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Autism Spectrum Disorder: Characteristics, Associated Behaviors, and Early Intervention

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Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and social interaction and the presence of restricted, repetitive patterns of behavior, interests, or activities present during early periods of development that negatively impact social, occupational, or other domains.¹ Different combinations and ranges of behavioral deficits and excesses are associated with an ASD diagnosis; therefore, ASD can affect individuals along a continuum of severity.¹ The cause of ASD is unknown, but research supports genetic and environmental factors.² One in every 59 children has a diagnosis of ASD,³ and ASD is 4 times as likely to occur in male than female individuals.⁴ ASD affects individuals across racial, ethnic, and

socioeconomic boundaries and has a high likelihood of occurring with another developmental disorder (ie, 83%) or psychiatric disorder (ie, 10%).⁴ The average age of diagnosis is 5 years; however, early warning signs can be observed in infancy.⁵ Longitudinal studies of infants at risk for developing ASD reported several behaviors, including poor eye contact, lack of visual tracking, no orientation to name, few imitation skills, lack of social interest, and limited language.^{6,7}

Early social skills begin to emerge at very young ages in children of typical development, but children with ASD often require targeted interventions to learn these foundational skills (eg, joint attention, social referencing, social engagement).⁸ Social skills are necessary for children to adapt to their environment and interact appropriately with others. Deficits in social skills may create limited relationships with peers and family members, likely straining familial relationships.⁹ Thus, early intervention should emphasize building skills for success in social opportunities like vocal communication.

An impairment in vocal language is not required for a diagnosis of ASD; however, a diagnosis may specify if the individual has an accompanying language impairment.¹ The acquisition of “useful language” by 2 years old is the strongest predictor of positive developmental trajectories,¹⁰ and vocal language is one of the strongest predictors of positive long-term outcomes for children with ASD.¹¹ The acquisition of speech by 5 or 6 years of age is associated with greater academic achievement and social independence and competence.¹¹

In addition to deficits in social communication and interaction, approximately one-third of children with ASD have deficient adaptive or daily living skills.³ This domain is not directly related to the core features of ASD; nevertheless, many individuals with ASD require intervention to acquire adaptive skills (eg, toileting, grooming).^{9,12} Deficits in adaptive skills may further limit the opportunities for social involvement in education and community settings due to issues with safety (eg, disrobing in public), availability of proper resources (eg, family restrooms), or social stigmatization. Individuals with ASD are more likely than their peers to remain dependent on others for care throughout the life span.¹² Deficits in adaptive skills and decreased independence require that parents and caregivers provide more assistance to children with ASD to complete tasks, which may limit the caregivers’ ability to spend time with others, work outside of the home, and develop and maintain their interpersonal relationships.⁹ Therefore, it is important to address adaptive skill deficits in early intervention as well.

Problem behavior, although not one of the core diagnostic features of ASD, is one of the main reasons for referral to services⁵ and a source of parental or caregiver stress and concern.¹³ Broadly defined, problem behavior is that which is not socially acceptable, may be physically dangerous, and negatively impacts functioning (eg, aggression, self-injurious behavior, tantrums, property destruction, elopement).¹⁴ Children with ASD are more likely than children with an intellectual disability, a psychiatric disorder, or typical development to engage in problem behavior.^{15,16} Estimates of the proportion of individuals with ASD who engage in at least one type of problem behavior vary widely, with some published studies reporting prevalence estimates as low as 8% or 25%⁹ and as high as 94%.^{14,15} In general, problem behavior is associated with poorer outcomes overall and is the factor most likely to lead to residential placement,¹⁶ and the use of pharmacotherapy (eg, antipsychotics).¹⁵

Problem behavior may affect skill development in social communication and social interaction, a core deficit of ASD.¹³ Individuals with ASD, especially those who engage in problem behavior, are more likely than typically developing peers to experience low rates of peer acceptance and high rates of peer rejection.¹³ Problem behavior can lead to increased isolation, interfere with educational and therapeutic interventions, and limit participation in social and community activities because of safety concerns.¹⁶ Problem behavior is likely to persist and increase in frequency and severity and is unlikely to be resolved without intervention.¹³ As children develop physically, intervention can become more difficult and dangerous.¹⁵ Therefore, early intervention to reduce problem behavior and replace it with functional skills is crucial (for more detailed information on

problem behavior, see the article by Patricia F. Kurtz and colleagues' article, "[Behavioral Approaches to Assessment and Early Intervention for Severe Problem Behavior in Intellectual and Developmental Disabilities](#)," elsewhere in this issue).

Given the breadth and depth of behavioral deficits and excesses associated with ASD, it may be no surprise to learn that the economic costs of ASD are staggering. In the United States, estimated annual costs for children with ASD range from \$11.5 billion to \$60.9 billion.⁴ These costs include medical care, loss of parental wages, and special education or intervention.⁴ Over one's lifetime, the costs of caring for an individual with ASD can exceed \$2 million.¹⁷ Nevertheless, the reported economic costs of ASD may not adequately describe the extent of public health costs because collateral costs like parental or familial stress are not included.¹⁷

Prevention and early intervention

The increasing prevalence of ASD and substantial economic and collateral costs at the individual, familial, and societal levels necessitate attention to interventions that could serve to prevent the development or exacerbation of behaviors associated with ASD. A child with ASD will likely have needs in several areas, including social communication and interaction, vocal language, adaptive skills, and problem behavior. Strategies to prevent and intervene early on behavioral excesses and deficits associated with ASD can reduce the child's level of impairment in adaptive, educational, and behavioral skills. There is extensive empirical support for early intervention based on the principles of applied behavior analysis (ABA), leading to mandated insurance coverage for interventions for children with ASD in 49 states and the District of Columbia.¹⁸ The most significant gains are likely to occur if a child begins intervention before 5 years of age¹⁴; however, ABA interventions are effective across the life span.¹⁹

There are many evidence-based ABA practices to address behavioral deficits and excesses associated with ASD and related disorders.¹⁹ We describe several evidence-based methods for developing early social skills, increasing communication, and establishing independence in functional life skills.

Behavioral Intervention to Establish Early Social Skills

Social and communication skills are critical behaviors to acquire in early childhood for an improved developmental trajectory and acquisition of more complex skills.⁵ Early social communication skills (ESCS), including eye contact, coordinated eye gaze shifting, joint attention, social referencing, and social orienting, often emerge via everyday interactions throughout the first 24 months.^{5,8} Although these skills are thought to be critical for development of more advanced social skills and predict success in academic, social, and adaptive contexts, additional research on ESCS with an emphasis on identifying pivotal skills and components of intervention that are most likely to lead to improvements.⁹ Despite the need for additional research, existing evidence supports the use of ABA to assess, teach, and maintain these important skills.⁵ Strategies described as follows have been shown to increase ESCS with very young children, including infants.⁵ The information that follows focuses primarily on joint attention; however, common techniques, such as providing reinforcers (ie, a consequence provided following a behavior makes it more likely to occur under similar circumstances in the future), prompting (ie, providing assistance to get the behavior to occur and removing the assistance systematically until the child engages in the behavior independently), and arranging motivating conditions (ie, events that occur before a behavior that make a behavior more likely and make a consequence more effective) can be applied to teach many ESCS.

Joint attention is the coordination or sharing of attention between 2 people and an object or event.²⁰ Joint attention begins as a gaze shift (ie, child looks from an interesting item or event to a familiar person and then back to the item) and progresses to include combinations of eye gaze shift, vocalizations, and gestures (eg, pointing, reaching, showing object to a person).²¹ Joint attention typically develops between the ages of 9 and

15 months, and is crucial to the development of language.²² Children with ASD often have delayed or impaired joint attention.²³ In fact, delayed or deficient joint attention is one of the behaviors used for early diagnosis of ASD.²¹ The acquisition of joint attention skills can be used to evaluate a child's progress in an early intervention program.²⁴ Furthermore, joint attention deficits have been associated with difficulties acquiring vocal language and developing social competence.^{21,23} For these reasons, joint attention skills are targeted in early intervention programs for children with ASD.

Joint attention is typically divided into 2 categories: (1) responding to joint attention and (2) initiating joint attention.²⁵ Both categories of joint attention begin with an interesting or novel item or activity in the environment (ie, a motivating condition), but they differ in terms of who attends to the interesting situation and seeks to share the experience with another person. A defining feature of joint attention responses and initiations is that the consequence for responding is social in nature because they produce shared attention to an item or activity (eg, both individuals looking at the item, an adult reaction to the item).

In a joint attention response, an adult or peer begins the interaction by pointing to, looking at, or gesturing toward an item or object in the child's environment.²⁵ After this gesture (perhaps with an accompanying vocalization like "Look!"), the child shifts his or her gaze (ie, looks from the person to the item and back to the person) and may comment on the item or activity. Then, the adult or peer makes a comment to the child or provides another social interaction like smiles or attention. For example, when walking with her child in the neighborhood, a mother spots a deer in a nearby yard, which is an unusual sight. The mother says, "Wow! Look over there!" and points to the deer. Her toddler looks from her to the deer and then back to her. The mother says, "It's a treat to see a deer here!" and smiles at her toddler.

In a joint attention initiation, the child engages in behavior to direct the adult's attention to the same item or activity.²⁵ For example, a child sees a deer, turns to her mother, and says "Mommy, look!" while turning her gaze back to the deer. The mother shifts her gaze to the location of the deer, says, "Wow! The deer is so pretty!" and turns back to her daughter to share her delight. Thus, the child recruits her mother's attention to share the experience, and the mother's attention is the reinforcer for the joint attention initiation.

Although children with ASD may require intervention for both types of joint attention, joint attention initiation is often impaired to a greater degree and less likely to emerge without targeted intervention.²⁴ Joint attention responses may occur because following an adult's directions has been previously taught and reinforced with preferred items.²¹ In comparison, joint attention initiations may be conceptualized as a mand (ie, request; described later in this article) for shared attention or experiences rather than the receipt of an item or information.^{21,26} If social attention and reactions of others are not effective reinforcers (ie, do not make a behavior more likely to occur in the future) for a child with ASD, then it is unlikely that the child will initiate an interaction that is purely social in nature (ie, joint attention initiations). Core deficits related to social communication and social awareness observed in children with ASD could help explain difficulties acquiring joint attention without intervention.

Taylor and Hoch²⁶ taught children with ASD to respond to and initiate joint attention within an early intervention program by carefully arranging motivating situations to create conditions for shared interest. Motivating situations were rotated often and included novel toys, altering the appearance of toys (eg, placing a clown wig on a toy horse), placing items in unusual locations or positions (eg, a bicycle turned upside down). The consequence for joint attention initiations and responses were social interest and not access to an item. Following intervention, children with ASD increased both joint attention responses and initiations. Joint attention is only one social skill, albeit a critically important one, that can be impaired in children with ASD and should be addressed with ABA treatment. When a child with ASD responds to and initiates joint attention with

familiar people in their lives, this can be the beginning of building a shared social experience and interactive communication.²⁶

Behavioral Intervention to Increase Communication

Interventions based on ABA are not the only option to address language deficits for children with ASD. However, an ABA-based approach to language development is unique to other forms of therapy in that it prioritizes the function of language, rather than the topography (ie, the specific words) or form, and examines the consequences produced by language. Other approaches to language acquisition (eg, linguistics) may assume that once a child acquires a word, that word is a representation or symbol of the item, and he or she will be able to use that word whenever appropriate. In contrast, an ABA-based approach to language (also called verbal behavior or the verbal behavior approach), with a focus on function, operates under the assumption that the child needs to learn to use that word under a variety of conditions; this is called functional independence.

Communication intervention based on ABA means that a practitioner carefully determines under which conditions language is (or is not) occurring and designs intervention to increase language based on the conditions and reinforcers. Assessments of and interventions for language are based on the verbal operants, the unit of language outlined by Skinner,²⁷ and the technical terms in this taxonomy are described as follows with a focus on the stimuli that occur before and following language. Skinner outlined 4 elementary verbal operants: the echoic, mand, tact, and intraverbal, which are commonly targeted in early intervention. Early intervention may focus on teaching communication through vocalizations, manual signs, or picture exchange systems.

The *echoic* is a verbal operant that matches, or closely approximates, the spoken or signed word that comes before it. The echoic is maintained or increased by a generalized reinforcer that follows it (eg, praise, hugs, tickles, and smiles). For example, a mother says, “airplane,” the child repeats, “airplane,” and the mother says, “so good!” while tickling her child. A proportion of early parent and child interactions attempt to establish echoic behavior, such as when a mother tries to get her young child to say “dada” when dad is not present. Echoic behavior can be used to establish other verbal operants (described as follows), because an adult can have the child imitate or repeat the vocalization in novel contexts.

The *mand* is a verbal operant that is a request for items, activities, or information that occurs under motivating conditions (eg, deprivation, aversive stimulation) that make these consequences reinforcers. The mand specifies its reinforcer, meaning that the vocalizations included in the response are typically associated with the consequence. For example, the mand, “I want the airplane,” indicates that giving the toy airplane to the child will reinforce (ie, strengthen) that response. Mands occur when a person is present who can provide the reinforcers. Mands are the verbal operant with the greatest benefit to the speaker, because mands allow the child to communicate to gain access to wants and needs in his or her environment.²⁸ Thus, mands are typically one of the first verbal operants taught in early intervention.

Initially, mands for items are targeted in early intervention by identifying preferred items (eg, toys, activities) and providing access to the items following targeted vocalizations, signs, or picture exchanges. When teaching mands, the therapist should arrange for a motivating condition like deprivation (eg, putting a favorite toy away for a period), as these are the environmental conditions that should lead to a mand in any setting. Mand training may establish initial sounds (eg, /oo/ for cookie) or single-word mands (eg, cookie, music) with the complexity of the mand increasing over time, such as requiring full sentences (eg, “May I have a cookie, please?” “Will you sing a song?”). In addition to accessing toys and activities, mands also help children acquire more control over their environment. Mand training can be used to teach a child to change or remove someone or something that is aversive. For example, a therapist may teach a child who cries when loud music is played near him to say, “Please turn it down.” For more on replacing problem behavior with appropriate behavior see the article by

Patricia F. Kurtz and colleagues' article, "[Behavioral Approaches to Assessment and Early Intervention for Severe Problem Behavior in Intellectual and Developmental Disabilities](#)," elsewhere in this issue.

Subsequent training targets mands for information, and the training context is designed to establish the receipt of information as a reinforcer. Early mand for information training might begin by hiding a child's favorite toy. When the child looks for the toy but cannot find it, training the mand for information occurs (eg, "Where is my fire truck?"). Immediately following the mand, the therapist gives the child the information that can be used to find the item (eg, "Your fire truck is under the couch"). Information on the whereabouts of the toy allows the child to find and play with the toy. Once learned, additional training could include mands for information about other people, items, and activities in their environment.

The *tact* is a verbal operant that is like a label of a nonverbal stimulus (eg, an object in the environment, a picture, a sound, a flavor) that produces generalized reinforcers (eg, praise, attention, tickles). For example, a child looks up at the sky and says, "Airplane" as an airplane zooms overhead, and the adult provides social interaction like saying, "Wow! That is a really big plane." Tacts permit children to speak about the environment around them and communicate or share the environment with others. A therapist might teach a child to tact a shoe by showing the child a variety of 2-dimensional and 3-dimensional shoes and providing a prompt (eg, "Say, shoe") until the child independently tacts different examples of shoes. The use of prompts and prompt fading are highly effective in teaching verbal operants to children with ASD, and this type of training can rapidly expand a child's contact and familiarity with objects in his or her environment.²⁸

The *intraverbal* is a verbal operant that follows a verbal stimulus (eg, a question, statement), but, unlike the echoic, the intraverbal does not match the preceding verbal stimulus. For example, a peer may ask, "What is your favorite toy," the child replies "airplane," and the peer provides social interaction like "I like planes, too." In typical language development, a child acquires quite a few mands and tacts before early intraverbal behavior emerges.²⁸ Thus, in early intervention, intraverbal training with children with ASD occurs after establishing some echoics, mands, and tacts, and the acquisition of intraverbal behavior is facilitated when relevant mands and tacts are learned first. For example, the child should be able to tact food and the action of eating before being taught intraverbal responses to a question like "What do you eat?"

Early intraverbals are generally simpler and may involve teaching fill-in-the-blank statements during interactive activities like games and songs. For example, if siblings are going to race toy cars on a track, the brother may say, "ready, set..." and wait for the sister with ASD to say, "go" before starting the race. Parents may also help to establish early intraverbal behavior by singing songs with their child with ASD and allowing the child to fill in the missing words (eg, "Old McDonald had a..."). Therapists establish other types of intraverbals that increase in complexity during early intervention, such as teaching answers to a variety of wh- (eg, what, who, where, when, and why) questions.

Intraverbals are one of the most important verbal operants because they form the basis for social interactions with others, conversations, and the development of friendships. Language without a robust intraverbal repertoire that includes appropriate responses to questions that further the conversation can limit social development.²⁹ In other words, it would be difficult to have a complete and meaningful conversation composed of only echoics, mands, and tacts.²⁹ Therefore, a particularly lengthy period of intervention is allocated to intraverbal training. Although some research suggests a sequence of simple to more complex intraverbals may be acquired by typically developing children and children with ASD,²⁹ considerably more research is necessary to establish prerequisite skills for specific types of intraverbal training and to understand better how to establish this critical but complex verbal operant in children with ASD.

Behavioral Intervention to Establish Independent Living Skills

Children with ASD often have deficits in adaptive skills that reduce independence. For example, children with ASD may not complete daily hygiene routines, such as getting dressed, brushing teeth, and taking a shower. The level of support that an individual with ASD requires to complete activities of daily living is negatively correlated with greater integration into society and independent living arrangements.⁹ Further, many young children with ASD are not toilet trained.³⁰ Reliance on supports from an adult to complete daily hygiene routines (eg, toileting) may increase a child's likelihood of abuse, which is especially concerning given that rates of sexual abuse in children with intellectual disabilities are 4 times that of typically developing children.³¹ Children who are not independent with daily living skills may miss out on social and educational opportunities, such as children who are unable to play dress up with peers because they cannot dress themselves.

Because of their importance, adaptive and independent living skills are often targeted in early intervention. Training of these skills typically occurs in several steps. The first step of intervention is to create a *task analysis*, which involves generating a step-by-step list of the behavior chain (ie, sequence of behaviors) that an individual engages in when completing the task (see Table 1 for an example). ABA practitioners may engage in the behavior chain themselves or watch an expert perform the skill while writing down the sequence of steps to create task analyses. Task analyses should be flexible with steps that can be combined if the child moves through them quickly, broken down further if a child needs additional support and practice, or adjusted to reflect how the child or the child's family completes the task. For example, the handwashing task analysis (see Table 1) would be modified if the family gets soap and rubs their dry hands together before wetting their hands.

Table 1. Example task analysis for handwashing

Step	Behavior
1	Move stool in front of sink
2	Step onto stool
3	Turn on water (hot and cold faucet handles)
4	Place both hands under water
5	Turn off water
6	Grab soap
7	Put soap in hand
8	Rub hands together
9	Rub top of one hand
10	Rub top of other hand
11	Place both hands under water
12	Rinse hands until soap is gone
13	Turn off water (hot and cold faucet handles)
14	Grab towel
15	Dry hands

After completing the task analysis, the next step is to identify an intervention to teach the child with ASD to complete the adaptive task. Several empirically validated training procedures have been used to teach children and adults with ASD and other developmental disabilities to successfully engage in behavior chains.³⁰ Four of those training procedures are forward chaining, backward chaining, total-task presentation, and activity schedules. *Forward chaining* involves teaching the very first step in the behavior chain and then adding steps one at a time. For example, the first step in the handwashing task analysis in Table 1 is moving the stool in front of the sink. Initially, the child would need to complete this step independently before accessing a reinforcer (eg,

brief playtime on a tablet). Once the child is consistently performing Step 1, then Step 2 (ie, step onto stool) would be added. Thus, the child would need to perform Steps 1 and 2 before accessing the reinforcer. This sequence of adding a step once earlier steps are completed independently continues until the child can execute all steps in the behavior chain.

Backward chaining also involves teaching one step and then adding steps sequentially; however, training begins with the last step in the behavior chain. For example, the last step (ie, Step 15) for handwashing in Table 1 is to dry hands with a towel. The actions required to correctly engage in this step would be taught although the child's hands would be dry already and the towel placed in his hands. Initially, the child needs to complete only the final step before accessing a reinforcer. Once the child consistently completes the last step independently, the therapist adds the penultimate step in the sequence. That is, the child would be required to grab the towel (Step 14) and dry hands with the towel (Step 15) to receive a reinforcer. Once Steps 14 and 15 are completed independently by the child, Step 13 is added. This sequence continues until all steps from beginning to end are completed independently by the child.

For both forward and backward chaining, the child is not required to complete any steps that are not currently the target of training. For example, in backward chaining, the child is not required to grab the towel if she or he is only acquiring the step of drying his or her hands with the towel. Generally, there are 3 options for the nontarget steps in a chain: (1) the child could be physically guided through the untrained steps (if necessary for the task), (2) someone else (eg, a teacher), could complete the steps for the child (this may not be possible for all tasks), or (3) the untrained steps are omitted altogether (eg, if unnecessary to complete subsequent steps).

In comparison, *total-task presentation*, a third approach to teaching a behavior chain, requires the child to complete every step of the entire behavior chain each time she or he practices the skill. The behavior chain is always taught in its correct order (ie, starts at Step 1), and the child is typically allowed an opportunity to try to complete each step independently (ie, Steps 1 through 15 in Table 1) before an increasing level of prompts is delivered (eg, the correct response is modeled, then partially guided, then fully guided) until the step is completed. All 3 of the methods described here can be effective in teaching behavior chains, but there may be differences in efficiency. Due to the completion of all steps in the sequence during every practice opportunity, total-task presentation can be less efficient (eg, more time consuming) than forward and backward chaining. In contrast, both forward chaining and backward chaining have been shown to be similarly efficient.³²

Behavior chains can be taught using an *activity schedule*, which is a series of pictures, words/sentences, or a video that shows steps in the behavior chain. An everyday example of a visual activity schedule for children is the instruction manual used to build a Lego set. These visual activity schedules show a sequence of pictures and block parts that are required to build the structure at each step. Krantz and colleagues³³ used a visual activity schedule to teach children with ASD to complete various daily living skills (eg, hanging a coat, getting a snack). The children flipped pages in a binder and each page showed a step or activity to complete. Once the child finished the step on the page, he or she turned to the next page to complete another activity, and accessed the reinforcer when the child finished all activities.

One limitation of activity schedules is that the child must have access to the materials while performing the behavior chain. For some activities (eg, showering, riding a bike from one location to the next), it may be difficult to arrange an activity schedule that does not get damaged or interfere with the behavior chain; however, integrating activity schedules with technology could offer some solutions. In the United States, roughly 80% of adults own a smartphone,³⁴ which could provide a portable and socially valid device for activity schedules at home and in the community. An activity schedule on a smartphone or tablet may include video models and video, picture, or audio prompts.³⁵ For example, when teaching showering, a parent may make use of timed

audio scripts or auto-advancing pictures on a tablet to make the prompts available without risking water damage.

Summary

Early intervention based on the principles of ABA can improve the functioning of children with ASD by addressing behavioral deficits and excesses. Early social skills deficits, such as joint attention, can be taught in early intervention that emphasizes motivating situations and the delivery of social interactions for targeted behavior. Deficits in social communication can be resolved by using ABA language interventions that establish early verbal operants, such as echoics, mands, and tacts, and increases the complexity and social aspects of language by teaching simple and complex intraverbals. Other behavioral deficits, such as independent living skills, are also addressed through behavioral interventions such as chaining and activity schedules.

Disclosure

The authors have nothing to disclose.

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