional setting. Too often, what may have started as an effort to engage the student in DTT to teach specific skills ends as a modified form of DTT in which (a) the discriminative stimulus was the presentation of the task, (b) the response was the interfering behavior, and (c) the cessation of the task served to negatively reinforce the interfering behavior. Based on the results of an FBA, an individually tailored behavioral support plan can be used to increase participation in instructional sessions and to decrease interfering behaviors. Behavioral support plans for students with autism and related disorders should often include some or all of the following interventions: functional communication training, antecedent modification (e.g., shifting to errorless learning or incidental teaching models), increased positive or negative reinforcement (i.e., breaks following appropriate behaviors), interspersed trials, and shaping procedures.

Advantages and Disadvantages of DTT

Implemented correctly, DTT clearly is one of the most powerful tools available for teaching children with autism; however, although DTT procedures can be highly effective in teaching single *units* of behavior (e.g., practicing a tennis serve over and over, color recognition, verbal requests for tangible rewards), they are not well suited to teaching *sequential* behaviors (e.g., making a bed; brushing teeth). In their manual describing methods of assessing and teaching language skills to children with autism and related disorders, Sundberg and Partington (1998) described several advantages and disadvantages of DTT procedures, which are summarized in Table 1. It is clear that DTT has many advantages to recommend its use. Although the procedures have a number of disadvantages as well, most can be offset by using DTT in conjunction with other ABA methods that teach skills requiring sequential behaviors and promote generalization of skills across people and natural contexts.

Interventions Beyond DTT

Incidental teaching (IT; Hart & Risley, 1975, 1982) is a well-established procedure for teaching social, communication, and academic skills to children with autism and related disorders. In contrast to DTT—in which teaching opportunities are restricted to structured, adult-directed activities—IT takes advantage of the child's naturally occurring motivation for objects or activities (Wilczynski et al., 2003). For example, consider a situation in which a preschooler is playing with blocks. The blocks are different colors, and each has a capitalized letter of the alphabet printed in large white letters. Taking advantage of the child's attention to the blocks, the teacher verbally states: "Show me the blue block." The child responds by pointing to the blue block, and the teacher responds with social reinforcement (e.g., "Great job showing me the blue block").

Charlop-Christy and Carpenter (2000) described Modified Incidental Teaching Sessions (MITS) as a methodology that combines aspects of both IT and DTT. MITS uses basic DTT procedures to

Table 1
Some Advantages and Disadvantages of DTT

Advantages of DTT	Disadvantages of DTT
• Allows for numerous training trials • Easy for many different staff to use • Good way to develop specific language skills • Ease of use in a classroom setting • Instructional stimuli and detailed curriculum provided to staff • Target responses are known and easily identified • Contrived consequence is often readily available and easy to deliver • Data collection is relatively straightforward • Progressive steps in the curriculum clearly delineated • Progress or lack thereof is measurable • May help to establish "ready to learn" behaviors (e.g., attend to teacher, expectation of reinforcement for correct response, ability to make discriminations, learns to sit and "work," acquires an increased tolerance of demands)	• Requires additional procedures to promote generalization • Prompts to respond often not present in natural settings • Primarily a teacher-directed activity • Immediate and powerful reinforcers often not available outside of the training session • The drill nature of the training may generate rote responding • Nonfunctional nature of the training may generate escape and avoidance behaviors • The interaction between the speaker and the listener is very different from that observed by typical speakers and listeners

Note. Adapted from Sundberg & Partington (1998).

teach specific skills within the context of naturally occurring, functional, and motivating conditions. For example, the teacher may take advantage of a child's interest in playing with a ball by teaching the child to teach expressive language skills during a naturally occurring play situation (e.g., point to the ball, say "What's this?," provide prompting as necessary, deliver reinforcement, pause and repeat at the next opportunity). This is a planned instructional session involving the same instructional steps used during traditional DTT, but the context has shifted from a table–chair setting to the natural environment. Unlike traditional IT—in which only one trial might be expected—with MITS, multiple trials can be arranged to achieve the benefits from the repetition required by many children with autism.

Further, consider an example in which a school psychologist used the MITS procedure to increase social initiations of a child with autism during a "break activity" within the student's school program. During baseline, no occurrences of independent initiations of social interactions with staff or peers were recorded, although the student was observed looking at a photo album which included photographs of both him and his family participating in high-preference activities (e.g., sailing, birthday party). To teach social-initiation skills, the intervention took advantage of the child's interest in the photo album. First, the school psychologist approached the child, but withheld attention until the child initiated a social interaction. When the student exhibited the targeted social interaction, social reinforcement (i.e., the school psychologist looking at the book with the student and commenting on pictures) and edible reinforcement (e.g., a small piece of candy) were provided. If the child did not independently initiate the greeting, the classroom teacher modeled the greeting and prompted the student to imitate the model. After 15 s of interaction, the school psychologist withdrew his attention, but continued to "stand by," thus providing an intertrial break. This sequence was repeated 10 times within a 5-min session. The student independently exhibited the target social behavior during the final three trials of the session. Later the

same day, the scenario was repeated within the school cafeteria. Following the third trial on each of the subsequent seven trials, the student independently initiated the social interaction. This behavior generalized quickly to other school staff, and within 2 weeks, the edible reinforcer was faded and the student maintained the targeted social behavior throughout the school day.

Task Analysis and Prompting Procedures

As mentioned previously, skills comprised of single-step responses are often addressed through repeated trials of DTT and IT; however, there is another set of skills that requires the display of several responses in a sequential chain. For example, brushing teeth requires the display of a set of behaviors beginning with locating, retrieving, and preparing materials, followed by performing the act of brushing one's teeth, and culminating with putting materials away (Foxx, 1982; Horner & Keilitz, 1978). This process involves a chain of several specific behaviors. Students with autism typically have deficits in a wide array of skills that require the display of a chain of behaviors to reach mastery (e.g., functional life skills such as bathing, dressing, cooking, bed making, and setting the table; community living skills such as ordering at a restaurant and shopping; recreation-leisure skills such as bowling and operating a DVD player; vocational skills such as operating a copying machine and delivering materials).

Instruction for these types of skills involves two principle components: a task analysis and some type of prompting procedure. Task analysis involves identification of the distinct behaviors and their sequence needed to perform a complex task. This ordinarily is accomplished by first performing the task and recording the steps required for completion of the activity. Once the task is analyzed into its component steps, various prompting procedures are used when necessary to promote initiation and completion of each step in the task. These include verbal, gestural, model, physical, or time-delay prompts (for a discussion of these procedures, see Miltenberger, 2004; Wilczynski et al., 2003). Prompts can begin at either the beginning of the task moving sequentially to completion or with the last step of the task and continuing one step backward following each successful teaching trial. This forward progression is known as forward chaining and involves teaching the initial steps in the task (Page, Iwata, & Neef, 1976). Backward chaining is a procedure in which the last step of the chain is taught first. The final step of the task analysis is then followed by the natural reinforcer for the skill. For example, when learning to put on a pair of pants in the morning, fastening the button (i.e., the final step) is followed by going to eat breakfast. Once the last response in the chain is mastered, the next-to-last response is taught, and the last two responses of the chain occur together. This training sequence proceeds until the student has learned all responses in the chain (Miltenberger, 2004). An alternative to forward and backward chaining is whole task instruction, in which the child is prompted to complete the entire task during each training trial (Steege, Wacker, & McMahon, 1987).

Comprehensive ABA-Based Programming

The Merrymeeting Center for Child Development (MCCD) in Bath, Maine, is a state-approved preschool and elementary-school program providing ABA special education and in-home supports to children with autism and related developmental disabilities and their families. The MCCD team follows a problem-solving model of assessment and intervention (Deno, 2005) that uses curriculum-based assessments (Sundberg & Partington, 1998) as the basis for designing individualized instructional goals, objectives, and procedures to promote the acquisition of skills. Likewise, to address interfering behaviors (e.g., stereotypy, self-injury, aggression), FBAs may be used to design behavioral support interventions (Steege & Brown-Chidsey, 2005; Watson & Steege, 2003). Based on these assessments, comprehensive programming for persons with autism and related disorders includes an IEP that addresses a wide range of social, academic, functional

living, and communication skills; individualized behavioral support plans designed to reduce interfering behaviors; an of array student-centered intervention methods to teach skills and to reduce interfering behaviors; and ongoing data-recording procedures to document student behavior change and evaluate the efficacy of interventions.

Selection of instructional methods to teach skills, data-collection procedures to record student progress (i.e., acquisition of skills and interfering behaviors), and procedures to reduce interfering behaviors is often a complex task. MCCD teams consider the full range of ABA interventions and data-collection procedures and match the methods to individual target behaviors, the goals of instruction, and the expected outcomes. In most cases, this involves the use of a dynamic blend of DTT, behavioral support interventions, incidental teaching, task analysis and prompting procedures, and a host of other behavior analytic and evidence-based interventions (e.g., visual activity schedules). Strategies for increasing functional communication skills (e.g., labeling, requesting, social interactions, etc.) also are embedded throughout the program day. Functional Communication Training procedures (Wacker et al., 1990) are routinely used to teach communication skills to replace interfering behaviors. Moreover, staff at MCCD regularly identify "teachable moments" and routinely probe for generalization of skills within natural environmental situations throughout the program day, especially within the home setting.

In addition to the use of data-collection procedures to measure student acquisition and generalization of skills, MCCD uses the Interval Recording Procedure (Watson & Steege, 2003) to measure interfering behaviors and contextual variables (e.g., time, setting events) throughout the school day and within the home setting. These data are used as part of an ongoing FBA and are reviewed daily, allowing team members to make informed decisions when individualizing instructional programming and behavioral supports. These data also are used as the basis for determining the effectiveness of interventions.

Summary

Many autism-specific special education programs represent themselves as "ABA programs;" however, ABA assessments and interventions in these programs are often limited to DTT. No one method of instruction is suited to all children with autism. ABA treatment is a dynamic, ever-changing process that will need constant reconsideration of the behaviors being taught, the goals of instruction, and the teaching methods and interventions for interfering behaviors that are most likely to be effective with an individual child. Comprehensive ABA programs use a wide range of assessments and interventions that are aimed at developing a broad range of cognitive, social, academic, leisure, and functional living skills needed for success at school, at home, and in the community. Additionally, ongoing assessments of student performance and interfering behaviors allow practitioners to objectively determine the effectiveness of interventions and make data-based decisions when modifying instructional and behavioral support procedures. It is this integrated combination of approaches that makes genuine ABA programs for children with autism and related disorders highly effective.

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