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SPECIAL SECTION: THE INTRAVERBAL RELATION

Empirical Investigations of the Intraverbal: 2005–2015

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Abstract Several papers have reviewed the literature based on Skinner's conceptual framework presented in his 1957 book, *Verbal Behavior.* These reviews have called for more research on the topic of verbal behavior generally and often for more research on particular verbal operants. For example, Sautter and LeBlanc (2006) urged the behavior-analytic community to conduct more research on the intraverbal because of the scant existing literature base at that time. In the current review, we replicate the procedures used by Sautter and LeBlanc focusing specifically on the intraverbal relation and on the literature published in the 10 years since their call for research. We summarize the publication themes, provide graphs of the trends and types of published articles, and offer ideas for future research specific to the intraverbal.

Keywords Intraverbal · Quantitative review · Skinner · Verbal behavior

Sautter and LeBlanc (2006) published a review summarizing the literature on empirical applications of Skinner's analysis of verbal behavior with humans. Their work was an extension and update of three earlier papers: a citation analysis (McPherson, Bonem, Green, & Osborne, 1984), a quantitative literature review (Eshleman, 1991), and a narrative literature review (Oah & Dickinson, 1989). Given the professional interest in Skinner's conceptual framework at the time, Sautter and LeBlanc sought to summarize the literature to provide the behavior-analytic community with an updated review across all verbal operants. They also urged researchers to provide additional empirical evidence for effective verbal behavior interventions for individuals with disabilities.

Sautter and LeBlanc (2006) revealed that the overall body of empirical support for verbal behavior had increased substantially in the prior 15 years, but research on certain verbal operants such as the intraverbal remained limited. By 2006, only 14 empirical

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studies on the intraverbal existed, the majority of which had been published between 1989 and 2004. These studies focused primarily on simple forms of the intraverbal (e.g., fill-in-the-blank responding). The authors encouraged more empirical investigations of the intraverbal stating, "this operant includes perhaps the most diverse group of responding and accounts for reading comprehension, conversation, and question answering and events that are traditionally conceptualized as thought or memory" (Sautter & LeBlanc, p. 41). Thus, this seemed an area rife for additional investigations based on this broad definition of the intraverbal (see Palmer, 2016, for a discussion of the merits of broader or narrower definitions of the intraverbal).

A decade has passed since Sautter and LeBlanc's review and tools for studying and applying Skinner's analysis (e.g., verbal behavior milestones assessment and placement program; VB-MAPP; Sundberg, 2008) have greatly increased. For example, some authors have evaluated a correlation between age and correct intraverbal responding with typically developing children and children with autism, which may be useful in the development and assessment of simple and complex intraverbal responding (Sundberg & Sundberg, 2011). The term verbal conditional discrimination has been introduced for when a verbal stimulus alters the evocative effect of another verbal stimulus in the same antecedent event and when verbal behavior is under sources of multiple control (Michael, Palmer, & Sundberg, 2011; Sundberg & Sundberg, 2011). Additionally, Axe (2008) has since provided a further evaluation of complex intraverbal responding that are under divergent and convergent control. However, a new literature review on the intraverbal is still warranted to examine the potential growth and diversity of the literature on this topic. Since Sautter and LeBlanc (2006) highlighted the need for research on the intraverbal in particular, the primary purpose of this paper was to review experimental publication trends on the intraverbal since 2005. The second and third purposes of this paper were to summarize the state of empirical support for the intraverbal while providing suggestions for future researchers investigating this elementary verbal operant.

Review Procedures and Selection Criteria

The current investigation replicated the Sautter and LeBlanc (2006) methodology for the years 2005 to 2015 with two main differences. First, the search criteria were narrowed to focus solely on the intraverbal. Second, an ancestral search was incorporated, which is further described below. Studies were first identified through a computer search of the PsycINFO database using the keywords: *intraverbal* and/or *verbal behavior.* Additionally, a manual review was conducted of *The Analysis of Verbal Behavior* (*TAVB*), *Journal of Applied Behavior Analysis* (*JABA*), *Journal of Experimental Analysis of Behavior* (*JEAB*), and *Research in Developmental Disabilities* (*RIDD*) from 2005 to 2015. Studies were selected based on two criteria. First, the word *intraverbal* appeared in the title or abstract of the article. Second, the study was empirical in nature. That is, the study had to include clearly defined independent and dependent variables and a research design. Finally, an ancestral search was conducted by reviewing the reference lists from the articles that met the aforementioned criteria and identifying any additional studies from the reference list that met the criteria for inclusion that had not appeared in the electronic search or journal review. These search procedures yielded a total of 53 studies.

Key Findings

Publication Trends

There has been an overall surge of research investigating the intraverbal in the past 10 years. In the decade since the Sautter and LeBlanc (2006) review, the number of articles on the intraverbal has nearly quadrupled. Figure 1 depicts the total number of studies published each year from 2005 to 2015. There has been an overall upward trend in the number of studies published on the intraverbal in the past 10 years. Although the number of articles per year was low until 2010 (range, 1–4), 2011 marked a significant increase with eight total articles published on the intraverbal that year. The frequency was slightly lower in 2013, but numbers continued to increase substantially in 2014 and 2015 with a total of 12 articles in 2015.

Figure 2 depicts the journal outlets in which studies on the intraverbal were published. Most articles were published in *TAVB*, which is consistent with the specific focus of this journal on verbal behavior. *Journal of Applied Behavior Analysis* contained 20 of the 53 (37.7 %) articles, indicating that the topic of verbal behavior is being investigated more frequently in the flagship applied behavior analysis journal. This publication trend seems to represent a heightened interest of the broader behavior-analytic community in Skinner's conceptual framework for language. The remaining journals each included a few articles (range, 0–4), with 4 of the 53 articles published in *Research in Autism Spectrum Disorders* (*RASD*), which did not exist during the years sampled in the previous review. One notable difference in the findings of the current review and Sautter and LeBlanc (2006) is that the journal, *RIDD*, which previously ranked third in articles published on the topic of verbal behavior across all operants, published no articles at all in the current review window; this might be a result of a shift of content being submitted to its sister journal, *RASD*. Figure 3 depicts the cumulative number of studies published on the intraverbal to date. The total number of studies

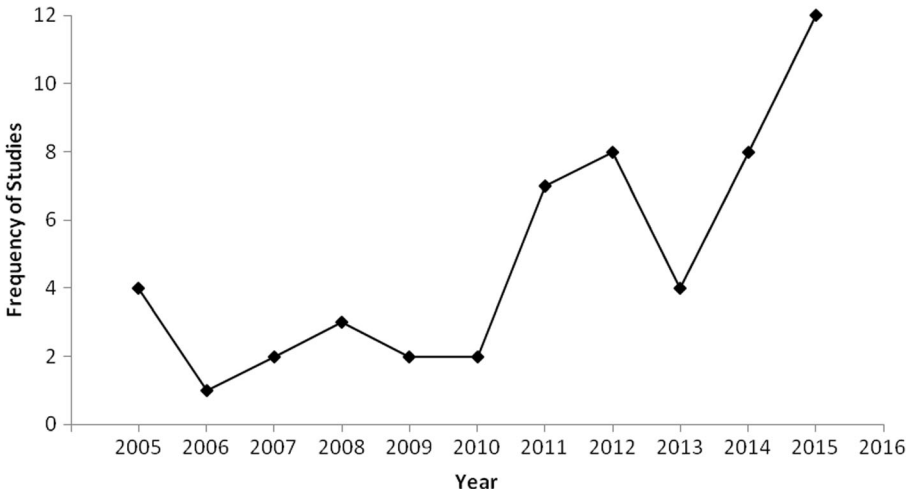

Fig. 1 Frequency of studies published on the intraverbal each year in all journals reviewed between the years 2005 through 2015

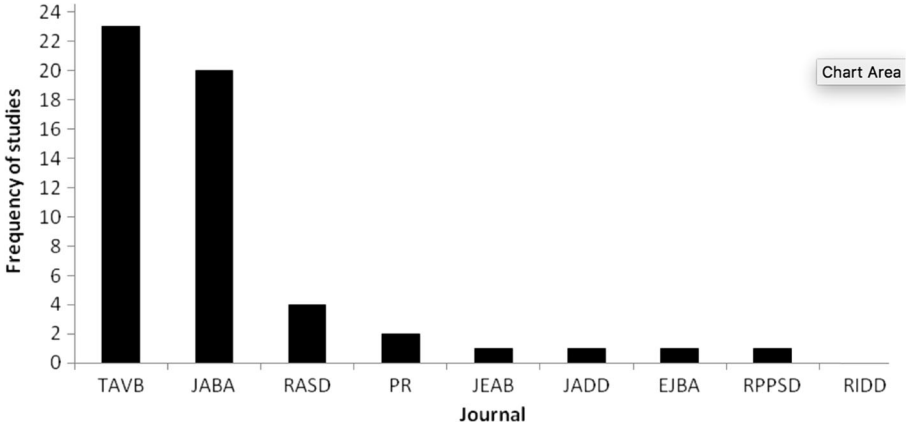

Fig. 2 The frequency of studies published on the intraverbal in *The Analysis of Verbal Behavior* (*TAVB*), *Journal of Applied Behavior Analysis* (*JABA*), *Research in Autism Spectrum Disorders* (*RASD*), *The Psychological Record* (*PR*), *Journal of the Experimental Analysis of Behavior* (*JEAB*), *Journal of Autism and Developmental Disorders* (*JADD*), *European Journal of Behavior Analysis* (*EJBA*), *Research & Practice for Persons with Severe Disabilities* (*RPPSD*), and *Research in Developmental Disabilities* (*RIDD*)

published on the intraverbal has increased each year in the last decade, from 14 articles before 2005 to a total of 53 in 2015.

Research Emphasis

Three main areas encompassed most of the work on the intraverbal published in the past decade: (1) direct intraverbal training, (2) emergence of one verbal operant after training of another, and (3) problem solving. Many studies involved direct training of intraverbal responses. These studies examined various procedures for teaching an intraverbal repertoire (e.g., investigation of a new teaching method, comparing teaching methods) with the primary dependent variable being the intraverbal (e.g., correct independent responses in intraverbal trials). Some studies instead focused on emergence and included any evaluation of emergent responses after intraverbal or other verbal operant instruction. These studies most often consisted of evaluation of emergence of the intraverbal as a result of training other operants; however, some studies (e.g., Ingvarsson, Cammilleri, & Macias, 2012) involved training the intraverbal directly with evaluation of possible emergence of other operants. A small number of studies focused on the unique topic of teaching a problem-solving strategy to establish a complex intraverbal repertoire. Though these studies could have been classified as targeting the intraverbal repertoire directly, given the unique conceptual analysis and distinct focus on a more complex repertoire, these studies were distinguished from studies that focused on the establishment of basic intraverbal exchanges. Within the context of the discussion provided by Palmer (2016), some of these studies might not be consistent with the narrow definition and examples of the intraverbal provided by Skinner (1957). In some instances, the repertoires targeted in these studies might better be described as targeting auditory conditional discriminations or forms of "intraverbal control" in which responding might be under multiple sources of control.

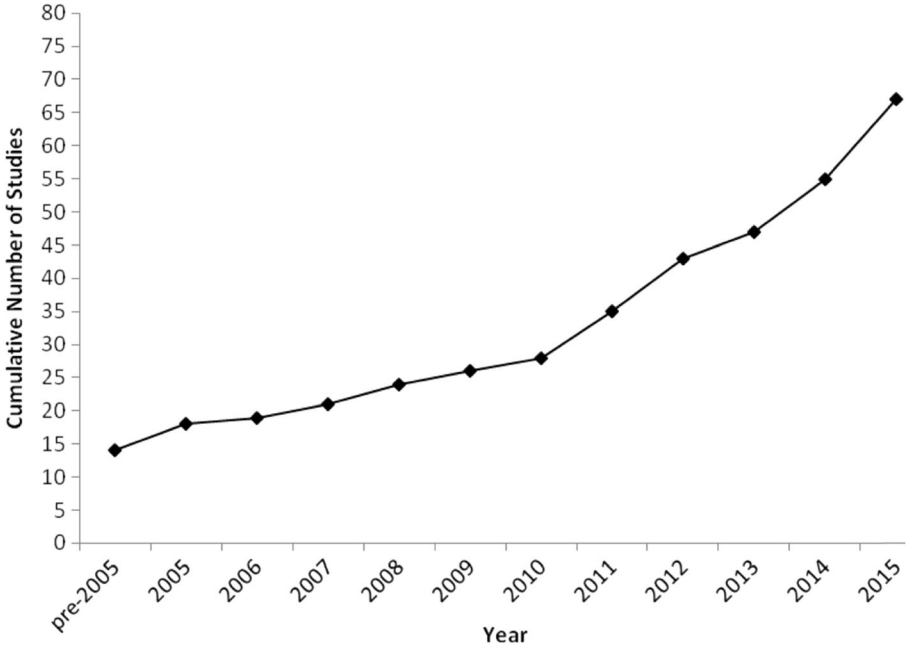

Fig. 3 Cumulative number of studies published on the intraverbal (pre-2005 to 2015)

Direct Intraverbal Training A total of 19 studies focused on direct intraverbal training. Most of these studies focused on the types of prompts (e.g., echoic, tact, textual) used to directly teach a vocal response to a vocal stimulus (Ingvarsson & Le, 2011; Kisamore, Karsten, Mann, & Conde, 2013). Others examined specific reinforcement procedures (Mason, David, & Andrew, 2015) and peer-mediated behavioral skills training (Beaulieu, Hanley, & Santiago, 2014; Weiner, 2005).

Eight studies focused on the effectiveness of an echoic prompt when teaching intraverbals directly. For example, Ingvarsson and Le (2011) demonstrated that echoic prompts took fewer trials to meet mastery criterion of target responses during initial training. Other research showed that an echoic prompt with error correction was more effective than a cue-pause-point procedure and tact prompts (Fuchtman, Kodak, & Paden, 2012). Kisamore et al. (2013) demonstrated that having typically developing children repeat the instruction (i.e., a differential observing response) using echoic prompts increased intraverbal acquisition. Similarly, Humphreys, Polick, Kodak, Howk, Thaxton, and Ivancic (2013) illustrated that using least-to-most echoic prompts increased intraverbal acquisition with two children with autism regardless of whether the discriminative stimulus was repeated or not by the therapist. The intraverbal was also used to establish mands for information (i.e., "I do not know" or "I do not know, please tell me") with children with autism (Ingvarrson & Hollobaugh, 2010: Ingvarsson, Tiger, Hanley, & Stephenson, 2007) Table 1.

Some studies have also shown that tact prompts can be effective in teaching intraverbals. For example, Goldsmith, LeBlanc, and Sautter (2007) taught children with autism to list items in common categories (e.g., "tell me some colors ... red, blue green, yellow") using errorless tact prompting procedures (i.e., time-delay prompts).

Table 1 Specific citations for each of the three categories of research on intraverbals

Category	Authors and year
Direct intraverbal training	Beaulieu et al. (2014) Carroll & Kodak (2015) Coon & Miguel (2012) Emmick et al. (2010) Goldsmith et al. (2007) Humphreys et al. (2013) Ingvarsson et al. (2007) Ingvarsson & Hollobaugh (2010) Ingvarsson & Hollobaugh (2011) Ingvarsson & Le (2011) Kisamore et al. (2013) Kodak et al. (2012) Mason et al. (2015) Polick et al. (2012) Vedora et al. (2009) Valentino et al. (2012) Valentino et al. (2015) Vedora & Conant (2015) Weiner (2005)
Emergence	Allan et al. (2015) Carp and Petursdottir (2012) Carp & Petursdottir (2015) Daar et al. (2015) DeSouza & Rehfeldt (2013) Dounavi (2011) Dounavi (2014) Grannan & Rehfeldt (2012) Greer et al. (2005) Houmanfar et al. (2005) Ingvarsson et al. (2012) Kobari-Wright & Miguel (2014) Kodak & Paden (2015) Lechago et al. (2015) Lee & Sturmey (2014) Loughrey et al. (2014) May et al. (2013) Miguel et al. (2005) O'Neill et al. (2015) O'Neill & Rehfeldt (2014) Pérez-González et al. (2007) Pérez-González et al. (2008) Petursdottir et al. (2008a, 2008b) Petursdottir & Hafliðadóttir (2009) Petursdottir et al. (2008a, 2008b) Petursdottir et al. (2015) Rosales et al. (2011) Santos et al. (2015) Susa & Schlinger (2012) Valentino & Shillingsburg (2011) Vallinger-Brown & Rosales (2014)
Problem solving	Kisamore et al. (2011) Mellor et al. (2015) Sautter et al. (2011)

This was one of the first studies demonstrating the effectiveness of this procedure to teach the intraverbal to children with autism. In a similar study, Ingvarsson and

Hollobaugh (2011) demonstrated that tact and echoic prompts were both effective in teaching children with autism intraverbals but fewer trials to criterion were required with tact prompts.

There is also some evidence that suggests textual prompts can be an effective transfer-of stimulus-control procedure to teach intraverbals especially when participants have an existing textual repertoire. For example, Emmick, Cihon, and Eshleman (2010) demonstrated that using a textual prompt and fluency training resulted in fewer trials to master target intraverbals compared to using a textual prompt only with some adolescents with autism. In a comparison of textual and echoic prompts, Vedora, Meunier, and Mackay (2009) showed that textual prompts were more effective in teaching intraverbals with young children with autism. One explanation for this finding is that textual prompts were not removed until the participants said the word, whereas echoic prompts are transitory in nature. Vedora and Conant (2015) found tact, textual, and echoic prompts equally effective in teaching intraverbals to young adults with autism. Coon and Miguel (2012) suggested that the most effective prompt type for participants depended on which type of prompt had a recent reinforcement history.

In an extension of basic prompt types, Valentino, Conine, Delfs, and Furlow (2015) demonstrated the effectiveness of a modified chaining procedure, textual prompts, and echoic prompting to teach children with autism to tell short stories. Including a model prompt (i.e., a sign) with an echoic prompt has also been shown to increase the acquisition of intraverbals faster than echoic prompts only with a 13-year-old female with autism and Down syndrome who had a history with American Sign Language (Valentino, Shillingsburg, & Call, 2012). Future researchers may consider an evaluation of a pre-teaching assessment that could predict the type of prompt that would be most effective in teaching intraverbal responses given a particular learner's response patterns and skill strengths. Few researchers have demonstrated the effectiveness of various reinforcement procedures on intraverbal acquisition (Mason, David, & Andrew, 2015; Polick, Carr, & Hanney, 2012). For example, Polick and colleagues showed that providing descriptive praise (i.e., saying "Great job saying ___") was more effective in teaching intraverbal behavior to young children with autism than general praise (i.e., saying "Great job"). Finally, peer-mediated behavioral skills training has been shown to increase appropriate complex intraverbal skills in the form of conversations (Beaulieu et al., 2014) and to improve unintelligible vocalizations which ultimately lead to longer intraverbal exchanges (Weiner, 2005) with children with moderate to severe developmental disabilities. The current literature suggests that no single prompt type is always superior when teaching the intraverbal. The results have been idiosyncratic and the most effective prompt to use may depend on the variable of interest (e.g., maintenance, instructional efficiency) and the repertoires and histories of the participants.

Emergence A response is described as "emergent" when it has not been directly taught or reinforced but comes to strength as a result of training on a different operant or set of conditional relations. There were 31 studies that examined emergence with respect to intraverbals in the past decade. Many of these studies focused on emergence of the intraverbal as a result of training other responses (Grannan & Rehfeldt, 2012; Petursdottir, Carr, Lechago & Almason, 2008a). Other authors trained the intraverbal and assessed emergence of other types of responses (Dounavi, 2011, 2014; Kodak & Paden, 2015). The primary purpose of these investigations has been to examine

functional independence and interdependence of verbal operants and to identify efficient teaching procedures in the interest of saving intervention time in treatment efforts for individuals with autism and other developmental disabilities.

Like the literature on the differential effects of prompt types, the studies on emergence have had mixed results. Emergence does not always occur, but when it does, it seems more likely to occur in less complex forms (e.g., simple tacts) than in more complex response forms (e.g., intraverbal categorization). There may be prerequisite skills associated with various forms of emergence, but not much is known about what those skills are and how they contribute to emergence of the intraverbal or other operants. For example, Petursdottir, Ólafsdóttir, and Aradóttir (2008b) found that if children were to tact the visual stimuli in Icelandic prior to selecting them or tacting them in Spanish during training, those tacts alone could suffice to establish the intraverbal relation that shared a common response form or a common discriminative stimulus (S^D) with the trained relation. Some additional key articles and findings in the investigation of emergence are summarized below and illustrate examples of some studies that demonstrate emergence and some that did not. In addition, studies on the use of multiple-exemplar instruction and lag-reinforcement schedules on variability and emergence are described.

Some research has shown that emergence of the intraverbal can occur after targeting other operants or listener behavior. For example, Grannan and Rehfeldt (2012) demonstrated that simple tact, category tact, and match-to-sample instructions were effective in the emergence of intraverbal responses. Additionally, Dounavi (2011, 2014) demonstrated emergence of foreign language intraverbal responses after establishing tact and native-foreign name intraverbal relations with typically developing adults. Kodak and Paden (2015) showed that acquisition of intraverbal and listener responses by function, feature, and class took equally long to reach mastery criterion; however, intraverbal training established emergent listener responding while listener response training did not establish an emergent intraverbal repertoire. However, other research has found that emergence may not occur after targeting other operants or listener behavior and that direct training of the intraverbal is necessary. For example, Miguel, Petursdottir, and Carr (2005) found minimal effects of multiple-tact and receptive discrimination training on the emergence of intraverbal responses with typically developing children, and so direct intraverbal training using a tact or echoic prompt was employed. Petursdottir et al. (2008a) showed that only one out of four typically developing children demonstrated an emergence of intraverbal categorizations after intraverbal and listener training of foreign country-name relations. These two studies may lend credence to the critical nature of immediate temporal proximity of the exact discriminative stimulus and exact response to establishing intraverbal stimulus control in young children.

Multiple-exemplar instruction (MEI) involves alternating instruction between two or more response functions (e.g., listener and intraverbal) in a subset of exemplars, which can result in emergent responding in initially functionally independent verbal operants or response forms. MEI has shown to be effective in the emergence of intraverbal responses with children with and without autism (Allan, Vladescu, Kisamore, Reeve & Sidener, 2015; Greer, Yaun, & Gautreaux, 2005; Rosales, Rehfeldt, & Lovett, 2011). For instance, Lechago, Carr, Kisamore, and Grow (2015) demonstrated that two out of six typically developing children engaged in emergent categorizations after listener

categorization training and MEI. Written dictation and visual-visual condition discrimination training has been effective in the emergence of vocal spelling and listing synonym responses with adults with developmental disabilities (De Souza & Rehfeldt, 2013). Research has also shown the effectiveness of instructional feedback on novel intraverbal responding with children with autism (Carroll & Kodak, 2015; Loughrey, Betz, Majdalany, & Nicholson, 2014).

Finally, multiple studies have demonstrated success with lag schedules of reinforcement on emergent intraverbal responding with children and adults with developmental disabilities (Contreras & Betz, 2016; Lee & Sturmey, 2014; O'Neill, Blowers, & Rehfeldt, 2015: O'Neill & Rehfeldt, 2014, Susa & Schlinger, 2012). For example, O'Neill and Rehfeldt used a lag-1 reinforcement schedule during selection-based training by reinforcing participants' responses when they selected a different response than the last prior response to an interview question presented on a computer screen. After selection-based responding was complete, the same interview questions were presented vocally and probes were conducted of participants' vocal responses to these verbal S^Ds. The authors illustrated the effectiveness of the selection-based protocol on the emergence of intraverbal responses to interview questions (topography-based responses) with two adults with learning disabilities. O'Neill et al. later demonstrated that requiring a topography-based response (i.e., reading the answer aloud) during selection-based instruction was more efficient than selection-based instruction alone in establishing accurate topography-based intraverbal responses to each interview question.

The literature on emergence involving the intraverbal relation is growing nicely. Given that the majority of articles published in the last 10 years have focused on emergence, we anticipate this line of literature will continue and that the intraverbal relation will be of primary investigation. Interested readers are directed to a brief review that summarizes the emergent literature (not specific to the intraverbal) until the year 2010 (Grow & Kodak, 2010). Given the surge of research on the emergence of intraverbals, an updated brief review on the topic of emergence may be warranted.

Problem Solving/Complex Intraverbals Skinner characterized problem solving as any behavior that makes a problem's solution more probable (Skinner, 1953). When problem solving, individuals emit behavior that generates supplementary stimuli that can, in turn, evoke behaviors that are likely to be reinforced (e.g., self-prompts). Self-prompting strategies might take the form of an intraverbal prompt or covert visualizing, among others. In recent years, three studies have examined the role of a problem-solving strategy as a mediating response on the acquisition of complex categorizations. Prior to reviewing these three studies, it is important to note that the phrase "intraverbal categorizations" has been used in the applied verbal behavior literature to refer to responses that are likely multiply controlled. This unique targeted behavior has been classified as intraverbal-based because a vocal S^D is presented in (e.g., "tell me some farm animals") and a vocal response in the form of a list (e.g., "pig, cow, horse") is provided. However, it is possible that the response products in these studies are not under stimulus control as an intraverbal. They are possibly multiply controlled or involve more complex mediating repertoires to generate a viable response. However, we use the term "intraverbal categorization" here to refer to this body of literature and type of responding due to its frequent use in literature.

In the first study in this grouping, Sautter, LeBlanc, Jay, Goldsmith, and Carr (2011) evaluated the effects of teaching verbal self-prompts on "intraverbal" categorizations with four typically developing preschool children. None of the four participants showed substantial increases in the number of items listed in an intraverbal categorization task (e.g., tell me some vehicles) until they were prompted to use a verbal self-prompt of a subcategory title that had been established in an intraverbal relation with specific items. Participants engaged in overt self-prompts which gradually decreased as accurate performance increased within one category and as additional categories were targeted. The final performances were best characterized as being under "intraverbal control" and the general approach was likely a more appropriate way to establish the repertoires rather than teaching them as intraverbal chains (i.e., the typical approach). In a follow-up study, Kisamore, Carr, and LeBlanc (2011) showed that increases in intraverbal categorizations emerged with three out of four preschool children when they were prompted to use a visual imagining strategy (i.e., "Remember you can imagine a place where [farm animals] go and tell me what you see") and responding maintained once a rule was provided to use the strategy. Finally, Mellor, Barnes, and Rehfeldt (2015) found that after multiple-tact instruction, responses to vocal S^Ds ("simple intraverbal questions" such as "caw") in response to "What is an eagle sound?" and novel vocal S^Ds ("intraverbal categorizations" such as "what are some sounds you know?") were established after an instruction to imagine was used with two kindergarten children. These initial investigations were all conducted with typically developing children; however, future research could investigate the effectiveness of these and other problem-solving strategies with individuals with disabilities. Albeit small, this literature is significant because it represents a way to establish repertoires that may more closely mirror the way individuals typically solve categorization problems. This body of literature may also provide practitioners the opportunity to teach repertoires that will allow individuals to obtain information from their environment without having to be taught every response.

Summary and Conclusions

The research literature on the intraverbal has increased substantially the last 10 years. Researchers have established substantial support of the efficacy of transfer-of-stimulus control procedures in teaching intraverbals directly and demonstrating emergent intraverbal repertoires with people with and without disabilities. In addition, a small but growing body of literature has established the effectiveness of teaching rules to establish intraverbal categorization response. Although there has been an increase in research on the intraverbal the past 10 years, additional research on the intraverbal is warranted.

In each of the studies described herein, it is important to consider whether the targeted responses are consistent with Skinner's (1957) definition of the intraverbal, as suggested by Palmer (current issue). In some instances, the repertoires targeted in these studies could be described as verbal conditional discriminations or a function of "intraverbal control" rather than as intraverbals. Under the broad interpretation of the intraverbal that Palmer (2016) describes, all of the responses targeted in the body of literature reviewed in this manuscript would still be classified as an intraverbal in that

they are verbal responses to verbal stimuli that lack point-to-point correspondence. Palmer notes that "in practice, the behavioral literature has not distinguished between the two definitions, thereby implicitly adopting the broader one" (p. 3).

As an example of a study that meets the broad definition, Valentino et al. (2015) utilized a modified chaining procedure to teach young children with autism to tell short stories. The final responses consisted of the telling of short stories in response to the verbal stimulus "Tell me the story about..." In this situation, if we consider the broad definition only, the verbal antecedent tell me the story about is clearly a different form than the response "once there was a dog..." and thus meets the broad definition of an intraverbal. However, Palmer encourages us to consider a narrow definition, "an intraverbal is a verbal response directly under control of a prior verbal stimulus as the result of a history of reinforcement for emitting that response in the presence of that stimulus" (p. 2). The repertoires established in the Valentino et al. study may not be best classified as a narrowly defined intraverbal in the same way as "2 + 6 = 8". The short stories in this study were created by the authors so the participants had no prior history with them. Additionally, participants often recited the stories in slightly different word order than was directly taught (i.e., there was response variability). Furthermore, a series of prompts including blank book pages, texts, and pictures were utilized to establish the final repertoires. The behavior established in the Valentino et al. study may be better classified as being under "intraverbal control." This interpretation allows us the opportunity to consider other relevant controlling variables (e.g., stimuli in the room, the text and pictures in the book). From a practical perspective, this inquiry is important because it may help us better understand how various antecedent stimuli come to occasion responses that we call "story telling." These responses could have been multiply controlled, partially by the verbal antecedent "tell me the story about" and partially by mediating behavior such as visualizing, responding to stimuli in the room, and many other potential influencing variables.

As another example, Sautter et al. (2011) utilized problem-solving strategies with self-prompting to teach children to provide multiple responses to categorization questions. This scenario almost exactly parallels an example provided by Palmer of an instance of intraverbal control requiring a more complex analysis. In Palmer's example, when one is asked to "name some animals that have antlers," responses are highly likely multiply controlled by covert visual stimuli among other sources of control. In the Sautter et al. study, participants ultimately responded to verbal antecedents such as "name some farm animals," though they never directly heard that question and did not have differential training with respect to possible answers. Instead, participants relied on a problem-solving strategy that was predicated on established intraverbal control ("farm: pig, cow, horse). These procedures likely established responses under multiple controls.

In summary, the literature on the intraverbal has increased substantially in the past decade. Many studies have examined procedures for directly establishing intraverbals while many others have examined emergence. Only a few studies have conceptualized complex repertoires such as problem solving as intraverbals. Future studies could directly examine responses that meet Palmer's narrow definition of intraverbal and responses that meet his definition of intraverbal control or multiple control. The utility of the new classification framework will be demonstrated if it leads to greater clarity in understanding and more effective teaching procedures than the current

broad definition. Although the body of literature from the past decade could not be easily coded according to the new framework as it was not informed by that framework, a future literature review employs a new classification framework. Additionally, future studies should continue to examine whether there are specific prerequisite skills or sources of stimulus control that must be in effect for other verbal operants to emerge when intraverbals are taught or for intraverbal control to emerge when other operants are taught. It may also be desirable to separate the literature on problem solving completely from the literature on intraverbals as many useful mediating responses that are not based on intraverbal control (e.g., imagining) are being examined (e.g., Kisamore et al., 2011).

Compliance with Ethical Standards

Conflict of Interest All the authors declare that they have no conflicts of interest.

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