

Empirical Applications of Skinner's Analysis of Verbal Behavior with Humans

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In *Verbal Behavior*, Skinner (1957) provided a conceptual framework and taxonomy for the controlling variables of language that defined independent verbal operants by their functional relations to antecedents and consequences (rather than by topography or meaning). Although professional interest in this area has recently increased within the behavior analytic community, Skinner's conceptual framework may not yet have fully impacted the experimental literature. This quantitative review of the literature examined the studies on verbal behavior that were empirical in nature, concerned with human verbal behavior, and addressed at least one verbal operant (e.g., mand, tact, echoic, autoclitic, and/or intraverbal behavior) within the experiment. The results of this review suggest that a growing body of research exists to support many of the tenets of Skinner's conceptualization and taxonomy but many areas of verbal behavior research have yet to be addressed. Continued research in this area is crucial for the development and implementation of effective verbal behavior interventions for people with disabilities.

Key words: verbal behavior, mand, tact, echoic, autoclitic, intraverbal, Skinner.

In his book *Verbal Behavior*, Skinner (1957) provided a conceptual interpretation of the controlling variables of language. He stated that verbal behavior was "behavior reinforced through the mediation of other persons" (Skinner, 1957, p. 2) and defined a particular verbal operant by its functional relations to antecedents and consequences rather than by topography. The primary verbal operants identified in his book included the mand, tact, intraverbal, and echoic; whereas, Skinner described an autoclitic as a form of secondary verbal behavior (Skinner, 1957).

Traditional linguists conceptualize language according to word meaning and syntactical structure and assume that a person who acquires the "meaning" of a word will readily use the word in a variety of contexts and conditions (Skinner, 1957, p.7). In contrast, one of the major tenets of Skinner's conceptualization of language is that each operant must be considered a separate and independent product of relevant environmental variables that control when and if the operant will be emitted (Skinner, 1957, pp. 187–190). This notion of functional independence suggests that the ability to say "cookie" when a child sees a cookie (i.e., tact) is separate from

the ability to say "cookie" when the child is hungry (i.e., mand). Although operants are considered to be functionally independent, they are also inter-related such that an established mand repertoire can be used to quickly develop other functional repertoires using transfer of stimulus control procedures (Braam & Poling, 1983). The interested reader is referred to several detailed reviews of Skinner's analysis (Bailey & Wallander, 1999; Michael, 1984; Oah & Dickinson, 1989) for supplements to the information provided later in this paper.

While Skinner's work has had a substantial influence on the basic conceptual framework of behavior analysis, several previous reviews have documented that the influence of *Verbal Behavior* on empirical investigations over the last 48 years has been more limited. McPherson, Bonem, Green, and Osborne (1984) conducted a citation analysis of studies published between 1961 and 1980 for citations of *Verbal Behavior*. While over 800 studies cited *Verbal Behavior*, only 31 of these studies explicitly examined one of Skinner's verbal operants which lead them to conclude that *Verbal Behavior* only influenced a small number of empirical studies and would probably not result in an increase in research in this area (McPherson et al., 1984). Eshleman (1991) conducted a quantitative review of five behavioral journals through 1984 and the convention programs (1975–1991) for the Association for Behavior Analysis (ABA) conferences. In

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contrast to McPherson et al., Eshleman concluded that verbal behavior research was growing at a steady rate and conveyed optimism about the increasing trend for future research. Finally, Oah and Dickinson (1989) published a narrative review of the empirical studies of the verbal behavior of both humans and animals published through 1988. They described the overall volume of empirical literature on verbal behavior (human and animal) as "limited" (p. 66). The authors provided brief synopses of various studies, highlighted some important areas for future research, and concluded that most published research focused on mands and tacts with relatively little investigation of other verbal operants.

Since the publication of these three reviews, three additional influential publications have sparked interest in Skinner's analysis of verbal behavior. Sundberg (1991) called for empirical research on Skinner's conceptual framework of language and detailed 301 different research ideas spanning 30 different research areas. He addressed specific challenges to behavior analysts working in the verbal behavior field creating the potential for practitioners to conduct important applied research on verbal behavior. In addition, two publications designed to disseminate Skinner's conceptual framework to parents and professionals in the field of autism treatment created a surge of interest in Skinner's framework. Sundberg and Partington (1998) published a Skinnerian language curriculum for children with autism and Sundberg and Michael (2001) described the benefits of Skinner's analysis of verbal behavior for language training with children with autism. Sundberg and Michael provided parents and professionals with a basic familiarity with Skinner's analysis and pointed out the importance of a functional approach to language and critical concepts such as automatic reinforcement and establishing operations. While there has been an almost three-fold increase in the number of presentations listed with "VRB" as the primary specialty area of the ABA program from 1996 to 2003, it is unclear whether there has been a corresponding surge in published empirical evaluations based on Skinner's work.

A new review of the empirical studies on human verbal behavior since 1989 is warranted. Over 15 years have passed since Oah and Dickinson's excellent review during which sub-

stantial dissemination efforts have occurred. These publications and increased interest in clinical applications of Skinner's framework may well have produced changes in the volume of empirical literature, the focus of that literature, or the general knowledge base produced by empirical work in the area. The primary purpose of the current paper is to review experimental studies with humans since 1989 and to examine publication trends in the area of verbal behavior with regard to frequency, publication source, and specific verbal operant studied. A second purpose is to briefly summarize the state of empirical support for some of the main tenets of Skinner's conceptual framework.

REVIEW PROCEDURES AND SELECTION CRITERIA

Studies were first identified through a computer search of Psychological Information (PsycINFO) using the key words *mand*, *tact*, *echoic*, *intraverbal*, *autoclitic*, and/or *verbal behavior*. Additionally, a manual review was conducted of *The Analysis of Verbal Behavior (TAVB)*, the *Journal of Applied Behavior Analysis (JABA)*, the *Journal of the Experimental Analysis of Behavior (JEAB)*, and *Research in Developmental Disabilities (RIDDD)* from 1989 to the present. Studies with humans were selected based on two criteria. First, the word or words *mand*, *tact*, *intraverbal*, *echoic*, and/or *autoclitic* appeared in the title or abstract of the article. Second, the study was empirical in nature. That is, the study included clearly defined independent and dependent variables and the results were evaluated using a research design. This search yielded 60 empirical studies, 16 of which were identical to those reviewed by Oah and Dickinson (1989). These 16 studies are listed in the reference list and will be included in numerical counts but will not be reviewed in narrative. Additionally, one study was identified that was published prior to 1989 and not included in the Oah and Dickinson review (Daly, 1987). This study will be included in the numerical counts for the later review period (1989–2004).

EMPIRICAL STUDIES OF VERBAL BEHAVIOR WITH HUMANS: 1989–2004

Although the publication of empirical appli-

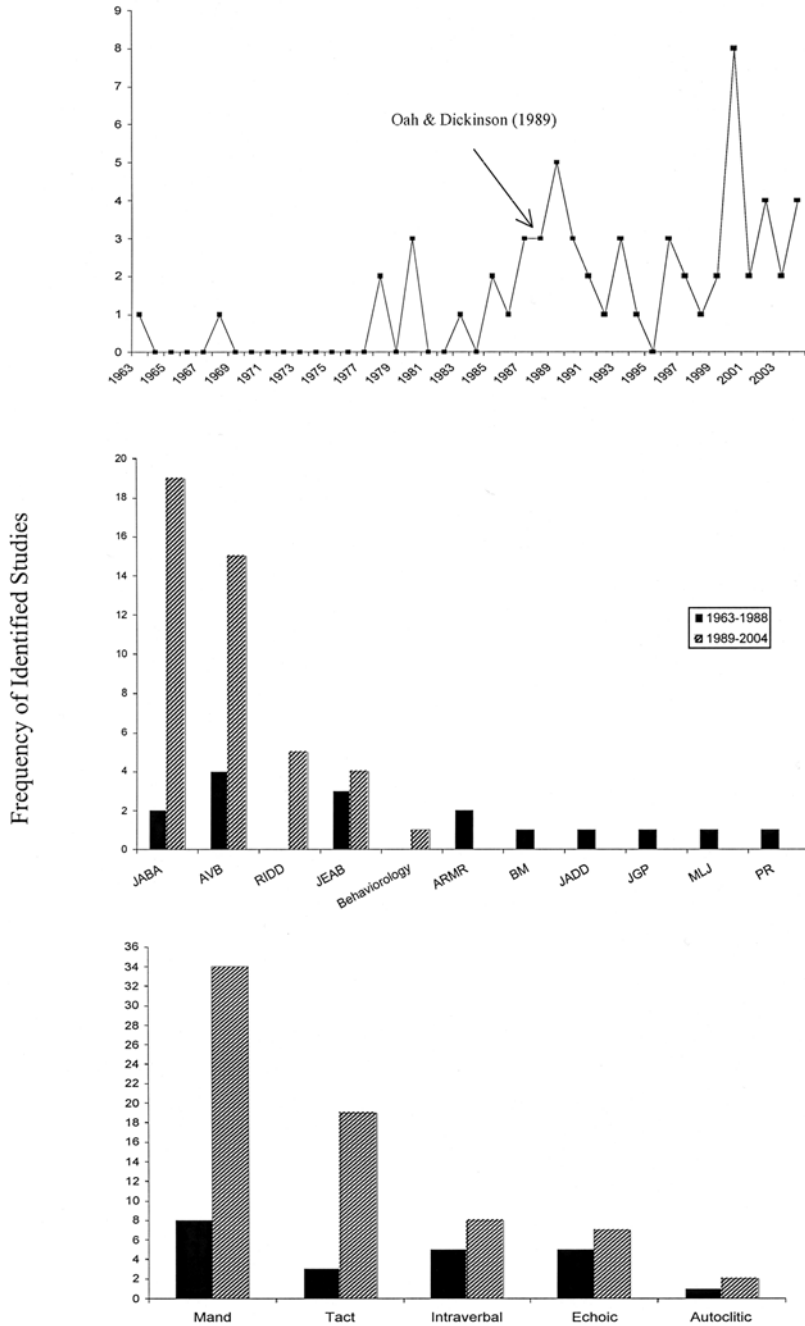


Fig. 1. The frequency of studies published each year between 1963 and 2004 (top panel). The frequency of verbal behavior studies published in the *Journal of Applied Behavior Analysis (JABA)*, *The Analysis of Verbal Behavior (TAVB)*, *Research in Developmental Disabilities (RIDDD)*, *Journal of the Experimental Analysis of Behavior (JEAB)*, *Behaviorology*, *Applied Research in Mental Retardation (ARMR)*, *Behavior Modification (BM)*, *Journal of Autism and Developmental Disabilities (JADD)*, *Journal of General Psychology (JGP)*, *Modern Language Journal (MLJ)*, and *Psychological Record (PR)*. The solid bars represent the early review period and the striped bars represent the later review period (middle panel). The frequency of studies of each verbal operant with the early review period represented as solid bars and the later review period as striped bars (bottom panel).

cations of Skinner's analysis of verbal behavior began slowly, there has been a substantial increase in the volume of literature in this area. Forty-four studies meeting our selection criteria have been published since the Oah and Dickinson review representing nearly a three-fold increase over the 16 studies with humans identified from 1963 to 1988. The top panel of the figure illustrates the frequency of these publications for each year.

The 60 articles with humans were published in 11 different journals with a clear shift in the source of publication when comparing the early period (1963-1988) to the later period (1989-2004). The middle panel of the figure depicts the frequency of publications for each publication outlet for both periods. In the early period, articles were distributed across nine different journals with a small number of publications in each journal (range 1-4). In the later period, articles were published in five journals and the number of publications in two of these journals was substantially higher than the other journals: *JABA* (19) and *AVB* (15). Although there are more empirical studies on Skinner's analysis of verbal behavior in the later review period, this literature is being published in a smaller number of journals that are primarily behavior analytic. This trend may restrict the likelihood of non-behavior analysts obtaining the information and benefiting from the research findings. Behavior analysis should certainly continue publishing a greater number of empirical studies pertaining to verbal behavior, but consider publishing these data in journals that may have broader readerships to make the greatest clinical and conceptual impact.

Notably, during the last 15 years the majority of studies have focused on certain verbal operants with virtually no studies on others, a pattern that was somewhat less evident when comparing the early period to the later period. The bottom panel of the figure provides a comparison of the frequency of publications in the two periods for each verbal operant. The greatest number of new publications focuses primarily on the mand followed by the tact with few studies examining the other categories. In the early period a majority of studies (56%) examined multiple operants and a similar pattern is evident for the later period (45%) (not shown in the figure). The following sections are organized by operant and review the literature on each verbal operant providing a brief

definition, a summary of the quantitative findings, and an examination of the findings of selected recent studies as evidence for or against Skinner's main premises.

Mand

A mand is defined by a unique relationship between a response and the reinforcer that is provided for that response (Skinner, 1957). Specifically, the mand is a verbal operant in which the response specifies the reinforcer and is controlled by the relevant establishing operation of deprivation or aversive stimulation (Michael, 1988). To date, 72% of the published empirical research on Skinner's analysis of verbal behavior (i.e., 43 of the 60 studies) has involved the development, assessment, or analysis of a mand repertoire either individually or in conjunction with other verbal operants. Eight of the 43 studies were identical to those identified by Oah and Dickinson while 35 of the studies were published after 1988. For the studies published after 1988, 20 (57%) focused on mands alone, while the remaining 15 studies assessed mands in conjunction with a variety of other operants.

These 15 studies experimentally demonstrate several critical components of the mand as well as the utility of incorporating Skinner's concept of the mand into the treatment of problem behavior. Several studies illustrate that mands, once developed, can be used to facilitate the development of other verbal operants (Arntzen & Almas, 2002; Braam & Sundberg, 1991; Drash, High, & Tudor, 1999), supporting Skinner's notion that the mand repertoire should be an initial focus of language training. Additionally, several studies illustrate that functional mands can be established for children with autism when and only when relevant establishing operations are incorporated into the training setting (Bowman, Fisher, Thompson, & Piazza, 1997; Sundberg, Loeb, Hale, & Eigenheer, 2002).

Sundberg et al. (2002) provide a recent example of the critical importance of the establishing operation for establishing a "pure" mand repertoire (i.e., responding occurs solely under the control of an establishing operation and is maintained by specific reinforcement). The researchers contrived establishing operations in conjunction with prompting, fading, and differential reinforcement to teach children

with autism to ask questions of others, which is referred to as a “mand for information” in the Skinnerian framework. They targeted “where” questions by hiding preferred items and prompting a request for location information and targeted “who” questions by giving a preferred item to someone and prompting a request for information about who possessed the item. Participants were able to mand for information using both types of questions when the relevant establishing operations were in effect and novel responses occurred in novel environments illustrating generalization of the treatment effects. Sundberg et al. suggested that two reinforcers existed for the children in their study: the preferred items and the information obtained by asking questions. They further suggested that there were three establishing operations manipulated for each “wh” question taught. To achieve a pure mand, it was crucial that the missing item had reinforcing value to the child, that the absence of the item from its typical location established finding the item as reinforcing, and that the information relevant to the item’s new location was “valuable.” The applied implication is that there may be a failure to establish a generalized question-asking repertoire if these critical establishing operations are not incorporated into teaching encounters.

Many of the other studies in the recent review period illustrate the utility of incorporating the mand and establishing operations into interventions designed to establish communicative repertoires and treat problem behavior (Brown et al., 2000; DeLeon, Fisher, Herman, & Crosland, 2000; Derby et al., 1997; Johnson, McComas, Thompson, & Symons, 2004; Kahng, Hendrickson, & Vu, 2000; Northup et al., 1991; Peck et al., 1996; Richman, Wacker, & Winborn, 2001; Sprague & Horner, 1992; Vollmer, Borrero, Lalli, & Daniel, 1999; Winborn, Wacker, Richman, Asmus, & Geier, 2002). The majority of these investigations incorporated functional communication training (FCT) to teach functional and appropriate mands to people with disabilities as replacement behaviors for problem behaviors. When problem behaviors were identified as maintained by social reinforcers, replacement mands for those same reinforcers (i.e., social interactions, a break from work) were taught using differential reinforcement of appropriate mands (e.g., sign, vocalization, picture exchange) and

extinction of problem behavior. This group of studies indicates that mand-training in the form of FCT can be a highly effective treatment for severe problem behavior in individuals with developmental disabilities, particularly when extinction or punishment procedures are incorporated into the intervention to shift responding away from the topography with the longer reinforcement history (Hagopian et al., 1998). It is worth noting that several of these studies did not cite *Verbal Behavior* as the source of the definition of the mand and did not incorporate Skinner’s larger conceptual framework for language into their analyses (Peck et al., 1996; Winborn et al., 2002).

A total of 14 studies in this review did not cite *Verbal Behavior* (1957). Thirteen of the 14 studies were published in *JABA* and all 14 studies focused solely on mands. Most of these studies used the concept of the mand as an important tool to treat problem behavior (e.g., FCT) and met the inclusionary criteria due to the use of the word “mand” or “mand training” in the abstract of the article. Thus the inclusion of these studies may create a somewhat false impression of the volume of literature on the mand. These 14 studies also did not make any other use of Skinner’s framework as a cohesive conceptual approach to the controlling variables of language. The intent of these studies was not to expand understanding of Skinner’s overall conceptual framework and they should not be faulted for achieving a different outcome. Instead, these studies make an important contribution to the applied literature on the treatment of problem behavior and have also resulted in evidence for the importance of the establishing operation in creating a functional mand repertoire.

Bowman et al. (1997) provide a unique example of a study of problem behavior that directly cited Skinner (1957). Bowman et al. illustrated that destructive behavior may occur to increase the probability of parental compliance with a wide variety of specific complex mands (e.g., walk in a circle and sing a specific song) that occurred in response to rapidly changing establishing operations. They conducted a standard functional analysis (e.g., demand, social attention conditions) that resulted in no occurrences of problem behavior with two verbally competent adolescents with mental health problems. The relevant establishing operations and reinforcers were somehow

not captured in the initial analysis. A subsequent “mand analysis” confirmed parental reports that problem behavior occurred when highly specific demands were not honored and that problem behavior often resulted in parental compliance with the child’s demands. This study illustrates the importance of the reinforcer specifying aspect of the mand.

Tact

The second most often studied of Skinner’s verbal operants is the tact, which is defined as a response form “evoked by a particular object or event or property of an object or event” (Skinner, 1957, p. 82). Thus, a tact occurs under the functional control of a discriminative stimulus rather than an establishing operation and is maintained by social reinforcers from a person’s verbal community. A total of 22 studies involving tacts were identified and three of these studies were included in the Oah and Dickinson review.

One of the 19 studies in this later review period focused on tacts alone (Horne, Lowe, & Randle, 2004) while the other 18 studies addressed tacts in combination with other verbal operants. The resulting findings provide support for the relation of the tact to other operants in several ways. First, these studies provide empirical evidence for Skinner’s notion of functional independence as detailed later in this paper (see “Studies of multiple operants and functional independence”). Second, several studies demonstrated the effects of transfer of stimulus control procedures in language training (Partington & Bailey, 1993; Sundberg, San Juan, Dawdy, & Arguelles, 1990; Watkins, Pack-Teixeira, & Howard, 1989) as well as barriers to developing functional tact repertoires (e.g., stimulus overselectivity) and acquisition procedures to remediate these barriers (e.g., enhancing nonverbal stimuli, differential reinforcement) (Arntzen & Almas, 2002; Partington, Sundberg, Newhouse, & Spengler, 1994; Sundberg, Endicott, & Eigenheer, 2000).

Braam and Sundberg (1991) illustrate the difference between “pure” tacts (i.e., an operant solely under the control of a discriminative stimulus) and multiply controlled tacts in their examination of two procedures for teaching functional tact repertoires to young adults with severe mental retardation and limited verbal skills. Participants were taught to tact items

using verbal prompts (“what is it?”), models of the correct response, and one of two types of reinforcement. In a “specific reinforcement” condition, participants tacted visible food items and received the item as a reinforcer resulting in a multiply controlled response (i.e., mand/tact). In a “non-specific reinforcement” condition, participants tacted a visible item and received some other preferred food item as a reinforcer (e.g., the tact “cookie” was reinforced with fruit), thus resulting in a pure tact. The two conditions were equally effective with no differences in rate of acquisition or resistance to extinction; however, the specific reinforcement condition produced a shorter latency in responding, a greater percentage of mand compliances during probe sessions, and an overall preference for this condition by all participants. This study illustrates that targeting multiply controlled operants rather than pure operants may result in higher compliance and greater enjoyment for the learner without sacrificing speed of acquisition or overall strength of the learned repertoire.

Echoic

A third commonly studied verbal operant is the echoic response, which is defined as verbal behavior under the functional control of a verbal stimulus with point-to-point correspondence between the stimulus and the response (Skinner, 1957, p. 55). That is, the response generated by the speaker sounds identical to the stimulus that evoked it. There have been 12 studies on echoic behavior and seven of these studies fall in the later review period (1989–2004). Five of the seven new studies on echoics have addressed echoic behavior in combination with other verbal operants. In addition, two of these five studies measured echoic behavior as one of the dependent variables in comparisons of educational curricula or program evaluations (Daly, 1987; Williams & Greer, 1993). Several other studies used transfer of stimulus control procedures to develop other verbal operants using an established echoic repertoire (Drash, et al., 1999; Finkel & Williams, 2001). These studies have demonstrated the utility of a generalized verbal imitative repertoire in language training programs. Additionally, two recent studies discuss the use and development of echoic behavior via conditioned reinforcement using a pairing

procedure that allows subsequent use of transfer of stimulus control procedures to train other operants (Sundberg, Michael, Partington, & Sundberg, 1996; Yoon & Bennett, 2000).

Yoon and Bennett (2000) compared a pairing procedure to direct echoic training with severely language delayed preschool children. In the pairing procedure, a target vocal sound was presented simultaneously with preferred physical attention to establish utterances as conditioned reinforcers. The pairing procedure was effective in increasing vocal behavior for all three children during pairing trials and immediately following pairing sessions. However, gains were typically temporary and the emission of target vocalizations during the pairing procedure created the possibility of adventitious reinforcement for two participants. When the pairing procedure was subsequently compared to traditional echoic training involving direct reinforcement contingencies for correct echoic responses, all participants consistently emitted the vocalizations targeted by the pairing procedure but not the ones targeted by echoic training. Thus, previously neutral stimuli (vocalizations) can acquire reinforcing properties after being repeatedly paired with established reinforcers. This stimulus-stimulus pairing procedure may provide a means to establish initial vocal behavior which can subsequently be shaped and differentially reinforced; however, recent studies not captured under the current search criteria have not been able to fully replicate these effects (Esch, Carr, & Michael, 2005; Miguel, Carr, & Michael, 2002;) thus further empirical investigations in this area are needed.

Intraverbal

An intraverbal is defined as a response for which there is no formal point-to-point correspondence with the verbal stimulus that evoked it (Skinner, 1957, p. 71). Intraverbal behavior is thought to be maintained by social reinforcement from a person's verbal community and, unlike the echoic, is not an exact replica of the evoking stimulus. A common intraverbal may be observed when someone responds "blue" to the verbal stimulus "red, white, and . . ." after a history of reinforcement of the temporal contiguity of these words under a variety of conditions. Fourteen studies of intraverbal behavior exist with nine of these studies pub-

lished between 1989 and 2004. One study focused solely on intraverbals in the form of reading comprehension (Tenenbaum & Wolking, 1989) while many others provided empirical support for Skinner's notion of functional independence and the utility of transfer of stimulus control procedures (Partington & Bailey, 1993; Partington et al., 1994; Sundberg et al., 1990; Sundberg et al., 2000; Watkins et al., 1989). 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 (i.e., covert mediating responses). This operant represents perhaps the largest potential for future investigations into complex human behavior. However, the existing studies have generally focused on the simplest forms of intraverbals addressing topics such as question answering, fill in the blank responding, and categorization skills.

Finkel and Williams (2001) taught intraverbal behavior in the form of question answering to a 6-year-old boy with autism and illustrated the differential effects of transferring stimulus control from different operants (i.e., textual prompts, echoic prompts). Answers to personal questions (e.g., name, address, birthday) were either prompted echoically (i.e., "Say ___") or textually (i.e., printed card with the verbal response) with subsequent fading procedures to ensure that the child's intraverbal responses became pure intraverbals and were not dependent on other stimuli. Both prompting procedures were effective but textual prompts resulted in faster rates of acquisition and dramatic improvement in the use of full-sentence responses. The authors suggest that, for this child, textual prompts more effectively occasioned intraverbals because these prompts were visual rather than auditory and because they did not require the social interaction that echoic prompts did. This study supports the notion of functional independence of verbal operants and also illustrates the importance of the unique repertoire of an individual in finding effective discriminative stimuli for transfer procedures, particularly for individuals with limited language.

Autoclitic

An autoclitic is conceptualized as verbal

behavior dependent on other verbal behavior (Skinner, 1957). Thus the speaker's verbal behavior modifies or changes the listener's behavior in a particular way. For example, a person's statement "He sort of looks like" preceding the name "Fred" has the intended effect of telling the listener that the man in question contains some but not all of the same physical characteristics that their friend Fred possessed. Autoclitics are often used to soften or otherwise modify the effects of subsequent statements (e.g., "I don't mean to criticize, but"). There have been no new studies solely on autoclitics published since 1988 but two studies published in the later review period examined autoclitics in combination with other verbal operants either as one of many dependent variables (Lodhi & Greer, 1989) or as part of a more comprehensive verbal behavior curriculum for children with autism (Williams & Greer, 1993).

Lodhi and Greer (1989) examined behavior of typically developing children during solitary play with anthropomorphic or human-like toys (e.g., dolls, stuffed animals) and with nonanthropomorphic toys (e.g., books, puzzles). They hypothesized that non-anthropomorphic toys might result in a preponderance of speaker-oriented operants (e.g., tact) while anthropomorphic toys might simulate an audience resulting in a more even distribution of speaker and listener oriented operants (e.g., mand, intraverbal, autoclitic). All participants emitted significantly more verbal behavior and a wider range of operants in the anthropomorphic condition and little-to-no conversational units in the nonanthropomorphic condition, demonstrating that the children acted as both speakers and listeners when interacting with the anthropomorphic toys. This finding supports Skinner's notion that people may act as both speakers and listeners demonstrating both overt and covert behavior in solitary play contexts.

Studies of Multiple Operants and Functional Independence

Almost half of the studies in the later review period addressed verbal behavior in the context of multiple operants. The majority of these studies either directly or indirectly addressed the notion of functional independence and the use of transfer of stimulus control procedures

to determine if one operant could be used to create another functional operant. The notion of functional independence is critical to Skinner's analysis because it focuses on the unique antecedents and consequences for language in a given context and does not assume that a general "meaning" of a word is acquired as traditional linguistic theories do. The basic premises of linguistic theories would suggest that other verbal operants would emerge spontaneously upon the acquisition of one operant because the child now "knows what the word means." However, Skinner's theory suggests that separate training under the right stimulus conditions is required to produce the emergence of additional operants. This critical difference in language theories means it is important to determine if functional independence of verbal operants in individuals acquiring language actually occurs and whether this phenomenon represents the rule or the exception.

Nine of the 44 studies in the later review period purposefully focused on the functional independence of different verbal operants while several other studies have provided incidental evidence for functional independence. Four of the nine studies specifically addressed the functional independence of mands and tacts (Nuzzolo-Gomez & Greer, 2004; Sigafoos, Dross, & Reichle, 1989; Sigafoos, Reichle, Dross, Hall, & Pettitt 1990; Twyman, 1996), while the remaining five studies addressed the functional independence of tacts and intraverbals (Partington & Bailey, 1993; Watkins et al., 1989), mands, tacts, and intraverbals (Sundberg et al., 1990), and mands, tacts, and echoics (Drash et al., 1999; Henry & Horne, 2000). Each study directly trained one verbal operant and then probed additional verbal operants to see if responding would spontaneously emerge. The results almost always demonstrated that the participants who were taught one specific operant did not spontaneously demonstrate the emergence of other untrained operants. Thus, the development of a functional communicative repertoire required direct intervention for each operant.

In one of the few studies conducted with typically developing children, Partington and Bailey (1993) examined the functional independence of tacts and intraverbals. Tact prompts (i.e., nonverbal pictorial stimuli) were used to teach children intraverbals related to object names and categories. Once the tact repertoire was estab-

lished, participants were asked to answer questions about category membership of those items (e.g., tell me some things you eat, furniture, toys) with no pictures present but these categorical intraverbals did not emerge. Thus, teaching one verbal operant to typical preschool children did not result in the spontaneous emergence of other untrained operants.

Drash et al. (1999) illustrated the utility of complex transfer of stimulus control procedures in developing multiple verbal operants for children with substantial language impairments with findings that also support the notion of functional independence. All participants were taught to mand independently for preferred items but subsequently failed to emit echoics and tacts for those items. The newly created mand repertoire was then used to expand echoic responses by matching a reinforcer to the topography of the child's vocalization (e.g., reinforcing an echoic response *ahhh* with a piece of apple). Finally, a transfer of stimulus control procedure was used to bring echoic responses under the functional control of discriminative stimuli, thus shaping a functional tact repertoire. Specific contingencies were required to transfer control from a mand to an echoic and from an echoic to a tact supporting the functional independence of these operants in children with autism. Additionally, the "quick transfer procedures" appear to be valuable clinical tools for overcoming similar problems and bringing language under the functional control of the desired verbal and non-verbal stimuli.

Two studies report notably different findings illustrating that verbal operants may not always prove functionally independent. Verbal operants with similar topographies and different functions may sometimes emerge without direct training (Nuzzolo-Gomez & Greer, 2004; Sigafoos et al., 1990). Sigafoos et al. demonstrated that mands for specific items emerged after children were taught to tact the items indicating a spontaneous transfer of control from the nonverbal stimulus to a relevant establishing operation. These results suggest that conducting tact training sessions may be sufficient for the emergence of specific mands of the same topography rather than a generalized mand repertoire. Similarly, Nuzzolo-Gomez and Greer demonstrated that multiple exemplar training resulted in the emergence of untaught adjective object pairs. They taught specific adjec-

tive-object pairs as both mands and tacts (small cup, medium cup, large cup or first box, second box, last box) and then showed the emergence of other untrained adjective-object tacts and mands (right bowl, middle bowl, left bowl) following multiple exemplar instruction sessions. Thus, although tacts and mands were initially functionally independent, procedures used to teach specific adjective-object pairs as both mands and tacts resulted in the spontaneous emergence of untrained pairs. These findings suggest that there is still much to be learned about the nature and extent of functional independence of verbal operants in individuals with and without language problems.

SUMMARY AND CONCLUSIONS

The volume of empirical support for Skinner's analysis of verbal behavior has increased nearly three fold over the past 15 years. To date, empirical investigations have provided initial support for Skinner's notion of functional independence, the importance of the mand as the preliminary focus of language training, the utility of transfer of stimulus control procedures, and the benefits of multiply controlled language in the acquisition and development of more complex verbal behavior. Additionally, several studies support the notion of the establishing operation as a critical controlling variable for the mand. This approach to language is being disseminated to a growing number of service providers and families of individuals with autism and developmental disabilities. This approach is viewed by many as a valuable alternative to the traditional linguistic conceptualization of language which focuses on a receptive-expressive distinction rather than a taxonomy of verbal operants (Carr & Firth, 2005; Sundberg & Michael, 2001). The trends evident in the top panel of the figure suggest that one can expect to see a continued small volume of research or potentially an increased volume of experimental research on Skinner's conceptualization of the controlling variables of language. With this in mind, we offer several suggestions for consideration for future publications.

First, researchers must extend the study of verbal behavior because this topic still remains understudied within behavior analysis and under disseminated to researchers outside of be-

havior analysis. Recent empirical demonstrations of Skinner's conceptual framework are being published in a limited number of journals ($n=5$) with almost exclusively behavior analytic audiences. By comparison, a review of empirical studies on functional analysis of problem behavior across a similar time frame resulted in 277 empirical studies in 34 different journals (Hanley, Iwata, & McCord, 2003). Journals such as *Psychological Record*, *Child Development*, and *Journal of Experimental Child Psychology* have professional readerships with broader interests, training, and experiences that could benefit from exposure to Skinner's conceptual framework. Additionally, autism professionals comprise one of the largest potential clinical consumer groups of Skinner's approach to language. Autism focused journals amenable to behavioral interventions such as *Journal of Autism and Developmental Disorders* published earlier studies on verbal behavior and may be an important avenue for influencing autism service providers along with newer journals such as *Focus on Autism and Developmental Disorders*. Submissions to these publication outlets will require researchers to find effective ways to communicate the importance of research findings to people with differing conceptual backgrounds without sacrificing an adequate understanding of behavioral principles for the ease of procedural application.

In addition to the restricted range of publication outlets, the range of operants studied and the target populations were also somewhat restricted with a majority of empirical studies still focusing on mands and tacts. Perhaps the limited studies on intraverbals and autoclitics are due to the fact that the majority of recent studies have examined clinical interventions for individuals with little-to-no communicative behavior, making the early verbal operants the only possible focus of study. While these findings are consistent with Skinner's notion that the mand should be the initial focus of early language development, there is still much to be learned about the application of his framework to more complex verbal behavior of typically developing children and adults with adequate or exceptional language repertoires. Additional empirical investigations on the basic behavioral processes involved in the development and maintenance of functional echoic, intraverbal, and autoclitic repertoires should be

conducted with typically developing people of all ages.

Additionally, there are still several basic tenets in need of extensive study and replication to determine the conditions under which some of Skinner's basic premises hold true. There is conflicting support for the utility of the pairing procedure as well as Skinner's notion of functional independence. Researchers must continue to investigate the conditions under which the pairing procedure establishes vocalizations as conditioned reinforcers for individuals with severe language impairments in order to develop specific clinical recommendations for this procedure. It is also critical to continue investigating the conditions under which functional interdependence is demonstrated (i.e., the spontaneous emergence of untrained operants) and how clinicians might best use this knowledge in applied settings to facilitate rapid acquisition of functional language in individuals with disabilities.

On a related note, the heightened interest in applied verbal behavior programs for children with autism is creating a demand for services that may not yet be based on sound empirical support for effective outcomes (Carr & Firth, 2005). Carr & Firth suggest that the current evidence for the effectiveness of this approach with children with autism is somewhat indirect. That is, the studies described in this paper certainly provide evidence for the validity of Skinner's framework but do not provide the same kind of evidence about overall treatment effects of comprehensive verbal behavior curricula in terms of the social validity of achieved outcomes. The reader is directed to their recent publication in *Journal of Early Intensive Behavioral Intervention* for discussion of the need for empirical case studies, summarized outcome data from multiple cases, and experimental and quasi-experimental treatment comparisons.

The increased volume of this literature and the growing empirical support for Skinner's analysis are encouraging. There is a substantially greater body of literature to enhance our conceptual understanding of Skinner's analysis and to illustrate the positive clinical impact associated with the use of this framework. The publication of conceptual and empirical works on verbal behavior is critical for the continued growth and development of this field. There is hope for continued growth in this line of re-

search over the next 15 years potentially addressing understudied verbal operants and new participant populations. It is also important for the authors of these much-needed empirical studies to consider publishing their works in a broad range of peer-reviewed journals including our highly receptive "old favorites" such as *JABA* and *TAVB* as well as journals with a more general readership.

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