International Electronic Journal of Elementary Education, December 2016, 9(2), 433-450.

Tutorial: Teaching Verbal Behavior to Children with ASD

Einar T. INGVARSSON [a] *

[a] *University of North Texas and Child Study Center, USA*

Received: August, 2016 / Revised: September, 2016 / Accepted: October, 2016

Abstract

Early and intensive behavioral intervention has been shown to result in favorable outcomes for children with autism spectrum disorder. Procedures and practices based on and influenced by B. F. Skinner's Verbal Behavior (VB) have been increasingly integrated into EIBI curricula in recent years. In this article, I give an overview of some basic tenets of VB as they pertain to behavioral interventions for children with ASD, with a special emphasis on the relevance of basic behavioral principles to verbal operants. Additionally, I provide a few examples of practical recommendations derived from VB.

Keywords: Autism spectrum disorder, Early and intensive behavioral intervention, Verbal behavior

Introduction

Early and Intensive Behavioral Intervention (EIBI) has become a widespread treatment approach for children with autism spectrum disorder. Several outcome studies, meta-analyses, and reviews of the literature support the effectiveness of EIBI as an intervention for this population (Eldevik et al., 2009; 2010; Klintwall, Eldevik, & Eikeseth, 2015; Lovaas, 1987). Autism is generally believed to be a disorder of the brain and genetic factors are thought to play a crucial role in its etiology (Rutter & Thapar, 2014; Volkmar & McPartland, 2014). However, environmental experiences can compensate for deficits presumably caused by brain structure or function (Thompson, 2007). This is especially true of experiences that occur early in life, due to the considerable neural plasticity that characterizes early brain development. Thus, the systematic, comprehensive, and intensive environmental input characteristic of EIBI seems to positively affect the developmental course of many children with ASD.

EIBI is based on the science of applied behavior analysis (ABA), and EIBI is frequently referred to as ABA therapy or treatment. ABA is the applied "branch" of the science of behavior analysis, rooted largely in the work of B. F. Skinner (1938; 1953). Behavior

* Address for correspondence: Einar T. Ingvarsson, PhD, BCBA-D, 1155 Union Circle, Department of Behavior Analysis, University of North Texas, Denton, Texas 76201. Phone: 940-565-2274. E-mail: Einar.Ingvarsson@unt.edu

ISSN:1307-9298

www.iejee.com

analysts study environment-behavior relations in a broad sense, and decades of laboratory work have led to the development of general principles of behavior. ABA researchers and practitioners apply these general principles to behavior of social importance (Baer, Wolf, & Risley, 1968).

Behavioral scientists in the Skinnerian tradition have sometimes been criticized for failing to account for complex human behavior, such as language, cognition, and social interactions (e.g., Chomsky, 1959). However, several behavior analysts have studied complex behavior-environment relations extensively (e.g., Hayes, Barnes-Holmes, & Roche, 2001; Horne & Lowe, 1996; Sidman, 1994). Although he didn't conduct much research on human behavior, Skinner published several books and papers in which he interpreted complex behavior in terms of basic behavioral principles established in the laboratory. In the book *Verbal behavior* (VB), published in 1957, Skinner provided a conceptual interpretation of language and communication. In addition, he proposed new terms (e.g., mands, tacts, intraverbals) to categorize verbal behavior based on its function. Skinner did not present any research on verbal behavior in the book. This may be part of the reason why its impact was somewhat limited in the years and decades after it was published (Dymond, O'Hora, Whelan, & O'Donovan, 2006; McPherson, Bonem, Green, & Osborne, 1984). However, the impact of Skinner's VB on research and practice has increased with time (Love, Carr, Almason, & Petursdottir, 2009; Sautter & LeBlanc, 2006).

The purpose of the current paper is to provide an overview of Skinner's analysis of verbal behavior as it pertains to behavioral interventions for individuals with autism spectrum disorder. Because language and communication deficits are a defining feature of ASD, Skinner's VB may be particularly important for this population. In addition to VB, the current discussion draws from sources that are consistent with, based on, and extend Skinner's work. This includes literature that may not have been directly influenced by Skinner's VB, but is nevertheless consistent with it (e.g., the literature on incidental teaching; Hart & Risley, 1978). I hope to outline the utility of VB, especially as it applies to early behavioral interventions for children with autism. This discussion assumes fundamental knowledge of basic principles of behavior such as reinforcement, stimulus control, and motivating operations, as well as common procedures (or classes of procedures) such as differential reinforcement, discrimination training, shaping, prompting, and fading.

The Definition of Verbal Behavior

In the first chapter of Verbal Behavior, Skinner defined verbal behavior as behavior whose reinforcement is mediated by another person. Even though this definition points to a crucial defining feature of verbal behavior, it can be argued that it fails to distinguish between behaviors commonly recognized as verbal from others few would call verbal (e.g., the experimenter mediates the reinforcement for rat's lever pressing in a Skinner box). Recognizing this, Skinner added the caveat that the behavior of the listener (who mediates reinforcement for the verbal response) had to be specifically conditioned to reinforce particular speaker responses. Thus, the listener reinforces responses that are consistent with the conventions of a verbal community.

Two aspects of Skinner's definition are especially noteworthy. First, it suggests that verbal behavior is neither special nor qualitatively different from behavior in general. Thus, we should analyze verbal behavior like any other behavior, using concepts and principles derived from basic research. However, there may be additional concepts that are useful (see below). Second, Skinner's analysis emphasizes response function rather than response form or topography. Thus, the same response topography can have multiple functions, depending on the nature of the environmental variables that are operating in

each instance. Conversely, different response topographies can have the same function. Further, Skinner's analysis doesn't differentiate between verbal responses in the form of spoken language, sign language, picture exchange, text messaging, gestures, or any other form, if the controlling variables are the same.

Verbal Operants

In VB, Skinner (1957) proposed several verbal operants, which are concepts that categorize verbal behavior according to characteristic antecedents and consequences. Essentially, the verbal operants are labels for categories of verbal responses, differentiated by the type of functional control involved. Verbal operants may or may not occur in their pure form in everyday situations, but the as analytic tools they are nevertheless useful. For the current purposes, they provide a way to organize assessment, instruction, and intervention on language and communication. Below, I provide brief definitions and examples of each verbal operant.

Mands. The mand is a verbal operant under the control of a motivating operation and reinforced by a characteristic reinforcer. One example of manding is asking for water when thirsty and receiving the water as a consequence. In this case, the thirst (or being deprived of fluids) is the motivating operation, and receiving the water is the characteristic reinforcer, specified by the response. Mands can also specify escape from or avoidance of aversive stimulation. An example would be to ask a person to turn down music that is too loud. In this case, the loud music is the motivating operation, and the other person turning down the music is the characteristic consequence. Thus, behavior that is referred to as "requesting" in everyday language is typically manding.

Tacts. The tact is a verbal operant under the stimulus control of a nonverbal stimulus and maintained by generalized (i.e., not specific) reinforcement. An example would be a child saying "cat" when a cat walks by, and the parent responds by saying, "that's right!" The response is evoked by a nonverbal stimulus (the cat), and the reinforcer is generalized in the sense that it is not specified by the response.

Intraverbals. Like tacts, intraverbal responses are also maintained by generalized reinforcement, which often takes the form of attention or other reinforcers inherent in social interactions and conversation. Unlike tacts, intraverbal responses are evoked by other verbal stimuli. Examples of intraverbal responses are answers to questions or completing a sentence that another person starts. An example is an adult asking, "How old are you?" and a child answering "I'm eight years old."

Echoics. Echoic behavior is functionally similar to intraverbal behavior, with one important difference. By definition, an echoic response has a point-to-point correspondence and formal similarity to the verbal stimulus that precedes it. An example is when a child says "cat" when an adult says "cat". Echoics can be viewed as a special case of intraverbal behavior (Vargas, 1986), but are typically considered as its own category due to the imitative nature of the response. As we will see below, the point-to-point correspondence and formal similarity that characterize echoic behavior have important implications for behavioral interventions.

Autoclitics. Autoclitic behavior refers to verbal behavior that modifies the effects of other verbal behavior. For instance, somebody might say "I think the party is tonight", or they might say "I'm sure the party is tonight." The sentence parts "I think" and "I'm sure" will likely influence the behavior of the listener in different ways. The listener might seek further confirmation before going to the party in the first case, but not in the second case. Relatively little research has been conducted on autoclitic functions. Due to the introductory nature of this article, I will not discuss autoclitics further.

Speaker and Listener Behavior

The behavior of the speaker is considered verbal if it's reinforced by a listener in accordance to the conventions of a verbal community. As defined above, all the verbal operants are examples of speaker behavior. However, the behavior of the listener is also crucial for a behavioral analysis of language and communication. Listener behavior is any behavior that is under the control of verbal behavior of the speaker and mediates the reinforcement for that behavior. Common examples are following instructions and identifying objects in the environment. For example, the speaker might ask the listener to hand him or her an object that is out of reach of the speaker. This mand is reinforced if the listener complies. In turn, the behavior of the listener might be reinforced through the speaker's approval. In an educational situation, a teacher (the speaker) might ask a student (the listener) to point to a particular letter of the alphabet when presented with an array of letters a worksheet. This mand is reinforced through the student's compliance with the teacher's instruction. The students' behavior is likely reinforced via the teachers' approval and through successfully completing the assignment. These kinds of tasks are often referred to as receptive identification or receptive labeling in the context of EIBI.

Based on strict interpretation of VB, only speaker behavior is considered verbal. Accordingly, behaviors such as following instructions and receptive identification would not be considered verbal. Despite this distinction, listener behavior is frequently included as an essential component of verbal behavior interventions and research on verbal behavior. Schlinger (2008) argued that listener behavior that participates in verbal episodes should be treated as verbal behavior. In accordance with this argument, I will discuss listener behavior along with speaker behavior where applicable.

Verbal Operants: Conceptual Strengths and Weaknesses

Verbal operants can be used to organize language assessment and intervention in accordance to behavioral function. Some of the ways in which verbal operants help with these tasks will be discussed below. However, it is not sufficient to simply label behavior as a mand, tact, or intraverbal. The labels do not take the place of an analysis of behavior in terms of basic behavioral principles (stimulus control, reinforcement, motivating operations). Using the labels can give the illusion of functional analysis, but important functional variables might not have been identified. Thus, it is important to avoid viewing VB as special approach that is separate from or superior to ABA and EIBI. Rather, it offers additional tools and insights that may be useful in in the practice and science of behavior analysis as it pertains to verbal behavior. Any behavior analyst making use of VB concepts should be fluent in basic behavioral principles. Further, multiple instructional methods and procedures are relevant to teaching verbal behavior, as is the case for EIBI in general (e.g., discrete trial instruction, incidental teaching, direct instruction, prompting and prompt fading, shaping, chaining, differential reinforcement, discrimination training, etc.). In the following section, I will discuss some examples of basic behavioral principles as they apply to Skinner's verbal operants.

Basic Behavioral Principles and Verbal Behavior

Motivating Operations. Motivating operations (MOs) are environmental variables that influence behavior by altering the reinforcing or punishing value of other environmental events. MOs can also directly evoke behavior because of a history of altering the value of the consequences for that behavior (Laraway, Snycerski, Michael, & Poling, 2003). Mands are defined in terms of control by MOs. Therefore, it is important to ensure appropriate MO control during mand training (Michael, 1993). In early intervention, therapists can either capture or contrive MOs. Both procedures rely upon identifying effective reinforcers and controlling access to them, and then delivering the reinforcers contingent on a specific

mand or an approximation to the mand. In everyday situations, MOs can be captured by following the child's lead and observing initiations towards preferred items or activities (for instance, pointing at or approaching toys). The therapist then acts to control access to the preferred items or activity, waits for the child to make an initiation response, and uses the opportunity to teach. The reinforcer (i.e., the item the child initiated towards) should then be delivered contingent on the target response or an approximation. If the target response doesn't occur, the therapist can teach using prompting and prompt fading (e.g., constant prompt delay) or shaping.

Contriving MOs works the same way, except that the therapist identifies preferred items and activities ahead of time and sets up the environment so that the child must emit a mand to access the item or activity. This can be a way to increase the number of mand training opportunities relative to capturing MOs. For instance, the therapist might place highly preferred toys out of the child's reach and wait for the child to make an initiation response towards the toys. MOs can also be captured during preferred activities. The therapist might observe that a child enjoys when an adult pushes him or her on a swing. After pushing the child a few times, the therapist pauses, waits for a response, and continues pushing the swing contingent on the response. Another approach to contriving an MO has been labelled the interrupted chain strategy (Carter & Grunsell, 2001). The client must complete a chain of responses to reach a terminal reinforcer, but the therapist manipulates the chain so that the client cannot complete it without emitting a mand. For instance, the child might prefer playing a video game, but the controller might be missing, so he or she must mand for it. One major benefit of capturing or contriving an MO is that teaching occurs at a moment when the client is highly motivated, therefore increasing the likelihood that a response will occur. Additionally, responding will directly benefit the speaker at that moment in time, because it brings her in immediate contact with a highly preferred item or activity.

Mand training that involves capturing or contriving MOs is similar to a well-established ABA procedure called incidental teaching (Hart & Risley, 1978). However, although many instances of mand training qualify as incidental teaching, not all incidental or naturalistic teaching is necessarily mand training (i.e., it can involve other kinds of behavior).

Motivating operations are most relevant to mand training, because mands are defined in terms of MOs. However, MOs are certainly relevant to other verbal operants, as well as early intervention in general. The strength of motivating operations can affect stimulus control and generalization (Lotfizadeh, Edwards, Redner, & Poling, 2012). Further, social motivation, or the extent to which social interactions function as reinforcers, is likely to affect generalization and maintenance of intraverbals, tacts, and listener responses in natural environments. We will return to this issue in the section on reinforcement below.

Stimulus Control. Stimulus control refers to the extent to which specific stimuli or stimulus compounds evoke behavior due to being correlated with the availability of reinforcement. Thus, if a behavior is reinforced in the presence of a stimulus and reinforcement is withheld in its absence, the behavior will be more likely to occur in the presence of that stimulus in the future. The stimulus will come to serve as discriminative stimulus (SD) for that behavior (Cooper, Heron, & Heward, 2007). Ensuring appropriate stimulus control by verbal and nonverbal stimuli is a crucial issue in teaching verbal behavior. We will consider each category in turn.

Nonverbal stimulus control. Control by nonverbal stimuli is involved in tacts and listener responses. With tacts, the response should be under the control of a nonverbal stimulus such as an object or action. One can also tact qualities and characteristics of objects such as color and shape, categories, abstract concepts such as emotions, and even private

events such as pain. One everyday example of tacting is a tour guide who points out and names novel landmarks to visitors. In an EIBI program a therapist might show a client a picture of a cow, and the child responds, "Cow". In both examples the controlling variables are broadly the same, in that verbal responses are under the control of nonverbal stimuli and maintained via generalized reinforcement not specified by the response (e.g., attention, approval, tokens, etc.). However, these situations are clearly different in one important respect: In the former case the speaker who emits the tact (the tour guide) is attempting to educate the visitors (most of whom probably don't know the names of the landmarks), but in the latter case the teaching trial is a part of a program in which the speaker who emits the tact (the client) is being educated. It is useful to keep in mind that in naturalistic situations, such as when a speaker is showing a listener a novel object or location, tacts are emitted for the benefit of the listener. In educational situations, such as those involved in EIBI, children are typically taught a variety of tacts that are judged to be important. However, the educational context does not necessarily share many similarities with naturalistic situations in which tacts are likely to occur, so generalization and maintenance of tacts may be limited in the absence of careful programming.

Establishment of a tact repertoire is an important building block in language acquisition. A strong tact repertoire that is under appropriate stimulus control provides one of the foundations of language comprehension, as that term is commonly understood. Thus, it is important to ensure that tacts occur under appropriate stimulus control. Research has suggested that individuals with autism may be more likely to display unwanted or restricted stimulus control (sometimes referred to as stimulus overselectivity; Lovaas, Koegel, & Schreibman, 1979). A child may learn to tact an object shown in a picture, but when other exemplars of the object are presented, the response does not generalize. When further test trials are conducted to isolate various components of the original stimulus, it is revealed that the child learned to tact an irrelevant part rather than the essential features of the object (of course, the part is irrelevant from our perspective, not the child's). The extent to which this occurs as a function of the disorder or due to inappropriate or insufficient teaching is unknown. In either case, behavior analysts can reduce the probability of restricted stimulus control and increase the likelihood of desired stimulus control by presenting multiple exemplars of stimuli from the very beginning, in which essential components, qualities, and features of objects remain constant, but all other components, qualities, and features can vary.

Certain types of listener responses, often referred to as receptive identification or receptive labeling, also occur under nonverbal stimulus control. However, these responses are under conditional stimulus control of both verbal and nonverbal stimuli. The verbal stimuli specify which nonverbal stimulus will serve as a discriminative stimulus (SD) for a listener response, and often take the form of an instruction. For instance, an adult might ask a child, "Please hand me the potatoes", while seated at the dinner table. In an EIBI program, a therapist might present several cards depicting different shapes and ask the child to "Point to the circle". In these kinds of tasks, the instructions are often referred to as samples and the items as comparisons. The response requires the child to select the correct comparison out of an array. The verbal instruction functions as a conditional stimulus, because it determines the function of the items (i.e., which item functions as a discriminative stimulus on each occasion). These kinds of discriminations are often referred to as auditory-visual discriminations, because auditory and visual stimuli interact to produce the response. When teaching these kinds of responses, it is essential to ensure control by both the auditory (sample) and visual (comparison) stimuli. To achieve that, it is necessary to present multiple samples (instructions) in a random sequence and randomize the positions of the comparisons. Grow, Carr, Kodak, Jostad, and Kisamore (2011) evaluated procedures to teach auditory-visual discriminations with children with

ASD, and Green (2001) has made important recommendations for instruction in this skill area. These types of listener responses are particularly important in language instruction, because they form some of the building blocks of understanding or language comprehension (Schoneberger, 1991).

Verbal stimulus control. As noted above, verbal stimulus control occurs in intraverbal behavior. The most straightforward example of intraverbal behavior is when the responses are directly evoked by a verbal stimulus. An example is when an adult asks a child "What is your name", and the child immediately answers, "Mary". For children who can vocally imitate words, this kind of response can be brought under proper stimulus control using common prompting and prompt-fading procedures (e.g., Goldsmith, LeBlanc, & Sautter, 2007; Ingvarsson & Hollobaugh, 2011; Ingvarsson & Le, 2011). The child may then be able to easily discriminate between questions such as "What is your name" and "How old are you". However, finer discriminations can cause difficulties, such as, "How are you", vs. "How old are you", or "What is your mother's name", vs. "What is your father's name" (Sundberg & Sundberg, 2011). Failures to acquire these relatively subtle discriminations may reflect lack of stimulus control by all relevant components of the questions. For instance, the response "Four" may be under the control of the word "you" only, rather than "How old are you". When asked "How are you", the child answers "Four". When multiple components of a verbal antecedents interact or combine to control an intraverbal response, this can be conceptualized either as conditional stimulus control (Axe, 2008; Sundberg & Sundberg, 2011) or convergent stimulus control by stimulus compounds (Eikeseth and Smith, 2013). In either case, it is important to arrange teaching so that stimulus control by multiple components of the verbal antecedent is ensured. Examples of procedures to establish appropriate stimulus control by complex sentences have been provided by Ingvarsson, Kramer, Carp, Petursdottir, and Macias (2016), Kisamore, Karsten, and Mann (2016), and Braam and Poling (1983).

Palmer (1991) pointed out that some answers to questions and other responses that on the surface look like intraverbal responses may instead be a result of a more extended process. When a response is not immediately available to us (e.g., we do not remember it), we are likely to engage in additional behavior that enables us to respond. Skinner (1953) referred to this additional behavior as problem solving. Problem solving can involve overt behavior and response products, or it may include covertly talking to oneself and visually imagining (i.e., the behavior we call "thinking" in everyday language). For instance, a person might arrive at the grocery story only to discover that the shopping list did not make the trip. Most people would probably attempt to recall which items they have or have not used up, what they have noticed is needed in the past few days, and might even attempt to visually imagine the current state of their refrigerator. Something similar might happen when we are asked a question that we don't immediately know the answer to, such as "What is 1890 divided by 4?" or "What year did you last see Radiohead?" In these examples, a chain of responses occurs between the verbal antecedent (the question) and the response (the answer). The controlling variables are therefore substantially different from intraverbal responses that are directly evoked by antecedent stimuli. In early behavioral intervention for children with autism, it may be necessary to specifically teach clients to engage in problem solving strategies when asked questions they don't know the answer to. Sautter, LeBlanc, Jay, Goldsmith, and Carr (2011) and Kisamore, Carr, and LeBlanc (2011) evaluated procedures to teach typically developing preschool children to engage in problem solving strategies (self-prompting and visual imaging) when instructed to list members of a category (e.g., "Tell me some kitchen items"). This is a case in which a verbal antecedent sets the occasion for multiple intraverbal responses (Michael, Palmer, & Sundberg, 2011).

Echoic behavior is also defined in terms of verbal stimulus control. As noted above, echoic behavior has a point-to-point and formal correspondence to the preceding verbal stimulus. In EIBI, echoic behavior is often referred to as verbal imitation. Some of the research on the effectiveness of EIBI has suggested that acquisition of verbal imitation is among the predictors of good intervention outcomes (Sallows and Graupner, 2005). Perhaps this is because echoic behavior can provide the building blocks for other verbal behavior. If the child can imitate verbal responses, the task of bringing them under other kinds of control (intraverbal, tact, mand) becomes easier and learning from the everyday environment is more likely. Further, establishing fluent echoic behavior ensures that the response topography is at strength in the client's repertoire prior to attempting to teach other verbal operants (Eikeseth & Smith, 2013). Echoic prompting and transfer-of-stimulus control procedures can then be used to bring the response topography under the desired stimulus control. For instance, when teaching the intraverbal response "Moo", the therapist can start by presenting the question, "What does a cow say?", and then immediately state the vocal (echoic) prompt, "Moo". When the child reliably echoes, the prompt is gradually faded until the response occurs under the control of the question. Eventually, it is necessary to intersperse other similar intraverbals (e.g., "What does a dog say") to ensure appropriate stimulus control.

The importance of distinguishing between "meaningful" versus "meaningless" or "rote" intraverbal behavior is worth emphasizing. For Skinner, the meaning of verbal responses was to be found in their controlling variables (Andery, Micheletto, & Serio, 2005). If the controlling variables are purely verbal (i.e., echoic prompts used to establish the intraverbal stimulus control), independent observers would probably consider the response rote and meaningless. An illustrative example is a second language learner who is taught, via echoic prompting, to emit various foreign language responses to common foreign language phrases. While the verbal stimulus control might be perfect, there is no guarantee that the responses are related to the corresponding native language verbal responses or to relevant nonverbal stimuli. Thus, the person might be able to say the foreign language equivalent of "two" when asked (in the foreign language), "What is 1+1?" However, because the relevant nonverbal stimulus control has not been established, the person would not be able to emit that response under other conditions (e.g., tacting quantity when shown two items). Therefore, as a rule, it is important to ensure that the intraverbal response topography is also taught as a tact or a listener response. For instance, if a child is taught to answer the question "What does a cow say?" the child should also be able to point to and/or tact a cow and should be able to identify the correct animal when asked "Point to the animal that says moo" (Ingvarsson, Cammilleri, & Macias, 2012).

Reinforcement. Operant reinforcement refers to an increase in the frequency of behavior that occurs because the behavior was followed by a specific consequence (a reinforcer) in the past (Catania, 1998). The behavior operates on the environment to produce the reinforcer (hence the term operant). Some important considerations are suggested when reflecting on the nature of reinforcement maintaining verbal behavior. One issue concerns contrived versus natural reinforcement. Contrived reinforcers are those that are introduced by the therapist or teacher to increase and maintain specific behavior, but would be unlikely to follow that behavior in the absence of the contrived contingency. For example, pointing at and tacting a novel object in the environment might be reinforced by the delivery of a token (a contrived reinforcer) in an EIBI program, but in the natural environment such responses would likely be reinforced through social interactions with conversation partners (natural reinforcers). Contrived reinforcers are often necessary in behavioral interventions because natural consequences (particularly those inherent in social interactions) may not be effective reinforcers for children with ASD. However,

verbal behavior will not maintain in everyday environments unless the behavior contacts effective naturally occurring reinforcement. For children with ASD, these naturally occurring reinforcers are relatively more likely to occur for mands than for other verbal operants, because mands specify reinforcers that are valuable for the individual at a given moment in time. Thus, mands for preferred items and activities are relatively likely to maintain and generalize across environments if the relevant motivating operations continue to occur, reinforcement for the mands is sufficiently frequent, and the individual has acquired a robust and varied mand repertoire. However, for other verbal operants, establishing social interactions and the social behavior of others as reinforcers is likely to be crucial. Listener behavior, tacts, and intraverbal responses are generally maintained by some aspects of social interactions with others and are unlikely to maintain in their absence. Lack of effective social reinforcers seems to be a characteristic of autism, and some scholars have suggested that lack of social motivation may be the primary underlying feature of ASD (Chevallier, Kohls, Troiani, Brodkin, & Schultz 2012). It is clear that some social interactions (e.g., praise, tickles) can function as reinforcers for children with ASD (Kelly, Roscoe, Hanley, Schlichenmeyer, 2014). However, the range of social stimuli that function as reinforcers may be restricted, and subtler social cues (e.g., facial expressions, nods, gestures) may not function as effective reinforcers to the same extent that occurs for those without autism.

Due to the apparent importance of social reinforcement in EIBI, treatment manuals have typically included recommendations to establish social stimuli as conditioned reinforcers. Conditioned reinforcers achieve their reinforcing value through associations with other reinforcers (e.g., primary reinforces such as food; Williams, 1994). Treatment manuals for EIBI have included recommendations for pairing social interactions (such as praise statements) with the delivery of already effective reinforcers (such as edibles; Anderson, Taras, & Cannon, 1996; Leaf & McEachin, 1999). In the most common scenario, the therapist waits for a specific response from the client (e.g., a correct response in a teaching program) and when the response occurs, delivers the social stimulus (e.g., praise) followed immediately by an already effective reinforcer (e.g., food). This procedure has been described as response-contingent pairing (Dozier, Iwata, Thomason-Sassi, Worsdell, & Wilson, 2012; Lepper & Petursdottir, in press). Relatively little research has focused on the effectiveness of this approach in early behavioral intervention for children with autism.

Another procedure that has been the target of increased research effort is to establish social stimuli as discriminative stimuli (SDs) signaling the availability of already effective reinforcers, such as toys and edibles (Lepper, Petursdottir, & Esch, 2013; Lovaas et al., 1966; Holth, Vandbakk, Finstad, Grønnerud, & Sørensen, 2009; Isaksen & Holth, 2009). Therapists can establish social interactions as SDs by presenting trials in which social interaction is present (SD trials) and not present (S-delta trials) in a random sequence. During both types of trials, preferred items (e.g., toys or edibles) are within the reach of the child, but the child is only allowed to access the reinforcers when social interaction is in place. The goal is to teach the child to observe the therapist and only reach for the reinforcers in the presence of specific stimuli, in this case social stimuli. While therapist social interactions may be established as a reinforcer through this procedure, it is likely that the therapist must continue to pair him- or herself with preferred items and activities to maintain the value of the conditioned reinforcers. More applied research is needed, but this procedure seems to hold some promise as an approach to establish a wider range of reinforcers, social and otherwise, for individuals with ASD.

A third method to establish conditioned reinforcement is stimulus-stimulus pairing, which involves presenting a currently neutral stimulus (e.g., a speech sound) simultaneously or

immediately prior to the delivery of a primary reinforcer (e.g., an edible item). No response is required from the child, other than orienting towards the therapist before the stimuli are presented. This procedure has been most frequently studied as a potential method to establish the reinforcing value of speech sounds. From a behavior analytic standpoint, it is likely that early language development includes both social and automatic reinforcement. With automatic reinforcement, producing speech sounds is reinforcing in and of itself (independent of socially mediated reinforcement) to the individual that emits the sounds. The conditioned reinforcing value is likely established via both operant and respondent processes that occur during adult-infant interactions. If a child with ASD does not produce speech sounds to the extent seen in typically developing children, part of the solution may be to establish speech sounds as conditioned reinforcers via stimulus-stimulus pairing. Research on this procedure has yielded mixed results (Schillingsburg, Hollander, Yosick, Bowen, & Muskat, 2015). However, it is possible that response-contingent pairing (see above) may yield better results (Lepper & Petursdottir, in press).

The ways in which conditioned reinforcement plays a potential role in verbal behavior are likely numerous. I will briefly describe one more case. In manding for information, a mand is reinforced by delivery of "information" (which often takes the form of verbal instructions, directions, or clarification) which in turn allow the individual to access the terminal reinforcer (Lechago & Low, 2015; Sundberg, Loeb, Hale, & Eigenheer, 2002). Thus, the "information" reliably predicts the availability of reinforcement and takes on conditioned reinforcing function. For instance, if a child wants to watch a favorite movie but can't find the TV remote control, the child might ask an adult where the remote is. The adult tells the child the location of the remote, and thus the child can find the remote and watch the movie. In this example, the MO is not having access to the favorite movie and the mand for information is the child asking where the remote is located. The information given by the adult predicts and signals access to the reinforcer (the movie), and will thus likely become a conditioned reinforcer.

Just as with other kinds of mand training, therapists can capture and contrive a variety of scenarios where the client must mand for information to access preferred items and activities. One common program (described by Taylor and Harris, 1995) involves placing a variety of items in front of the child and asking the child to tact the items. Some of the items are known to the child while others are novel. When the child gets to the unknown items, the therapist prompts the child to ask "What's that?" The therapist then answers the question, which in turn allows the child to complete the task. The therapist can then evaluate generalization to novel items and situations and whether the child acquires new tacts because of manding for information about novel items.

Novel and Emergent Verbal Behavior. It's safe to assume that a large proportion of everyday verbal behavior is not directly taught, but emerges as a function of previous learning and current stimulus conditions. Critics from outside the field have sometimes assumed that behavior analysis lacks the tools to explain emergent behavior. However, there exist several theoretical approaches to study emergence from a behavioral perspective. A thorough treatment of this vital issue is beyond the scope of this paper, so a brief discussion of a few pivotal areas must suffice.

Functional Independence and Interdependence. An important aspect of Skinner's notion of verbal operants is their functional independence. Thus, acquiring a particular topography as one verbal operant (e.g., a mand) will not automatically result in being able to emit the same topography under different conditions (e.g., those characteristic of the tact; Lamarre & Holland, 1985). The same is frequently true of listener and intraverbal relations (Petursdottir, Carr, Lechago, & Almason, 2008). Thus, EIBI service providers are well advised to assess and teach each response topography under all relevant environmental

conditions (e.g., as an echoic, mand, tact, and intraverbal). However, it is also the case that verbal operants are often interdependent (i.e., not independent). This is particularly true for advanced speakers. For instance, it may be enough for a verbally capable adult to acquire a word as a tact and it will occur as an intraverbal with no further training (e.g., Dounavi, 2014). In early intervention for children with autism, it is advisable to conduct probes and assessments on a regular basis to evaluate functional independence and interdependence. Further, behavior analysts may choose to conduct teaching programs in which multiple verbal operants are taught for each response topography (e.g., listener response, tact, and intraverbal).

Naming. According to the influential naming account (Horne & Lowe, 1996) the interaction of speaker and listener behavior in the same individual plays an important role in verbal development. A child is said to have acquired the naming capability when the acquisition of a listener response automatically results in the corresponding tact, and vice versa (Miguel & Petursdottir, 2009). This capability allows the child to acquire language at a rapid rate from naturally occurring interactions if adults and others in their environments provide frequent opportunities for learning (i.e., modeling the names of items and activities as they occur). However, the same may not be true of children with ASD. It may be particularly important to evaluate the naming capability with this population and attempt to establish bi-directional listener and tact behavior by interspersing listener and tact teaching trials (Greer & Ross, 2008; Sundberg & Partington, 1998).

Recombinative Generalization. One way in which complex novel verbal responses occur is through recombinative generalization, in which previously acquired elements (e.g., sounds, words, or short phrases) recombine to form novel responses under specific stimulus conditions (Goldstein, 1983; Suchowierska, 2006). For instance, an individual might learn to tact "red circle", "yellow square", and "blue triangle" in the presence of these specific color-shape combinations. If the person can then emit the correct phrase when presented with novel combinations, such as a red square, yellow triangle, blue circle, and so on, recombinative generalization has occurred. This approach is potentially efficient because many novel combinations can result from teaching a limited number of responses. To maximize instructional efficiency, the elements to be taught and tested can be arranged in a matrix (Axe & Sainato, 2010; Frampton, Wymer, Hansen, & Shillingsburg, 2016; Kohler & Malott, 2014; Pauwels, Ahearn, & Cohen, 2015). In addition to offering a way to maximize instructional efficiency, recombinative generalization is attractive because it offers a potential explanation for the occurrence of novel combinations of previously learned response units in everyday behavior.

Derived Relations. Two influential theoretical accounts, stimulus equivalence (SE) and relational frame theory (RFT), have inspired considerable research that is relevant to verbal behavior (Hayes et al., 2001; Sidman, 1994). Although these accounts differ in important ways, both offer theoretical frameworks to explain how novel stimulus relations can occur as a function of previously acquired relations. For instance, by learning the relation between a toy car and the spoken word "car" (A-B) and between a toy car and the printed word CAR (A-C), an individual will typically be able to relate the spoken word and the printed word without further training (B-C). Thus, like recombinative generalization, these frameworks offer ways to increase the efficiency of learning as well as potential explanations for novel behavior. Much of the research has, however, been limited to studying selection responses (e.g., pointing to or otherwise selecting stimuli) that are often quite arbitrary in the sense that the response topography is of little importance. This is adequate to study complex stimulus relations, but in verbal behavior, the response topography is usually important because it is related to environmental

events in unique ways. Nevertheless, there is little doubt that both SE and RFT can be integrated with Skinner's VB analysis (e.g., Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000).

Additional Practical Recommendations

The preceding sections have included several practical recommendations, but I will conclude by offering some additional advice. Some of these recommendations are specifically based on VB research, while other recommendations are more general in nature and apply to multiple skill areas targeted in EIBI.

Three curriculum guides exist that are based on Skinner's VB, but also cover general aspects of EIBI: *Teaching Language to Children with Autism and Other Developmental disabilities* (Sundberg & Partington, 1998), *The Assessment of Basic Language and Learning Skills-Revised* (ABLLS-R; Partington, 2008), and the *Verbal Behavior Milestones Assessment and Placement Program* (VB-MAPP; Sundberg, 2008). Several other highly influential EIBI curriculum guides include a focus on verbal behavior but are not organized according to Skinner's verbal operants. These include: *Teaching Individuals with Developmental Delays: Basic Intervention Techniques* (Lovaas, 2003), *A Work in Progress* (Leaf & McEachin, 1999), *Behavioral Intervention for Young Children with Autism* (Maurice, Green, & Luce, 1996), and *Making a Difference: Behavioral Intervention for Autism* (Maurice, Green, & Foxx, 2001). These documents provide resources for skills assessment and treatment goal selection. However, selection of treatment goals should also be informed by relevant developmental and ecological considerations (Dyer & Peck, 1987).

Although curricular sequence should be determined on an individual basis, general guidelines can be offered based on Skinner's verbal operants. An early goal should be to establish a functional mand repertoire. This is important for at least two reasons: First, as stated above, mands benefit the speaker because they are related to a current motivating operation. Therefore, it is likely that reinforcement of communicative responses under these conditions will be especially effective. Problem behavior often serves a communicative function in the sense that it is maintained by socially mediated reinforcement (Hanley, Iwata, & McCord, 2003). Socially appropriate mands can replace problem behavior, and therefore mand training can form a part of a behavioral intervention plan. Teaching an appropriate mand to replace problem behavior is often referred to as functional communication training (FCT; Carr & Durand, 1985). Note that in the early stages, the functional communication response may be general rather than specific (i.e., it does not specify a particular reinforcer). However, the responses can often be shaped into more specific and complex mands over time.

For children who do not have an echoic repertoire it may be beneficial to use picture exchange communication (PECS) or signs to facilitate quick acquisition of communication responses. Depending on their abilities and progress, some children may continue to use PECS (Bondy & Frost, 2001), signs, or speech generating devices (SGDs), while with others, it may be feasible to gradually shape up vocal speech. It is sometimes possible to begin the process of shaping up speech by delaying access to reinforcement following non-vocal mands, prompt a vocal response, and then fade out the prompts over time (Gevarter et al., 2015).

When implementing behavioral interventions to increase vocal speech, the establishment of echoic behavior (generalized verbal imitation) should be an early priority. An echoic repertoire functions as a "minimal response repertoire", which facilitates the acquisition of additional verbal operants (Alessi, 1987; Palmer, 2012). The desired verbal topography can be evoked as an echoic and then brought under the desired stimulus control. In other

words, therapists can take advantage of the client's echoic repertoire to teach other verbal operants.

In the early stages of intervention, it can be beneficial to combine echoic and mand training, thereby taking advantage of the current motivating operation to establish echoic behavior. This can be done in the context of incidental teaching (Hart & Risley, 1978), in which the therapist controls access to preferred items and activities and uses the child's initiations towards the preferred items and activities as opportunities to teach. The child's communicative responses are then reinforced by access to the specific preferred item or activity. With children who have no echoics, tacts, or mands, the program can start with the therapist reinforcing any vocal response. Over time, the therapist starts delivering specific vocal models, and gradually shapes the child's vocalizations. When the child can reliably echo sounds, the therapist can start shaping up words. When the child can successfully echo under these conditions, it may be possible to begin practicing and teaching vocal imitation in separate discrete trial sessions. When the child has acquired a robust echoic repertoire (i.e., he can vocally imitate novel words and phrases on the first opportunity), the therapist can take advantage of the echoic repertoire to teach new mands, tacts, and intraverbals as indicated for each client.

As implied above, it is generally a good idea to establish echoic and mand repertoires prior to focusing on other verbal operants. When echoics and mands have been established, the next step would be to focus on listener and tact repertoires. In typical development, young children acquire listener responses (e.g., pointing, orienting towards stimuli) before tacts. However, it may not be most efficient to follow that sequence of programming in EIBI. On the contrary, the relevant research literature suggests that tact training is somewhat more likely to lead to emergence of the corresponding listener responses than vice versa (Petursdottir & Carr, 2011). It can be argued that tacting cannot occur without some sort of listener response (at minimum, orienting towards the stimulus). Therefore, listener responses may occur incidentally during tact trials and become members of a common response class. However, when listener responses are taught, it is not necessarily the case that tacts occur incidentally. This may explain the why teaching tacts is more likely to lead to emergence of listener responses than vice versa.

As noted above, it is advisable to establish listener and tact responses before intraverbal behavior. However, it may be appropriate to teach a limited number of intraverbals prior to the establishment of tact and listener responses if those intraverbal responses are judged to be sufficiently important instructional targets (e.g., stating one's name if asked). However, teaching of more advanced intraverbal responses is likely to be successful only after the child has acquired a robust echoic, listener, and tact repertoire. Instruction can then proceed to more advanced verbal behavior, such as recall, various mands for information, abstract properties, syntax and grammar, various autoclitics, perspective taking, conversational exchanges, and so on.

• • •

References

Alessi, G. (1987). Generative strategies and teaching for generalization. *The Analysis of Verbal Behavior, 5,* 15.

Anderson, S. R., Taras, M., & Cannon, B. O. (1996). Teaching new skills to young children with autism. In C Maurice, G. Green, & S. C. Luce (Eds.), *Behavioral intervention for young children with autism* (pp. 181-194). Austin, TX: Pro-Ed.

Andery, M. A., Micheletto, N., & Sério, T. M. (2005). Meaning and verbal behavior in Skinner's work from 1934 to 1957. *The Analysis of verbal behavior, 21,* 163-174.

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.

Axe, J. B., & Sainato, D. M. (2010). Matrix training of preliteracy skills with preschoolers with autism. *Journal of Applied Behavior Analysis, 43,* 635–652. doi:10.1901/jaba.2010.43-635

Barnes-Holmes, D., Barnes-Holmes, Y., & Cullinan, V. (2000). Relational frame theory and Skinner's Verbal Behavior: A possible synthesis. *The Behavior Analyst, 23,* 69-84.

Braam, S. J., & Poling, A. (1983). Development of intraverbal behavior in mentally retarded individuals through transfer of stimulus control procedures: Classification of verbal responses. *The Analysis of Verbal Behavior, 4,* 279-302.

Bondy, A., & Frost, L. (2001). The picture exchange communication system. *Behavior Modification, 25,* 725-744.

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18,* 111-126.

Carter, M., & Grunsell, J. (2001). The behavior chain interruption strategy: A review of research and discussion of future directions. *Research and Practice for Persons with Severe Disabilities, 26,* 37-49.

Catania, A. C. (1998). *Learning (fourth edition).* Upper Saddle River, NJ: Prentice-Hall.

Chevallier, C., Kohls, G., Troiani, V., Brodkin, E. S., & Schultz, R. T. (2012). The social motivation theory of autism. *Trends in Cognitive Sciences, 16,* 231-239.

Chomsky, N. (1959). A review of Skinner's Verbal behavior. *Language, 35,* 26-58.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis.* Upper Saddle River, NJ: Pearson/Merrill Prentice Hall.

Dounavi, K. (2014). Tact training versus bidirectional intraverbal training in teaching a foreign language. *Journal of Applied Behavior Analysis, 47,* 165-170.

Dozier, C. L., Iwata, B. A., Thomason-Sassi, J., Worsdell, A. S., & Wilson, D. M. (2012). A comparison of two pairing procedures to establish praise as a reinforcer. *Journal of Applied Behavior Analysis, 45,* 721-735.

Dyer, K., & Peck, C. A. (1987). Current perspectives on social/communication curricula for students with autism and severe handicaps. *Education and Treatment of Children, 10,* 338-351.

Dymond, S., O'Hora, D., Whelan, R., & O'Donovan, A. (2006). Citation analysis of Skinner's Verbal Behavior: 1984-2004. *The Behavior Analyst, 29,* 75-88.

Eikeseth, S., & Smith, D. P. (2013). An analysis of verbal stimulus control in intraverbal behavior: Implications for practice and applied research. *The Analysis of Verbal Behavior, 29,* 125-135.

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2009). Meta-analysis of early intensive behavioral intervention for children with autism. *Journal of Clinical Child & Adolescent Psychology, 38,* 439-450.

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2010). Using participant data to extend the evidence base for intensive behavioral intervention for children with autism. *American journal on intellectual and developmental disabilities, 115,* 381-405.

Frampton, S. E., Wymer, S. C., Hansen, B., & Shillingsburg, M. A. (2016). The use of matrix training to promote generative language with children with autism. *Journal of Applied Behavior Analysis.* doi:10.1002/jaba.340

Gevarter, C., O'Reilly, M. F., Kuhn, M., Mills, K., Ferguson, R., Watkins, L., ... & Lancioni, G. E. (2015). Increasing the vocalizations of individuals with autism during intervention with a speech-generating device. *Journal of Applied Behavior Analysis, 49,* 17-33.

Goldsmith, T. R., LeBlanc, L. A., & Sautter, R. A. (2007). Teaching intraverbal behavior to children with autism. *Research in Autism Spectrum Disorders, 1,* 1-13.

Goldstein, H. (1983). Recombinative generalization: Relationships between environmental conditions and the linguistic repertoires of language learners. *Analysis & Intervention in Developmental Disabilities, 3,* 279-293.

Green, G. (2001). Behavior analytic instruction for learners with autism: Advances in stimulus control technology. *Focus on Autism and Other Developmental Disorders, 16, 72–85.*

Greer, R. D., & Ross, D. E. (2008). *Verbal behavior analysis: Inducing and expanding new verbal capabilities in children with language delays*. New York: Pearson/Allyn and Bacon.

Grow, L. L., Carr, J. E., Kodak, T. M., Jostad, C. M., & Kisamore, A. N. (2011). A comparison of methods for teaching receptive labeling to children with autism spectrum disorders. *Journal of Applied Behavior Analysis,* 475-498.

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36,* 147-185.

Hart, B., & Risley, T. R. (1978). Promoting productive language through incidental teaching. *Education and Urban Society, 10,* 407-29.

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (Eds.). (2001). *Relational frame theory. A post-Skinnerian account of human language and cognition.* New York: Kluwer Academic / Plenum Publishers.

Holth, P., Vandbakk, M., Finstad, J., Grønnerud, E., & Sørensen, J. (2009). An operant analysis of joint attention and the establishment of conditioned social reinforcers. *European Journal of Behavior Analysis, 10,* 143-158.

Horne, P. J., & Lowe, C. F. (1996). On the origins of naming and other symbolic behavior. *Journal of the Experimental Analysis of behavior, 65, 185-241.*

Ingvarsson, E. T., Cammilleri, A. C., & Macias. H. (2012). Emergent listener responses following intraverbal training in children with autism. *Research in Autism Spectrum Disorders, 6,* 654-664.

Ingvarsson, E. T., & Hollobaugh, T. (2011). A comparison of prompting tactics to establish intraverbal responding in children with autism. *Journal of Applied Behavior Analysis, 44,* 659-664.

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*. doi:10.1007/s40616-016-0071-5

Ingvarsson, E. T., & Le, D. D. (2011). Further evaluation of prompting tactics for establishing intraverbal responding in children with autism. *The Analysis of Verbal Behavior, 27,* 75-93.

Isaksen, J., & Holth, P. (2009). An operant approach to teaching joint attention skills to children with autism. *Behavioral Interventions, 24,* 215-236.

Kelly, M. A., Roscoe, E. M., Hanley, G. P., & Schlichenmeyer, K. (2014). Evaluation of assessment methods for identifying social reinforcers. *Journal of Applied Behavior Analysis, 47,* 113-135.

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 disorders. *Journal of Applied Behavior Analysis.* doi:10.1002/jaba.344

Klintwall, L., Eldevik, S., & Eikeseth, S. (2015). Narrowing the gap: Effects of intervention on developmental trajectories in autism. *Autism, 19,* 53-63.

Kohler, K. T., & Malott, R. W. (2014). Matrix training and verbal generativity in children with autism. *The Analysis of Verbal Behavior, 30,* 170-177. doi:10.1007/s40616-014-0016-9

Lamarre, J., & Holland, J. G. (1985). The functional independence of mands and tacts. *Journal of the Experimental Analysis of Behavior, 43,* 5–19.

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36,* 407-414.

Leaf, R., & McEachin, J. (1999). *A work in progress.* New York: Autism Partnership.

Lechago, S. A., & Low, A. (2015). A review of the mand-for-information training research literature. *International Journal of Behavior Analysis & Autism Spectrum Disorders, 1,* 35-54.

Lepper, T. L., & Petursdottir, A. I. (in press). Effects of response-contingent stimulus pairing on vocalizations of nonverbal children with autism. *Journal of Applied Behavior Analysis.*

Lepper, T. L., Petursdottir, A. I., & Esch, B. E. (2013). Effects of operant discrimination training on the vocalizations of nonverbal children with autism. *Journal of Applied Behavior Analysis, 46,* 656-661. doi:10.1002/jaba.55

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting 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., Freitag, G., Kinder, M. I., Rubenstein, B. D., Schaeffer, B., & Simmons, J. Q. (1966). Establishment of social reinforcers in two schizophrenic children on the basis of food. *Journal of Experimental Child Psychology, 4,* 109-125.

Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in autism: a review of research. *Psychological Bulletin, 86,* 1236-1254.

Love, J. R., Carr, J. E., Almason, S. M., & Petursdottir, A. I. (2009). Early and intensive behavioral intervention for autism: A survey of clinical practices. *Research in Autism Spectrum Disorders, 3,* 421-428.

Lotfizadeh, A. D., Edwards, T. L., Redner, R., & Poling, A. (2012). Motivating operations affect stimulus control: A largely overlooked phenomenon in discrimination learning. *Behavior Analyst, 35,* 89.

Maurice, C., Green, G., & Foxx, R. M. (2001). *Making a difference: Behavioral intervention for autism.* Austin, TX: Pro-ed.

Maurice, C. E., Green, G. E., & Luce, S. C. (1996). *Behavioral intervention for young children with autism: A manual for parents and professionals.* Austin, TX: Pro-ed.

McPherson, A., Bonem, M., Green, G., & Osborne, J. G. (1984). A citation analysis of the influence on research of Skinner's verbal behavior. *The Behavior Analyst, 7,* 157-167.

Michael, J. (1988). Establishing operations and the mand. *The Analysis of Verbal Behavior, 6,* 3-9.

Michael, J., Palmer, D. C., & Sundberg, M. L. (2011). The multiple control of verbal behavior. *The Analysis of Verbal Behavior, 27,* 3-22.

Miguel, C. F., & Petursdottir, A. I. (2009). Naming and frames of coordination. In R. Rehfeldt & Y. Barnes-Holmes (Eds.). *Derived relational responding: Applications for learners with autism and other developmental disabilities* (pp. 129-148). Oakland, CA: New Harbinger Press.

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. (2012). The role of atomic repertoires in complex behavior. *The Behavior Analyst, 35*, 59-73.

Partington, J. W. (2008). *The assessment of basics language and learning skills-revised: Scoring instructions and IEP development guide.* Pleasant Hill, CA: Behavior Analysts.

Pauwels, A. A., Ahearn, W. H., & Cohen, S. J. (2015). Recombinative generalization of tacts through matrix training with individuals with autism spectrum disorder. *The Analysis of Verbal Behavior, 31,* 200–214. doi: 10.1007/s40616-015-0038-y

Petursdottir, A. I., & Carr, J. E. (2011). A review of recommendations for sequencing receptive and expressive language instruction. *Journal of Applied Behavior Analysis, 44,* 859-876.

Petursdottir, A. I., Carr, J. E., Lechago, S. A., & Almason, S. M. (2008). An evaluation of intraverbal training and listener training for teaching categorization skills. *Journal of Applied Behavior Analysis, 41,* 53-68.

Rutter, M., & Thapar, A. (2014). Genetics of autism spectrum disorder. In F. R. Volkmar, S. J. Rogers, R. Paul, & K. A. Pelphrey (Eds.), *Handbook of autism and pervasive developmental disorders* (fourth edition), (pp. 411-423). Hoboken, NJ: Wiley.

Sallows, G. O., & Graupner, T. D. (2005). Intensive behavioral treatment for children with autism: Four-year outcome and predictors. *American Journal on Mental Retardation, 110,* 417-438.

Sautter, R. A., & LeBlanc, L. A. (2006). Empirical applications of Skinner's analysis of verbal behavior with humans. *The Analysis of Verbal Behavior, 22,* 35-48.

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.

Schoneberger, T. (1991). Verbal understanding: Integrating the conceptual analyses of Skinner, Ryle, and Wittgenstein. *The Analysis of verbal behavior, 9,* 145-151.

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.

Schlinger, H. D. (2008). Listening is behaving verbally. *The Behavior Analyst, 31,* 145-161.

Sidman, M. (1994). *Equivalence relations and behavior: A research story*. Boston, MA: Authors Cooperative.

Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis.* Cambridge, MA: B. F. Skinner Foundation.

Skinner, B. F. (1953). *Science and human behavior*. New York: The Free Press.

Skinner, B. F. (1957). *Verbal behavior*. Acton, MA: Copley Publishing Group.

Suchowierska, M. (2006). Recombinative generalization: Some theoretical and practical remarks. *International Journal of Psychology, 41,* 514-522.

Sundberg, M. L. (2008). *Verbal behavior milestones assessment and placement program: The VB-MAPP.* Concord, CA: AVB Press.

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., & Partington, J. W. (1998). *Teaching language to children with autism and other developmental disabilities.* Pleasant Hill, CA: Behavior Analysts, Inc.

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.

Taylor, B. A., & Harris, S. L. (1995). Teaching children with autism to seek information-acquisition of novel information and generalization of responding. *Journal of Applied Behavior Analysis, 28,* 3-14.

Thompson, T. (2007). *Making sense of autism.* Baltimore: Paul H. Brookes.

Vargas, E. A. (1986). Intraverbal behavior. In P. N. Chase & L. J. Parrott (Eds.), *Psychological aspects of language (pp. 128-151*). Springfield, IL: Charles C. Thomas.

Volkmar, F. R., & McPartland, J. C. (2014). From Kanner to DSM-5: Autism as an evolving diagnostic concept. *Annual Review of Clinical Psychology, 10,* 193-212.

Williams, B. A. (1994). Conditioned reinforcement: Experimental and theoretical issues. *The Behavior Analyst, 17,* 261-285.