Verbal Behavior Analysis: A Program of Research in the Induction and Expansion of Complex Verbal Behavior

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Both applied and conceptual experiments based on Skinner's theory of verbal behavior have led to significant benefits for: (a) persons with language disorders and delays, (b) students who need to bridge the achievement gap, (c) professionals who work with students, and (d) individuals who wish to design functional curricula and pedagogy to meet international educational standards. In our efforts to develop schools that provided an evidence-based education that was comprehensive in scope, we needed to address complex curricular goals that could be addressed scientifically only by drawing on Skinner's theory. This need then led to the conduct of over 40 experiments on Skinner's theory leading to procedures that filled many of the gaps needed to provide a total educational experience based entirely on scientifically derived procedures and curricula. We discuss the individual and cumulative findings of this research program (from dissertations, published papers, and papers in the publication process) including procedures for individuals for whom existing procedures were not effective. Procedures were identified for: (a) inducing speech and communicative *functions* for persons with autism and developmental disabilities, (b) replacing faulty speech with effective communication, (c) teaching self-editing and self-management repertoires for functionally effective writing, and (d) teaching complex problem solving repertoires to professionals such that stronger treatment and educational outcomes resulted for a variety of learners. Finally, we describe how these findings and recent research in multiple exemplar instructional histories suggest procedures for teaching generative forms and functions of verbal behavior building on Skinner's work and the role of multiple exemplar instructional histories.
Key words: verbal behavior, verbal operants, inducing complex language, verbal behavior analysis.

Skinner's (1957) book on the communicative function of language is a complex theory of communicative behavior based on extrapolations from the basic science of behavior and Skinner's considerable knowledge of English literature. In the 45 years since its publication, the theory has been dismissed by Chomsky (1959) (apparently as a result of confusion – see Chomsky & Place; 2000) and misunderstood by psychologists and linguists – including many behavior analysts (see MacCorquodale, 1970). Skinner and other radical behaviorists were slow in responding to the critics (MacCorquodale, 1970). However, over the last two decades, a few behavior analysts have acted to explain the theory (Catania, 1998; Michael, 1984; Vargas, 1982) motivating others to test the theory for its conceptual validity and applied utility (Lamarre & Holland, 1985; Lodhi & Greer, 1989; Ross & Greer, 2003; Tsiouri & Greer, 2003; Sundberg, Michael, Partington, & Sundberg, 1996; Williams & Greer, 1993).

In this paper we review a program of applied research drawing on Skinner's functional theory of verbal behavior that led to gains in how to: a) identify the controlling variables for some functions of verbal behavior, b) induce vocal verbal behavior when it is lacking or induce "spontaneous" verbal behavior, c) ameliorate or eliminate some types of faulty verbal behavior, and d) use the concept of verbally-governed behavior of scientists (as outlined by Skinner, 1957) to

analyze and teach complex problem-solving repertoires to students with verbal deficits and to professionals involved in education or therapy. The research program has involved over 40 different experiments summarized in more than 20 papers. These tested procedures have been, in turn, used with hundreds of students in CABAS schools over two decades as the instructional needs of students are identified via continuous measurement and analysis as a part of the instruction process.

Our program of research studies in verbal behavior was necessitated by a two decade-long-quest to design schooling based entirely on findings of, and in-situ applications of teaching as a science. The quest for science-based schooling was made possible by the partnership between the Programs in Applied Behavior Analysis at Teachers College Columbia University and CABAS® (Comprehensive Application of Behavior Analysis to Schooling) schools. Some of the research studies we describe were conducted with and for persons with severe communication delays or deficits; while others were completed with students that teaching as an art "left behind"—children from impoverished communities who enter school without the necessary language experiences as reported in Hart & Risely (1996). While our research in verbal behavior has added to what Catania (1998) described as "the conceptual validity" of Skinner's theory, our objective in this paper is to share our findings on the utility of the theory for professionals who treat language disorders and teach students who are lacking verbal repertoires in the hope that they find them useful and, perhaps, even interesting.

The CABAS Model and Verbal Behavior Research

Over the last 20 years, we have endeavored to develop working educational models of excellence that were driven by: (a) the needs of individual learners, and (b) the comprehensive application of scientific findings to all aspects of education. By all aspects of education, we mean teaching, curriculum design, replacing destructive with constructive behavior, supervision, administration, university training programs and parent education. Since the model is a behavioral systems approach we called it CABAS® (See Greer, Keohane, & Healy, 2002 for a brief description of the model). In the development of our schools, we drew on 65 years of basic and applied behavior analytic research while adhering to the belief that science should serve the learner in a pragmatic fashion inspired by Skinner's book *A Science and Technology of Teaching* (1968). We also drew on educational research findings and specialized applications found in the behavior analytic literature—Precision Teaching, Eco-Behavior Analysis, The Behavior Analyst Consultant Model, Direct Instruction, and The Morningside Model (Greer, 1996b). Our efforts led to the development of several schools that are accredited models of educational excellence in the United States, Ireland, England, and new programs seeking accreditation as CABAS schools in Argentina and Hong Kong. Much of this work was informed by Skinner's verbal behavior theory. The resulting research and demonstration efforts from the university and the schools have driven and continue to modify the model. The experimental analyses of components of CABAS® and the entire package are detailed in several publications (See Greer, 1994a, 1994b, 1996a, 1996b, 2002; Greer, Keohane, & Healy, 2002; Greer, McCorkle, & Williams, 1989; Ingham & Greer, 1992; Lamm & Greer, 1991; Selinski, Greer, & Lodhi, 1991; also see <www.cabas.com>). Suffice it to say that the building of a learner driven school that was *based entirely on schooling as scientific activity* created a need to draw on all of the research and theory associated with the science of the behavior of the individual, especially Skinner's theory of verbal behavior.

Research and applications from Skinner's theory of verbal behavior provided critical solutions to many of the problems we encountered with our students—problems not solvable with the existing corpus of behavior analytic tactics that did not incorporate the verbal behavior conception (i.e., scientific approaches to problem solving, "self-management," generative behavior,

enlarged communities of reinforcement, academic literacy). Our research in verbal behavior and the research of others over the last 17 years has led to procedures that have improved the prognosis for individuals who have mild to severe communicative delays and disorders or who lack communicative repertoires of any sort. Additionally, research built on the theory has led to analyses of complex behaviors of learners ranging from non-vocal and non-communicative children with developmental disabilities to analyses of the scientific verbal behavior of those who provide treatment, pedagogy, and supervision. Finally, the theory has led to a conceptualization of curricula that brings together the seemingly disparate views of "progressive education" and behavior selection (Greer, 2002; Greer, Keohane, & Healy, 2002).

Skinner's Theory of Verbal Behavior

According to Catania (1998), the 20th century provided two psychologies of language -- a structural and a functional account. The linguists' structural accounts of language provide the components of the forms of communication and are a necessary part of schooling (i.e., dictionaries, syntax, grammar, punctuation). However, the structural or linguistic *theoretical accounts of the origins of language* are characterized by a belief that language acquisition occurs through innate determinism (Chomsky & Place, 2000; Pinker, 2000). The latter theoretical account does not provide any tools or strategies for those who could not communicate or who do not communicate effectively.

The functionalist perspective is characterized by an emphasis on the effect of the speaker or writer on an audience. Units of speech are identified according to their function for the speaker or writer. The acquisition of speech or other communicative topographies, regardless of their genetic origins, is learned in much the same manner that nonverbal behavior is acquired. The functions of speech, sign language, or writing occur within environmental contingencies that consist of the antecedent and consequent components of behavior along with the setting events or contextual events in which the verbal operant exists and the individual's instructional history. Rigorous experimentation is used to test for functional relations between environmental variables that include other verbal behavior.

Verbal behavior, vocal and non-vocal topographies, does differ from non-verbal behavior in that verbal behavior typically involves another person or persons—a listener (or observing person in the case of sign or picture topographies). The listener mediates between the verbal and non-verbal world for the *benefit of the speaker*. Thus, while verbal functions are operants, they have special characteristics based on the social contingencies surrounding verbal operants. In contemporary societies, the verbal environment is the environment that selects out those who are to succeed, the source of socialization, and levels of independence. Our understanding of verbal behavior is key to the analysis and teaching of new operants—the role of education.

Linguistic theorists concerned with the origins of language have not embraced Skinner's theory (Chomsky, 1959 Pinker, 2000). However, his theory of verbal behavior was not intended as a refutation of a structuralist analysis of language, but, instead, offered a functional perspective that is complementary to that of a structural analysis (Catania, 1998). Skinner's theory was an extension of both laboratory findings and a behavior selection epistemology (Skinner, 1957; Vargas, 1993). He named his analysis *verbal behavior* to describe his functional account of language as communicative behavior. We characterize our research and applications with children and professionals as *verbal behavior analysis*, since it is an application of Skinner's theory as well as applications of the entire corpus of research and educational practice in the applied and basic sciences of the behavior of individuals.

Skinner's use of the term *verbal* referred to both vocal and non-vocal functions of communication (i.e., gestures, signs, and speech) from the perspective of the speaker. In our application of Skinner's verbal operants, we divide both communicative and non-communicative instructional goals into *form and function*. *Form* refers to the topography or structure of language or specific responses such as words, signs, or symbols, and *function* refers to the effects of the behavior. A child may emit the vocal/sign/symbol "milk," but we need to know the function of this form for the child. It is the function that determined Skinner's (1957) elementary verbal operants. They are: echoics, mands, tacts, intraverbals, textual responses, and autoclitics. More importantly, by identifying these as operants, Skinner paved the way for identifying the controlling variables for the operants and subsequently providing the means for inducing them when individuals did not have them. The following is an overview of Skinner's theory, one that is necessarily superficial.

Skinner (1957) defined *echoic* operants as vocal verbal behavior that has point-to-point correspondence with a vocal verbal model. If a parent says, "cookie," for example and a child echoes the parent by saying, "cookie," echoic behavior occurred. A *mand* is "a verbal operant in which the response is reinforced by a characteristic consequence and is under the functional control of relevant conditions of deprivation or aversive stimulation (Skinner, 1957, p. 36)." The essential antecedent conditions are the deprivation conditions and a listener; however, the item may or may not be present. If a form of verbal behavior is: 1) a result of certain deprivation or aversive conditions, 2) is preceded by a non-vocal antecedent, and 3) specifies a particular reinforcer, the operant function is that of a pure mand. For example, if a child says, "juice, " (form) when he or she is thirsty (deprivation) and the delivery of juice is the reinforcer for that instance of verbal behavior (function), a mand has occurred. The child may mand "juice" in the presence or absence of a container of juice for consumption. Typically we teach first instances in the presence of the object under the relevant establishing operations and fade the presence of the object.

When children emit mands or other forms of verbal behavior naturally and without verbal questions or prompts from others, their speech is characterized as spontaneous. The so-called "spontaneity" in speech seems to emerge from the child without any environmental sources (Pinker, 2000). Such spontaneity is often seen as missing in children with autism or other language delays and when linguistic or structural topographies are the focus of operant conditioning rather than verbal operants, the speech that results seems lacking in spontaneity (See Williams & Greer, 1993 for an experimental comparison). For example, individuals taught to communicate using operant procedures but structural objectives are sometimes taught to "request needed items," but the operant often taught is a response to a question (i.e., "what so you want?"). Skinner's theory suggested the controlling variables that allow instruction of the type of communication erroneously attributed to spontaneity. Verbal behavior theory and research identified the relevant and often inconspicuous sources of spontaneity in speech as certain establishing operations and an audience that might deliver (Lodhi & Greer, 1989; Williams & Greer, 1993). Often speech that is characterized as "non-spontaneous" consists of verbal emissions that are emitted under certain prompted vocal verbal antecedents (e.g., say "thank you," "what do you want?") rather than the establishing operations without verbal antecedents. The non-spontaneous speech is simply under the control of different establishing operations and contingencies than those that are attributed to spontaneity—they are different types of verbal operants (Williams & Greer, 1993) that do not fit the natural contextual setting. Those that are seemingly spontaneous are under the control of variables that a structural analysis omits (i.e., pure mand and tact conditions).

Tacts are verbal operants involving a nonverbal antecedent, the tacted stimulus that is present, and a generalized reinforcer, such as praise or affirmation from an adult. Thus, if a child says "juice" in the presence of juice and the reinforcer consists of a parent responding, "Yes, that is juice," the utterance functions as a tact operant. Both the mand and tact functions described above

are *pure mands and tacts* because there are no verbal antecedents (Williams & Greer, 1993). That is, the child says juice even if not asked (i.e., "What do you want?"). In the case of the tact the child says "juice" even if not asked (i.e., "What is that?"). If another modifying function associated with the primary operant function, such as "*Chocolate* milk," is spoken, this latter modifying function is termed an *autoclitic* and it functions to specify, quantify, specify, negate, or affirm the mand and tact. There are many types and variations of tacts (e.g., metaphorical extensions) and the reader is encouraged to go to the original treatment (Skinner, 1957). Impure mands and tacts are mands and tacts under multiple control (e.g., verbal and nonverbal stimuli as in responses to a verbal antecedent "what color" in the presence of an object of a particular hue) and they are key repertoires in educational settings. Tacts are particularly important to the various verbal communities of science (e.g., tacts of reinforcement or reinforcement operations by behavior analysts, see the chapter on the verbal behavior of scientists in Skinner's *Verbal Behavior*).

Intraverbal behavior is "verbal behavior showing no point-to-point correspondence with the verbal stimuli which evoke them" (Skinner, 1957, p. 71). For example, when a teacher says, "2 plus 2" and a student says, "4" under certain conditions an incident of an Intraverbal has occurred. Another example is an instance when someone says, "How are you?" and an individual responds, "Fine." The parts of the initial spoken behavior do not correspond topographically with the spoken response. In still another case recitation of a poem or the alphabet can be incidences of Intraverbal behavior.

Autoclitics consist of verbal behavior that modifies, qualifies, affirms, identifies possession, negates, or specifies functions for the primary verbal operants. For example a child may mand the *big* cookie or *bigger* cookie, or tact the *blue* bird (identifying the blue one as opposed those that are not blue). Autoclitics function to avoid punishment from an audience (i.e., "consider the possibility that") or improve the likelihood of affecting the behavior of the listener (i.e., "please, pretty please"). Like all types of verbal behavior autoclitics act to persuade the listener or reader.

Textual responding consists of "a visual or tactile verbal stimulus [print, or Braille] that controls auditory patterns of verbal behavior [such that] a vocal response is under the control of a non-auditory verbal stimulus" (Skinner, 1957, pp. 65-66). Examples of textual behavior include reading a menu or reading text from print or Braille. Textual responding is only one component of reading, however. Linguists might refer to this component as "decoding;" however, obviously no code is broken any more so than the pushing of a button to turn on a radio involves decoding. Other aspects of reading like other aspects of verbal behavior involve multiple stimulus control including instructional histories and the development of joint stimulus or establishing operation control (Greer, Yuan, & Gautreaux, 2003; Nuzzolo & Greer, in press).

In addition to the basic operants, there are many other aspects of the theory that address critical and neglected aspects of education. For example, the relative roles of speaking and listening suggest new ways to organize instruction and curriculum design, as does the differences between contingency-shaped (i.e., event-governed behavior) and verbally-governed behaviors (i.e., nonverbal or verbal behaviors evoked by other verbal behavior), or the taking of dictation (i.e., hear word and write word) versus transcription (i.e., see word and write word). For example, the spelling of a word vocally is a very different behavior than writing a word that is heard as in dictation and this has implications for pedagogy and curriculum design. Moreover, selection as in the case of multiple choice responding differs from production. The later has more characteristics of listener/reader repertoires and the former characteristics of speaker/writer repertoires. The development of joint stimulus functions across these different repertoires holds still other ramification for pedagogy and curriculum (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001; Hayes, Barnes-Holmes, & Roche, 2000; Lowe, Horne, Harris, & Randle, 2002).

Curriculum and Verbal Behavior

In our CABAS® schools for children with and without disabilities, we organize curriculum and instruction by functional levels of verbal behavior rather than age or developmental norms alone (Greer, in 2002, pp 87, 118-119). These functional categories allow us to determine what each student needs to be taught and what kinds of tactics from the science are likely to be successful (See Chapter 7 in Greer, 2002). They are instructional hierarchies. The arrangement of curricula into task analyzed instructional hierarchies is a key contribution of behavior analysis to education (Daly, & Martens, 1994). Much of the traditional approach involves structural hierarchies rather than hierarchies based the functional hierarchy of verbal development. Arguably, our functional verbal hierarchies may be *natural fractures* of verbal and cognitive development. The learner categories, which are arranged in order of increasing complexity, and possibly naturally occurring developmental levels, include: (a) pre-listener, (b) listener, c) speaker, (d) speaker-listener exchanges, (e) speaker as own listener (including naming, see Lowe et al., 2003), (f) reader (including the textual and other components of reading), g) writer, (h) writer as own reader (self-editing), and (i) verbally-governed behavior for problem solving (Greer, 2002). Some of these categories involve behaviors that are verbally governed such as listening, reading, taking dictation, transcribing, following a mathematical formula to solve a problem. Some involve behaviors that are "verbal governors" to affect the behavior of others such as writing, speaking, producing a mathematical formula. Some are verbally governed by others, as in listening and writing responses. Still other categories involve interlocking relations governing and governed behaviors such as the naming, self-talk (speaker as own listener), self-editing (e.g., listening-editing to one's own speaking as would a target audiences, reading-editing one's own writing as a specific audience). Individuals with sophisticated editing repertoires will read and write a manuscript such that when the target readers encounter the writing, the audience will be persuaded or directed to the as designed by the writer. In both of these cases the person who is writing/speaking is in the same skin as the one who is reading/listening, but the speaker/listener or reader/writer functions are alternated. In a similar fashion, other notions of the psychological construct of *self* (e.g., self-discipline, self-management, or self-regulation) are attributable to interlocking speaker/listener or reader/writer functions. So identified, they become repertoires that are subject to direct instruction and manipulation.

Each student's level or repertoire of verbal expertise, and graduations within those levels, determines the degree of dependency of the student on teacher or parent directed learning. The student achieves learner independence by moving through the verbal behavior levels. Table 1 illustrates how, and why, we categorize our curriculum and instruction according to verbal behavior levels.

Table 1. Verbal Repertoires and Their Effects.
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1) Pre listener Status

     Individuals without listener repertoires are entirely dependent on others for
     their lives. Interdependency is not possible.

2) Listener Status

     Individuals can reliably follow speaker instructions (e.g., respond to come here,
     stop, eat, no). Individuals can comply with instructions, track tasks (e.g., do
     this, now do this), and avoid deleterious consequences while gaining habilitative
     outcomes. The individual is still dependent, however direct dependent
     physical control (e.g., holding the individual's hand to cross the street) can be

replaced by indirect verbal control.
The individual may make contributions to the well-being of society because
interdependency is feasible.

3) Speaker Status
Individuals, in the presence of a listener, can verbally govern consequences in their
environment by using another to mediate the contingencies (e.g., eat now,
toilet, coat, help). This is a significant step towards controlling the
contingencies by the individual. The culture benefits others
proportionately, too.

4) Speaker listener exchanges,
Individuals with speaker listener exchanges (e.g., conversational units) have
social skills that allow them to obtain and provide reciprocal verbal   reinforcement.
This repertoire is the key to social interaction.

5) Speaker as Own Listener Status Including Naming
Individuals can function as a listener to their own verbal behavior (e.g.,
first I do this, then I do this), by reconstructing the verbal behavior given by
another or eventually constructing speaker-listener self-talk). At
this stage, the person achieves significant independence. The level of
independence is dependent on the level of the person's listener
sophistication. What level of sophistication does the speaker have as a
listener? Can the speaker function as a sophisticated listener? The
function is a self-editing one (Lodhi & Greer, 1990). These individuals can emit
speaker behavior after learning something as a listener or vice-versa.

6) Reader Status
Individuals who have reading repertoires can supply useful, entertaining,
necessary responses to setting events and environmental contingencies that
are obtainable by written text. The verbal material may be selected by the
reader without the time constraints controlling the speaker-listener
relationship. The advice of the writer is under greater reader control than
the advice of a speaker; that is, the reader can access printed stimuli at any given
time, while, the listener is limited to the presence of a speaker or an audio recording.

7) Writer Status (governing the behavior of others through written verbal text)
A competent writer may control environmental contingencies through the
mediation of a reader across seconds or centuries in the immediate vicinity
of a reader or on a remote continent. The function is to affect the behavior of
the reader. There are two major categories: (a) writing for technical or
scientific effects, and (b) writing for aesthetic effects.

8) Writer as Own Reader: The Self-Editing Status
As writers increase their reading repertoires and their own writing from the
perspective of their eventual audience, writers grow increasingly independent
of frequent reliance on prosthetic audiences (e.g., teachers, supervisors, colleagues).
A more finished and more effective writing provides the
writer with wide-ranging control over environmental contingencies such that
time and distance can be virtually eliminated.

9) Verbal Mediation for Solving Problems (An Expansion of the Self-Editing Repertoire)

A sophisticated self-editor who has the verbal repertoires associated with formal approaches to problem solving (e.g., methods of science, logic including mathematics, authoritative sources) can solve complex and new problems in a progressively independent fashion. The characterization of the problem is done with precise verbal descriptions. Verbal descriptions occasion other verbal behavior that can, in turn, direct the action of one who is governed by the verbal community (formal approaches) associated with the discipline appropriate for the solution of particular kind of problem (e.g., scientific problems, logic problems, source-of-authority problems).

Interestingly, when curricula and educational goals are conceptualized in terms of functional goals (i.e., repertoires that work the environment), such as the levels of verbal behavior, they provide kinds of goals that pragmatic philosophers such as Dewey (1910, 1916) sought. Moreover, verbal behavior provides the tools and functional instructional objectives to teach repertoires, rather than what Whitehead (1929) characterized as "inert ideas." In fact, the American pragmatic view of education was one that saw the goal of education as the teaching of functional repertoires— behavior that works. The student was to learn under conditions of "needing to know." Interestingly, the epistemology of behavioral selection (the contemporary philosophy of those who study the behavior of the individual from a functional perspective) has its roots in American Pragmatism (Dewey, 1916, Moxley, 2001/2002). However, without the contemporary selectionist perspective (i.e., the role of establishing operations or instructional history) and the body of existing research, the goals of progressive education are not feasible. Using what verbal behavior analysis contributes, we have recast international and state standards into functional goals for our CABAS schools (Greer & McCorkle, 2003) leading to the use of educational standards that meet the both structural and functional requirements and eliminate the problems associated with criticisms of these standards by some educators (i.e., the standards don't provide for "authentic" instruction). Moreover, the verbal behavior model of curriculum design led to the incorporation of additional standards that are not found in international lists of educational standards such as the development of joint establishing operation control of novel forms from mand to tact functions or vice versa without direct instruction in both (Nuzzolo & Greer, in press). Thus, not only does verbal behavior provide new tools to teach students communicative behavior and remediate deficits, it also provides the means to design broader and more effective curricula.

We have applied the results of research findings on verbal behavior in all of our CABAS schools for over seventeen years. When the research identifies a new tactic from verbal behavior analysis, we apply that tactic to particular children who need it in all of our schools within a matter of weeks resulting in the immediate dissemination of the research and replications. Several hundred children and adolescents have benefited and those findings that are most powerful result in major advances for children with autism, communicative delays, or students without native disabilities but who have minimal language experiences like those described by Hart and Risely (1998). However, many or most of these findings are not known by those engaged in early and intensive behavioral interventions. Our purpose is to share these findings such that others may apply and test them.

The following sections summarize some of the verbal behavior research on which we base our pedagogy, therapy, and curricula in CABAS® schools in Europe and the USA. Sources for learning the specifics components of the procedures are identified in advance of a book that will provide detailed explanations (Greer & Ross, 2003).

Inducing Echoics, Mands, and Tacts

Lovaas (1977) developed operant procedures to teach children with autism to speak early on in his decades-long work with this population. However, he drew on linguistic structures to which he applied operant procedures. While these procedures proved effective for many children, the introduction of Skinner's functional approach building on Lovaas' work has led to greater gains with the children we have studied and taught (Ross & Greer, 2003; Tsiouri & Greer, 2003; William & Greer, 1993).

Within the CABAS® schools, we found that our students' verbal behavior was maintained and demonstrated generalized stimulus and establishing operation control significantly more when we taught *form through function* using Skinner's functional approach than when we used traditional behavioral approaches to teaching speech or speech substitutes (See Williams & Greer, 1993, for a comparison of operant procedures using linguistic approaches versus a verbal behavior analysis approach). We learned that not only the form, but also the controlling variables or contextual controls of the function needed to be taught. Once the function of a single form was learned, we could quickly teach additional forms belonging to mand, tact, or other verbal operant functional classes. Autoclitics, that have a modifying function, could also be taught because they were pulled along by the primary functional operants (Twyman, 1996; Williams & Greer, 1993). Thus, the learner could acquire more complex functions such as, "Could I have the large glass of chocolate milk, please?" by building on the primary function. One of the benefits of these procedures was that students learned to emit "spontaneous" communication. That is the environmental context was taught along with the form resulting in true verbal operants.

Consistent with Skinner's theory, several research studies have demonstrated that acquiring the mand function does not mean that a learner has acquired the tact function or vice versa (Lamarre & Holland, 1985; Twyman, 1996; Williams & Greer, 1993). Thus, we designed instruction that arranges the specific contextual conditions associated with the separate repertoires for each form. In addition, we teach concepts or *classification* as consisting of several response classes that are only arbitrarily defined as classes. When a child is taught her colors, for example, we simultaneously teach matching and pointing to colors (i.e., listener responses), emitting pure tacts and emitting impure tacts of the color when asked to do so (i.e., impure tacts under multiple control). In traditional approaches, one class of responding is taught and the student is assumed to have naturally learned all of the others. Instead, we teach all off the different response classes (e.g., multiple choice, or selections and production), and do not assume that the teaching of one results in the emission of the other functions until students have acquired a special repertoire involving, for example, acquisition of joint establishing operations across mand and tact functions or joint stimulus control across verbally-governed (i.e., listener or reader functions) and verbally-governing repertoires (i.e., speaker or writer functions). That is, recently we have found a promising way to teach mands and tacts and autoclitic frames such that children can learn only one response class and emit the others without direct instruction through multiple exemplar instruction (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001; Greer, Yuan, & Gautreaux, 2003; Nuzzolo & Greer, 2003).

The initial instruction of mands and tacts typically begins with echoic behavior, if the targeted form is not present. Skinner (1957) maintained that vocal point-to-point repetition of what was heard constituted an echoic, but that it was not *imitative behavior*. In the echoic function, the person echoing the vocal sounds of a speaker cannot see the operations involved in the production of speech, thus an echoic is not imitation. For example, a parent says, "butterfly," and the child immediately says, "butterfly" as an echoic response. The child does not observe the physiology involved in the production of the response, thus the response of the child is not imitation. This notion may explain a great deal about why echoic behaviors are difficult for some children even when those children can imitate extensively. Perhaps once the child learns the echoic repertoire and has the naming function, one may speak of verbal imitation. While the evidence suggest that

imitation and echoics are independent, it is possible that the acquisition of joint stimulus control across imitation and echoic responding may result in a new class of responding in which imitation and echoic responding may result in a kind of "vocal-verbal imitation" (See Ross & Greer, 2003). We simply need to know more.

Once the child has the echoic function, they must be taught to use the form (i.e., *butterfly*) in both a tact or mand function depending on how the teacher arranges motivational conditions and reinforcers (Greer, 1987, 1994a). That is the two functions are taught for the same form. Our basic procedures teach echoic-to-mand or echoic-to-tact as separate operants. Thus, forms are identified that have high probability of functioning as mands for a particular student and others are relegated to tact functions. We arrange those in tandem relations such that the emission of independent of echoic tacts results in praise or generalized reinforcement *and the opportunity to mand*. Mand items are first in view and then faded out of view. Thus, we teach in a scientifically identified context.

Applied experimental research devoted to the induction of echoics has led to first instances of functional speech with children for whom other tactics from both early operant research for individuals who could not speak (Lovaas, 1977) was not effective. Moreover, we found that some students would not speak even with the verbal behavior procedures that we developed in the early research (Sundberg et al, 1996; Williams & Greer, 1989). Building on the echoic-mand procedure Ross (1998) (Ross & Greer, 2002) identified that rapid generalized imitation presentations under deprivations led to the induction of vocal verbal behavior for several children one whom was 9 years of age. Tsiouri & Greer, (2003) replicated Ross' findings and extended the procedure to include the tact and establishing operations for the tact. These latter procedures expanded the numbers of children that we could teach actual speech instead of using topographical substitutes.

Sundberg, Michael, Partington, and Sundberg (1996) introduced still another procedure that acted to induce echoic responding by involving the pairing of a teacher saying a word with the presentation of preferred events and edibles that resulted in the children repeating the sounds as automatic reinforcement (See Sundberg& Partington, 1998 for a description of this and other verbal behavior tactics developed in another program of research). Yoon (1998) replicated this latter procedure and inserted the newly evoked echoics into the echoic-mand condition and developed true vocal mands. Once the children could echo as a result of acquiring saying sounds as automatic reinforcement, they acquired mand, tact, and autoclitic functions when these latter operants were taught under the conditions specified in Skinner's theory using the research-based curriculum from the CABAS® schools (Greer, 1987, 1994a). Thus there are two additional procedures for inducing speech for children for whom our the echoic-mand and echoic to tact, the interrupted chain procedure, or incidental teaching procedure do not work. These procedures have expanded the numbers of children who can communicate with speech rather than sign language or pictures. There remain some children still for whom none of these work and sign language or picture exchanges are used but treated as verbal behavior with associated contextual conditions. More recently we have found that computerized speaking devices can be used under verbal behavior conditions to produce computerized functional verbal behavior, but additional research is needed before this procedure can be disseminated. When children can use speech there educational prognosis is greatly enhanced.

After the basic speech or substitute speech units are introduced along with the several types of autoclitics we move on to the next level of the verbal hierarchy. The next significant level is the development of speaker listener exchanges that we call conversational units.

Teaching Conversational Exchanges and Self-Talk

One of the key points of Skinner's theory is that *verbal behavior is social behavior*. That is, verbal behavior requires a listener as well as a speaker. Indeed, one of the differences between verbal behavior and other operant behavior is that verbal behavior is indirect. Verbal behavior is behavior *mediated by another* (Vargas, 1982). Building on the social aspect of Skinner's treatment of intraverbals and verbal episodes, we identified *conversational units* in our research (Becker, 1989; Donley & Greer, 1993; Lodhi & Greer, 1991).

A conversational unit involves at least two individuals who exchange the roles of speaker and listener. The initial speaker emits a communicative response in the presence of a relevant or useful listener (i.e., the listener who mediates between the speaker and the environment). The listener responds in turn as *both* a listener and a speaker. The initial speaker then responds as a listener. Both the listener and the speaker emit vocal and non-vocal behaviors that are evoked and consequated by verbal stimuli (vocal or non-vocal) and each is reinforced by the response of the other. Both the speaker and listener is involved in *interlocking* three term contingencies of verbal behavior. One of these complete exchanges constitutes a single conversational unit (Becker, 1988; Chu, 1998; Donley & Greer, 1993, Lodhi & Greer, 1989).

We use the conversational unit both as a curricular goal and as a measure of true social behavior in our research and daily instruction. For example, some children need to learn social behavior at its most basic level. We found that when certain conditions of deprivation were established, we were able to evoke conversational units between peers who had not done so before (Donley & Greer, 1993). Some children with diagnoses of autism who were physically assaultive to their peers or siblings decreased or ceased such physical assaults when they were taught to emit mands in social skill training conditions (Chu, 1998). The related research demonstrated that the assaults were a function of the lack of mand repertoires and the usefulness of the new mand repertoire displaced the function of the physical assault (see Carr & Durand, 1985). That is, the function of both the assault and the mand is reinforcement; however, it is simply easier to obtain reinforcement with verbal behavior that specifies its reinforcement in the case of the mand or results in generalized reinforcement in the case of the tact. For example, in research conducted by Chu (1998), induction of mands in a play setting generated conversational units between target children and their siblings and decreased assaults, whereas a social skills training program without the training of verbal operants did not do so. Thus, the target children developed basic social conversational units or true social behavior in addition to decreasing assaults.

The conversational unit may be one of the first measures that are a "natural fracture" of social behavior. The social skills literature has been replete with mixed findings that we believe may be due to the inadequacy of topographical measures of socialization (i.e. proximity, playing side-by-side, and sharing). In conversational units, socialization occurs because mutual reinforcement operations (exchanges in which each party's verbal behavior is reinforced by the other) are incorporated. Thus each instance of mutual reinforcement exchanges between individuals is an incidence of social behavior and the more frequent the exchanges the greater the incidences of social behavior. Interestingly, Becker (1988) found that a disinterested observer did not need to consider the content of the exchanges, since mutual reinforcement was the function.

Conversational units are interlocking operants between individuals. Another type of interlocking verbal operant is the learn unit. The learn unit has been identified as one of the most if not most powerful predictor of instructional effectiveness and represents a different type of verbal episode (See Greer & McDonough, 1999 for a review of the literature). Learn units involve interlocking operants between a teacher or teaching device and learners involving instructional presentations, student responses and teaching consequences of reinforcement or correction operations (See Chapter 2 of Greer, 2003).

One of the most important developments in verbal behavior research and theory concerns what the developmental literature refers to as "self-talk." Skinner (1957) described the phenomenon of talking to oneself as an instance in which an individual acts as both speaker and listener. Using the research-based construct of conversation units we have been able to create conditions under which self-talk will occur (Lodhi & Greer, 1989). When young children play alone under certain conditions, they take on the reciprocal role of both speaker and listener (Lodhi & Greer, 1989). Instructional and environmental events can be arranged to evoke self-talk as conversational units within the same person (e.g., in the presence of anthropomorphic toys). The development of self-talk is a critical learning juncture--it is the basis for thinking. The research on conversational units suggests that using self-talk conversational units as both a measure and an instructional goal is a useful tool for inducing or correcting deficits in self-talk. However, sometimes there are problems with students who speak but have what we term faulty intraverbals and faulty audience control.

Problems of Faulty Intraverbal and Audience Control

Children with diagnoses of autism or developmental delays frequently have a propensity to echo speech when it is not appropriate to do so. When this occurs immediately after hearing the speech of another, it is termed echolalia (Skinner, 1957). When repetitive echoing occurs much later, as in the case when some children repeat sounds or words from cartoons or speech repetitively, it is called palillalia (Skinner, 1957). Speech therapists sometimes refer to this as "preservative" speech. Whether or not there are related brain or physiological behaviors occurring beneath the skin, a functional perspective of the environment offers a point of departure for instruction and treatment. Preservative speech is a psychological construct that characterizes or describes behavior; it does not offer sources for explanation. Thus, we draw on the findings of behavior-environment relations to drive our instructional practices when treating echolalia or palillalia.

Skinner's (1957) theory of verbal behavior suggested to us that it might be useful to treat the problems of echolalia and palillalia as faulty Intraverbal behavior and faulty audience control. Thus, we view echolalia and palillalia as extreme forms of faulty *Intraverbal control or faulty audience control*. By approaching echolalia as faulty intraverbal control, we have found one tactic to be successful in the elimination of echolalia or another tactic with palillalia for some children (Bruno & Greer, 1996; Karmali, 2000).

In the case of a child who can read, we use textual or written prompts for responses to verbal questions and, gradually, shift stimulus control from the printed to the vocal antecedent (Bruno & Greer, 1996). When a speaker says to a child, "Hi, John, how are you?" the echolalic child may respond with point-to-point vocal correspondence by saying, "Hi, John, how are you?" However, for some children with this problem, having them respond to a printed script (i.e., "Hi. I'm fine") before they emit the echo allows the teacher to gradually shift the control such that the child learns the appropriate Intraverbal control with non-scripted responses. We repeat these scripts across a variety of exchanges while shifting scripted control to vocal antecedent control such that the responses by the child are accurate intraverbals. Doing this across numerous Intraverbal exchanges in a multiple exemplar fashion teaches the accurate Intraverbal function and not just the form. For some of our children, who have the textual responses we described, this has eliminated echolalia.

A second procedure that is useful for some children who emit both echolalia and palillalia involves the interruption of an instance of palillalia by a teacher who states an accurate tact of what

the child is doing using our echoic to tact procedure (Karmali, 2000). Thus, before the child completes the faulty behavior, the instructor interrupts with an accurate statement of what the child is doing (e.g., "I am coloring") followed by the student responding with the echoic tact. This procedure has worked to eliminate palillalia for numerous children, in addition to those who participated in the original experiments, and has led to an increased use of appropriate tacts and mands that replace the function of the former faulty Intraverbal. The child learns to recruit appropriate reinforcers from the teacher by emitting accurate forms of vocal verbal behavior (i.e., tacts), which previously functioned as a possible source of inadvertent reinforcement of the echolalia. Interestingly, the data showed that mands increased as much or more than tacts suggesting that it is not a specific reinforcement function alone that is located but rather a means to obtain more overall reinforcement. The problem with palillalia may not be faulty intraverbal behavior alone but may be one of faulty audience control too. When we teach the child to accurately tact rather than emit palillalia we are replacing the problem behavior with an accurate tact. It is quite possible that the problem is lack of audience control in that the child is simply acting as speaker as own listener, but needs to learn to move the behavior underground so to speak. Perhaps, the emission of tacts and mands recruit reinforcement and that reinforcement selects out tact or mand responses rather than inappropriate self-talk and inadvertently teaches audience control for appropriate contexts for self-talk.

Speaker immersion is another procedure we have found useful (Greer, 1987, 1994a; Ross, 1995). When a learner has a small repertoire of mands and tacts but does not frequently emit them, we arrange conditions such that all transitions in their environment require the use of different forms and functions (the student is immersed in establishing operations). For example, they may be required to ask to stand, to exit the classroom with the remainder of the class, to receive a coat, or to receive each portion of an edible reinforcer or moment with a toy. This occurs until the physical response to the speaker immersion procedure, which is costly to the student in terms of effort, is replaced by the less costly response of emitting pure or spontaneous mands at a high frequency. In other words, vocal and other forms of appropriate communicative behavior maximize reinforcement with less effort. We have found that for some children this tactic leads the child to discover the utility of communicative behavior just as Carr & Durand (1985) found that teaching impure mands (e.g., mands with verbal antecedents such as "What do you want?") reduces physical assaults whose apparent function had been "mand-like" in nature. By creating establishing operations as we teach we found that we do not have to wait for incidental teaching because *we create the conditions of incidental teaching*. Of course, the naturally occurring incidents are used too, but when good establishing operation tactics are used the child simply has many more occasions to learn and use the verbal operants (See Schwartz, 1994 for a comparison of tested tactics for creating establishing operations for emission of mand operants including the interrupted chain, the brief establishing operation, and incidental teaching; See Greer & Tsiouri, 2003, for procedures to provide establishing operations for tacts).

The few examples we have described above deal with what appears to be the more simple functions of verbal behavior. However, the teaching and scientific processes underlying them are complex. Without such procedures, many children with disabilities do not acquire the basic functions of verbal behavior nor do they acquire the more advanced functions that are built on these prerequisite skills. In addition to the basic functions of verbal behavior, ongoing research in the other areas addressed by Skinner's theory has allowed us to directly examine more complex forms of verbal behavior such as reading, self-editing, effective writing, self-instruction/self-management, and complex problem-solving.

Complex Functions of Verbal Behavior

Our experimental research in the area of complex functions of verbal behavior has frequently focused on tactics to increase effective reading, math, and writing skills. We have found that applications of Skinner's theory in the distinction between verbally-governed behavior, verbally-governing behavior and event-governed behavior is helpful, because most students with learning deficits have problems related to fluency with textual stimuli.

Event-governed behavior consists of behavior under the control of direct events, while verbally governed behavior represents behavior controlled by verbal stimuli. Thus, following step-by-step instructions to use a software program is verbally governed behavior. Once the behavior of operating the computer is directly controlled by the situation, responding is event-controlled. Event-controlled or contingency-shaped behavior is automatic and does not require "thought" or, as we would say, verbal mediation. Skinner's differentiation between these two types of responding led us to tactics to reduce problems when teaching complex verbal repertoires (See also Catania, Mathews, & Shimoff, 1990 for a discussion of verbal contingency shaped behavior).

Much of our research on reading has used the concepts associated with event-governed behavior and rule-governed behavior to test the long-term effects of mastery teaching with a rate or speed criterion versus mastery teaching without a rate or speed criterion (Hanratty & Greer, 2001; Kelly, 1996; Kelly & Greer, 1998; Singer, 2000). Our research comparing rate and mastery instruction has indicated that beneficial maintenance of reading skills is tied to producing automatic or non-verbally mediated responding during instruction (Marsico, 1998; Singer, 2000). This contingency shaped outcome for fast rate instruction is particularly important for designing instructional sequences.

Teaching the "rules" or concepts of subject matter (i.e., decoding operations for reading or using math manipulatives) has been the goal in much of the curricular design found in schools today. However, our research suggests that behavior controlled by rules (verbally governed behavior) is actually the first step. If students are to maintain skills and use them to acquire more complex repertoires, ensuring that rule-governed repertoires become automatic or contingency-shaped is the next and critical step (Singer, 2000). Thus, at each level, rule-governed mastery needs to be followed by contingency-shaped mastery in which the student performs the operations without referring to rules (i.e., the use of verbal operations).

One of the more difficult repertoires of verbal behavior to teach is effective writing. Drawing on the theory of verbal behavior, we developed motivational conditions to evoke effective functional writing by relying on the contextual motivational control, also known as the *establishing operation*. Establishing operations are momentary deprivation or aversive conditions that increase the effects of the consequences of behavior as either reinforcers or punishers, as well as the rate of the behavior associated with the punishers or reinforcers (Keller & Schonfeld, 1950; Michael, 1982, Michael, 1993). Establishing operations are essential components in Skinner's theory of verbal behavior. They are essential components of verbal behavior. Incidental learning is an example of capturing establishing operations; however, waiting for such occurrences is not enough. Our research and that of others has identified ways to provide multiple incidence of teaching via establishing operation tactics (Sundberg, Partington & Sundberg, 1996; Ross & Greer, 2003, Schwartz, 1994; Tsiouri & Greer, 2003).

We applied establishing operations to writing and textual behavior. We set aside a portion of the day in which all communication between students, their peers, and their teachers *required* written responses and written consequences. That is no one may use vocal speech, rather all communication is done in written form. This introduced conditions of deprivation (i.e., the need to know) that could be reduced only by effective writing responses; essentially, writing responses in

which we progressively increase requirements for structural and functional complexity. The student's structural and functional writing skills increased significantly as a result of this tactic (Gifaldi, Greer, & Pereira, 2003; Jadlowski, 2000; Madho, 1997). Thus we provided contextual motivation to teach not only the structural components of writing but also the reinforcement effects of writing and reading, just as brief deprivation of a desired item can serve as an establishing or motivational condition that is critical to the mand function.

Skinner's theory on rule-governed or verbally governed behavior (Vargas, 1982, 1993) provided another area of research for reader/writer behavior and children with disabilities – self-editing. Behavior that is controlled by written or spoken verbal behavior is verbally governed behavior according to Skinner's theory. Learning to come under the control of vocal and written verbal behavior is a critical part of the educational process and can be accomplished through self-editing. Our research and teaching replications show that for some children the most effective way to teach the self-editing repertoire is to have the target student serve as an editor for other students until the writers can accurately affect the behavior of their readers (Jadlowski, 2000). Thus, serving as a reader for others is a key component of changing the writer's self-editing repertoire. In related research with emerging self-editors who are reader/writers, we found that independent readers selected writing samples of students as effective writing following writer immersion tactics with middle school students (Gifaldi, Greer, & Pereira, 2003). These effects were related to the writer acquiring the repertoires of "reading their own work" such that they responded consistent with the target audience

We found that students who were easily distracted in the fourth through middle-school grades could be taught to work without distraction (measured as latency between distractions) and improve their academic skills through self-instruction using written scripts (Marsico, 1998). First, we taught the students how to read a rule and do what the rule stated. In other words, we taught the correspondence between saying and doing or, in this case, reading and doing (See Paniagua & Baer, 1982 for the classic study on saying and doing). Once we taught the student to follow what was written, we provided scripts that they used to teach themselves new math concepts. The written stimulus control generalized to using novel scripts for language arts activities. Thus, we taught two objectives: the learning of specific subject matter and the learning of self-instruction (Marsico, 1998). Once students were taught and reinforced for correspondence between reading and performing, instruction for learning new concepts could be provided without direct teacher intervention. Teaching students to read and perform reliably also leads to learner independence. This procedure is now part of the CABAS® curriculum for teaching self-instruction and self-regulation in both social and academic domains. It is both a *pedagogical procedure to teach the repertoire and a verbal curricular standard* that students need to acquire when they do not have the repertoire.

Teachers as Scientists

A basic repertoire of teachers and therapists who function as strategic scientists or reflective professionals is to choose specific research-based tactics from the scientific literature to solve a particular student's specific learning problem. The use of individualized-treatment tactics is now part of the advance repertoires of behavior analysis (Greer, 2002). While functional assessment has two decades of research for coping with "bad" behavior, these efforts are directed to existing operants. The source of functional assessments for instruction involves behavior analysis for the development of new operants and differs from analyses of the controlling variables for existing operants. Contemporary behavior analysis in education is not a one tactic fits all approach; rather it is a science of individualized treatment. Each student comes to the table with different instructional histories, thus different tactics are required for students when the basic best practices do not work, a crucial reason for why the continuous collection of data is critical to the prognosis of students (Se

Greer, 2002 for an in depth treatment of a data based approach to individualizing treatment or educational interventions). We found the chapter in Skinner's *Verbal Behavior* that describes the behavior of the scientist particularly useful for instructing educators to choose potential tactics to solve particular learning problems. However, this is a complex and advanced repertoire and, until findings from our recent research, it was difficult for us to ensure that our teachers mastered these repertoires.

Based on our research we now teach and measure the mastery of "reflective teaching" by using a task analysis or a decision tree. The decision tree is comprised of written and spoken verbal behavior (controlling verbal stimuli) that we teach educators and therapists to use. The decision tree guides or governs the teachers' decision making process by: 1) identifying when is a decision needed, 2) locating the source of a learning problem within a student-teacher interaction (the learn unit), or the learn unit context involving setting events, or instructional history, and c) deciding which tactic from the list of over 200 tested tactics is likely to ameliorate the problem (Greer, 2002).

When teachers have the prerequisite verbal scientific repertoires, we teach them such that our decision tree verbally governs their decision process. They learn to come under the control of graphs of the student's progress, their scientific tacts of the student's performance, and to identify which scientific questions to ask. Of course, they are previously taught correspondence between scientific terms and teaching operations. This algorithm, which serves as a verbal governor of the decision-making process, significantly decreases instructional time and costs for teaching students to master instructional objectives (Keohane, 1997; Greer, Keohane, & Healy, 2002). Thus, the complex problem-solving repertoire can be taught using Skinner's conception of problem solving as verbally governed behavior. In this way, teachers and therapists can become reflective instructors with scientifically accurate repertoires since every student requires different tactics at critical junctures. The decision tree approach is also used to teach our more students the basic problem solving strategies of logic, authority, and the scientific methods across different disciplines (i.e., determining best courses of action).

Current Research in Generative Verbal Behavior

We are currently conducting research in two new areas of verbal behavior. The first involves revisiting the role of listener. While Skinner did not write extensively about the role of the listener, listener responding is key in the development of communicative functions (Skinner, 1989). Recent data suggest that teaching students who are pre-listeners to acquire mastery of listener responding results in significant decreases in the amount of instruction they require to master other educational objectives (Greer, Chavez-Brown, Nirgudkar, Stolfi, & Rivera-Valdes, 2003). Until students learn the correspondence between the auditory components of the speech of others, they are simply responding to visual stimuli and cannot advance. Once we teach mastery to sets of instructions that they can only respond to as auditory stimuli, we teach them to respond at a rate of 17-30 correct listener responses per minute from a tape recording with commands given by several different voices. After mastering the listener emersion objective, the numbers of learn units required by students to meet instructional objectives were drastically reduced.

The role of the listener is also critical in a function that Fergus Lowe, Pauline Horne and colleagues have characterized as *naming* (Horne & Lowe, 1996; Lowe, Horne, Harris & Randle, 2002). When individuals have naming they can learn something as a listener and produce respond as a speaker without direct instruction or vice versa. That is, learning to match point colors and point to colors does not lead to pure tacts of colors or multiply controlled responses to colors (e.g., "what color is this?") without direct instruction. These are initially independent operants but at

some point children who receive rich language experiences learn to do so (Hart & Risely, 1996). Children with communication delays or deficits or who have a paucity of language -experiences have to be taught these separately. We have preliminary findings showing that teaching a subset of stimuli via multiple exemplar instruction resulted in the production of untaught listener or speaker responses to novel stimuli without direct instruction (Greer, Chavez-Brown, Nirgudkar, Stolfi, & Rivera-Valdes, 2003).

The listener, speaker and speaker-listener exchange and speaker as own listener research provide ways to teach children to move through these critical verbal stages. Incidentally, they also serve as empirical validations of the stages of verbal behavior as potential fractures of human development. The stages of verbal development suggested in Greer (2002) may be natural fractures of communicative development (See Table 1). The listener emersion work showed that after students had the achievement of an empirically measurable level of verbal behavior (i.e., they became listeners) the students required vastly reduced instruction—they were markedly more independent and were more competent learners. In addition, the use of multiple exemplar instruction to teach the naming repertoire resulted in student who moved to the speaker as own listener stage—they were markedly more independent learners than when they did not have naming.

The second area of research involves the development of *generative* verbal behavior. Relational fame theorists (Hayes, Barnes-Holmes, & Roche, 2000) suggested a remote but experimentally accessible environmental source of previously unexplained generative verbal functions—the development of joint control of initially independent verbal operants. They suggested that the source was multiple exemplar experiences (i.e., instructional histories) rather than non-testable psychological constructs such as "intrinsic grammar" (Pinker, 2000). While relational frame theorists have many important conceptual and applied implications, for us, their work suggested that we might be able to teach children much faster. That is, we could teach one function and the other would emerge without direct instruction. Also, our children were now emitting what the relational frame theorists propose as "real verbal behavior" (Hayes et al., 2000). Moreover, we could have access to teaching important cognitive behaviors that were obscured by psychological construct labels. These included: (a) spelling functions, (b) naming functions, (c) transformation of establishing operations across mand and tact functions, (d) acquisition of metaphorical functions, (e) production versus selection functions, and (f) explanations for children's *creative* use of verb tenses (See Catania, 1998 for a discussion of higher order classes of behavior).

Spelling words vocally (an Intraverbal response) is a different repertoire from writing (a dictation response) and these are independent repertoires initially. We have found recently that teaching a subset of these two responses in alternating multiple exemplar fashion resulting in student producing untaught response to novel words without direct instruction resulting in the child emitting generative verbal behavior (Greer, Yuan, & Gautreaux 2003). We also found that the use of multiple exemplar instruction can result in teaching either a mand or tact function with a particular word and gaining the child's usage of an untaught function (either mand or tact) (Nuzzolo & Greer, 2003; Greer, Nirgudkar, & Park 2003). Multiple exemplar instruction also led to the emission of untaught production responses in geometry from learning selection responses only for middle school students for which these responses were initially independent (Gautreaux, Keohane, & Greer, 2003) Moreover, the use of multiple exemplar instruction led to the development of metaphor usage with middle school students who did not do so prior to multiple exemplar instruction (Meincke, Keohane, Gifaldi & Greer, 2003). Finally, Greer & Yuan (2003) found that children's novel, though grammatically incorrect, verb tenses emerged as a result of multiple exemplar experiences with a subset of verb tenses transformed to irregular verb usage (See Pinker, 2000 for an argument that this function is "intrinsic grammar"). While these are early days in our research on these topics the findings are promising.

Conclusions

The nature of a behavior analytic approach to teaching and treatment is, itself, an applied scientific exercise—*applied verbal behavior analysis*. That is, measurement of student responses and graphic displays are critical components of what we do. While we begin our instruction with what we regard as primary best practices, we find that the individual variability of our students leads us to a process that involves fitting one of many tactics to the particular problem encountered by each of our students. Thus, all of our instruction is individualized regardless of class size. For professionals who treat language disorders, individualized treatment is standard procedure, and, thus, the tactics we presented may prove useful to other behavior analysts, and to speech and language therapists who encounter language disorders or deficits such as those we described. The approach may be best characterized as verbal behavior analysis.

Measurement is key to any authentic behavior analysis, be that analysis verbal or nonverbal. This is increasingly important as our armada of research-based tactics grow. The strategies and tactics that we describe herein are effective for students with particular repertoires and deficits and the in situ instructional measurement is necessary to determine which specific tactic is likely to work for a given child. This applies not only to verbal behavior but nonverbal behavior also. This is particularly important in behavior analytic instruction that is devoted to teaching new operants. While the modification of existing operants (e.g., classroom management and the treatment of "bad behavior"), requires certain measurement and analytic procedures, such as the identification of the reinforcement contingencies surrounding "bad behavior," the analysis of the instructional contingencies needed to teach new operants is even more complex. In instructional behavior analysis, the analysis must involve not only the student's behavior and contingencies, but those of the teacher, as well as the joint effects on each of setting events or establishing operations, instructional histories, and certain repertoires associated with phylogeny or environmental insults (i.e., hearing impairments, visual impairment) See Greer (2002) for an elaboration of and research bases for teaching as applied behavior analysis. It is clear that contemporary verbal and applied behavior analysis has progressed to the level of individualized educational treatment.

Skinner's theory has helped us develop research and instructional programs that have proved useful both to the students in our schools and to the professionals in our field. The research on Skinner's theory is used daily in CABAS® schools for several hundred students and has continued to be effective in both the short and long haul. Of course, our research and applications have raised new questions and new perspectives for old problems.

We have described our research findings in this summary rather than all of the literature on verbal behavior because that would be beyond the scope of a single article. Interested readers are encourage to review issues of *The Analysis of Verbal Behavior* for other research findings and theoretical analyses in verbal behavior. In addition, space prohibited us from detailing the specifics of the tactics that have proved useful. However detailed operations can be found in the sources that we have cited and a book in progress (Greer & Ross, 2003).

In closing, we acknowledge that there are many more conceptual research studies needed on Skinner's theory. However, our specific goal was and continues to be pragmatic; that is, does the theory provide potential solutions to instructional or treatment problems that we encounter with our students? That is, does it work? Our answer to date is that Skinner's theory has allowed us to serve our students more effectively and to reorganize instruction and curricula into repertoires of function—it works! In many instances the results have been dramatic, as for example in the cases of students who developed functional verbal behavior or middle school students who met state

writing standards. These were direct benefits of Skinner's contribution. We are encouraged to test further applications as the problems of our students dictate and to disseminate research-based operations that can be used by other professionals and we encourage others to use and further test our findings.

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Several of the papers that we referenced are not published, although most are dissertations available on-line. Nevertheless, except for the section of the paper on generative research, all of the findings have been replicated extensively in practice with numerous children. Given the potential of these findings for improving children's educational prognosis, we believe it important to disseminate our work now. To our way of thinking, this is one of the most important contributions that electronic journals can make to science. We hope the report will encourage applications and further research by other scientists. In the last analysis, the data will tell.

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