Applied behavior analysis: Behavior management of children with autism spectrum disorders in dental environments
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The Centers for Disease Control and Prevention announced in 2009 that approximately one in 100 8-year old children have an autism spectrum disorder (ASD). Given this statistic, it is likely that dentists will treat patients with an ASD in their practice. Therefore, having an understanding of ASDs is essential to planning effective patient treatment.

ASDs are neurobehavioral disorders. The developmental disabilities that comprise ASDs are autistic disorder, pervasive developmental disorder—not otherwise specified and Asperger syndrome. ASD is known as a spectrum of disorders since the behavioral characteristics in an individual can range from mild to severe. A child with an ASD does not have dysmorphic characteristics or a biological marker; the diagnoses of the disorders that comprise ASD are made on the basis of observable behaviors defined in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders. This manual lists diagnostic criteria in three main areas of development: qualitative impairments in social interactions; restricted repetitive and stereotyped patterns of behavior, interests and activities; and qualitative impairments in communication. Owing to impairments in these areas of development, people with ASDs often have problematic behavior patterns that create chal-

**ABSTRACT**

**Background.** There are a limited number of studies addressing behavior management techniques and procedural modifications that dentists can use to treat people with an autism spectrum disorder (ASD).

**Methods.** The authors conducted a search of the dental and behavioral analytic literature to identify management techniques that address problem behaviors exhibited by children with ASDs in dental and other health-related environments.

**Results.** Applied behavior analysis (ABA) is a science in which procedures are based on the principles of behavior through systematic experimentation. Clinicians have used ABA procedures successfully to modify socially significant behaviors of people with ASD. Basic behavior management techniques currently used in dentistry may not encourage people with cognitive and behavioral disabilities, such as ASD, to tolerate simple in-office dental procedures consistently. Instead, dental care providers often are required to use advanced behavior management techniques to complete simple in-office procedures such as prophylaxis, sealant placement and obtaining radiographs. ABA procedures can be integrated in the dental environment to manage problem behaviors often exhibited by children with an ASD.

**Conclusions.** The authors found no evidence-based procedural modifications that address the behavioral characteristics and problematic behaviors of children with an ASD in a dental environment. Further research in this area should be conducted.

**Clinical Implications.** Knowledge and in-depth understanding of behavioral principles is essential when a dentist is concerned with modifying behaviors. Using ABA procedures can help dentists manage problem behaviors effectively and systematically when performing routine dental treatment. Being knowledgeable about each patient's behavioral characteristics and the parents' level of involvement is important in the successful integration of the procedures and reduction of in-office time.

**Key Words.** Dentistry; applied behavior analysis; autism spectrum disorders; developmental disabilities; pediatric dentistry; dental care management; behavior management.
Challenges for dentists when delivering routine oral health care.4,5 There are a limited number of studies that address basic behavior management techniques and procedural modifications with regard to dental treatment of children with ASDs. One such behavior management technique is the D-Termined Program for Repetitive Tasking and Familiarization in Dentistry.6 Anecdotal reports suggest that there are beneficial results from using the program. Its effectiveness, however, has not been established through long-term scientific studies.

To modify problematic behaviors of patients with ASDs while facilitating the improvement of skills they need to undergo dental treatments, dentists have to examine existing basic behavior management procedures and identify effective management techniques that are based on empirical study results. Friedlander and colleagues7 provided a comprehensive review of the prevalence, etiology, behavioral characteristics, medical treatments and dental implications of patients with ASDs.

We conducted a review of the dental and behavioral analytic literature to identify management techniques that address problem behaviors exhibited by children with ASDs in dental and other health-related environments. Using the terms “pediatric dentistry,” “behavior management,” “autism,” “autism spectrum disorders” and “applied behavior analysis,” we searched the PubMed, PsycINFO and Education Resources Information Center (also known as ERIC) databases to find articles published through December 2010.

In this article, we identify the potential challenges of treating patients with ASDs that can be encountered when using current behavior management techniques. We also introduce the science of applied behavior analysis (ABA) and describe procedures adapted from it that are used to manage patients with ASD in dental offices.

EVALUATION OF CURRENT BEHAVIOR MANAGEMENT TECHNIQUES

Procedures such as tell-show-do, voice control and positive reinforcement are effective with children.9 These procedures, however, do not necessarily address the behavioral characteristics of patients with ASD. In tell-show-do procedures, the provider describes and models the procedure before treatment. It may be ineffective, however, owing to lack of joint attention in people with ASD. Joint attention is the process of drawing a person’s attention to a stimulus in the environment by using a cue such as a gaze or gesture, and it is a critical skill needed for social development.9 An example is pointing to an object to draw the patient’s attention to the object. Joint attention is reciprocated when the patient attends to the item being referenced by the person providing the cue.

Voice control is used commonly in pediatric dentistry as a way to reduce problematic behavior during treatment. In voice control procedures, the provider presents a request in an authoritative tone in an effort to intercept or reduce undesirable behaviors during dental treatment; the provider’s facial expressions must match his or her tone of voice. The behavioral sciences consider voice control to have a punishing effect if there is a reduction in the behavior.10 However, a host of conditions may render this procedure ineffective. For example, a child with an ASD may not have the receptive (understanding) language to comply with the directions given by the care provider or may have difficulty interpreting emotions.11

Unless positive reinforcement (for example, socially mediated statements such as “good job”) is conditioned as a reinforcer, it may not guarantee the future occurrence of the desired behavior in people with ASDs. For a child with limited receptive skills and lack of joint attention, “good job” may not compete adequately with aversive conditions presented during dental treatment. Therefore, these types of statements may be ineffective in increasing the future occurrence of appropriate behavior.12 Children who are developing neurotypically might receive positive reinforcement through the use of tangible items such as stickers or small toys that are given to them at the end of the dental visit. For a child with an ASD, such items may not be valuable, and since reinforcement is not provided immediately after the occurrence of the desired behavior, it may not be effective in increasing desired behaviors for future dental visits.13 Positive reinforcement, however, is an important principle of behavior that we discuss in depth below.

Although the use of physical restraints such as restraint boards is controversial, they often are used when treating people with ASDs to prevent potential aggressive or self-injurious behavior. Kamen and Skier14 indicated that the use of physical restraint is unnecessary and

ineffective in managing problematic behavior. Other investigators reported that the use of restraint boards had a calming effect on patients.15,16 This theory has been adapted from the occupational therapy literature, which indicated that experiencing deep pressure can be calming to the sensory systems of people with ASDs,17,18 thus justifying the use of a restraint board. However, deep pressure theories from the occupational therapy literature do not include simultaneous manipulation of oral tissues in dental environments. In addition, results from empirical studies supporting such claims are lacking. Patients with ASDs who have moderate to severe behavioral problems in the dental office are treated by using advanced behavior management techniques such as restraint or having the patient undergo sedation or general anesthesia.

BEHAVIOR ANALYSIS

The science of behavior analysis consists of three major branches: behaviorism, which is the philosophy of the science of behavior; experimental analysis of behavior, which is the area of basic laboratory research; and ABA, which is concerned with analyzing and developing strategies for behavior modification.19

The history of modern behavior analysis can be traced to John B. Watson, who promoted the objective study of behavior in the early 1900s. The direct observation of the relationship between environmental stimuli and the responses they evoke became known as stimulus-response psychology.19 These responses, which also are called “respondent behavior,” are elicited by stimuli that immediately precede the responses20 and are involuntary—for example, the constriction of the pupil in response to a bright light.

In 1913, Watson published an article entitled “Psychology as the Behaviorist Views It.”21 This article was a catalyst in the behaviorism movement, in part because of Watson’s denial of “consciousness and mental processes” as explanations for human behavior.22 He believed that observable behavior should be the focus of psychological research and that environmental stimuli control behavior. This notion was a radical departure from traditional psychological theories of the time and inspired the work of the behavioral scientist B.F. Skinner.

Skinner uncovered the basic principles of behavior—reinforcement, punishment, extinction, stimulus control and motivation—which he outlined in “The Behavior of Organisms.”23 Skinner not only focused on stimulus-response theories proposed by Watson but also examined how events or consequences that follow a specific behavior strengthen or weaken that behavior. Skinner defined this type of behavior as “operant behavior.” The stimuli or events presented after a behavior can either strengthen or weaken the future occurrence of the behavior, depending on the value of the stimuli or events (operant conditioning).24 For example, when someone is driving, a red stoplight signals that he or she should engage in the behavior of stepping on the car’s brake pedal. As a result, the driver avoids a traffic accident or violation, which is the consequence for the behavior of stepping on the brake pedal in the presence of the red stoplight. Therefore, in future driving situations when a red light is present, the driver will be more likely to apply the brake.

Through systematic experimentation with animals, Skinner demonstrated functional relationships between behavior and environmental events that follow the occurrence of the behavior. The process of operant conditioning is the basis of behavior modification.

Applied behavior analysis is a branch of psychology that is focused on the analysis and modification of human behavior.

APPLIED BEHAVIOR ANALYSIS

ABA is a branch of psychology that is focused on the analysis and modification of human behavior. In ABA, emphasis is placed on the functional relationship between human behavior and the environment, the measurement of behavior and a reliance on observable variables. ABA differs from other psychological fields of study in that it does not use hypothetical and unobservable explanations for behavior.25 ABA practices are based on the basic principles developed by Skinner. Baer and colleagues26 provide an in-depth explanation of the characteristics of ABA.

ABA practitioners examine the functional relationship between environment and behavior to modify socially significant behaviors (or behaviors that will improve the quality of a person’s life).19 Development of social, linguistic, academic, recreational and self-care behaviors often are the focus of behavior analytic procedures.27 Woods and colleagues28 suggest use of ABA in a variety of settings and populations such as health care, mainstream clinical environments, people with developmental disabilities and geriatric people.
ABA has been used successfully to treat aberrant behaviors in people with developmental disabilities and mental illnesses. Fuller conducted one of the first studies on the use of operant conditioning in humans. In this study, he taught a person with profound developmental disabilities to move his arm. He gave the person a small amount of sugar-milk solution orally to reinforce each instance of arm movement. As a result, the person began to raise his arm at a higher frequency.

Perhaps the most influential validation of behavioral techniques as an effective method in educating people with autistic disorder was Lovaas' 1987 study. The participants in the study were young children with autistic disorder who were assigned to an intensive-treatment group, a minimal treatment group or a control group. The children in the intensive-treatment group received one-on-one intensive therapy based on reinforcement (operant) theory for more than 40 hours per week. The children in the minimal treatment group received therapy for 10 or fewer hours per week. The children in the intensive-therapy group showed considerably greater intellectual gains than did the children in the other two groups. The results of this study demonstrated the effects of intensive teaching and the long-term outcomes in children with autistic disorder. This study also was the catalyst in the advent of the most widely used and effective strategies in education of people with ASDs.

Using intensive behavior-based programming is an effective strategy for educating children with ASDs. Parents, educators and caregivers have been able to use ABA—research-driven procedures to manage undesirable behaviors—and teach daily life skills to children with ASD.

ABA has been used in other disciplines to manage problem behaviors in children with ASD. Souders and colleagues discuss methods such as appropriate use of reinforcement, differential reinforcement, shaping and making choices—which are based on principles of behavior—to help people with autism tolerate venipuncture, physical examination and other medical procedures. These strategies were developed as part of a larger experiment that required 52 participants with autism to accept these challenging procedures. These strategies were used successfully in conjunction with other methods that were based on theories and knowledge of nursing, child development, psychology and pain management.

The use of ABA strategies to increase tolerance of medical procedures in people with ASDs has been studied systematically in the behavior analytic literature. Shabani and Fisher examined the effects of stimulus fading (systematic change of a stimulus while the response stays the same) and differential reinforcement (providing reinforcement when a response occurs during a certain situation or at a certain time and not when it occurs in other situations or times) for the treatment of needle phobia in a youth with autism and diabetes. The results of their study showed that the use of ABA strategies was successful in training this patient to allow for blood samples to be drawn daily to measure his blood glucose levels.

Routine, professionally delivered dental care, as well as home-based oral hygiene, are socially significant events for people with ASDs. These experiences can induce problem behaviors in people with ASDs, resulting in management issues for care providers; therefore, they require appropriate attention.

The basic principles of behavior can be used in the dental environment in a manner similar to that in the medical environment to increase instructional control with patients with ASD, manage problematic behaviors and teach the skills necessary to accept dental treatment. In our experience, many of the prerequisite skills (behaviors) necessary for accepting treatment (for example, sitting skills, tolerating dental instruments and reducing oral defensiveness) can be taught in home or school environments by instructors or parents versed in treatment strategies based on the principles of behavior. Therefore, dental treatment should be seen as a team effort, focused on identifying variables that can cause problematic behavior in the dental office and modifying those behaviors to encourage favorable, long-lasting outcomes.

**THE FUNCTION OF BEHAVIOR**

An important element of ABA is to analyze the function (purpose) of the behavior. Understanding the function of behavior is important when selecting which procedures to use to modify socially significant behaviors. In most cases, problem behaviors are maintained by the...
consequences that follow them. For example, a child who struggles in the dental chair, bolts from the treatment room or both may do so because of a learned (successful) history of escaping from aversive situations or stimuli as the result of engaging in these behaviors. In these types of situations, the undesirable behavior is reinforced accidentally by the care provider and is more likely to be repeated in future visits. Another example is that a child may gag or vomit in the presence of a dental mirror because, in the past, such responses were reinforced by termination of the procedure. Determining the variables that maintain the patient’s behavior can help in the development of treatment protocols that promote lifelong acceptance of dental treatment.

Any formalized method of obtaining information regarding the variables that maintain behavior is known as functional behavior assessment. Functional behavior assessment methods can be direct or indirect. The results of research has indicated that direct observations are most suited to identifying the function of useful behaviors. In lieu of direct observations, indirect methods such as informant responses (that is, via questionnaires or interviews) have been used to predict behavioral functions in educational settings. Conducting previsit intake interviews with parents and teachers about the frequency, history and topography (description) of problematic behavior can provide great insight into the function of behavior.

The previsit intake interview and recommendations for home-based preparation not only provide opportunities to plan for the upcoming visit but also allows the dentist to make recommendations to parents to help prepare the child before the appointment. Home-based preparation may include familiarization with dental instruments in educational environments; teaching prerequisite skills through ABA procedures in the home such as “open your mouth” or “counting teeth”; and developing personalized picture books for the families so they can help the child with an ASD become familiar with the dental environment.

Analysis of the function of behavior and understanding of behavioral principles is key when selecting from the many procedures and methods already established in ABA. Below, we discuss the key behavioral principles of reinforcement and introduce procedures such as conditioned reinforcement and shaping, which may help in the management of children with ASD in the dental environment.

### KEY BEHAVIORAL CONCEPTS

Reinforcement is one of the most important principles of behavior and often is misunderstood. Reinforcement is said to occur when there is an increase in a behavior as a consequence of a stimulus or event that follows the behavior. Behavior can be modified by using positive or negative reinforcement.

As we mentioned above, often the term “positive reinforcement” is used to define the bestowing of social praise or a tangible item such as a toy or sticker. From an ABA perspective, however, “positive” means the addition of a stimulus. Reinforcement is said to occur only if the addition of that stimulus results in the increase of future occurrence of behavior. For example, praising a patient with a statement such as “good job” for sitting still in the chair serves as a positive reinforcer only if it leads to an increase in the behavior of sitting still in the chair. In other words, a reinforcer is not necessarily a reward—a concept that is not always clear to care providers. Positive reinforcement is a component of behavioral strategies such as pairing and shaping, which we discuss below.

As with positive reinforcement, “negative reinforcement” is a term that can cause confusion among care providers. In addition, negative reinforcement often is mistaken for punishment. Negative reinforcement occurs when an aversive stimulus is withdrawn or terminated after the occurrence of a behavior that results in an increase in that behavior. For example, a child who refuses to sit in the dental chair is allowed to leave the chair after sitting still for a count of 10 (withdrawal of the stimulus). Thus, the child’s behavior is reinforced negatively by having the option to escape the aversive condition for a specified amount of time. The cycle is repeated until the entire examination is completed. As a result, the child complies so that he or she can get a break from the chair sooner. In this example, allowing the child to leave the chair may lead to an increase in appropriate sitting.

The effectiveness of reinforcers can vary among children with ASD. Many children may find reinforcing value in typical, age-appropriate reinforcers such as praise, stickers or video clips,
while other children’s behavior might be reinforced by engaging in self-stimulatory behaviors (for example, hand flapping or self talk) or obsession with unusual objects. The previsit interview is an appropriate time to identify the child’s preferences for items that can be used later as reinforcers during the dental treatment.

Although having valuable reinforcing stimuli can influence the behavior of a patient with an ASD, other factors contribute to a reinforcer’s effectiveness, including rate and immediacy of delivery. For example, a patient who is allowed access to a preferred item at a high rate during treatments can become satiated with the reinforcer, thus lessening the reinforcing effectiveness of the item. Conversely, if a patient does not access enough of a reinforcer or if a reinforcer is not presented immediately after the patient engages in a target behavior, aversive stimuli may overpower the value of reinforcing stimuli. Therefore, finding an effective balance is important.

Enduring reinforcement properly can be an effective way to establish a favorable rapport with a patient with an ASD. Conditioned reinforcement occurs when previously nonreinforcing stimuli are presented simultaneously with established reinforcing stimuli.

Dental care providers who initially give a patient with ASD unrestricted access to a wide array of known reinforcing stimuli can condition themselves as reinforcers. In other words, by having a patient’s favorite video playing on a television as the patient enters the treatment room or handing a patient a variety of preferred toys, dental care providers can pair themselves with a favorable set of conditions, thus conditioning themselves as potential reinforcers. This process can increase joint attention and trust between the dental care provider and patient.

Care providers who use ABA also can use the process of shaping to develop appropriate behaviors that a patient does not currently exhibit. During shaping, successive approximations of behaviors selected for change (target behavior) are reinforced positively until the person engages in the behavior independently. For the dental care provider, shaping strategies can be useful when teaching patients the necessary skills to tolerate in-office treatment. For example, they can be used to teach the child to sit appropriately and independently in a dental chair by reinforcing the approximations of sitting in the dental chair (target behavior) until the objective is met. Sitting skills are the foundation for developing other skills required for in-office treatments.

CONCLUSIONS

Procedures based on ABA are evidence based and accepted by the American Academy of Pediatrics in the management of ASD. In dentistry, the use of these procedures has the potential to improve the results of traditional behavior management procedures. By increasing the likelihood of patients accepting simple and routine dental procedures, dentists can decrease the need for more intrusive procedures such as restraints and sedation.

However, incorporating the principles of behavior into behavior management strategies is not without limitations in a busy dental practice. Although they can be effective, they also can be challenging to dental professionals, as they can be time consuming and require professional training to implement properly.

Although the pediatric dental curriculum includes many procedures from the behavioral sciences, the opportunity to have an in-depth understanding of the fundamental principles of behavior is limited. A care provider may benefit from having an in-depth knowledge of the principles of ABA, so he or she can modify procedures to manage a patient with ASD effectively. We hope that this article will encourage empirical evaluation of these procedures in the dental environment.

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