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Intraverbal Behavior and Verbal Conditional Discriminations in Typically Developing Children and Children with Autism

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Individuals with autism often experience difficulty acquiring a functional intraverbal repertoire, despite demonstrating strong mand, tact, and listener skills. This learning problem may be related to the fact that the primary antecedent variable for most intraverbal behavior involves a type of multiple control identified as a verbal conditional discrimination (VC^D). The current study is a descriptive analysis that sought to determine if there is a general sequence of intraverbal acquisition by typically developing children and for children with autism, and if this sequence could be used as a framework for intraverbal assessment and intervention. Thirty-nine typically developing children and 71 children with autism were administered an 80-item intraverbal subtest that contained increasingly difficult intraverbal questions and VC^Ds. For the typically developing children the results showed that there was a correlation between age and correct intraverbal responses. However, there was variability in the scores of children who were the same age. An error analysis revealed that compound VC^Ds were the primary cause of errors. Children with autism made the same types of errors as typically developing children who scored at their level on the subtest. These data suggest a potential framework and sequence for intraverbal assessment and intervention.

Key words: autism, intraverbal, language assessment, language intervention, typically developing children, verbal conditional discrimination

Much of our day-to-day verbal interaction with each other involves intraverbal behavior. For example, a phone conversation or e-mail exchange between two people consists of one person saying or writing something, and the other person responding to the content of what was said. The key aspect of the interaction is that the two verbal statements do not match each other. If they did, the verbal behavior would be classified as echoic or copying-a-text, neither of which would result in a useful conversation. There are many examples of intraverbal behavior such as the ability to answer questions, tell stories, describe events, solve problems, engage in debates, recall the past, and talk about the future. In terms of society at large, many important elements of civilization involve intraverbal behavior such as education, science, literature, history, intelligence, thinking, perception, and creativity (Skinner, 1957, 1974).

Relative to Skinner's (1957) other elementary verbal operants (i.e., echoic, mand, tact, textual, transcriptive) and the listener relations, the intraverbal relation has received the least amount of conceptual or empirical attention over the past 54 years. However, this situation has begun to change as demonstrated by the increased number of empirical studies on intraverbal behavior published in the past few years (e.g., Goldsmith, LeBlanc, & Sautter, 2007; Ingvarsson, Tiger, Hanley, & Stephenson, 2007; Miguel, Petursdottir, & Carr, 2005; Perez-Gonzalez, Garcıa-Asenjo, Williams, & Carnerero, 2007; Petursdottir, Carr, Lechago, & Almason, 2008; Petursdottir & Haflioadottir, 2009; Shillingsburg, Kelley, Roane, Kisamore, & Brown, 2009). (For historical reviews of intraverbal research see Oah & Dickinson, 1989 and Sautter & LeBlanc, 2006.)

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The types of intraverbal interactions that people have with each other range from simple to extremely complex, and are endless in number. Early intraverbal responses in typically developing children may be simple, but establish the foundation for more advanced intraverbal interactions. For example, a young child around the age of 1 ½ to 2 years old begins to learn to sing songs, provide sounds that animals and objects make (e.g., ''a kitty says …'' or ''a train goes …''), and to fill-in words to reinforcing phrases (e.g., ''peek-a …''). By 2 years of age most children can provide their first name when asked, fill-in various phrases, and respond to simple questions and word associations (e.g., ''mommy and …''). Typically, 2-year-olds do not have the skills yet for conversations on a specific topic, but they usually do have an extensive listener vocabulary, as well as a strong speaking vocabulary that consists mainly of echoics, mands, and tacts (Sundberg, 2008). Verbal development then occurs rapidly between the ages of 2 and 3 (Bijou, 1976; Brazelton & Sparrow, 2006; Brown, Cazden, & Bellugi, 1969; de Villers & de Villers, 1978; Ervin-Tripp, 1970; Hart & Risley, 1995; Moerk, 1986; Novak, 1996; Schlinger, 1995), and much of this development involves intraverbal behavior.

A common problem faced by children with autism and those with other types of developmental disabilities is the failure to acquire a functional intraverbal repertoire, despite acquiring a sizeable repertoire of mands, tacts, and listener skills (e.g., Miklos, Dipuglia, & Galbraith, 2010, May). Often, these children do learn some simple intraverbal behavior, but fail to attain more complex behavior. For example, they may be able to provide their name and respond to simple questions, but have problems answering more difficult questions, describing experiences, or staying on a specific topic of discussion. They may also emit irrelevant or rote intraverbal behavior that may be independent from the current verbal context. These weak intraverbal skills may then have a substantial impact on the acquisition of academic and social skills because of the central role that intraverbal behavior plays in those repertoires. For example, conversations between two or more people depend heavily on the intraverbal repertoires of each participant. Failing to acquire an intraverbal repertoire leaves conversation incomplete because it is nearly impossible to have much of a discussion about any specific topic with only echoics, mands, and tacts.

Intraverbal behavior is often difficult to acquire due to the inherent complexity of verbal stimulus control. Verbal stimuli usually contain multiple parts, occur rapidly in discourse, and are transitory. For example, a sentence containing 7 or 8 words may be spoken in 2–3 seconds and these verbal stimuli dissipate immediately after being emitted. On the other hand, tacting nouns for example, may involve a visual item that is presented for a period of time and the stimulus may not dissipate. Nonverbal items can be contrasted with non-examples (S-deltas) and stimulus discriminations as well as stimulus and response classes can be systematically established.

There are a variety of prerequisite verbal and nonverbal skills that can help to ensure that intraverbal behavior does not become a rote verbal relation. That is, talking about things and events when they are absent (intraverbal behavior) is less likely to be rote if a child can accurately and fluently talk about and respond to those things and events when they are present (tact and listener skills). For example, in order to fluently answer intraverbal questions such as ''What grows on your head?'' ''What grows in a garden?'' and ''What do you wear on your head?'' it is usually valuable that a child can already emit the words ''grow,'' ''head,'' ''wear,'' and ''garden'' as tacts and respond correctly to those verbal stimuli as a listener (e.g., ''Can you find something that grows?''). In addition, it is important that the child has a generalized tact and listener repertoire regarding items that can grow (e.g., flowers, grass, people, hair), items to wear (e.g., hats, shoes, coats) and so on. Of course just the ability to tact nonverbal stimuli and respond to them as a listener does not necessarily result in the emergence of intraverbal behavior. The data suggest that these verbal operants are functionally independent and specific training is usually required to transfer stimulus control from nonverbal to verbal antecedents (e.g., Braam & Poling, 1982; Miguel, Petursdottir, & Carr, 2005; Petursdottir & Haflioadottir, 2009).

Perhaps the most complex aspect of establishing the verbal stimulus control necessary for intraverbal behavior is that multiple control is almost always involved. Skinner (1957) describes two types of multiple control: ''(1) the strength of a single response may be, and usually is, a function of more than one variable and (2) a single variable usually affects more than one response'' (p. 227). An example of the first type of multiple control was suggested above, where the interaction among the multiple verbal stimuli in the question, ''What grows in a garden?'' plays a role in evoking a correct response, while the second type of multiple control is demonstrated by the behavior of listing a variety of things that can grow. These two types of multiple control have been termed *convergent multiple control* and *divergent multiple control*, respectively (Michael, Palmer, & Sundberg, 2011).

Convergent multiple control can be observed in almost all instances of verbal behavior. There are endless configurations of convergent multiple control because it can involve any verbal or nonverbal stimulus affecting any sense mode, including private stimulation (e.g., auditory, visual, tactile, pain, kinesthetic), and control can be shared with other antecedents such as conditioned and unconditioned stimuli, motivating operations, and audiences. The current study focuses on a special type of convergent multiple control commonly identified as a conditional discrimination (e.g., Saunders & Spradlin, 1989; Sidman & Tailby, 1982; Spradlin, Cotter, & Baxley, 1973). Michael (2004) defined a conditional discrimination as a type of multiple control where ''the nature or extent of operant control by a stimulus condition depends on some other stimulus condition'' (p. 64). That is, one discriminative stimulus (S^D) alters the evocative effect of a second stimulus in the same antecedent event (or vice versa), and they collectively evoke a response. For example, in standard matching-to-sample training a child is shown a sample stimulus such as a picture of a ball (stimulus 1) and asked to match that stimulus with a corresponding picture (stimulus 2) located in a comparison array. The child is successful only when the sample stimulus alters the evocative effect of one stimulus in the array. Specifically, the first picture of a ball establishes the second picture of the ball as an S^D that evokes the selection (matching) response, which is then reinforced. Simultaneously, the other stimuli in the comparison array are established as S-deltas (selection responses are not reinforced).

A conditional discrimination can be contrasted with a ''simple discrimination'' where a response is evoked by a single stimulus condition. For example, saying ''dog'' as a function of seeing a dog involves a single antecedent and a single response. However, multiple control may still be involved. A stimulus may contain several parts, usually referred to as a complex stimulus (e.g., Groskreutz, Karsina, Miguel, & Groskreutz, 2010; Markham & Dougher 1993; Stromer & Stromer, 1990), but still may only involve a simple discrimination. For example, the dog has a tail, paws, fur, etc., but these multiple stimuli occur together so reliably they constitute a single stimulus configuration requiring only a simple discrimination and it is not necessary to discriminate among the individual parts of the dog. If the response is reinforced, it will be more likely to be evoked in the future when all or part of the configuration of controlling variables occurs again. Multiple simple discriminations may also come together later as components of a conditional discrimination (e.g., Groskreutz et al., 2010; Saunders & Spradlin, 1989). There are many examples of simple discriminations in early language training such as learning echoic and imitative behaviors, tacting single nouns and verbs, song fill-ins, word associations, and performing specific actions on command.

However, there are many circumstances where the antecedent stimuli involve multiple components that do not reliably occur together, or may only come together on a single occasion. A correct response under these circumstances is typically dependent on a conditional discrimination where one stimulus alters the evocative effect of another stimulus, but neither stimulus alone is sufficient to evoke the correct response. For example, if a person is shown an array of different dogs and asked to find the schnauzer, a correct response is dependent on the word ''schnauzer,'' establishing the picture of that particular type of dog as an S^D for selection while simulta-

neously establishing all other types of dogs in the array as S-deltas. The word ''schnauzer'' without an available array of dogs, or the picture array of dogs without the spoken word ''schnauzer'' could not individually evoke the same response. These types of conditional discriminations involve what has been termed *compound stimulus control* and have been contrasted with complex multiple control described above (e.g., Groskreutz, et al., 2010; Markham & Dougher, 1993; Perez-Gonzalez & Alonso-Alvarez, 2008; Stromer, McIlvane, & Serna, 1993; Stromer & Stromer, 1990).

There is an extensive and productive body of basic research on conditional discriminations involving both humans and nonhumans, much of which is in the context of studying stimulus equivalence relations (for reviews see Sidman, 1994; Schrier & Thompson, 1980). A majority of this research has been conducted within a matching-to-sample preparation involving both visual-visual and auditory-visual discriminations and nonverbal selection responses (Sidman, 1994). The current study sought to extend the study of conditional discriminations to verbal operant relations that exclusively involve compound verbal antecedents and topography-based intraverbal responses.

Skinner (1957) first used the term ''compound verbal stimulus'' (p. 76) when discussing intraverbal behavior evoked by multiple verbal stimuli in a single antecedent event. The term ''conditional discrimination'' had not yet appeared in the behavioral literature when Skinner wrote his book *Verbal Behavior* (1957), but his analysis of the antecedent events in this type of verbal behavior is consistent with what is now often referred to as conditional discriminations involving compound stimuli (e.g., Alonso-Alvarez & Perez-Gonzalez, 2006; Axe, 2008; Perez-Gonzalez & Alonso-Alvarez, 2008). The current paper is primarily interested in compound conditional discriminations that involve only verbal stimuli. In an effort to avoid the etymological sanctions of the terms ''compound'' and ''complex,'' and the historical focus on nonverbal matching-to-sample preparations with classifications of discriminations by sense mode (i.e., visual-visual, auditory-visual) rather than function, the term *verbal conditional discrimination* (VC^D) is suggested. A VC^D can be defined as two or more components of a verbal stimulus where one verbal stimulus alters the evocative effect of another verbal stimulus (or vice versa) in the same antecedent event. For example, Catania (1998) describes an autoclitic relation where the verbal stimulus, ''I doubt (alters the evocative effect of) the coffee is ready'' (p. 258), and collectively through conditional discrimination, appropriately affects a listener's behavior. Had the speaker said, ''I'm sure the coffee is ready'' a different response would have been evoked, again through conditional discrimination.

The current study extends Catania's analysis to situations where a verbal stimulus enters into a conditional discrimination and alters the evocative effect of a second verbal stimulus, and these two stimuli collectively evoke an intraverbal response. Thus, the entire relation contains conditional discriminations involving only verbal stimuli and verbal responses, which is the foundation for almost all intraverbal behavior (Axe, 2008; Skinner, 1957). Verbal conditional discriminations can become increasingly difficult as more verbal stimuli are added to the antecedent such as different verbal modifiers (e.g., adjectives, prepositions, pronouns, conjunctions), more complex concepts (e.g., negation, ordinal positions, time, relativity), more complex vocabulary words and topics (e.g., ''dependable,'' ''considerate,'' ''global warming''), and so on. These types of verbal discriminations are ubiquitous in normal discourse and may help to explain why children with language delays have such a difficult time acquiring a functional intraverbal repertoire commensurate with their typically developing peers.

An important contribution to the treatment of children who fail to acquire intraverbal behavior would be data on typically developing children and the nature of their acquisition of intraverbal responses such as answering questions and engaging in conversations (e.g., Brown et al., 1969; de Villers & de Villers, 1978; Ervin-Tripp, 1970). In addition to the published books and research papers, there are 100s of different language development charts available on the Internet and in the print media that track the various components of typical language acquisition (e.g., www.cdc.gov, www.asha.org, www.

abp.org). However, none of these charts specifically track intraverbal development, but most do give some examples of intraverbal behavior. Many suggest that early verbal responses that would be classified as intraverbal behavior according to Skinner (1957) begin to occur around 1½ to 2 years of age and consists of singing songs and providing rhymes, as well as a child's ability to state his first name on request. Conversations and answering questions are usually identified as a 3 to 4 year old skill (see Ervin-Tripp, 1970 for more detailed information regarding specific types of questions). However, none of these charts provide information regarding the complexity of verbal antecedents for intraverbal behavior and as one might expect, do not identify conditional discriminations as being involved in this type of language.

Poon and Butler (1972) conducted the only known study that specifically examined increasingly complex intraverbal behavior with a large number of typically developing children of varying ages. These authors administered a modified version of the intraverbal subtest of the Parsons Language Sample (Spradlin, 1963) to 89 typically developing 5 to 7 year old children. The authors presented 24 intraverbal questions to the children and scored their responses as verbal, gestural, bimodal, correct, or incorrect. The primary goal of the study was to identify the role of gestures in intraverbal development, but the results also demonstrated several differences in the intraverbal behavior of the participants. The results showed that ''age was the significant main effect … (and) point to the possibility of a developmental sequence of intraverbal behavior'' (Poon & Butler, 1972, p. 306).

The current study is a replication and extension of Poon and Butler (1972). The study sought to further examine intraverbal development, but with younger typically developing children and with children with autism. The study employed an 80-item intraverbal subtest that was designed to determine if there is a general sequence of increasingly complex verbal stimuli and intraverbal behavior, and if this sequence could be beneficial to language assessment and intervention programs for children with language delays. The study also sought to determine the differences in intraverbal development between typically developing children and those with autism.

METHOD

Participants

Thirty-nine typically developing children and 71 children with autism served as participants. The typically developing children were between the ages of 23 months and 61 months, and the children with autism were between the ages of 35 months and 15 years old. Participants were recruited in a variety of ways. Many, but not all of the typically developing children had a parent or friend of the family who worked with children with special needs (e.g., a classroom teacher, speech pathologist, behavior analyst), or were siblings of children with special needs. The participants were drawn from several different parts of the United States and Canada (see the authors' note). The majority of participants were unknown to the authors. The children with autism were recruited from public school classrooms that the first author consulted with, and from colleagues who also worked with children with autism (see the authors' note). The current study represents the third large-scale administration of the 80-question assessment tool. In total, the three administrations of the subtest involved 91 typically developing children and 262 children with autism. However, the data from the first two administrations are not presented in the current paper, but the data did contribute to extensive modifications of the intraverbal subtest.

Setting

The typically developing children were administered the assessment in their own homes, in the homes of family friends who participated in the project, or in a classroom setting. The children with autism were administered the assessment in their homes or classrooms. No specific requirements were provided regarding the arrangement of the test setting, but some suggestions were made (see Appendix 1). For example, it was suggested not to conduct the whole assessment in one setting or in order of the items

listed, and to reinforce correct responses while making the process fun and feel like a game.

Intraverbal Assessment Subtest

An intraverbal assessment subtest was designed with increasingly complex intraverbal tasks (Appendix 2). There were earlier versions of the assessment tool that were gradually modified over a 5-year period as a result of several small-scale administrations and two large-scale administrations. The two large-scale administrations (Sundberg, Roden, Weathers, Hale, Montano, & Muhlestein, 2006, March; Sundberg, 2006, August) were part of the field-test data for the development of the intraverbal section of the *Verbal Behavior Milestones Assessment and Placement Program: The VB-MAPP* (Sundberg, 2008). The results from those administrations helped to establish, prioritize, and sequence the intraverbal skill area of the VB-MAPP, and to further refine that assessment tool. The revisions in the subtest mainly involved changing the items, changing the level of the items, or modifying the specific categories for each set of items. The version used in the current study (v. 5.21) was the result of these previous revisions, however some minor revisions were made during the course of the current study.

The assessment subtest contains 8 sets of items with 10 verbal stimuli in each set, resulting in a total of 80 intraverbal items. The first set contains simple intraverbal relations such as filling in the words to common songs (e.g., ''The itsy bitsy …''), providing the sounds that animals make (e.g., ''a kitty says …'') and fill-in-the-blanks involving reinforcers (e.g., ''Ready, set …''). Each set becomes increasingly complex along 5 general dimensions: (1) the transition from simple verbal stimulus control to VC^Ds, (2) the use of the WH (or similar) question format in a true VC^D, (3) increasing complexity of the parts of speech (moving from nouns to verbs, to adjectives, to prepositions, to pronouns, etc.), (4) increasing the complexity of the concepts (e.g., negation, relative adjectives, time, ordinal position), and (5) increasing the complexity of the individual vocabulary words contained in the verbal antecedents. There were two blank spaces at the bottom of each set in order to include any child-specific intraverbals that might be strong in the child's repertoire. (However, the various administrators of the test rarely used these spaces.)

Administration Instructions

Each person who administered the assessment received a set of instructions (see Appendix 1). The instructions identified the general goal of the assessment tool, specific suggestions for conducting the assessment (e.g., don't prompt responses, multiple presentations of an item are acceptable, write exactly what the child says), and the scoring instructions.

Reliability

A second person independently scored the transcribed intraverbal responses as correct or incorrect. IOA was assessed using the point-by-point agreement method for 33% of the participants. Agreement was calculated by dividing the number of agreements for each correct or incorrect response by the total number of agreements plus disagreements and multiplying by 100%. The mean agreement across participants was 93.4% and the scores ranged from 84% to 100%.

RESULTS

Approximately 8,500 intraverbal responses were collected from the 110 participants and scored as correct or incorrect primarily by the authors. Figure 1 shows the number of correct intraverbal responses across the 39 typically developing children. The age in months of each child is presented on the left *y axis* and his or her specific score on the subtest is presented on the right *y axis*. The data show that there was a general correlation between the age of the child and the number of correct intraverbal responses. Not surprisingly, the older the child, the higher the score. However, there was considerable variability in the individual scores of children who were similar in age.

The most interesting aspect of Figure 1 is the sharp increase in the number of correct intraverbal responses that begins to occur for

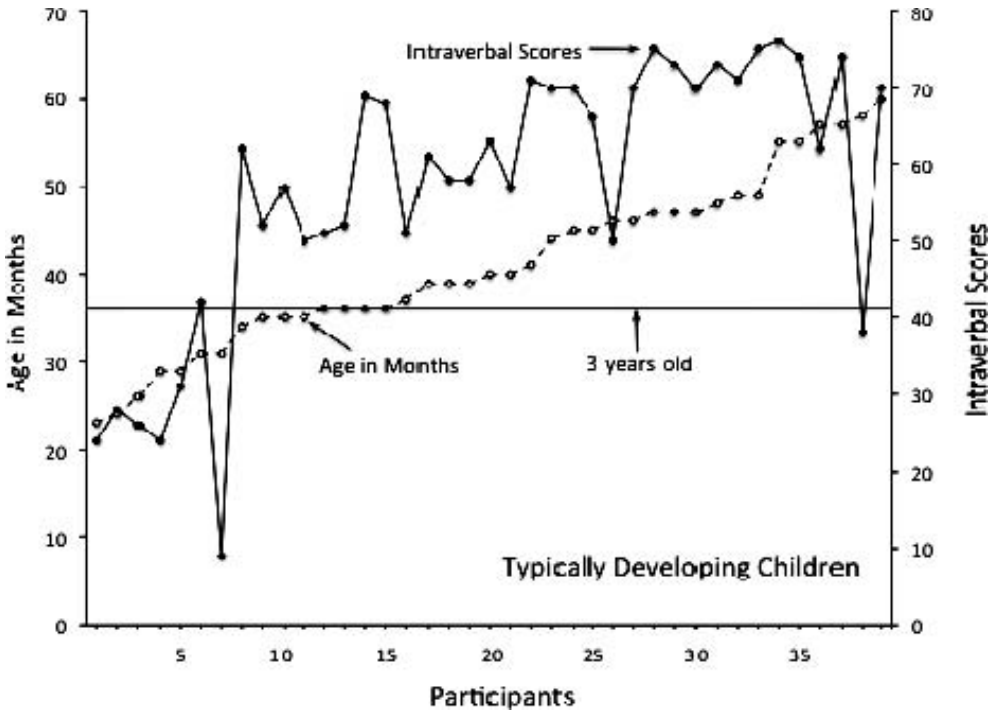

Figure 1. The age in months is presented on the left *y axis* and the scores on the intraverbal subtest is presented on the right *y axis* for typically developing children. A line is provided at three-years-of-age to provide a frame of reference.

the children who were reaching 3 years of age. Beginning with participant 8, who was 34 months old, the average scores more than doubled compared to the average score of the children 31 months and younger. The 7 children who were 31 months old or younger had an average score of 26 correct intraverbal responses. The 9 children between the ages of 34 and 38 months old had an average score of 58 correct intraverbal responses.

Perhaps the most valuable information in these data is the errors that the children made. The types of errors varied by age groups. The younger children tended to make errors that consisted of not responding to the question, pointing to a location, emitting an echoic response, repeating a previous response, or emitting a general response such as ''things,'' ''stuff,'' ''huh,'' or ''yeah.'' Some of these children also had a ''favorite error response'' for multiple questions (e.g., one child responded ''oranges'' for 7 items, another said ''elephants'' for 6 items). Older children tended to make some of these errors, but would be more likely to say, ''I don't know,'' instead of not responding, pointing, or emitting echoic responses (although echoic responding did occur for several older children). The most common errors for the older children were those that showed some degree of simple discrimination, but poor or absent VC^D control, especially with more complex parts of speech and content (e.g., ''What do you smell with?'' evoked ''Poopies''). Table 1 contains a sample of the types of errors made by the typically developing children at six different age levels, and more detail about the nature of their errors is presented below.

The 3 children in the 2-year-old group had a mean score of 26 correct responses. They were able to do song fill-ins, simple associations, fill-in-the blanks, and some limited answers to WH questions. However, they were unable to provide correct responses to items that contained VC^Ds or more complex parts of speech. These children frequently emitted echoic responses to many of the questions that they could not answer.

The 4 children in the 2½-year-old group had a mean score of 26.6 (this score was

Table 1
Samples of Error Patterns and Error Analysis for the Typically Developing Children

N =	Age and range	IV scores	Error analysis and comments
3	2-year-olds Range = 23–27 months old	Mean = 26 Range = 24–28	• Some simple intraverbal behavior, but no VC^Ds • Can do song fill-ins, reinforcing intraverbals (part mand), some associations, animal and object sounds, common fill-ins • Limited answers to WH questions (e.g., provides first name, or one word intraverbal answers) • Frequent echoic responding, pointing, or not responding
4	2½-year-olds Range = 29–31 months old	Mean = 26.5 Range = 9–42	• Some simple intraverbal behavior, getting some easy WH questions • Frequent echoic responding, or ''What?'' ''Yeah'' ''Things'' ''Huh?'' • When some intraverbal control was demonstrated it was often a simple intraverbal relation, minimal VC^Ds; the last, or prominent word was usually the source of stimulus control, for example … • ''What do you smell with?'' … ''Poopies'' • ''What grows on your head?'' … ''Shoulders'' • ''What helps a flower grow?'' … ''Up''
9	3-year-olds Range = 34–38 months old	Mean = 58 Range = 50–69	• Well established basic intraverbal repertoire, 1000s of intraverbal relations • But VC^D errors were prevalent, for example … • ''What grows on your head? … ''Plants'' • Many ''WH'' questions caused problems, for example … • ''Where do you eat?'' … ''Food''

Table 1, *cont.*

N =	Age and range	IV scores	Error analysis and comments
			• Rote responses were evident, for example …
			• ''What day is today?'' … ''Rainy'' (it was sunny)
			• Problems with prepositions and adjectives in VC^Ds, for example …
			• ''What's under a house?'' … ''roof''
			• Trouble with negation and personal information
			• ''What's something you can't wear?'' … ''Shirt''
			• ''What is your last name? … ''Noah,'' ''Gabriella,'' ''Sofia,'' ''Neil''
7	3 ½-year-olds Range = 39–44 months old	Mean = 62.9 Range = 57–71	• Strong intraverbal repertoire, but VC^D errors were still common, for example …
			• ''What grows on your head?'' … ''Hat''
			• ''Name some clothing'' … ''For the body'' ''When do we set the table?'' … ''After dinner''
			• Negation still a major problem
			• Still having problems with, prepositions, adjectives, adverbs in VC^Ds
			• Still having problems with time concepts
			• Still emitting echoic responses when no intraverbal occurred

Table 1, *cont.*

N =	Age and range	IV scores	Comments and error analysis
10	4-year-olds Range = 45–49 months old	Mean = 69.7 Range = 50–75	• Very strong intraverbal behavior, VC^D errors were still common, for example… • ''What do you smell with?'' … ''A skunk'' • But VC^Ds are clearly getting stronger, for example … • ''What's above a house?''…''An airplane, and stuff that's on the roof'' • Negation, time concepts, prepositions, and adjectives in a VC^D continued to be a problem for many children • Specific words and concepts like ''different,'' ''between,'' ''take,'' ''how,'' and ''why'' caused problems
6	5-year-olds Range = 55–60 months old	Mean = 65.7 Range= 38–76	• Children at this age are generally more successful with VC^Ds, for example… • ''What's in a balloon?'' … ''Helium,'' ''Air'' • However, they still have problems with negation, time concepts, and prepositions • Many 5-year-old children missed ''What day is today?'' ''What day is before Tuesday?'' ''What's your last name?'' ''How is a car different from a bike?'' ''What number is between 6 and 8?''

reduced by one extremely low score). Overall, the 2½-year-old children demonstrated stronger intraverbal behavior, but their error analysis revealed that the intraverbal control was usually restricted to simple discriminations involving the last or prominent single word in a sentence (e.g., ''What grows on your head?'' evoked ''shoulders''). These children were also unable to correctly respond to questions involving VC^Ds, and frequently emitted echoic responses or a general response (e.g., ''things'') to the more complex questions.

The 9 children in the 3-year-old group had a mean score of 58 and were beginning to correctly respond to questions involving VC^Ds (e.g., ''Where do you find wheels?'' evoked ''The bottom of a car.''). However, errors involving VC^Ds containing more complex parts of speech were still prevalent (e.g., ''What's under a house?'' evoked ''roof''). Children at this age had trouble with WH questions that contained prepositions, pronouns, adjectives, adverbs, negation, time concepts, and especially combinations of these. None of the 3-year-olds could provide only their last names when asked. Four of the children emitted their first names (i.e., ''What is your last name?'' evoked ''Noah,'' ''Gabriella,'' ''Sofia,'' and ''Neil''), 4 children emitted their full names, and 1 child did not respond to the question.

The 7 children in the 3½-year-old group had a mean score of 62.9 correct intraverbal responses. They made fewer errors, but were still having difficulty with VC^Ds involving prepositions, adjectives, negation, time concepts, etc. These children often said, ''I don't know'' when they could not answer the question, but they still emitted echoic responses on occasion.

The intraverbal repertoire was quite strong for most of the 4-year-old children. The 10 children in this group had a mean score of 69.7 on the assessment. They were clearly able to emit responses involving VC^Ds (e.g., ''What's above a house?'' evoked ''An airplane and stuff that's on the roof''). However, they too had difficulty with prepositions, various adjectives, negation, and time concepts.

The 6 children in the 5-year-old group had a lower mean (65.7) primarily due to 1 low score, but most of the 5 year olds were able to correctly respond to almost all of the questions containing VC^Ds. They still however demonstrated weaknesses with prepositions, adjectives, negation, ordinal positions, and time concepts within a VC^D (e.g., none of these children could answer ''What day comes before Tuesday?'', most responded ''Wednesday'').

The results of the children with autism are presented in Figure 2. These data show a greater variability in the scores among the 71 children than demonstrated by the typically developing children. In general, there was a gradually increasing trend in scores with age, but some of the best performances were with the younger children. However, the participants in this study do not represent a random selection of children with autism. Most of the participants came from programs that followed a behavioral approach to language assessment and intervention, and if appropriate, had been receiving intraverbal training as part of their daily programs (see the authors' note).

As with the typically developing children, the analysis of errors provided useful information. Rote intraverbal and echoic responding was more frequent for the children with autism, as was the occurrences of negative behavior during the assessment, especially with questions involving the more complex VC^Ds. These types of problems were more prevalent for the older children. The most interesting results from the children with autism were that they tended to make the same types of errors made by typically developing children who scored at their level. That is, children who had a similar total score on the assessment made the same types of errors throughout the assessment regardless of age or handicapping condition (Table 2). For example, when asked, ''What shape are wheels?'' A typically developing child with a total score of 40 responded ''triangles'' while a child with autism who also scored 40 responded ''cars.'' Both errors represent simple intraverbal stimulus control, but not the necessary VC^D needed to answer the question correctly.

DISCUSSION

The current study supports the conclusion by Poon and Butler (1972) that there is a

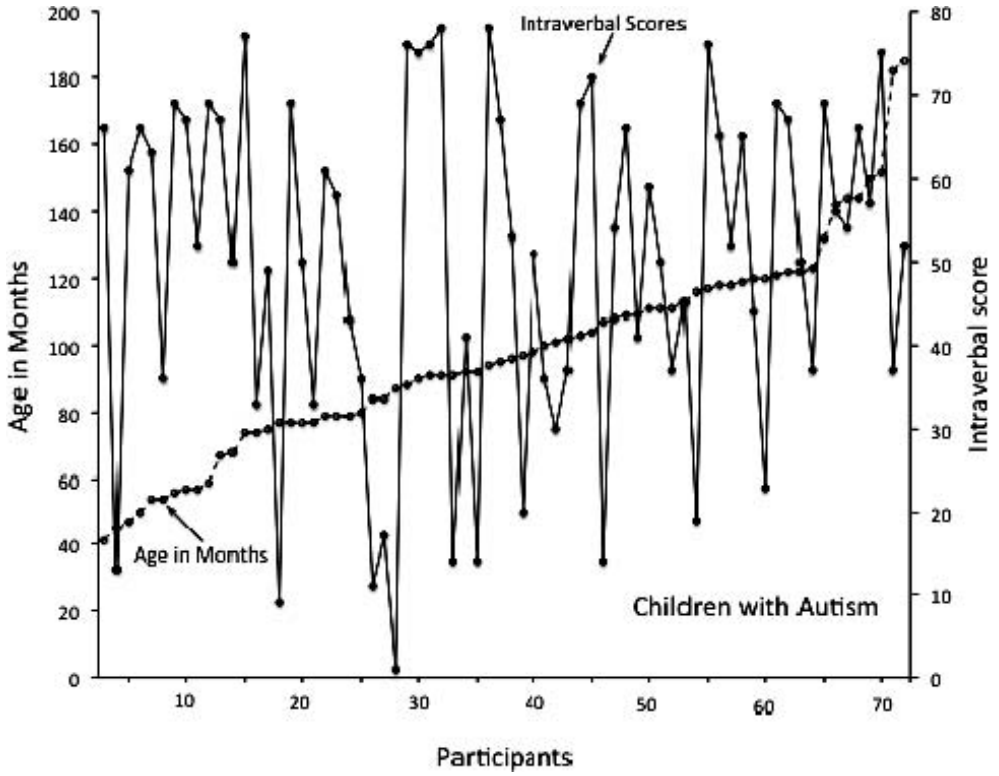

Figure 2. The age in months is presented on the left *y axis* and the scores on the intraverbal subtest is presented on the right *y axis* for children with autism.

general sequence of intraverbal acquisition. The data suggest that this sequence is primarily a function of the complexity of the verbal stimulus control involved in a given intraverbal relation. Typically developing children between the ages of 23 and 31 months of age were only able to emit intraverbal responses controlled by simple forms of verbal stimulus control, and were unable to respond to those involving verbal conditional discriminations (VC^Ds). It was not until approximately 3 years of age that typically developing children were consistently able to emit these types of verbal discriminations. These data suggest that the substantial growth in the intraverbal repertoires of typically developing children that occurs between 2 and 3 years of age may be partially related to the acquisition of responses controlled by VC^Ds.

The error analysis demonstrated at least 5 ways that verbal antecedents become more complex: (1) as suggested above, the transition from simple verbal stimulus control to VC^Ds; (2) the use of the WH (and similar) question format in a true VC^D; (3) the inclusion of more complex parts of speech (and words) in a VC^D (i.e., prepositions, adjectives, adverbs, conjunctions); (4) the inclusion of more complex concepts in a VC^D (e.g., negation, relative adjectives, time, ordinal positions); and (5), the inclusion of more complex vocabulary words in a VC^D. There was a clear correlation between the age of a child and his or her success with these more complex discriminations. While the data do provide support for Poon and Butler's (1972) conclusion that ''age was the significant main effect'' (p. 306) for intraverbal development for typically developing children, there was wide variability between individual children at the same age.

The results from the 71 children with autism supported the results obtained from the typically developing children in a variety of ways, but also provided additional insight on intraverbal development. An error analysis revealed that children with autism dem-

Table 2
Samples of the Errors Made By Typically Developing Children and Children With Autism Whose Total Scores Were in the Same Bracket

Assessment total score	Intraverbal question	Typically developing child	Child with autism
20–29	What can fly?	''All gone shirt''	''Water''
	What can you sing?	''Yes''	No response
	What's outside?	''Outside''	''Outside''
30–39	What are some colors?	''1, 2, 3''	''Coloring''
	Why do you use a Band-Aid?	''On my finger''	''Happens''
	Where do you take a bath?	''Mommy and daddy''	''With toys''
40–49	What grows outside?	''Sand''	''Playground''
	What shape are wheels?	''Triangle''	''Cars''
	What do you wear on your head?	''A ear''	''Boo boo''
50–59	What do you eat with?	''Cheese''	''Pizza''
	What color are wheels?	''Circle''	''Red''
	Name some clothing.	''Clothing''	''Clothing''
60–69	What's in a balloon?	''It pops''	''String''
	What makes you sad?	''Cry''	''Cry''
	What grows on your head?	''A plant''	''Hats''
70–79	What day comes before Tuesday?	''Wednesday''	''Wednesday''
	What's your last name?	Gave full name	Gave full name
	What number is between 6 and 8?	''9''	''9''

onstrated the same difficulty with increasingly complex verbal stimuli described above, and made errors similar to those made by typically developing children who obtained similar scores on the 80-item intraverbal assessment, regardless of age. Thus, the overall score on the assessment was a better predictor of intraverbal skills and deficits than the age or the handicapping condition of the child. However, it is important to note that the targeted population of children with autism came from programs that specifically provided intraverbal instruction, which is likely responsible for the fact that several of these children had near perfect scores. It would be interesting and important to examine the scoring patterns and errors demonstrated by children with autism who have not received formal intraverbal instruction.

The results of this study also have several implications for intraverbal assessment and intervention for children and adults with language delays. In order to design an appropriate intraverbal intervention program it is critical to identify a child's existing intraverbal skills (and any barriers to acquisition). The original intraverbal assessment tool developed by Spradlin (1963) contained 29 items of increasing complexity and served as the foundation for all other intraverbal assessments that followed (e.g., Braam, Sundberg, & Stafford, 1978, May; Partington & Sundberg, 1998; Sundberg, 1983, 1990, 2008; Sundberg, Ray, Braam, Stafford, Reuber, & Braam, 1979). The 80-item subtest presented in the current study continues the work started by Spradlin by providing a quick sample of an intraverbal repertoire. This revised sequence of intraverbal complexity represents a data-based intraverbal assessment tool (Sundberg, 2008) that corresponds with typical developmental milestones and is conceptually consistent with Skinner's (1957) analysis of verbal behavior and basic principles of behavior.

Future research involving the assessment subtest and especially VC^Ds could be conducted with other populations as well, such as children who are identified ''at risk,'' or

are demonstrating other types of language delays (e.g., expressive language disorder). The current version of the subtest was developed for children, but the items could be modified to suit different populations. For example, a modified version of the assessment could be valuable for identifying and ameliorating the intraverbal difficulties experienced by members of the adult or geriatric population (e.g., Gross, Fuqua, & Merritt, 2010, May). In addition, individuals with traumatic brain injury often face intraverbal problems (e.g., Sundberg, San Juan, Dawdy, & Arguelles, 1990) and could benefit from a modified version of the assessment, as might those who are learning a second language (e.g., Petursdottir & Haflioadottir, 2009). The current intraverbal subtest, along with a careful analysis of errors related to VC^Ds, could also be used as a dependent variable for measuring intraverbal change for any individual who is experiencing intraverbal delays.

The current data also have several implications for the development of an intraverbal intervention program for children with language delays. Perhaps the most valuable contribution is that the acquisition of intraverbal behavior by typically developing children can serve as a guide for sequencing intraverbal tasks, and for developing Individual Educational Programs (IEPs). The data suggest programmers should avoid attempts to teach advanced intraverbals such as those containing VC^Ds, modifiers, and complex concepts until a child has the necessary prerequisite verbal skills. It is speculated that the failure to appreciate the complexity of VC^Ds is a major cause for the development of rote intraverbal responding and/or echolalia often demonstrated by children with autism or other developmental disabilities. For example, before a child is presented with WH questions containing adjectives and prepositions he should have a solid history of simple verbal discriminations, noun and verb intraverbal discriminations, and general verbal conditional discrimination training. Further empirical investigation of these variables could substantially improve existing intraverbal intervention programs.

Another contribution of the current data to language intervention programs is the observation that intraverbal development takes a long time for typically developing children. This study shows that children seem to stay at the simple verbal discrimination level for many months, before progressing to early forms of VC^Ds. These same children may emit thousands of mand, tact, and listener responses per day (Hart & Risley, 1995; Moerk, 1986), yet still are unable to emit more complex intraverbal behavior. Further research on this process could be quite beneficial to determining how fast one should progress through the various levels of intraverbal training. The implication is that a thorough analysis of a child's intraverbal levels and targeted intraverbal tasks be regularly conducted. Programmers should be careful about increasing the complexity of the verbal antecedent too quickly or moving from the nonverbal context too soon (tact and listener discriminations). Also, the error analysis used in the current study could be a beneficial tool for monitoring a child's intraverbal development and adjusting the program accordingly.

Future research on the role of motivation (MOs) as an additional antecedent variable in intraverbal interactions could also be quite productive (Sundberg & Michael, 2001). In early intraverbal training the use of MOs (convergent multiple control) seems to facilitate intraverbal development when a response is established as part mand and part intraverbal (e.g., ''Ready, set, …''). Motivation clearly plays a role in more advanced intraverbal behavior as is demonstrated by individuals who emit strong intraverbal behavior regarding topics that they are highly interested in, but weak intraverbals regarding less interesting topics. There are also a number of other thematic lines of research that could be conducted in the use of various forms of multiple control for intraverbal development (see Chapters 9–11 of Skinner, 1957 for many examples).

The primary antecedent variables in most intraverbal behavior involve VC^Ds, which are a type of multiple control (Skinner, 1957). However, very little research has been conducted on VC^Ds and topography-based intraverbal responses (Axe, 2008). Direction for future research in this area can come from the extensive body of work on selection-based conditional discriminations, especially those involving compound conditional dis-

criminations (e.g., Alonso-Alvarez & Perez-Gonzalez, 2006; Markham & Dougher, 1993; Perez-Gonzalez & Alonso-Alvarez, 2008; Saunders & Spradlin, 1989; Stromer & Stromer, 1990). For example, Perez-Gonzalez and Alonso-Alvarez, (2008) conducted a VC^D analog study designed to establish discriminations containing 4 interchangeable stimuli. The study involved arbitrary stimuli based on the verbal analog, ''Select a French painter,'' ''Select a French writer,'' ''Select a Spanish painter,'' and ''Select a Spanish writer.'' The results demonstrated ''that learning the four single-sample conditional discriminations is sufficient for some persons to demonstrate the emergence of the compound-sample conditional discriminations'' (p. 95). However, other persons required ''experience with a compound-sample conditional discrimination … for the emergence of the compound-sample conditional discrimination'' (p. 95). The authors concluded with the suggestion that

> in order for children with autism to answer questions with two relevant stimuli … the present study suggests that they should learn first to answer questions with only one relevant stimulus… . It also suggests they should learn the relational [autoclitic] frame corresponding to two-stimuli questions'' (p. 99).

These data support the previous suggestion that establishing an intraverbal repertoire for children with language delays involves several prerequisite skills. For example, if the goal is to teach a child to intraverbally answer (in a non rote manner) the questions, ''Can you name a red fruit?'' ''Can you name a red vegetable?'' ''Can you name a yellow fruit?'' and ''Can you name a yellow vegetable?'' the tact and listener skills involving red, yellow, fruit, and vegetable should be individually established, generalized, and discriminated from other classes of stimuli. In addition, divergent intraverbal control should be individually taught for each word and intraverbal response classes established (i.e., Perez-Gonzalez & Alonso-Alvarez, 2008). The compound verbal stimuli could then be brought together for the first time in a listener VC^D task that provides a nonverbal prompt (e.g., a listener responding by function, feature, and class task). For example, the four verbal combinations of the two adjectives and two nouns (e.g., ''Can you find a red fruit?'' ''Can you find a yellow vegetable?'') can be presented along with an array of comparison stimuli that includes the target stimulus and a variety of similar nonverbal items (e.g., green fruit, red meat, yellow bus, orange vegetable). The next step is to fade out the nonverbal stimulus, and transfer stimulus control to a slightly modified verbal stimulus (i.e., ''can you name …''), thus establishing an intraverbal relation. Many variations of this procedure are possible and could generate a thematic line of research that would be of great value in developing intraverbal training programs.

Intraverbal behavior is often hard to acquire because of the inherent complexity of verbal stimulus control. More often than not, many of the various verbal antecedents for daily intraverbal behavior do not reliably occur together, or may only come together on a single occasion. Children with autism who may thrive on sameness and routine may find the constantly changing and often novel configurations of verbal stimulus control quite difficult. The current data suggest that the intraverbal repertoires of typically developing children can provide a guide for intraverbal assessment and intervention for individuals with language delays. In addition, the data suggest that verbal conditional discriminations are ubiquitous and mandatory in daily intraverbal relations and should be a major focus for the future study of intraverbal behavior.

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APPENDIX 1

Instructions for Conducting the VB-MAPP Intraverbal Assessment Subtest

Dear participant:

We have been working on improving the intraverbal curriculum for children with language delays and request your help in obtaining information on children's responses to the 80 items contained in this subtest. The information will give us some baseline data and guide us in sequencing the types of intraverbal tasks presented to language delayed children. We need data on both typically developing children (between 12 and 48 months of age) and children with any type of language delay.

There are 8 sets of intraverbal items on this subtest. Each set contains 10 questions and two individualized supplemental items (identified on the forms as ''other'') that are meant to replace one or two of the questions that the child has no exposure to the specific words or topics. The purpose of the supplemental items is to give a child credit for an intraverbal response that s/he might be able to emit on a topic more familiar to him/her that is commensurate with the group being tested (if the child does not get all 10 correct). For example, a child may not be able to intraverbally respond to one of the song fill-ins if they don't know the song listed in set 1, but s/he may be able to fill-in a different song. The assessor could include up to 2 individual items for each set, but the child's total score for each set still cannot exceed 10 (i.e., if the child gets all 10 listed items correct, the individualized items will not increase the score). Please make sure to fill out the information on the top of the form. Last names are optional (or use the first letter only if two children have the same first name).

Here are some specific suggestions for conducting the assessment.

- Make it fun for the child by making it seem like a game
- Reinforce correct responses
- Don't correct or punish incorrect responses (i.e., ''no'')
- Don't prompt responding in any way (this is a baseline test)
- There is no time limit, take your time
- Spread out the assessment over a variety of activities (avoid presenting all 80 questions in a row, or in one setting)
- Intersperse the test items with other verbal and nonverbal activities
- Mix up the items for each category (e.g., a song fill-in, then a ''where'' question)
- Repeat the question two or three times if necessary
- Re-phrase minor words if necessary (e.g., ''What animal has stripes'' can be re-phrased to ''Can you tell me an animal with stripes''). Please note any changes to the question on the form

Scoring instructions

- Fill in the general information at the top of the form
- Write the child's exact response in the blank space to the right of the test item
- Don't worry about scoring, we will score the test, but feel free to score it if you want
- Please email or fax us back the filled out forms by May 11th if you can

Appendix 2
The Intraverbal Assessment Subtest

Child's name: Tester:
Date of birth: Testing date (s):
Diagnosis if any: Total score____ (give a 0 or 1 for each item)

Group 1: Animal sounds & songs fill-ins)	**Score**	Write the exact response given by the child
A kitty says...		
Twinkle, twinkle, little...		
Ready, set …		
The wheels on the bus go...		
Rock-a-bye...		
A dog says...		
Peek-a…		
The itsy bitsy...		
Head, shoulders, knees and...		
Happy birthday to...		
Other:		
Other:		
Total points (10 points maximum):		

Group 2 (name, fill-ins, associations)

What is your name?
You brush your...
Shoes and...
You ride a...
You flush the...
You sit on a...
You eat…
One, two...
You wash your...
You sleep in a…
Other:
Other:
Total points (10 points maximum):

Group 3 (Simple What questions)	**Score**	Write the exact response given by the child
What can you drink?		
What can fly?		
What are some numbers?		
What can you sing?		
What's your favorite movie?		
What are some colors?		
What do you read?		
What is outside?		
What's in a kitchen?		

Appendix 2, *cont.*

What are some animals?
Other:
Other:
Total points (10 points maximum):

Group 4 (Simple Who, Where, & How old?)

Who is your teacher?
Where do you wash you hands?
Who lives on a farm?
Where is the refrigerator?
Who drives the car?
Where do you take a bath?
How old are you?
Where are the trees?
Who do you see on TV?
Why do you use a bandaid?
Other:
Other:
Total points (10 points maximum):

Group 5 (Categories, function, features)	**Score**	Write the exact response given by the child

What shape are wheels?
What grows outside?
What can sting you?
What do you do with with a spoon?
What can you push?
Where do you find wheels?
What do you smell with?
Name some clothing.
What's something that's sharp?
What color are wheels?
Other:
Other:
Total points (10 points maximum):

Group 6 (adjectives, prepositions, adverbs)

What do you wear on your head?
What do you eat with?
What animal moves real slow?
What's above a house?
What do you write on?
What's in a house?
What are some hot things?
What grows on your head?
What is under a boat?
Where do you eat?
What's under a house?
Other:

Appendix 2, *cont.*

Other:		
Total points (10 points maximum):		
Group 7 (Multiple part questions)	**Score**	Write the exact response given by the child
What makes you sad?		
What animal has a long neck?		
Tell me something that is not a food.		
What helps a flower grow?		
What is something you can't wear?		
What do you do with money?		
What number is between 6 and 8?		
What's in a balloon?		
What's your last name?		
What's something that is sticky?		
Other		
Other		
Total points (10 points maximum):		
Group 8 (Multiple part questions)		
Where do you put your dirty clothes?		
What do you take to a birthday party?		
What day is today?		
What do you see in the country?		
What day comes before Tuesday?		
Why do people wear glasses?		
When do we set the table?		
How is a car different from a bike?		
How do you know if someone is sick?		
What did you do today in school?		
Other		
Other		
Total points (10 points maximum):		