



Behavioral Approaches to Language Training for Individuals with Autism Spectrum Disorder

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Abstract

Behavior analysis is among the most sought-after early-intervention programs for children with developmental disabilities, with language training being a common primary objective. Many early-intervention programs subscribe to a traditional conceptualization of language skills and focus on developing a robust vocabulary. Conversely, Skinner's (*Verbal behavior*. Prentice Hall, Englewood Cliffs, NJ, 1957) conceptualization of language emphasized the function of an individual's language use rather than the topography. To assist in understanding Skinner's conceptualization, this chapter is designed to introduce readers to four elementary verbal operants (i.e., mands, tacts, echoics, and intra-verbals). In doing so, we provide a definition for each operant, outline the importance of and specific environmental variables responsible for each, provide some basic guidelines for teaching, and discuss their implications for practitioners.

Lovaas (1987) published the results of an extensive investigation into the effects of behavior analytic intervention on outcomes for individuals with autism spectrum disorder (ASD). Results of the investigation showed that, when 40 h of treatment per week began prior to age 4, many individuals with ASD demonstrated improvements across all areas of functioning; some even “lost” their diagnosis. As such, Lovaas set the precedent for desired early-intervention treatments. Now behavior analysis is among the most sought-after early-intervention programs for children with developmental disabilities (Sundberg & Michael, 2001).

One of the most important findings of Lovaas (1987) was that children with ASD could demonstrate communicative skills on par with typically developing peers following intensive intervention. Missing milestones in language development is a commonly reported “red flag,” and deficits in this area can inform a diagnosis (American Psychiatric Association, 2013). According to Sundberg and Michael (2001), language is a cornerstone deficit among the ASD population, and it is critical that therapists intervene as language facilitates further learning and interactions with individuals and the environment. Given the widespread importance of language in development and overall functioning, early intervention programs often include language training objectives (Sundberg & Michael, 2001).

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Despite the success of behavior analysis in teaching language, not all early-intervention language-training programs adhere to the functional approach to language proposed by B.F. Skinner (Sundberg & Michael, 2001). Rather, many programs align with a traditional linguistic conceptualization of language. The traditional conceptualization of language, and consequently these language-training programs, focuses primarily on the topography of a child's communication. As such, linguists study the words and grammatical structures used to communicate across forms (e.g., writing, speech, sign language; Skinner, 1957). Further, linguists typically study the practices of communities rather than individuals, which may prove problematic when developing individualized treatment goals.

Traditional linguistic conceptualizations of language also separate communication skills into two categories: receptive and expressive (Skinner, 1957). Sundberg and Michael (2001) explain that receptive skills are those that occur when an individual behaves because of something they read or heard, while expressive skills are those that occur when an individual conveys a message to another individual. As such, a basic underlying assumption of this approach is that the individual can emit each topography, or word, across contexts after using it in one context (Sundberg & Michael, 2001). For example, if a child says "cookie" following a model by his mother while she holds up a cookie, traditional linguists expect the child can then say cookie when shown a picture of a cookie, when only the cookie is present, when only the model is present, and when the child is hungry but neither the cookie nor the model are present.

Skinner (1957) expressed concern that language skills, when interpreted via the traditional framework, appear as though they are the result of private processes within the individual; moreover, traditional linguistics does not address individual language practices, only those of larger communities. Additionally, traditional linguistics emphasize the role of speech and written text in communication, effectively excluding other modalities from examination. In response, Skinner proposed a functional approach to language in which the function of language is ana-

lyzed across all possible modalities. Further, Skinner avoided the terms receptive and expressive, instead proposing several verbal operants (discussed below) to explain the functionally specific ways in which individuals communicate. For example, Skinner's functional approach assesses the controlling variables associated with an individual's use of the word "cookie"—does he say it when cookies are present? When he has not eaten for several hours? After his mother says it first? And what happens following his use of the word cookie? Given this focus on function, Sundberg and Michael (2001) suggest that instructors carefully target and assess each word a child emits across various contexts, rather than assume that the child has interdependent use of a word until the child demonstrates functionally different uses.

Given this focus on function and the environmental variables surrounding language, Skinner's functional approach provides instructors with observable measures of language and a means of intervening upon language responses. As Sundberg and Michael (2001) explain, looking at external variables rather than assuming language originates within the child allows instructors to arrange the environment in ways to promote language. This allows instructors to systematically intervene across all functions of language, or verbal operants. These include mands, or, in common terms, requests for items, activities, and termination of events; tacts, or labels of items and actions currently in the individual's environment; echoics, or directly repeating a vocalization made by another individual; intraverbals, wherein individuals respond to what another person says without directly repeating it; copying a text, involving individuals' copy-written words; transcriptions, wherein an individual converts spoken words to written text; and textuials, or reading written language (Skinner, 1957). Each operant serves a separate function, and has different effects on the individual's environment, which instructors can analyze and use for language training.

Though Skinner did not devise the verbal operants with the intention of remediating language deficits, the implications and applications

of this approach to language training have been suggested and evaluated (Sundberg, 2008; Sundberg & Michael, 2001; Sundberg & Partington, 1998). To assist in the training of language skills, this chapter is designed to introduce readers to four of the elementary verbal operants (i.e., mands, tacts, echoics, and intraverbals) and provide suggestions for effectively teaching these responses to children with ASD. This chapter provides definitions for each operant, outlines the importance of and specific environmental variables responsible for each, provides some basic guidelines for teaching, and discusses their implications for practitioners. While it is possible to establish the verbal operants across communica-

tion modalities (e.g., sign language, speech, voice output devices, picture exchange), our chapter will focus primarily on vocal responses for ease and consistency. See Table 7.1 for a list of behavioral terms and their definitions.

7.1 Mand Overview

The mand is a type of verbal operant that is reinforced by a characteristic reinforcer and is evoked by the establishing operation for that reinforcer. Establishing operations (EO) refer to variables such as deprivation and aversive stimulation that momentarily alter the reinforcing effectiveness

Table 7.1 Basic behavioral terminology

Term	Definition	Example
Antecedent	An environmental condition or stimulus change existing or occurring prior to a behavior of interest (Cooper, Heron, & Heward, 2007)	His stomach growls, and then he asks for a cookie
Reinforcer	A stimulus change immediately follows a response and increases the future frequency of that type of behavior in similar conditions (Cooper, Heron, & Heward, 2007)	Receiving a cookie after asking, "Can I have a cookie, please?"
Verbal behavior	Behavior that is reinforced through the mediation of another person's behavior (Skinner, 1957)	One person says, "Water please" and someone else brings the water
Speaker	Someone who gains access to reinforcement and control their environment through the behavior of listeners (Michael, 2007)	The person saying, "Water please"
Listener	Someone who provides reinforcement for verbal behavior (Michael, 2007)	The person bringing the speaker water
Establishing operation (EO)	A motivating operation that establishes (increases) the effectiveness of some stimulus, object, or event as a reinforcer (Cooper, Heron, & Heward, 2007)	A person has not had any water for several hours, thereby making water more valuable
Echoic	An elementary verbal operant involving a response that is evoked by a verbal discriminative stimulus and that has point-to-point correspondence and formal similarity with the response (Skinner, 1957)	A mother says, "Moo," and her child says, "Moo," immediately after
Mand	An elementary verbal operant is evoked by a motivating operation and followed by specific reinforcement (Skinner, 1957)	Asking "Can I have a snack?" when he has not eaten in a few hours, and then receiving a bag of chips
Tact	An elementary verbal operant evoked by a nonverbal discriminative stimulus and followed by generalized conditioned reinforcement (Skinner, 1957)	A child saying "Puppy!" when a dog is present
Intraverbal	An elementary verbal operant that is evoked by a verbal discriminative stimulus and that does <i>not</i> have point-to-point correspondence with that verbal stimulus (Skinner, 1957)	A child saying "boat" when her mother sings, "Row, row, row your ..."

of other events and momentarily alter the frequency of responses that have been reinforced by those events (Michael, 1982, 1988; Sundberg, Loeb, Hale, & Eigenheer, 2002). That is, the mand is a verbal operant in which motivation determines what is said and the consequence of the mand is specific to what is said. In common terms, the mand is often referred to as a demand or request to obtain objects or bring about conditions that are not present (Sundberg & Michael, 2001). For example, if a child has not eaten for a few hours (EO), she may say “food please” (mand) to her mother. Her mother will then give her food (reinforcer) following this request. The mand is the only verbal operant that results in specific reinforcement, which refers to a consequence that is directly related to an individual’s verbal behavior. The consequences for the other verbal operants are not specific to the individual’s verbal behavior, meaning other verbal operants are reinforced via social praise and attention (Braam & Sundberg, 1991; Sundberg & Michael, 2001).

7.2 Importance and Implications

When considering that the mand is the only verbal operant that specifies its consequence, it is also the only verbal operant that directly benefits the speaker (Sundberg & Michael, 2001). Researchers and clinicians recommend that the mand be taught first in language training programs for children with ASD. According to Sundberg and Michael (2001), there are a variety of reasons to target the mand before other verbal operants, including the fact it is typically the first verbal operant acquired by children of typical development (Schlinger, 1995). It gives children control over their environment as it allows them to ask for items they desire. Mand training may establish the value of effective verbal behavior since children learn that engaging in a verbal response can directly benefit them. Due to the mand’s relation to EOs, it is also the verbal operant that is most likely to be emitted spontaneously and result in generalization to untrained

items and conditions (Miguel, 2017). First, mands may generalize across EOs, with mands occurring in the presence of different motivating variables. Second, Miguel (2017) notes that mands may also generalize across different responses, when a child engages in new mand topographies in the absence of direct training. For example, if a child learns that asking for food results in access to food, the child may begin asking for water and other items without any training for those particular responses. Third, mands are subject to stimulus generalization, wherein children mand in the presence of people and environments not associated with training (Miguel, 2017).

Parents have also reported that they prefer mand training to teaching other operants, and that children are more willing to participate in this type of language training (Sundberg & Michael, 2001). It is also possible that teaching the mand first will make further language training easier. This claim was supported by a study conducted by Carroll and Hesse (1987), which demonstrated that teaching children with ASD to mand for items might facilitate the learning of a tact repertoire. Researchers also found that children with ASD may engage in problem behavior (e.g., aggression, tantrums) that functions as mands (Carr & Durand, 1985). For example, a child may cry or hit his mother when he is hungry because doing so has resulted in access to food in the past. Teaching alternative, appropriate mands that result in desired consequences may decrease the occurrence of such problem behavior. Such decreases lead to widespread benefits and gains, including improved quality of life for the individual and significant others in his life. Therefore, behavior interventions often include some formal mand training to bring about the desired behavior change (Geiger, Carr, & LeBlanc, 2010).

7.3 Types of Mands

There are categories of mands that require special consideration and ways of arranging the instructional environment. One of the simplest mand

types, often acquired first, is the mand for tangible items. These types of mands involve the presence of an item. Children may reach for the item or say its name, which results in access to the item. The variable common to these mands is deprivation (an EO). If a child has not played with a particular toy, its reinforcing value may be increased and the child is more likely to mand for that toy. Mands for missing preferred items are similar to mands for tangibles because these mands result in access to tangible items or conditions. Mands for missing preferred items occur in the absence of items or conditions in the environment. If there is an EO for a particular item or condition that is not currently present, a child may mand for it, which results in access to that item.

Another type of mand that is often learned in early development is the mand for the removal of aversive stimuli. This mand type is categorized by the presence of an aversive stimulus (another EO), which is terminated when a mand occurs (Sundberg & Michael, 2001). For example, a child may say “stop” to her mother when she attempts to remove a toy she is playing with. Other common mands for the removal of aversive stimuli may include “no,” “go away,” or “don’t.”

Another category of mands is the mand for information, which involves asking questions. Questions are defined as mands that are reinforced by the verbal behavior of someone else who supplies useful information about the environment and are under the control of EOs that make that information valuable (Sundberg & Michael, 2001). The specific reinforcer for mands for information is verbal information, rather than tangible items or conditions which reinforce other types of mands (Sundberg et al., 2002). Two EOs are involved in asking “Wh” questions, which include a need or want for an item or a person, and the absence of that stimulus. To teach mands for information, the instructor must make information regarding a stimulus valuable (Sundberg et al., 2002). In other words, the instructor must make obtaining the information reinforcing. This could be accomplished, for example, by placing a preferred toy out of sight (prompting “where is it?”) or giving a needed item to another person (prompting “may I

have___ ?”). Information regarding the item’s location, or the identity of who possesses it, will reinforce that response and allow the child to acquire the item. Similarly, children can be taught to mand “how” when an EO is in place for information about how to extend nonverbal repertoires and contact new reinforcers (Lechago, Howell, Caccavale, & Peterson, 2013). For example, the instructor would present the materials needed to complete a behavior chain the child cannot complete independently (e.g., volcano kit) and provide an instruction to complete the activity (e.g., “Make the volcano”). When the outcome of a chain of behaviors is reinforcing, but the child lacks the skills or information to complete that chain, they may ask “how” to complete that chain of behaviors. See Lechago and Low (2015) for a review of the mand-for-information research literature.

7.4 Teaching Mands

When teaching children to mand, there are a variety of teaching procedures instructors can choose from.

7.4.1 Transfer of Stimulus Control

As with all of the verbal operants, mand training may involve a transfer of stimulus control procedure. In fact, many of the strategies outlined below include the transfer of stimulus control. Typically, this will involve presenting the mand via an echoic prompt (LeBlanc & Dillion, 2009). When using an echoic prompt, the instructor presents a vocal model of the target response (e.g., saying “water” while teaching the child to mand for water) in the presence of an EO (e.g., when the child has eaten salty foods and not drank water for some period of time). While mands may be established under multiple sources of control (e.g., echoic and EO control), the supplemental forms of control are eventually removed and only the EO exerts control. For example, an echoic prompt is faded through either increasing the delay between the EO and

the prompt or gradually removing words or phonemes from the prompt.

7.4.2 Capture EOs

One option is to capture EOs in the child's natural environment. Hart and Risley (1975) described a procedure called incidental teaching, which involves an interaction between an instructor and a child that arises naturally in an unstructured situation. The instructor uses the interaction to transmit information or give the child an opportunity to practice a skill. These interactions involve a child-selected activity. Instructors should begin by waiting for the child to initiate for an item by reaching for or looking at it. The instructor should respond by making eye contact. If the instructor's presence and eye contact do not evoke the response of asking for the item, they can provide a nonspecific prompt (e.g., "What do you want?"). If the child still does not respond with the name of the item, or an approximation of the name, the instructor can prompt the name of the item (e.g., say, "truck"). If the child imitates the mand, the item should be delivered immediately. The main advantage of this teaching procedure is that there is a naturally occurring EO (e.g., hunger, thirst) in place at the time of teaching (LeBlanc, Esch, Sidener, & Firth, 2006). However, waiting for child initiations may be time consuming, so it is often necessary to use alternative procedures to teach children to mand.

7.4.3 Contrive EOs

Rather than using procedures that capture existing EOs, instructors can contrive the EO. Instructors can contrive motivation to mand for tangible items by manipulating the environment in a way that makes mands more likely to occur. For example, highly preferred toys can be placed out of the child's reach or moved from their typical locations. When teaching mands under these conditions, there are a variety of teaching procedures to choose from. Prompts and prompt fading may be used. If the response is already in the child's repertoire, a prompt to engage in that

mand can be provided (Bourret, Vollmer, & Rapp, 2004). That prompt can then be faded by systematically decreasing the number of words in the prompt phrase (e.g., "cookie," "cook-," "coo-," "c-"). A progressive prompt delay, in which the prompt is delivered after an increasing number of seconds, can also be used to fade the prompt (Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012). Under these types of prompt fading procedures, the mand contacts reinforcement and should begin to occur independent of the prompt (Bourret et al., 2004).

7.4.4 Shaping

If the response is not already in the child's repertoire, using a shaping procedure is recommended (Baer, Peterson, & Sherman, 1967). This procedure involves reinforcing successive approximations to the target mand and can be used when the child can imitate parts of a phoneme prompt, but not the full topography (Bourret et al., 2004). Reinforcement in the form of the item or condition the child manded for is provided based on the child's current level of responding, until reinforcement is provided only for saying the full name of the item or condition. For example, if a child is manding for a toy car, the initial response "c-" can result in access to the car. Next, only the response "ca-" will result in reinforcement. Finally, only the full response "car" will result in reinforcement in the form of access to the car.

7.4.5 Chaining

Teaching more complex mands for information involves similar procedures. When teaching the "where" mand, the instructor should move the item from its typical location and then instruct the child to get the item. When the child cannot find the item, the instructor should model the mand "where is ___?" and then reinforce imitative or echoic responses with information about where the item is located (Sundberg et al., 2002). Mands involving the word "who" can follow the same procedure, although the item should be given to a different instructor. After the child

mands for the location of the item, the instructor should tell the child that another instructor has it. The instructor should then prompt the mand “who?” if necessary and reinforce imitative responses with information about the instructor who has the item. “How” mands can be taught by exposing the child to the terminal reinforcer at the end of a chain of responses the child cannot perform independently. The necessary materials can then be provided to the child and the teacher should tell them to complete the chain of responses. The mand “How ___?” should then be prompted and reinforced with information about how to complete the chain (Lechago et al., 2013).

7.4.6 Interrupted Chain Procedure

The interrupted chain procedure is an alternative teaching procedure that involves contriving EOs when teaching mands for missing items or information (Albert et al., 2012; Hall & Sundberg, 1987). First, an instructor should teach the child to complete a chain of behavior that leads to a terminal reinforcer. Then, the instructor should provide the child with all but one of the required materials and tell them to complete the chain. The instructor can prompt the mand for the missing item and reinforce the response by providing the item. For example, if a child learned how to make a bowl of cereal when all the materials are provided, the spoon can be moved from its usual location so that the child must mand for the spoon. This procedure can also be used for teaching “where” and “who” mand frames by either putting in the item in a different location or giving it to another instructor.

7.5 Clinical Guidelines and Recommendations

Through reviewing the literature on mands and mand training, we provide the following recommendations for establishing a manding repertoire with a child with language delays:

1. Target the manding repertoire first, before addressing other verbal operants (Sundberg &

Michael, 2001). If the first strategy you select is not effective, attempt to use another strategy until you determine what works best for the child (Cividini-Motta, Scharrer, & Ahearn, 2017).

2. While transfer of stimulus control procedures is common in establishing a mand repertoire, always include a prompt fading strategy to remove the other forms of control over time (LeBlanc & Dillion, 2009).
3. When possible, capitalize on current EOs in the child’s environment as this will help establish the mand under the appropriate control (Hart & Risley, 1975; LeBlanc et al., 2006). However, it is often necessary to contrive EOs to provide enough opportunities for the child to mand (Bourret et al., 2004).
4. Begin mand training with simpler responses and gradually shape mands to the desired utterance length or pronunciation (Bourret et al., 2004).

7.6 Echoics Overview

Skinner (1957) defined an echoic as a verbal operant that is under the influence of a verbal stimulus with formal similarity and point-to-point correspondence. In other words, an echoic occurs when a speaker repeats sounds of another speaker or himself (i.e., an auditory verbal stimulus; Sundberg, 2008). The echoic is maintained by generalized conditioned reinforcement (such as social attention). For example, a mother says the word “milk” and the child repeats the word “milk.” In this example, the mother saying the word “milk” would be the auditory verbal stimulus, and the child repeating the word “milk” would be the echoic. Echoics are also referred to as verbal imitation.

7.7 Importance and Implications

Echoics are an important verbal operant because they are typically used to teach other verbal operants (e.g., mands, tacts, intraverbals; Kodak & Clements, 2009; Lovaas, 2003; Sundberg & Partington, 1998; Watkins, Pack-Teixeira, & Howard, 1989; Williams, Donley, & Keller, 2000).

For example, when teaching a child to label a cup, the instructor may hold up a cup and present the vocal model, “cup,” and provide reinforcement when the child repeats the word. This process can be used to teach responses to social questions (e.g., “How are you? Good”) and requests for items (e.g., after denying the child access to a cookie, saying, “What do you want? Cookie”). Echoics are also important for listener responding. Listening involves responding to the verbal stimuli that have been emitted by a speaker (Schlinger, 2008). In addition, when a person is listening they are typically repeating the verbal stimuli to themselves (i.e., engaging in a self-echoic).

Not only do echoics serve as a means of teaching other verbal operants, but they also help individuals achieve parity. Palmer (1996) defines parity as when a speaker abides by the verbal practices of her community, or, in common terms, sounds like the people around her. This match between the model and the individual’s response eventually reinforces language use resembling larger community practices (Palmer, 1996). Echoics are necessary in achieving parity as they allow a speaker to practice responses in the presence of a model and contact reinforcement for point-to-point correspondence.

Echoics may also serve as a foundation for problem-solving skills. Skinner (1957) explains that individuals can emit covert echoics following a verbal model, and these covert echoics can prompt other responses. Palmer (1991) extended this discussion to the analysis of problem solving from a behavioral perspective; individuals emit mediating responses between the presentation of a problem and the final solution because they cannot immediately emit the terminal response. In other words, people emit chains of responses to solve problems, and some responses may be covert. One example is emitting covert echoics until the terminal response is achieved (Palmer, 1991). For example, if an instructor tells a child, “Go to the kitchen and grab me a cup,” the child may repeat “kitchen, cup, kitchen, cup,” as a self-echoic until he retrieves the cup. As such, covert echoics may serve as the foundation for more complex problem-solving skills, such as visual imagining (e.g., picturing the kitchen in his mind; Kisamore, Carr, & LeBlanc, 2011) and covert intraverbals (e.g.,

asking and answering, “What am I grabbing? A cup from the kitchen”; Palmer, 1991; Sautter, LeBlanc, Jay, Goldsmith, & Carr, 2011).

7.8 Teaching Echoics

In the following section we review strategies to establish an echoic repertoire with children with ASD. The basic and more widely used strategies include vocal imitation training, stimulus-stimulus pairing, and mand-model. Other strategies include chaining and rapid motor imitation antecedent training.

7.8.1 Vocal Imitation Training

Vocal imitation training is typically used with children who emit vocalizations, but the child’s vocalizations may not reliably occur under echoic control (e.g., following a verbal stimulus presented by an instructor). During vocal imitation training, the instructor presents a target verbal stimulus, and allows the child a short period of time (e.g., 5 s) to imitate the response. If the child imitates the response, reinforcement is provided. For example, the instructor says, “ah”; the child immediately repeats, “ah”; and the instructor delivers praise. Several studies have shown the effectiveness of this procedure (e.g., Baer et al., 1967; Lovaas, Berberich, Perloff, & Schaeffer, 1966).

7.8.2 Stimulus-stimulus Pairing

Stimulus-stimulus pairing is a procedure that involves presenting a verbal stimulus with a reinforcer and is used with children who produce minimal vocalizations. During this procedure, the instructor emits an utterance several times (e.g., “ba, ba, ba”), and then provides the child a preferred item (e.g., a favorite toy or snack). Conceptually, stimulus-stimulus pairing may lead to an increase in vocalizations because by pairing a verbal stimulus with a reinforcer, the target verbal stimulus itself may come to function as a reinforcer (Shillingsburg, Hollander, Yosick,

Bowen, & Muskat, 2015). In a review of the stimulus-stimulus pairing literature, Shillingsburg et al. (2015) documented a moderate intervention effect for children with language delays (i.e., effective for two-thirds of participants); additionally, stimulus-stimulus pairing was most effective for participants without functional language (i.e., verbal behavior that produces reinforcement). Further, stimulus-stimulus pairing has been more effective with younger (ages 5 and under) versus older (ages 6 and over) learners. Procedurally, stronger effects have been documented when delayed pairing was used. In delayed pairing, the verbal stimulus is followed by a reinforcer presented simultaneously with or upon completion of the final vocal model (Shillingsburg et al., 2015). For example, the instructor says “ba,” “ba,” “ba,” and then gives the child a piece of candy. In the studies, the number of times the experimenter emitted the target sound varied between one and three times.

7.8.3 Mand-model

The mand-model is another strategy to increase vocalizations through teaching echoics wherein instructors capitalize on EOs. When using the mand-model, the instructor identifies items the child prefers, makes them available throughout a teaching session, and determines a starting point for the name of the item (e.g., “bun” for a preferred toy bunny). During a teaching session the instructor will first review the target sound (e.g., the instructor holds up the toy bunny and says, “This is bun”), holds up the preferred item (e.g., the toy bunny), and provides a prompt (e.g., “What do you want?”). If the target response is emitted (i.e., the child mands, “bun”) the item is immediately presented; if the child does not mand for the item, the instructor provides an echoic prompt (e.g., “say, bun”) (Cividini-Motta et al., 2017; LeBlanc et al., 2006). Research using this method has been effective for some, but not all, participants (e.g., Nigam, Schlosser, & Lloyd, 2006).

7.8.4 Chaining

Chaining has been used to increase the complexity of echoics in children with ASD (Tarbox, Madrid, Aguilar, Jacobo, & Schiff, 2009). Tarbox et al. (2009) demonstrated the effectiveness of chaining when teaching echoics involving one to three syllable words. First the target is divided into two components (e.g., “orange” is divided into “or” and “ange”; “ball” is divided into “b” and “all”). One echoic is targeted in three sequential trials as quickly as possible while delivering reinforcement for correct imitations. During the first trial, the instructor models the first component (e.g., “say, b”). If the child imitates the first trial within 5 s of the model, the instructor immediately models the second component (e.g., “say, all”). If the child imitates the second trial within 5 s of the model, the instructor models the entire target echoic (e.g., “say, ball”). If the child engages in an incorrect response during any trial, the instructor repeats that trial, and then resumes the sequence.

7.8.5 Rapid Motor Imitation Antecedent Training

In rapid motor imitation antecedent training (i.e., high-probability sequencing), the instructor presents a series of rapid nonvocal imitation models ending with the target echoic model. The sequence is typically six fine and gross motor responses currently in the child’s imitative repertoire, and then the target echoic model (Tsiouri & Greer, 2007). The instructor should conduct a preference assessment prior to rapid motor imitation antecedent training and select preferred items for the echoic models. For example, imagine a truck was selected as a highly preferred item. The echoic target would be “truck.” An instructor would then present a series of rapid nonvocal imitation models (e.g., touching the head, waving a pinkie), ending with the target echoic model (e.g., “truck”). If there are two incorrect responses to the echoic model, the target

word can either be changed (e.g., “truck” can be changed to “uck”) or an instructor can add more motor responses to the sequence.

7.9 Clinical Guidelines and Recommendations

After reviewing the extant literature, we offer the following recommendations when establishing an echoic repertoire with an individual with ASD:

1. When establishing echoics, it is best to provide direct reinforcement of a target sound following a vocal model (Carroll & Klatt, 2008).
2. If the child already emits vocalizations, try using vocal imitation training (Baer et al., 1967; Lovaas et al., 1966).
3. If the child emits no vocalizations, vocal imitation training and stimulus-stimulus pairing will not likely be effective (Shillingsburg et al., 2015).
4. If the first strategy you select is not effective, attempt to use another strategy with the child until you determine what works best (Cividini-Motta et al., 2017).
5. Attempt to use one of the basic teaching strategies (i.e., vocal imitation training, stimulus-stimulus pairing, mand-model) before trying a more complex strategy that incorporates some of the basic strategy (i.e., chaining, rapid motor imitation antecedent training).
6. If you want to increase the complexity of echoics, try using chaining (Tarbox et al., 2009).

7.10 Tacts Overview

Skinner (1957) defined the tact as a verbal operant occasioned by a nonverbal discriminative stimulus and maintained by generalized conditioned reinforcement (such as social attention). For example, if a child says “Dog!” when a dog is nearby, this would be praised; conversely, if the child says “Lizard!” in the presence of a dog, this

will not be praised as it does not correspond with the nonverbal stimulus in the environment. Tacts specify stimuli or properties of stimuli in our environment, and it is important to note that tacts can be occasioned by auditory, tactile, visual, olfactory, and gustatory stimuli.

7.11 Importance and Implications

Skinner (1957) indicated that tacts are the most important verbal operant, and as such are critical in the early development of social and communicative behaviors for children. While mands benefit the speaker, tacts benefit the listener by providing specificity of information needed for conversational skills and general educational environments (LeBlanc & Dillion, 2009). This may include verbal behavior that is under the control of private stimuli such as emotions, pain, hunger, and nausea (Sundberg & Michael, 2001). Further, tacts can promote safety skills such as identifying food burning in the oven and facilitate useful nonverbal behavior such as refraining to touch a hot stove after tacting a parent’s social cue (e.g., parent gasps paired with disapproving facial expression).

A developed and robust tact repertoire is necessary for a number of reasons. One, the tact helps a listener to attend to the same stimuli as a speaker and facilitates further communication between the two. This is in direct contrast with the mand, which specifies a reinforcer for the speaker. Moreover, the tact provides a listener with more information about the environment (Skinner, 1957). Two, a tact repertoire may serve as a foundation for the speaker to develop more complex skills such as naming and emergence of listener responses (Skinner, 1957).

7.12 Types of Tacts

The environment can consist of an endless number of nonverbal stimuli and possible relations among stimuli that a child may respond to, and thus there are many different types of tacts that can be taught.

Basic tacts, which should be targeted first, consist of labeling three-dimensional objects and people the child interacts with. After the child develops a robust repertoire, the instructor can introduce two-dimensional representations of objects and locations. Following these, instructors may begin targeting more complex tacts, such as actions and functions of objects. Finally, instructors can address relational and descriptor tacts, such as prepositions, adjectives, and adverbs.

Modality of the nonverbal stimuli should also be taken into consideration. Increased awareness of our environment emerges from the use of our senses, so nonverbal stimuli should include auditory, tactile, visual, olfactory, and gustatory items. For example, sounds of common household items can be taught (i.e., auditory stimuli). A predetermined number of sound clips can be used and while playing with a dollhouse the instructor can play the doorbell sound clip and ask the child “What’s that?” to evoke the tact. Although a bulk of the tact literature has focused on examining strategies to teach visual stimuli, researchers have begun examining effective procedures to teach tacts of other modalities (Dass, Kisamore, Vladescu, Reeve, & Reeve, 2018). When conducting tact training, therapists should be sure to address tacts from all sensory modalities, as well as take measures to present the stimuli in isolation. For example, strawberry scent bottles can be purchased and tact training consists of bringing the scent bottle to the individual’s nose, rather than presenting an *in vivo* strawberry in the kitchen where other olfactory stimuli may be more salient to the individual (Dass et al., 2018).

7.13 Teaching Tacts

The literature on tact training demonstrates a couple strategies that have been effective in establishing a tact repertoire. While the specific procedures of a tact training program should be individualized, there are two basic approaches to teaching tacts: the natural language paradigm and transfer of stimulus control procedures.

7.13.1 Natural Language Paradigm

In a study conducted by Gillett and LeBlanc (2007), parents implemented an intervention consisting of modeling appropriate play actions with moderately preferred toys, followed by waiting for 5 s for the child to independently vocalize or comment about the event. If the child did not emit a comment, the parent continued to play and tact the event up to three times (Gillett & LeBlanc, 2007). Once the child imitated the response, the parent provided social attention and gave the child a turn to play with the toy. This approach is considered more naturalistic as it can be integrated into and mirrors the teaching processes through which typically developing children learn language skills.

7.13.2 Transfer of Stimulus Control Procedures

Discrete trial instruction can be used to transfer the control of one verbal response to an additional stimulus. However, the strict definition of the tact specifies that the controlling antecedent variable is a nonverbal stimulus. In research and applied settings, the target item is often paired with a question or an instruction to evoke the tact. Miguel and Kobari-Wright (2013) taught children with ASD to tact nine pictures that fell under three different categories (i.e., clothing, vehicle, animals) via a transfer of stimulus control procedure from an intraverbal prompt. Sessions consisted of nine trial blocks where the instructor presented one target picture and asked “What is it?” and modeled the correct response. A progressive prompt delay procedure gave participants the opportunity to respond independently across sessions. Sundberg, San Juan, Dawdy, and Arguelles (1990) used echoic prompts to teach tacts (i.e., stating the correct verbal response and reinforcing the child’s echoic) and gradually faded reinforcement so only responses that followed the nonverbal stimuli rather than the echoic prompt resulted in praise. Marchese, Carr, LeBlanc, Rosati, and Conroy (2012) compared

two teaching procedures where one condition included the supplemental question and the other condition only presented the item. Results showed mixed results where half of the participants acquired tacts more efficiently without the supplemental question and the others with the question. Moreover, Sundberg, Endicott, and Eigenheer (2000) taught two nonvocal children to reliably tact with signs. Changing the instruction from “What is that?” to “Sign (object)” resulted in increased correct responding. In sum, the child’s learning history should be assessed prior to the initial tact training. Studies have shown that adding the standard question asking to identify an object may enhance attending for some learners, yet reduce attending for others. Given these considerations, instructors should carefully probe a child’s performance across instructional methods to ensure that nonverbal stimuli exert control over tacts.

7.14 Clinical Guidelines and Recommendations

Given the current literature on developing a tact repertoire, we recommend the following techniques:

1. Wait to begin tact training until the individual has established echoic and mand repertoires (Sundberg & Partington, 1998).
2. Teach tacts with multiple exemplars, rotated during each teaching session, to promote generality of the tacts to the natural environment.
3. Focus primarily on familiar three-dimensional objects and people before targeting pictures of these same stimuli (LeBlanc & Dillion, 2009).
4. During teaching, present the nonverbal stimulus and a supplemental question only if needed. Be sure to conduct pure tact probes (i.e., trials without the supplemental question) to ensure that the nonverbal stimulus develops control over the tact.
5. Reinforce correct tacts with social reinforcers.

7.15 Intraverbal Overview

Skinner (1957) defined the intraverbal as a verbal operant evoked by a verbal discriminative stimulus lacking point-to-point correspondence with the antecedent verbal stimulus and maintained by generalized conditioned reinforcement (such as social attention). In other words, an intraverbal (e.g., answering “Fine”) is made in the presence of another verbal stimulus (e.g., the question “How are you?”) that does not match (i.e., does not have point-to-point correspondence with) the preceding stimulus.

While seemingly complicated, intraverbals account for the majority of our daily conversations including answering questions, making small talk, reciting trivia, telling stories, and more (Michael, 2007). Further, intraverbals allow individuals to discuss and think about stimuli not currently found in the environment. According to Michael (2007), individuals begin differentially responding to the verbal behavior of others through a history of reinforcement and shaping; for example, instructors will praise correct answers and punish or extinguish those deemed off topic. Skinner (1957) explains that novel verbal stimuli may evoke intraverbals due to their similarity to other verbal stimuli. Multiple stimuli may evoke the same intraverbal, and one verbal stimulus may also come to control multiple intraverbals.

7.16 Importance and Implications

Given the variety of responses that can be classified as an intraverbal, this repertoire is important for the development of many academic and social skills. It is likely that instructors prioritize this skill when determining goals for child with ASD. The intraverbal functions as the basis of conversation beyond present stimuli or EOs; therefore, it is necessary to have a well-developed intraverbal repertoire to succeed academically and socially.

As Skinner (1957) writes, the intraverbal repertoire facilitates the acquisition of many other

responses, both verbal and nonverbal. Some responses taught through traditional education paradigms (e.g., reciting dates of historical events) are typically acquired through intraverbal training. According to Michael (2007), an intraverbal repertoire enables children to “learn to learn,” or talk to themselves about their current repertoire and prepare to practice new skills. For example, when an instructor tells her class, “Today we’re learning about the American Revolution,” the child likely emits a number of covert intraverbals listing what he knows about the topic and what he would like to know. This may include asking himself “What have I learned about this before?” and responding “Oh, I remember! That’s the one with George Washington” and so on. In this way, intraverbals help prime the child for the upcoming lesson.

Another important aspect of the intraverbal is its function as a transition from the listener to speaker role. As explained by Aguirre, Valentino, and LeBlanc (2016), the ability to respond to one’s own questions is crucial for problem-solving skills wherein the individual must mediate her own responding until reaching a solution. A variety of problems involve complex verbal stimuli evoking covert intraverbals. Covert intraverbals are when a child thinks to herself, asking and answering questions or planning other behaviors. Without the intraverbal, though, the child could not do this and would require additional strategies to problem solve.

Given the complexity and variety of these responses, an intraverbal repertoire can be difficult to establish in children with ASD. Sundberg and Sundberg (2011) explain that many children with ASD struggle to acquire verbal conditional discriminations, or the ability to respond correctly and appropriately when the response depends upon two or more parts of the evocative verbal stimulus. These include questions such as “What’s your mother’s name?” which requires the individual to attend to both “your mother” and “name” to respond and contact reinforcement. Both portions of the antecedent must exert control over the response, though this will be discussed further in the following section. The majority of daily conversations consist of verbal

conditional discriminations, yet children with ASD often struggle to acquire them; moreover, Sundberg and Sundberg (2011) found that even those children who do acquire verbal conditional discriminations often emit them with qualitative differences than their typically developing peers. Rote responding or providing invariant responses each time the verbal stimulus is presented makes up a common difference seen in children with ASD.

Similarly, intraverbals appear to be one of the more complex and challenging verbal operants for typically developing children to acquire. Sundberg and Sundberg (2011) conducted a study wherein children of typical development and those diagnosed with ASD were given an intraverbal assessment. They concluded that children might develop intraverbal repertoires in a given sequence. Generally, the intraverbal repertoire of 2-year-olds consists of fill-in-the-blanks, songs, animal sounds, and some one-word responses to personal information questions. Two-and-a-half-year-olds start acquiring more intraverbals, but they rely on echoic responding or attend only to the last word in a question; as such, there are almost no verbal conditional discriminations in their repertoire. By the time the child is 3 years old, he begins answering WH questions with some accuracy, but with evidence of rote responding and restricted stimulus control when verbal conditional discriminations are presented. Overall, Sundberg and Sundberg (2011) demonstrate a potential developmental sequence to intraverbal repertoires, with verbal conditional discriminations being among the final skills to be acquired. Such information should inform programming when working with children with ASD.

7.17 Types of Intraverbals

While all intraverbals are controlled by an antecedent verbal stimulus, different categories exist depending on the specific stimulus control involved. Simple intraverbals are those where one verbal stimulus controls responding (Sundberg & Sundberg, 2011). In common terms,

the child needs to attend to only one component of the verbal stimulus to respond. Examples of simple intraverbals include word associations and fill-in-the-blanks with nursery rhymes (e.g., “The itsy bitsy-” or “Humpty Dumpty sat on a-”; Sundberg, 2016).

Compound intraverbals are those in which multiple vocal stimuli, presented together, evoke certain responses; however, each vocal stimulus evokes different intraverbals on its own (Sundberg, 2016). For example, “red” and “white” each evokes numerous responses when presented individually, yet the phrase “Red, white, and-” evokes “blue” in American communities. According to Sundberg (2016), the compound intraverbal allows for more complex language use as the number of verbal stimuli presented increases.

Verbal conditional discriminations consist of two or more verbal stimuli, and one stimulus alters the evocative effects of the other (Sundberg, 2016). As a result, the child must attend to both stimuli to respond. With respect to intraverbals, this means the child emits a response specific to this combination of verbal stimuli because one stimulus alters the function of another within the antecedent. Many questions fall under the category of verbal conditional discriminations, such as “What do you eat with?” versus “What do you drink with?” (Sundberg, 2016). “Eat” and “drink” alter the function of “with,” and thus the child emits different intraverbals.

Verbal function-altering intraverbals are those where one verbal stimulus alters the function of another verbal stimulus presented later; the intraverbal is emitted following this altered verbal stimulus. Often these come in the form of rules (Sundberg, 2016). For example, an instructor says, “Count to ten when I say your name,” thereby altering the function of hearing one’s name because, in other contexts, hearing one’s name would evoke different responses.

7.18 Teaching Intraverbals

As for developing a teaching sequence, Sundberg and Sundberg’s (2011) findings suggest that easier intraverbals include fill-in-the-

blanks, nursery rhymes, and one-word answers. Next, they recommend targeting common animal sounds and WH questions, beginning with “what.” Also, common word associations strengthen intraverbal repertoires, so exposure to various word associations and verbal stimuli is key to developing a robust intraverbal repertoire. After the child acquires simpler intraverbals, instructors may begin training verbal conditional discriminations.

Researchers have evaluated a variety of prompting procedures when teaching children with ASD an intraverbal repertoire. Axe (2008) explains that overselectivity or responding to only one of the relevant antecedent stimuli often becomes a problem during this process. Axe recommends requiring differential observing responses (having the child demonstrate attending to both relevant verbal stimuli), using within-stimulus prompts (exaggerating those relevant stimuli), and altering schedules of reinforcement (varying questions with one or multiple relevant antecedent stimuli) to help overcome this barrier. Michael (2007) also suggests using expansion prompts, or asking the child to keep responding, to increase response variability.

Aguirre et al. (2016) conducted a review of the research on teaching intraverbals and reported that echoic prompts, tact prompts, differential observing responses, and textual prompts were commonly used during transfer-of-stimulus-control procedures. Prompts were often faded with a constant or progressive prompt delay, meaning the time between the verbal antecedent stimulus and the prompt increased based on a predetermined criterion. With respect to trial presentation, Dickes and Kodak (2015) highlighted the importance of varying the antecedent topography because in the natural environment individuals produce verbal stimuli differently. For example, both “What is your mom’s name?” and “Your mom’s name is?” may occur. Another option is the blocked trial procedure. Blocked trials consist of consecutive presentations of the same question before presenting another question multiple times; gradually, the number of trials per question is reduced. Ingvarsson, Kramer, Carp, Petursdottir, and Macias (2016) explain that blocked trials assist with acquisition of verbal

conditional discriminations by slowly requiring the child to attend to all of the relevant features of the verbal antecedent stimulus as the blocks shift. Ingvarsson et al. found the procedure to be effective, and participants acquire subsequent intraverbals more efficiently.

7.18.1 Differential Observing Responses

Differential observing responses verify the discrimination of critical features of antecedent stimuli; in other words, these responses help instructors ensure that the child attends to the important parts of an instruction. For example, when asking “What do you eat with?” the instructor may require the child to repeat “Eat with” before providing an answer (e.g., spoon, fork). Kisamore, Karsten, Mann, and Conde (2013) taught typically developing preschoolers to emit a differential observing response of repeating the adult’s question. All participants acquired intraverbals acquired via the differential observing response. The authors also conceptualized this differential observing response, repetition, as a form of problem solving, meaning this technique may have ancillary effects. Similarly, Dube and McIlvane (1999) demonstrated that a differential observing response and delayed matching-to-sample skills may improve intraverbal performance because they counteract restricted stimulus control.

7.18.2 Textual Prompts

A textual prompt consists of a stimulus with the correct response written out. During a trial, the instructor will present the verbal antecedent, and then hold up the textual prompt for the child to read. Finkel and Williams (2001), in a comparison of textual and echoic prompts on the rate of intraverbal acquisition, found textual prompts to be more effective, though participants acquired responses with both prompts. Vedora and Meunier (2009) replicated these findings when fading the textual prompt on a progressive prompt delay.

Valentino, Conine, Delfs, and Furlow (2015) found that backward chaining with textual prompts embedded within an activity (i.e., reading a book) paired with echoic prompts was effective for teaching storytelling intraverbals.

7.18.3 Tact Prompts

Typically, a tact prompt consists of the instructor presenting a visual stimulus, usually an image, in the same manner as a textual prompt. For example, the instructor may say, “Woof woof goes the,” and hold up a picture of a dog for the child to tact. Ingvarsson and Hollobaugh (2011) found that tact prompts using pictures were more effective for training intraverbals than echoic prompts, but participants acquired intraverbals under both procedures. Miguel, Petursdottir, and Carr (2005) found that the students acquired intraverbals trained via tact prompts; previously, Miguel et al. probed for emergence after multiple tact training and listener responding, but found that these procedures were not effective. Partington and Bailey (1993) found tact training insufficient for intraverbal emergence. However, the authors concluded that expansion prompts and tact prompts were effective for intraverbal acquisition. These studies emphasize that, while an intraverbal repertoire may emerge following the establishment of a tact repertoire, this may not occur for all children with ASD. Additionally, the presence of the prompt must be faded so the response comes under intraverbal control rather than remaining solely under tact control (Belloso-Diaz & Perez-Gonzalez, 2015; May, Hawkins, & Dymond, 2013).

7.18.4 Echoic Prompts

An echoic prompt consists of the instructor presenting a vocal model of the correct response following the verbal antecedent. To demonstrate, the instructor may say, “How old are you?” followed immediately by the child’s age. The instructor may present the echoic prompt by speaking or playing a recording (Allan, Vladescu, Kisamore,

Reeve, & Sidener, 2015). Vedora and Conant (2015) compared the effects of echoic and tact prompts, and found no meaningful difference in the rate of acquisition across the two prompting procedures. Sundberg et al. (1990) used echoic prompts with adults diagnosed with traumatic brain injury, and found these prompts to be effective. Sundberg et al. differentially reinforced unprompted and prompted correct responses and faded the echoic to the initial sound during intraverbal training. Ingvarsson, Tiger, Hanley, and Stephenson (2007) effectively used echoic prompts to teach the intraverbal response, “I don’t know, please tell me,” to novel questions. Allan et al. (2015) provided the echoic prompt via a voice recording; this may help prevent inappropriate echoic control wherein the child responds, “say__.” It is recommended that instructors do not include the instruction “Say” when presenting the echoic prompt.

7.19 Clinical Guidelines and Recommendations

After reviewing the research on teaching intraverbal responses, here are some recommendations for targeting this verbal operant:

1. When beginning intraverbal training, follow the sequence reported by Sundberg and Sundberg (2011) as simpler intraverbals may serve as prerequisite skills for complex intraverbals.
2. Wait until the child has generalized tact, mand, and listener repertoires to begin intraverbal training (Sundberg & Sundberg, 2011).
3. During intraverbal training, vary the exact wording when targeting answers to questions to avoid restricted stimulus control (Dickes & Kodak, 2015). Similarly, be sure to ask the reverse form of the verbal stimulus. For example, “The dog goes” and “Woof goes the.”
4. When selecting prompting strategies, begin with those that have successfully helped the child acquire other skills in the past (Dickes & Kodak, 2015).

5. As the targeted intraverbals become more complex, reinforce multiple appropriate responses to reduce the likelihood of rote responding. Also, reinforce responses with praise and continued social interaction so the child’s intraverbal repertoire is maintained by naturally occurring reinforcers (Sundberg & Sundberg, 2011).
6. Assess the child’s intraverbal repertoire regularly and track the types of errors they emit to inform your programming. For example, is the child consistently responding only to the last word in the question? Are all questions including “you” followed by the child’s name? (Kisamore, Karsten, & Mann, 2016; Sundberg & Sundberg, 2011).

7.20 Summary

A functional approach to language considers the antecedents and consequences surrounding language responses, which allows instructors to arrange the teaching environment to target specific operants, as well as capitalize on naturally occurring teaching opportunities. Moreover, instructors can observe and measure the occurrences of verbal behavior, allowing instructors to make data-based decisions regarding their teaching. Across verbal operants, some practices are standard within a verbal behavior language-training program. To begin, identify a variety of reinforcers, including social reinforcers (e.g., praise). As Skinner (1957) noted, the majority of the elementary operants are maintained by social interactions in the natural environment, so using these classes of reinforcers may facilitate response generalization and maintenance outside of the teaching environment. At this time, instructors should also assess the child’s existing verbal behavior repertoires so training targets only those operants the child needs to establish (Sundberg & Michael, 2001). Sundberg and Michael (2001) recommend establishing the mand repertoire first as this operant allows the child to directly meet his needs and produces specific reinforcement. Research supports the use of transfer of stimulus

control procedures to establish many verbal operants, and instructors must be sure to remove variables that should not ultimately control responding. Finally, instructors must collect data and use those data to inform decisions regarding the continuation or discontinuation of a teaching procedure.

References

- Aguirre, A. A., Valentino, A. L., & LeBlanc, L. A. (2016). Empirical investigations of the intraverbal: 2005–2015. *The Analysis of Verbal Behavior*, 32, 139–153. <https://doi.org/10.1007/s40616-016-0064-5>
- Albert, K. M., Carbone, V. J., Murray, D. D., Hagerty, M., & Sweeney-Kerwin, E. J. (2012). Increasing the mand repertoire of children with autism through the use of an interrupted chain procedure. *Behavior Analysis in Practice*, 5, 65–76.
- Allan, A. C., Vladescu, J. C., Kisamore, A. N., Reeve, S. A., & Sidener, T. M. (2015). Evaluating the emergence of reverse intraverbals in children with autism. *The Analysis of Verbal Behavior*, 31, 59–75. <https://doi.org/10.1007/s40616-014-0025-8>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Axe, J. B. (2008). Conditional discrimination in the intraverbal relation: A review and recommendations for future research. *The Analysis of Verbal Behavior*, 24, 159–174.
- Baer, D. M., Peterson, R. F., & Sherman, J. A. (1967). The development of imitation by reinforcing behavioral similarity to a model. *Journal of the Experimental Analysis of Behavior*, 21, 405–416. <https://doi.org/10.1901/jwab.1967.10-405>
- Belloso-Diaz, C., & Perez-Gonzalez, L. A. (2015). Effect of learning tacts or tacts and intraverbals on the emergence of intraverbals about verbal categorization. *The Psychological Record*, 65, 749–760. <https://doi.org/10.1007/s40732-015-0145-0>
- Bourret, J., Vollmer, T. R., & Rapp, J. T. (2004). Evaluation of a vocal mand assessment and vocal mand training procedures. *Journal of Applied Behavior Analysis*, 37, 129–144.
- Braam, S. J., & Sundberg, M. L. (1991). The effects of specific versus nonspecific reinforcement on verbal behavior. *The Analysis of Verbal Behavior*, 9, 19–28.
- Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis*, 18, 111–126.
- Carroll, R. A., & Klatt, K. P. (2008). Using stimulus-stimulus pairing and direct reinforcement to teach vocal verbal behavior to young children with autism. *The Analysis of Verbal Behavior*, 24, 135–146. <https://doi.org/10.1007/BF03393062>
- Carroll, R. J., & Hesse, B. E. (1987). The effects of mand and tact training on the acquisition of tacts. *The Analysis of Verbal Behavior*, 5, 55–65.
- Cividini-Motta, C., Scharrer, N., & Ahearn, W. H. (2017). An assessment of three procedures to teach echoic responding. *The Analysis of Verbal Behavior*, 33, 41–63. <https://doi.org/10.1007/s40616-016-0069-z>
- Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis* (2nd ed.). Upper Saddle River: Pearson.
- Dass, T. K., Kisamore, A. N., Vladescu, J. C., Reeve, K. F., & Reeve, S. A. (2018). Teaching children with autism spectrum disorder to tact olfactory stimuli. *Journal of Applied Behavior Analysis*, 51(3), 538–552.
- Dickes, N. R., & Kodak, T. (2015). Evaluating the emergence of reverse intraverbals following intraverbal training in young children with autism spectrum disorder. *Behavioral Interventions*, 30, 169–190. <https://doi.org/10.1002/bin.1412>
- Dube, W. V., & McIlvane, W. J. (1999). Reduction of stimulus overselectivity with nonverbal differential observing responses. *Journal of Applied Behavior Analysis*, 32, 25–33.
- Finkel, A. S., & Williams, R. L. (2001). A comparison of textual and echoic prompts on the acquisition of intraverbal behavior in a six-year-old boy with autism. *The Analysis of Verbal Behavior*, 18, 61–70.
- Geiger, K. B., Carr, J. E., & LeBlanc, L. A. (2010). Function-based treatments for escape-maintained problem behavior: A treatment-selection model for practicing behavior analysts. *Behavior Analysis in Practice*, 3, 22–32.
- Gillett, J. N., & LeBlanc, L. A. (2007). Parent-implemented natural language paradigm to increase language and play in children with autism. *Research in Autism Spectrum Disorders*, 1, 247–255.
- Hall, G., & Sundberg, M. L. (1987). Teaching mands by manipulating conditioned establishing operations. *The Analysis of Verbal Behavior*, 5, 41–53.
- Hart, B., & Risley, T. R. (1975). Incidental teaching of language in the preschool. *Journal of Applied Behavior Analysis*, 8, 411–420.
- Ingvarsson, E. T., & Hollobaugh, T. (2011). A comparison of prompting tactics to establish intraverbals in children with autism. *Journal of Applied Behavior Analysis*, 44, 659–664. <https://doi.org/10.1901/jaba.2011.44-659>
- Ingvarsson, E. T., Kramer, R. L., Carp, C. L., Petursdottir, A. I., & Macias, H. (2016). Evaluation of a blocked-trials procedure to establish complex stimulus control over intraverbal responses in children with autism. *The Analysis of Verbal Behavior*, 32, 205–224. <https://doi.org/10.1007/s40616-016-0071-5>
- Ingvarsson, E. T., Tiger, J. H., Hanley, G. P., & Stephenson, K. M. (2007). An evaluation of intraverbal training to generate socially appropriate responses to novel questions. *Journal of Applied Behavior Analysis*, 40, 411–429. <https://doi.org/10.1901/jaba.2007.40-411>
- Kisamore, A. N., Carr, J. E., & LeBlanc, L. A. (2011). Training preschool children to use visual imagining

- as a problem-solving strategy for complex categorization tasks. *Journal of Applied Behavior Analysis*, *44*, 255–278.
- Kisamore, A. N., Karsten, A. M., & Mann, C. C. (2016). Teaching multiply controlled intraverbals to children and adolescents with autism spectrum disorder. *Journal of Applied Behavior Analysis*, *49*, 826–847.
- Kisamore, A. N., Karsten, A. M., Mann, C. C., & Conde, K. A. (2013). Effects of a differential observing response on intraverbal performance of preschool children: A preliminary investigation. *The Analysis of Verbal Behavior*, *29*, 101–108.
- Kodak, T., & Clements, A. (2009). Acquisition of mands and tacts with concurrent echoic training. *Journal of Applied Behavior Analysis*, *42*, 839–843. <https://doi.org/10.1901/jaba.2009.42-839>
- LeBlanc, L. A., & Dillion, C. M. (2009). Establishing mand and tact repertoires. In R. A. Rehfeldt & Y. Barnes-Holmes (Eds.), *Derived relational responding* (pp. 79–108). Oakland, CA: New Harbinger Publications, Inc..
- LeBlanc, L. A., Esch, J., Sidener, T. M., & Firth, A. M. (2006). Behavioral language interventions for children with autism: Comparing applied verbal behavior and naturalistic teaching approaches. *The Analysis of Verbal Behavior*, *22*, 49–60. <https://doi.org/10.0007/BF03393026>
- Lechago, S. A., Howell, A., Caccavale, M. N., & Peterson, C. W. (2013). Teaching “How?” mand-for-information frames to children with autism. *Journal of Applied Behavior Analysis*, *46*, 781–791. <https://doi.org/10.1002/jaba.71>
- Lechago, S. A., & Low, A. I. (2015). A review of the mand-for-information training research literature. *International Journal of Behavior Analysis & Autism Spectrum Disorders*, *1*, 35–54.
- Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Counseling and Clinical Psychology*, *55*, 3–9.
- Lovaas, O. I. (2003). *Teaching individuals with developmental delays: Basic intervention techniques*. Austin, TX: Pro-Ed.
- Lovaas, O. I., Berberich, J. P., Perloff, B. F., & Schaeffer, B. (1966). Acquisition of imitative speech in schizophrenic children. *Science*, *151*, 705–707. <https://doi.org/10.1126/science.151.3711.705>
- Marchese, N. V., Carr, J. E., LeBlanc, L. A., Rosati, T. C., & Conroy, S. A. (2012). The effects of the question “what is it?” on tact-training outcomes of children with autism. *Journal of Applied Behavior Analysis*, *45*, 539–547.
- May, R. J., Hawkins, E., & Dymond, S. (2013). Brief report: Effects of tact training on the emergent intraverbal vocal responses in adolescents with autism. *Journal of Autism and Developmental Disorders*, *43*, 996–1004. <https://doi.org/10.1007/s10803-012-1632-7>
- Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior*, *37*, 149–155.
- Michael, J. (1988). Establishing operations and the mand. *The Analysis of Verbal Behavior*, *6*, 3–9.
- Michael, J. (2007). Verbal behavior. In J. O. Cooper, T. E. Heron, & W. L. Heward (Eds.), *Applied behavior analysis* (2nd ed., pp. 525–547). Upper Saddle River, NJ: Merrill-Prentice Hall.
- Miguel, C. F. (2017). The generalization of mands. *Analysis of Verbal Behavior*, *33*, 1–14. <https://doi.org/10.1007/s40616-017-0090-x>
- Miguel, C. F., & Kobari-Wright, V. V. (2013). The effects of tact training on the emergence of categorization and listener behavior in children with autism. *Journal of Applied Behavior Analysis*, *46*, 669–673.
- Miguel, C. F., Petursdottir, A. I., & Carr, J. E. (2005). The effects of multiple-tact and receptive-discrimination training on the acquisition of intraverbal behavior. *The Analysis of Verbal Behavior*, *21*, 27–41.
- Nigam, R., Schlosser, R. W., & Lloyd, L. L. (2006). Concomitant use of the matrix strategy and the mand-model procedure in teaching graphic symbol combinations. *Augmentative and Alternative Communication*, *22*, 160–177. <https://doi.org/10.1080/07434610600650052>
- Palmer, D. C. (1991). A behavioral interpretation of memory. In L. J. Hayes & P. N. Chase (Eds.), *Dialogues on verbal behavior* (pp. 261–279). Reno, NV: Context Press.
- Palmer, D. C. (1996). Achieving parity: The role of automatic reinforcement. *Journal of the Experimental Analysis of Behavior*, *65*, 289–290.
- Partington, J. W., & Bailey, J. S. (1993). Teaching intraverbal behavior to preschool children. *The Analysis of Verbal Behavior*, *11*, 9–18.
- Sautter, R. A., LeBlanc, L. A., Jay, A. A., Goldsmith, T. R., & Carr, J. E. (2011). The role of problem solving in complex intraverbal repertoires. *Journal of Applied Behavior Analysis*, *44*, 227–244.
- Schlinger, H. D. (1995). *A behavior analytic view of child development* (pp. 215–242). New York: Plenum Press.
- Schlinger, H. D. (2008). Listening is behaving verbally. *The Behavior Analyst*, *31*, 145–161. <https://doi.org/10.1007/BF03392168>
- Shillingsburg, M. A., Hollander, D. L., Yosick, R. N., Bowen, C., & Muskat, L. R. (2015). Stimulus-stimulus pairing to increase vocalizations in children with language delays: A review. *The Analysis of Verbal Behavior*, *31*, 215–235. <https://doi.org/10.1007/s40616-015-0042-2>
- Skinner, B. F. (1957). *Verbal behavior*. Englewood Cliffs, NJ: Prentice Hall.
- Sundberg, M. L. (2008). *Verbal behavior milestones assessment and placement program: The VB-MAPP*. Concord, CA: AVB Press.
- Sundberg, M. L. (2016). Verbal stimulus control and the intraverbal relation. *The Analysis of Verbal Behavior*, *32*, 107–124. <https://doi.org/10.1007/s40616-016-0065-3>
- Sundberg, M. L., Endicott, K., & Eigenheer, P. (2000). Using intraverbal prompts to establish tacts for children with autism. *The Analysis of Verbal Behavior*, *17*, 89–104.

- Sundberg, M. L., Loeb, M., Hale, L., & Eigenheer, P. (2002). Contriving establishing operations to teach mands for information. *The Analysis of Verbal Behavior, 18*, 15–29.
- Sundberg, M. L., & Michael, J. (2001). The benefits of skinner's analysis of verbal behavior for children with autism. *Behavior Modification, 25*(5), 698–724.
- Sundberg, M. L., & Partington, J. W. (1998). *Teaching language to children with autism or other developmental disabilities*. Pleasant Hill, CA: Behavior Analyst, Inc..
- Sundberg, M. L., San Juan, B., Dawdy, M., & Arguelles, M. (1990). The acquisition of tacts, mands, and intraverbals by individuals with traumatic brain injury. *The Analysis of Verbal Behavior, 8*, 83–99.
- Sundberg, M. L., & Sundberg, C. A. (2011). Intraverbal behavior and verbal conditional discriminations in typically developing children and children with autism. *The Analysis of Verbal Behavior, 27*, 23–43.
- Tarbox, J., Madrid, W., Aguilar, B., Jacobo, W., & Schiff, A. (2009). Use of chaining to increase complexity of echoics in children with autism. *Journal of Applied Behavior Analysis, 42*, 901–906. <https://doi.org/10.1901/jaba.2009.42-901>
- Tsiouri, I., & Greer, R. D. (2007). The role of different social reinforcement contingencies in inducing echoic tacts through motor imitation responding in children with severe language delays. *Journal of Early and Intensive Behavior Intervention, 4*, 629–647. <https://doi.org/10.1037/h0100397>
- Valentino, A. L., Conine, D. E., Delfs, C. H., & Furlow, C. M. (2015). Use of a modified chaining procedure with textual prompts to establish intraverbal storytelling. *The Analysis of Verbal Behavior, 31*, 39–58. <https://doi.org/10.1007/s40616-014-0023-x>
- Vedora, J., & Conant, E. (2015). A comparison of prompting tactics for teaching intraverbals to young adults with autism. *The Analysis of Verbal Behavior, 31*, 267–276. <https://doi.org/10.1007/s40616-015-0030-6>
- Vedora, J., & Meunier, L. (2009). Teaching intraverbal behavior to children with autism: A comparison of textual and echoic prompts. *The Analysis of Verbal Behavior, 25*, 79–86.
- Watkins, C. L., Pack-Teixeira, L., & Howard, J. S. (1989). Teaching intraverbal behavior to severely retarded children. *The Analysis of Verbal Behavior, 7*, 69–81. <https://doi.org/10.1007/BF03392838>
- Williams, G., Donley, C., & Keller, J. (2000). Teaching children with autism to ask questions about hidden objects. *Journal of Applied Behavior Analysis, 33*, 627–630. <https://doi.org/10.1901/jaba.2000.33-627>