Verbal Behavior: What is the Function of Structure?

David C. Palmer
Smith College

How can structural phenomena in verbal behavior be subsumed by a functional account? There are functional segments of behavior longer than the fundamental verbal operants identified by Skinner, segments that "hang together" but are seldom repeated. Verbal behavior conditions the behavior of the listener with respect to an object, condition, or state of affairs, and an utterance is functionally complete when it has done so. Using the effect on the listener as a defining criterion, a behavioral analysis identifies units of analysis that embrace the functional properties of the everyday concept of the sentence, but such units are more flexible and sensitive to context. They can be understood, in part, as autoclitic frames and the variable terms that are interwoven with such frames. Some speculations are offered on how autoclitic frames are acquired and how they are interwoven with other verbal operants.

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Skinner's *Verbal Behavior* (1957) is remarkable for its originality, its erudition, its consistency, and its parsimony. However, on the occasion of the 50th anniversary of its publication, the most fitting homage one can pay to the book is to ask what remains to be done. In this article I argue that one important goal for the next 50 years is to suggest how structural phenomena in verbal behavior can be subsumed by a functional account. By "structural phenomena" I mean the temporal and prosodic arrangement of verbal elements, patterns that are in part embraced by the vernacular term "grammar." I begin such an extension by proposing a behavior analytic interpretation of the "sentence," for as commonly conceived, grammar is a property of sentences, and the structure of sentences is constrained by grammar. It is evident that there are functional segments of behavior that are larger than the primary verbal operants identified by Skinner, segments that "hang together" but are seldom repeated. I suggest that the traditional concept of sentence can be captured, in part, by autoclitic frames and the variable terms that are interwoven with such frames. Our experience with such frames accounts for much of the apparent "behavioral reality" of traditional grammatical terms. However, such an account is not adequate in itself: The behavior of the listener must be taken into account as well. Verbal behavior commonly conditions the behavior of the listener with respect to an object, condition, or state of affairs. An utterance of this sort is, in a sense, "functionally complete" when it does so. I suggest that such distinctions embrace the functional properties of the everyday concept of *sentence*. This falls short of the linguistic notion of the term, but the residue is of no behavioral interest. My remarks on this topic are necessarily tentative, and they are supported only by anecdotes, but they are offered as a starting point to those who would attempt to cross the thin ice of speculation about structural properties of verbal behavior.

There can be little dispute that Skinner's book is an important intellectual landmark, for in its day, it was the clearest example, in the behavioral domain, of a powerful kind of explanation in science, namely, the use of well-

Address correspondence to: David C. Palmer, Department of Psychology, Smith College, Northampton, MA 01063. E-mail: *dcpalmer@smith.edu*

established laboratory principles to make sense of complex and poorly controlled phenomena outside the laboratory. The strategy has long been used in evolutionary biology and particularly in the physical sciences, where principles are well developed. (For a fuller treatment of this topic, see, for example, Donahoe & Palmer, 1989; Palmer, 1991; 2003) Skinner began with the assumption that verbal behavior is just like any other behavior and asked, in effect, "What must be true, if my assumption is correct?" Units of behavior must be sensitive to their consequences; they must come under control of antecedents; they must be sensitive to motivating operations; they must fall into classes; generalization and discrimination must be evident. Much of Skinner's book is allocated to the task of partitioning verbal phenomena along such lines. It was a conservative and parsimonious strategy, and most of it seems to me to be beyond controversy, for it is simply an acknowledgement of the relevance of variables known to affect all behavior. Who can doubt that motivation, stimulus control, response topography, and stimulus modality are relevant to verbal behavior?[1]

But language has some distinctive features that do not seem to arise in an obvious way from such variables. In particular, I refer to structural regularities, that is, constraints on the temporal arrangement of verbal units. It makes a difference whether we say *the light is orange, orange is the light, the orange is light*, or *light orange is the*. The first three examples are "acceptable" in the sense that we can imagine sets of controlling variables under which they might be emitted, and we can imagine other members of the verbal community responding effectively to them. The fourth is acceptable only as an example of a random concatenation of terms, and other members of the verbal community would not differentiate it from a great number of other random concatenations. That is to say, they would all be "nonsense" in that verbal community. Other examples illustrate that even sensible utterances are regarded in some sense as "wrong" or ill-formed: *I gave the library the manuscript* occasions no complaint by a listener fluent in English, but *I donated the library the manuscript* will "sound odd" and although easily understood, it may even occasion a protest.

Of course such regularities have long been studied by other disciplines, and they are the principal subject matter of a branch of linguistics. Although most of our appreciation for the subtlety and complexity of such regularities comes from such sources, the conceptual tools of the linguist and behavior analyst differ substantially. It is unclear how the findings of the former can be used by the latter to extend Skinner's analysis.

The effects of order reflect the conventions of verbal communities; order is not constrained by basic processes, apart from the obvious consideration that two incompatible responses cannot be emitted at the same time. Because such conventions are specific to particular verbal communities, they are of interest only as tests of the adequacy of our approach. Our task is not to explain the idiosyncrasies of English, or any other language, but to show that, as cases in point, they fall within the purview of behavior analysis, for such idiosyncrasies are mysterious from any point of view. We presume that comparable analyses can be applied to the structural regularities of other languages. Skinner devoted about a third of his book to a consideration of such order effects, but his account is incomplete. There are many odd conventions of speech that do not lend themselves to ready interpretation in behavioral terms. In contrast, one can usually invoke a structuralist interpretation of such conventions in terms of rules operating on grammatical categories such as nouns, verbs, phrases, and other parts of speech. Of course such structural interpretations themselves will be inadequate, as they require, in turn, an ac-

[1] That is not to say that the book is without critics. *Verbal Behavior* has been criticized from outside the field of behavior analysis, most notoriously by Chomsky (1959), and from within it (e.g., Hayes, Barnes-Holmes, & Roche (2001), Place (1981), Stemmer (2004), Tonneau (2001).) It is not my purpose to debate these matters here. I find Skinner's book to be sound, and my aim is to extend the analysis, not to defend it. Nor do I object to other behavior analytic approaches to the topic: Variation is fundamental to progress, and it is particularly adaptive when a field is faced with a challenge and the way forward is not obvious. My natural preference for my own speculations is second to my wish for an adequate behavior analytic treatment of the subject matter, whatever its origins.

count of the origin and operation of the rules they invoke, but they provide at least the illusion of progress.

The "Behavioral Reality" of Grammatical Terms

Our first challenge is that the grammatical role of a word or phrase, as traditionally conceived, appears to be a controlling variable in verbal behavior. Such structuralist units do not seem to be mere explanatory fictions. Suppose we make up a nonce term and say, for example, "I zonked my spare hotel key to Robin." Playing along with the whimsy, our listener might respond, "Oh yes; I was zonking mine to the bellhop when I heard a knock at the door;" "Will you ever zonk it to her again?" "Are you still zonking it to her now?" or "I heard that Joe usually zonks his to his mother-in-law on Mondays." Each example illustrates a different conjugation of *zonk* as if it were a "verb." One can easily do an analogous demonstration for nonce nouns, adjectives, and so on. It is evident that a single exposure to a term in a *linguistic* context is sufficient for a listener to generalize in a systematic grammatical way, but it is not obvious what the corresponding behavioral processes are. It is a kind of generalization, but not along a stimulus dimension.

This puzzling generalization is not restricted to nonsense words. When a familiar word is used in an unfamiliar construction, listeners immediately respond to the term according to its grammatical context in defiance of their long histories of responding to it in other ways. P. G. Wodehouse often exploited, for humorous effect, this amiable tendency in his readers. For example, in the following passage a salutation is used as a noun:

> 'I like your nerve, coming bounding about the place, saying "Well, Gussie". That's about all the "Well, Gussie" I shall require of you, Wooster.' (Wodehouse, 1934, p. 83)

Here an interjection is used as a present participle:

> I presumed that he and his girl friend must have just arrived, and that this telephone call was Aunt Dahlia what-the-helling. (Wodehouse, 1963, p. 132)

In the next case, a noun of address is used as a gerund:

> "Less of the 'Bertie, darling'. 'Bertie, darling', forsooth! Nice time to start the 'Bertie, darling' –ing." (Wodehouse, 1937, p. 143)

The third example is particularly apt, for we accept it despite our strong tendency to resist the anomaly of the double syllable. Our task is to offer tentative interpretations of the effortless tendency of speakers to emit such novelties and of listeners to interpret them, but we must do so in our own terms. At present, nouns, verbs, and other parts of speech are not technical terms in behavior analysis; we must either embrace them, translate them, or propose an account that does not employ such concepts.

The apparent control of behavior by nouns, verbs, and other grammatical concepts is only part of the challenge a behavioral analysis faces; perhaps even more formidable is the task of interpreting the orderliness of the relationships among such terms.

The Sentence as a Unit of Analysis

In conventional terms, we say that some strings of verbal behavior are grammatical sentences and are therefore "acceptable" in a verbal community; others are not. In much of contemporary linguistics the sentence is the primary unit of analysis and sentences are defined by their conformity to a set of ordering rules, or grammar. But *grammatical sentence* is not a fundamental behavioral term. Skinner used the term *sentence* 128 times in *Verbal Behavior*, and Chapter 14 was devoted entirely to composition and grammar, but he defined such terms only obliquely:

> The larger segments of verbal behavior resulting from autoclitic activity are usually called sentences. It is commonly said that the sentence, not the word, is the unit of speech, but we have no reason to use the notion of sentence to obtain a unit of verbal behavior more active than word. Verbal behavior is characteristically

dynamic regardless of size or complexity. (p. 345)

He found traditional definitions inadequate or irrelevant to his task:

> Efforts have been made to define a sentence in terms of what it says. The *Concise Oxford Dictionary* gives this definition: "set of words complete in itself containing subject and predicate (either, or part of either or both, sometimes omitted by ellipsis), and conveying a statement, question, or command." Note that the verbal response itself (or the record it leaves) is not the statement, question, or command, but merely "conveys" it. This suggests the expression of an idea or proposition. Characteristically, a sentence is said to be complete only if the "thought" is complete, and so on. But while we may find criteria for the properties of a sentence, *possibly in its effect on the listener with respect to a given state of affairs,* the definition does not help to explain how sentences are emitted. (p. 345, emphasis added.)

At length, Skinner dismissed the topic as behaviorally incoherent:

> A sentence has been characterized as an exercise in "progressive correction"—a response is made and possible misunderstandings are then corrected. We have little reason to suppose, however, that all sentences will show such a pattern or that they are designed to serve any one general function. The primary operants in a sentence are due to complex and changing variables, and many other responses are strengthened as soon as a sentence is begun. The speaker may later find himself with unused responses which must somehow or other be incorporated into the sentence, or with lacunae which must be filled by a search for new material. It is scarcely worth dignifying the result of all these activities with a special name which might be taken to imply a single process. (p. 354)

We can perhaps agree that the term *sentence*, inherited from the vernacular and codified by an incompatible discipline, is not a unified behavioral concept. Nevertheless, that does not mean that there is nothing to explain. That the term so often appears in Verbal Behavior as an informal, self-evident concept suggests that it is not the superfluous effluvium of an outmoded discipline. Let us begin with the hypothesis that there are units of behavior longer than the primary verbal operants identified in Verbal Behavior. How might we evaluate this hypothesis, without resorting to grammatical conventions or vague concepts such as "complete thought?"

I too surveyed dictionary definitions and other scholarly discussions of the sentence, and like Skinner, found them to be behaviorally circular; that is, definitions included terms that themselves required a behavioral interpretation. However, some authorities have also noticed the problem of circularity and attempted to address it. Consider the following fragments: *Tomorrow, if I have anything to say about it*; *Not as far as I know*; *Not on your life*; and *On the shelf*. In appropriate contexts, such expressions are perfectly acceptable to a listener, but traditional grammarians would not call them *sentences,* for they do not conform to standard grammatical rules. Nevertheless, William Fowler, an authority on English grammar and style, remarked:

> These cannot be denied the right to be called sentences, but it would be straining language to say that they are elliptical in the sense that 'a subject or predicate or verb (or more)' must be 'understood'. Grammarians are free to maintain that no sequence of words can be called a sentence unless it has a grammatical structure, but they should recognize that, except as a term of their art, the word has broken the bounds they have set for it. . . [*Such expressions*] *must be judged by their success in affecting the reader [or listener] in the way the writer intended.* (Fowler, 1965, p. 546, emphasis added)

Notice that both Skinner and Fowler suggest that the orderliness they seek lies in the effect on the listener. Of course this, by itself, is not

a novel suggestion. It is the standard practice of linguists to consult the grammatical intuitions of native speakers. But such intuitions are not regarded as fundamental or decisive, for judgments of grammaticality are notoriously variable and inconsistent; under some conditions almost anything is acceptable to a listener. To a behavior analyst, this is unremarkable, for all behavior must be understood in context, but linguists set aside questions about units of behavior in favor of pursuing an essentialistic abstraction that transcends the peculiarities of individual cases. They assume that it is possible to model language without reference to stimulus and response classes. However, as Fowler points out, this view of the sentence is just a paradigmatic assumption, "a term of their art." Therefore, traditional assumptions need not constrain us. Free of such constraints, we can begin our own inquiry by reflecting on the behavioral tradition in which defining properties of concepts are determined.

Identifying Units of Analysis in a Science of Behavior.

The identification of units of analysis is science is often left to the whims of the scientist. Behavior analysis is unusual, among other ways, in that such identification is referred to the subject matter itself, a policy codified by Skinner (1935) in *The Generic Nature of the Concepts of Stimulus and Response.* Specifically Skinner suggested that the optimal definitions of both stimuli and responses are those that yield the most orderly relationships between terms and that this is an empirical matter, not one to be decided by fiat. For example, in a differential-reinforcement-of-low-rate 5-second schedule of reinforcement (DRL-5") we might choose to count only key-pecks with an interresponse time of 5.0 to 5.05 seconds. But as I have found, responses that meet this narrow window occur haphazardly in time. By successively adjusting the definition of the response to be within narrower and wider temporal windows I have found an optimal response definition under such a schedule to be from about 4.5 to 5.5 seconds; so defined, responses occur at a steady rate over time: A cumulative record of such responses is nearly a perfectly straight line. According to Skinner, these observations suggest that the broader definition of the target response in this context is preferable; narrower definitions and still broader definitions of the response lead to a weakening of observed relationships between behavior and its controlling variables. Thus the behavior analyst does not impose a definition in his subject matter; he discovers it. (See Palmer & Donahoe, 1992, for further development of this topic.)

Skinner found, at least for behavior in the operant chamber, that responses can often effectively be defined by their effect upon the environment; "any behavior that closes the switch behind the lever" is commonly an appropriate starting point for discovering an optimal definition. Mechanisms of behavior control evolved in natural environments; it is fitting that responses that have similar effects on the environment should covary. Thus, following prolonged exposure to a contingency of reinforcement, a response can commonly be effectively defined as any behavior that meets the prevailing contingency (cf. Catania, 1973.). Of course, the appropriate response definition must be modified following systematic programs that lead to response differentiation (such as DRL schedules).

Identifying Extended Units of Analysis in Verbal Behavior.

Consider how we might apply these methodological precepts to the definition of units of verbal behavior. We must abandon a priori grammatical definitions and look for order in the behavioral context in which such putative units occur. Unfortunately, rate of response is of limited use in the domain of verbal behavior, for verbal responses change the context in which they occur. Specifically, they change the listener from someone who, so to speak, does not know what we have to say into one who has already heard what we have to say and is in no mood to hear it again. Since social contingencies punish repetition of verbal responses under most conditions, the effect of reinforcement must be evaluated relative to a naïve audience under otherwise identical controlling conditions.

Such circumstances are rare and difficult to arrange.[2] The successive refinement of response definitions described by Skinner (1935) must be suited to the peculiar features of the subject matter. For purposes of merely demonstrating that relatively long sequences of verbal elements can be considered behavioral units, we can perhaps follow the suggestion of Skinner and Fowler and look to the effect of an utterance on the listener as a defining criterion. As noted above, operants are commonly defined by their effects on the environment, social or otherwise. For present purposes, I speak of "verbal elements," as a vague term of uncertain application, rather than "verbal operants" in order to avoid committing myself in advance to an assumption that the larger units we are considering are strings of verbal operants.

When we apply the methodological precepts of Skinner (1935), we immediately discover a level of organization larger than that of primary verbal operants. Let us interview a shepherd, unschooled in the niceties of formal grammar—if we can still find so unspoiled a person—and watch his responses to various verbal strings extracted from a scrap of speech overheard in my kitchen: *Has anyone fed the cat yet? She acts as if she's starving*. Following Skinner, we vary the size of the putative response units:

cat yet
yet she acts
the cat yet she
fed the cat yet she acts as if

and so on, with our window shrinking and expanding and shifting location irrespective of our own prejudices as native speakers of the tongue. Our hypothetical shepherd will respond with good-natured bewilderment for all such nonsense, but will respond quite differently to the strings, *Has anyone fed the cat yet?* and *She acts as if she's starving*. To put it another way, for the listener there is greater coherence within certain verbal strings, as stimuli, than between such strings. That is, *the cat yet* "goes with" *has anyone fed* more than it "goes with" *she acts* or any other concatenation of terms. The boundaries at which the light of intelligence suffuses our shepherd's face will typically coincide with strings considered by the grammarians to be sentences.[3]

This exercise may seem like a peculiar, awkward, and unnecessary way of arriving at the obvious conclusion that verbal behavior is organized at a level longer than the word and, apparently, longer than, and different from, the primary verbal operants discussed by Skinner. But at the very least we have identified an objective procedure with an impeccable behavioral pedigree that enables us to identify units of analysis that are independent of our own opinions as speakers.[4] It is not enough that a conclusion be obvious; it must be consistent with the precepts of our discipline. More importantly, the procedure yields some unexpected results: In many cases, our shepherd will respond appropriately to strings that do not conform to the rules of the grammarian. In certain contexts, for example in response to a question, the utterance *There!*, or *On the top shelf*, or *Behind the peanut butter*, or a mere gesture will be just as effective as any grammarian's sentence, as Fowler observed. Moreover, one some occasions

[2]Such conditions tend to hold for actors and comedians who tend to meet naïve audiences on successive occasions that are otherwise nearly identical. A line that gets an enthusiastic response on one occasion is likely to be repeated on another. In recent years speed-dating services have become available in which hopeful individuals meet for a few minutes with prospective partners and then move on to the next person, rather like a chess master playing twenty opponents simultaneously. Although such conditions emulate a discrete trial procedure rather than a free-operant procedure, response frequency might be a fair index of response strength under these circumstances, at least for a narrow range of topics.

[3]It is evident that such a procedure will not produce unique results with textual stimuli. A word or phrase, such as *quickly*, or *in my opinion*, might easily be the end of one unit or the beginning of another. However, spoken verbal behavior is marked with prosodic cues that serve to identify the boundaries of units. In text, initial capitalization and the closing period serve to mark unit boundaries, and it is testimony to the importance of identifying such units that these conventions are so commonly observed. The contrary fashion among "text messagers" is likely to fade, for it necessarily leads to ambiguity.

[4]The procedure I have described appears, at first, to be identical to that of the linguist who consults the intuitions of native speakers to distinguish between grammatical and ungrammatical strings. An important difference is that the linguist views the effect of an utterance on an audience to be, not a primary datum of interest, but only a clue to an underlying grammar. Judgments that do not conform to a prevailing grammatical model are dismissed as errors. In contrast, the behavior analyst adopts the axiom that behavior is always "correct" and that our theories must adapt themselves to the data, not vice versa. Thus the units of interest to the behavior analyst will necessarily differ from those of the linguist. Gestures, grunts, phrases, numbers, verbal slips, and so on, will sometimes be given consideration equal to that of paradigmatic sentences.

a sentence, as traditionally conceived, will be too short a unit. The joke offers a convenient example. It hangs together as a verbal unit and is not complete until the punch-line is reached. Our listener will not thank us for telling the first few lines of a joke and walking away. Jokes are intraverbal chains, and as in all such chains, topography by itself is particularly misleading as a guide to the size of the unit of response. Thus, as often happens, the behavioral unit does not conform neatly to the traditional term. In fact, the behavioral unit corresponds more closely to our observations, for it is commonly noted that speech is littered with fragments, anomalies, and false starts, all of which are commonly acceptable to listeners. Moreover, such a procedure weeds out grotesque strings of words that are easily generated by formal grammars but that are gibberish to a listener, such as deeply embedded relative clauses: *The man the senator the woman the plumber the gardner advised flirted with voted for condemned in a stump speech slept till noon;* as well as those that are composed by drawing adjectives, nouns, verbs, and so on, from a row of jars, like Chomsky's well-known example, *Colorless green ideas sleep furiously*, and an infinite number of other strings that have no more behavioral effect on a listener than white noise. Our task was to identify appropriate behavioral units of analysis, not to justify traditional formulations.

I have deliberately left the "response" of our hypothetical shepherd vague, for there is no invariant listener response to extended verbal units. I have resorted to the intuitive notion that our shepherd will announce that some strings "make sense," that they are "acceptable," that he can imagine conditions under which someone might utter them, but these responses do not exhaust the class of appropriate responses to a verbal string, nor are they even typical. A rat may press a bar because in the past bar-pressing has been followed by food, but speakers seldom utter strings because in the past listeners have pronounced such strings "acceptable." If units of verbal behavior are to be identified by their effects, we must look to other responses of the listener. A survey of such effects is far beyond the scope of this paper, but I discuss two that seem to me to be particularly important.

In many cases, a verbal unit will occasion effective action in the listener. He will tend to respond effectively to utterances such as *There!,* or *On the shelf*, or *You'll find the keys in the top left-hand drawer*, or *Please hand me that wrench*. Prompt, effective action in the listener is therefore one possible consequence of an effective unit of behavior. Typically such consequences are reinforcing to a speaker, but the verbal community tends to supply supplementary reinforcement if necessary.

In many other cases, however, the listener does not appear to respond at all, but at a later time we discover that his behavior has been modified: If I announce that my brother's name is Arthur, or that I was born in Massachusetts, my listener may not respond overtly, or at least in any conspicuous way, at all; however a half-hour later he may respond correctly to a question about my brother's name or my native state. In the former case, in which the listener takes effective action, verbal behavior serves some discriminative function, and one can imagine a history that would lead to such discriminative control. However, the latter case of "imparting latent knowledge" is particularly arresting, for it illustrates the conditioning of novel behavior of the listener by a verbal stimulus in the apparent absence of contingencies of reinforcement. This topic is too complex, and I understand it too poorly, to analyze it further here (but see Palmer, 2005, for some tentative ideas). Nevertheless, many verbal strings have the following effect: They condition the behavior of the listener with respect to some stimulus, complex of stimuli, condition, or state of affairs and are functionally complete when they have done so. In such cases, the stimuli that reinforce the behavior of the speaker are necessarily subtle and indirect: The listener's gaze and expression will convey "understanding;" he may nod or mutter assent. We can see the importance of such cues when they are absent; if a listener's expression is vacant or confused, we repeat ourselves or speak more slowly. On the telephone, we require frequent murmurings from our listeners, and if the line is silent for long, we ask for confirmation that our listener is still there.

In traditional terms, a sentence consists of a subject and a predicate. In behavioral terms, the subject is the stimulus, condition, or state of affairs, with respect to which the listener's behavior is conditioned, and the predicate brings about the conditioning of new behavior with respect to the subject. It is this effect, among others, that listeners discriminate when they label something as a "sentence," or mark it "acceptable," or say they "understand it." In effect, they are saying, "My repertoire has been successfully altered with respect to the subject at hand."

Almost any salient verbalization brings about some conditioning. If I announce "The boy's bicycle…" my listeners are likely to be able to report, some half-hour later, that I brought up the boy's bicycle. In this case, their behavior has been conditioned with respect to my behavior as a stimulus, as it might have been conditioned by witnessing any salient event: a frog on the porch, a salt-shaker in the shape of a nutcracker, a jogger with a ponytail. However their behavior has not been modified with respect to the boy's bicycle. But if I announce "The boy's bicycle is blocking the driveway," they can report what I said, as they would with respect to any other event, but they will also behave in a new way with respect to the boy's bicycle. This analysis applies to paradigmatic expressions customarily considered to have a subject and a predicate, but it applies equally to strings of interdependent strings (jokes, anecdotes, epigrams, etc.) and, with contextual support, to phrases ("on the shelf"), clauses ("when I get around to it"), or single words ("there!"). In the latter cases grammarians speak of "elliptical sentences" with subjects or other terms "understood," but that exercise is merely an attempt to salvage structuralist models of verbal behavior and is of no relevance here.

I am suggesting, then, the following:

1) Although many examples of verbal behavior exert simple discriminative control over the behavior of the listener, other examples condition the behavior of the listener with respect to a condition, stimulus complex, or state of affairs. (The role of the listener in this process is poorly understood. See Palmer, 2005.)
2) This conditioning is occasioned by strings of verbal elements that are often, but not necessarily, longer than the primary operants discussed by Skinner.
3) It is the function of structural properties of verbal behavior to bring about such conditioning.
4) Listeners can usually discriminate the successful conditioning of their behavior and mark strings as "acceptable," "grammatical," "complete," or "intelligible" accordingly.
5) This conditioning, whether it is discriminated by the listener or not, provides one behavioral interpretation of the traditional notion of "grammatical sentence."
6) The overlap in the two concepts is by no means complete, but the linguistic residue may be of no behavioral interest. The behavioral unit is fluid, flexible, and must be analyzed with respect to the unique complex of prevailing conditions.
7) This proposal is not intended to be exhaustive. Some utterances have other effects on the listener, and they will be marked "acceptable" or "unacceptable" accordingly. I am limiting myself to examples that seem to me to be particularly relevant to structural features of verbal behavior.

I believe that these suggestions accommodate, at least in part, the apparent "behavioral reality" of the everyday concept of the sentence and the intuitive notions of subject and predicate.

However, we are still left with many puzzles. Verbal strings that have the required effect on listeners are seldom repeated, so we must explain how they come to have the structure they do and how they exert their effects. In addition, we must explain the origin of subtle grammatical intuitions and the ease with which people generalize nonsense words according to their apparent grammatical category. I suggest that Skinner's concept of the autoclitic frame provides the starting point for an interpretation of such phenomena.

The Role of Autoclitic Frames in Verbal Behavior

Skinner identified various verbal operants he named autoclitics that, broadly speaking, serve to arrange and modify the effect of other verbal operants. It is these responses that serve as the latticework that provide much of the structure under consideration. The most general of the autoclitics discussed by Skinner is also the most relevant here: Autoclitic frames are verbal operants consisting of alternating fixed and variable elements controlled by some feature common to all cases. For example, the frame *X gave the Y to the Z* can be completed by a vast variety of variable terms, X, Y, and Z, that are specific to particular contexts: *I gave the letter to the postman; He gave the change to the cashier; I gave the tickets to the lady at the desk;* and so on. In any verbal community there are a vast number of such intraverbal frames, far more than there are words, for a given word is often an element of a variety of frames, e.g., *X gave me the Y*.

Very young children quickly become adept at such frames. "Sing X again!" "Play X again!" "Give me an X!" are common cries. In some repetitive children's songs, such as Old MacDonald, a single frame is reiterated with different animals, objects or numbers serving as variables. Within a few years, their speech is riddled with frames: *X goes to Y; X gave the Y to the Z; X gave Z Y; Put the X on the Y; The X is being Y-ed by the Z; If X then Y; When W X's, Y Z's,* and so on. In speech directed to children in their first year or two, approximately half of all new words occur in constructions that appear to be autoclitic frames (Cameron-Faulkner, Lieven, & Tomasello, 2003). A few standard frames account for most of the cases: *Look at the X; Give me the X; Where's the X? Do X again*. Moreover, these frames serve an important function as indexed by the fact that children respond discriminatively to words about 120 msec faster when they appear in frames than when they occur in isolation (Fernald & Hurtado, 2006).

Such frames are a type of complex intraverbal and like all intraverbals have *formal* structure; one cannot substitute terms without losing the intraverbal control that is characteristic of such frames. Thus the functional feature *is* the structure. This fact perhaps accommodates the prevalence of structuralist approaches to verbal behavior.

But it is a formidable task to identify such frames, for structure alone is no guide; a given string can have arise from a variety of controlling variables, as Skinner has amply noted. Moreover the boundary between frame and variable is often unclear, since some elements of the frame appear to change according to context. Under some conditions we might say, *He gave the change to a cashier*, or *to his cashier*, rather than *to the cashier*. Is the definite article part of the frame or part of the variable? Verbal behavior is so flexible that the very notion of frames as units must be considered with caution.

Nevertheless, the plausibility of an analysis in terms of autoclitic frames can be demonstrated in highly constrained contexts (Palmer, 1998; Wright, 2006). In a demonstration experiment, Silvestri, Davies-Lackey, Twyman, and I found that young children would conform to a distinctive frame repeatedly modeled by an adult. Specifically, children learned a particular form of the passive construction: T*he X is being Y-ed by the Z*. The adult would present a picture of two animals interacting and announce, according to context, *The panda is being tickled by the chicken*, or *The elephant is being pulled by the mouse.* Over the course of 20 to 40 trials all six subjects acquired all or most of the frame, when describing novel picture, in just the form in which it was modeled, with only the variable terms changing according to context. In this case, the frame was repeated exactly as modeled, suggesting that the prepositions and definite articles were acquired along with the other parts of the frame. This is consistent with studies by Tomasello and his colleagues who have found that in the initial stages of learning some expression children are very conservative in generalizing to novel examples (e.g., Akhtar & Tomasello, 1997; Tomasello, 1992; Tomasello, Akhtar, Dodson, & Rekau, 1997). Such experiments suggest that frames are acquired in a particular form through modeling by the verbal community but that individual elements of a frame eventually become subject to

multiple sources of control. For example, the relative response strength of the definite article and the indefinite article shifts according to context in a wide variety of verbal expressions. Thus the form of any expression may be partly determined by the autoclitic frame, as commonly heard in a particular verbal community, and partly by concurrent variables, according to one's history.

It is evident that a frame of the sort *X gave me the Y* is, in traditional terms, a sentence waiting for a context. When an appropriate context occurs, the behavioral processes by which autoclitic frames are interwoven with variable terms will generate a string that conditions the behavior of the listener in a characteristic way with respect to X and Y. It may be, then, that autoclitic frames account for a substantial portion of the structural properties of verbal behavior that underlie linguistic models of language as well as popular notions of the organization of verbal units.

Autoclitic frames are usually dominated by one distinctive response form; the other elements are common to many frames; e.g., *X sent the Y to the Z*; *X gave the Y to the Z; X presented the Y to the Z.* In the English language, terms traditionally called verbs tend to serve as the dominant term in autoclitic frames, with prepositions, articles, and affixes serving subordinate roles, and nouns, adjectives, and adverbs serving as variables. Although there are many exceptions, the regularity is noteworthy. To the extent to which it is true, it offers another bridge between traditional grammatical concepts and a functional account. To investigate the generality of this suggestion, I consulted a list of verbs compiled by Levin (1993), discarded those with a common root, and took a random sample of the remaining 2941 verbs. I found that 88% of my sample typically appear in characteristic autoclitic frames: *X abandoned Y; X is preoccupied by Y; X proves Y; X coincides with Y; X sent the Y to the Z*; and so on. It appears, then, that verbs, as traditionally conceived, typically employ a retinue of other terms in distinctive roles; or in short, they typically occur in autoclitic frames.

As noted above, verbs constrain the variable terms in their frames to characteristic roles. In the frame *X gave the Y to the Z*, X is a "giver," Y is something "givable," and Z is a "receiver." These roles come close to having distinctive stimulus properties, albeit complex ones, and therefore imply gradients along which generalization might occur. (It is possible that the most reliable of such properties are to be found in the response of the witness rather than in the properties of the role-players and their actions; to give someone measles is quite different from giving him a pencil, and to leave someone an inheritance is quite different from leaving him a book. Nevertheless, the unity implied by the concept of a "role" offers a point of application for concepts of stimulus control, discrimination, and generalization. My survey of verbs confirmed that they tend to be occasioned by circumstances that, although temporally extended, are evanescent, whereas the variables controlling nouns tend to be stable over time. Again, despite exceptions, the regularity offers another possible objective foundation for the apparent behavioral reality of formal grammatical concepts.)

Implications for Grammatical Intuitions

In English, verbs are conjugated according to tense, person, and number, and in many examples, the modification by these variables is consistent and predictable, i.e., the verbs are "regular." To the extent to which verbs are verbal operants that entail certain types of frames, speakers can generalize appropriately. The frame *X zonked his Y to Z*, has distinctive features that control appropriate generalization to *X was zonking his Y to Z; Will X zonk his Y to Z;* and so on. It is not the fact that *zonked* is a verb that enables us to generalize so, for *zonked* isn't "really" a verb. It is the fact that *zonked* appears in a distinctive frame that enables us to generalize so. A *verb* is an abstraction that plays a role in our models of verbal behavior. A *frame* is a set of intraverbally related terms that have stimulus properties when heard, and response properties when spoken, and it therefore has dimensions that permit us to talk, however tentatively, of generalization.

The concept of autoclitic frames helps us

interpret the "behavioral reality" of parts of speech. We accept Wodehouse's diverting verbal novelties because his terms fall into appropriate roles in autoclitic frames. For example, *It was Aunt Dahlia what-the-helling* is an example of the frame *It was X, Y-ing*, occasioned by a scene in which X is doing Y, and *Nice time to start the Bertie darling-ing!* is an example of the frame *Nice time to X the Y-ing*, occasioned by a scene in which the activity Y is falling short of or exceeding its welcome. Such frames are familiar to the reader; if they were not, the verbal novelty would fall flat. Even our shepherd will understand the novel constructions. In contrast, he would be baffled if he encountered *Bertie darling-ing* in isolation, and it wouldn't help to tell him "*Bertie darling-ing* is a gerund." It appears to me that the concept of the autoclitic frame accommodates "grammatical intuitions" better than traditional grammatical concepts, for such frames take their place in stimulus and response classes better than the formalisms of grammar do.

The Acquisition of Autoclitic Frames

According to the present hypothesis, the acquisition of verbal expressions that have distinctive structural features should be interpreted, at a minimum, as the acquisition of autoclitic frames and variable terms appropriate to those frames. Through modeling in a verbal community, many autoclitic frames are acquired under distinctive stimulus control. If we covertly echo a sufficient number of cases of *The X is being Y-ed by the Z* in the context of pictures of Z doing something to X, that frame will have strength in that context in the future, like any other intraverbal sequence. The variable terms, X, Y, and Z are tacts and are acquired separately. The context will typically evoke both the frame and the tacts concurrently. Moreover, we can assume that this potentiating effect of the context will generalize to other contexts that either share critical features with the training context. Perhaps more commonly, the effect will generalize to contexts that evoke behavior that shares critical features with that evoked by the training context: If one laughs at an anecdote and laughs at a cartoon, or tacts both a predator and a disease as dangerous, the corresponding events may have no stimuli in common but still potentiate many of the same verbal operants, including autoclitic frames.[5]

Once an utterance is initiated, stimulus control over verbal behavior oscillates between variable and frame, variable and frame, until the utterance is complete. The variables responsible for these shifts in stimulus control are obscure. (See Donahoe & Palmer, 1994/2004, pp. 312-317 for further discussion.) Setting aside this problem for now, the potential scope of this proposal appears to be vast: Listeners are exposed to a great, albeit finite, number of examples of such frames, and if acquired, can be generalized to a much greater number of circumstances in which the requisite roles of the variable terms are encountered.

Empirical work is consistent with the proposal that frames can be acquired through exposure and generalized to novel contexts. As noted previously, young children can acquire the passive voice frame in a highly specific context through modeling of appropriate autoclitic frames (Whitehurst, Ironsmith, & Goldfein, 1974; Wright, 2006). A study by Goldberg and her colleagues found similar results with college students exposed to an artificial grammar in which nonsense words appeared in novel frames (Goldberg, Casenhiser, & Sethuraman, 2004). Each frame was viewed, with various probabilities, in the context of a video of a person and an object. The nonsense word in the frame was given the suffix "-o" and inflected as if it were a verb. The corresponding video would show a puppet scene with a character or object appearing out of nowhere. For example, in the presence of the string, *The king the ball moopoed*, a ball would roll from off-screen into the presence of the king. Thus the inflection of the nonsense word, in a form suggesting a verb function, was correlated with a particular novel meaning, namely, the appearance of the relevant

[5]Generalization according to the stimulus properties of behavior rather than environmental stimuli can be presumed to underlie many examples of appropriate responding to stimulus relations. The relation "X is one meter to the left of Y" lies not in the stimuli themselves, which can vary nearly without limit, but in one's response to the stimuli. Such behavior can be as explicit as a measurement response, as subtle as a saccade, or, perhaps, as intangible as a covert shift of gaze.

variable term. Thus subjects were exposed to a variety of examples of the autoclitic frame, *The X the Y Z-oed*, in contexts sharing a distinctive stimulus property. After only a few minutes exposure to such examples, subjects generalized to novel examples of nonsense words and the theme of appearance, and the effect was particularly pronounced for those subjects who had encountered the same "verb" with relatively high frequency. The point of this study was to show that high-frequency exposure to a particular frame facilitates acquisition and generalization, for children commonly hear a few verbs in particular roles at very high frequency, such as *give*, *go*, and *put*. Mastery of those verbs-in-frames may facilitate generalization to other dative and locative verbs that are encountered less frequently but occur in similar frames with variable terms playing similar roles.

Such studies illustrate that repeated exposure to sequences of autoclitic frames in characteristic contexts is sufficient to modify the subsequent behavior of the listener. The listener interprets novel examples of such frames correctly, but also utters them in appropriate contexts when he speaks. This is clearly of great importance in language acquisition, for it is a tenable hypothesis that all "grammatical" phenomena are acquired in this way: In a verbal community a person hears a vast number of examples of such frames; to the extent that such experiences induce a corresponding change in his repertoire, there will be "structural" features of his verbal behavior characteristic of that verbal community. That is, grammatical regularities will spread through a verbal community.[6]

Something of the sort must happen, of course. But it is unclear how such an effect is produced by such experiences, and formidable interpretive problems remain. The behavior of the listener is poorly understood. The listener must "pay attention," and that everyday term covers a lot of behavioral events. I suggest that one such event is covert echoic behavior. Echoic behavior transforms a verbal stimulus into a verbal response. If I mention that Lenox is the summer home of the Boston Symphony Orchestra, and if my listener subsequently responds *Lenox* to the question, *Where did he say the summer home of the orchestra was?* we must explain why the word *Lenox* has any strength at all in the person's repertoire (assuming it to have been a novel word). But if we assume that the listener echoed the statement, the word would have been, in effect, transduced from a verbal stimulus to a verbal response at the moment it was heard.

Covert echoic behavior plays a central role in any interpretation of verbal behavior, for it can explain how novel frames and other verbal stimuli acquire strength in the listener's repertoire in characteristic contexts. Although it is experimentally intractable, it has the advantage of being both plausible and consistent with the little evidence we have about the physiological relationship between auditory stimuli and vocal behavior (e.g., Fadiga, Craighero, Bucchino, and Rizzolatti, 2002; Hickok, Buchsbaum, Humphries, and Muftuler 2003; Paulesu, Frith, and Frackowiak, 1993).

Let us suppose, then, that autoclitic frames are heard and echoed in characteristic contexts and that such episodes are sufficiently rich that some reinforcement of behavior typically occurs. In this way the relevant context acquires control over the autoclitic frame, and in the presence of a suitable audience and under appropriate motivating conditions, subsequently evokes it. For example, an act of giving tends to potentiate the frame *The X is giving the Y to the Z*, *X is donating the Y to the Z*, and no doubt many others. Which frame is dominant, if any, will presumably be determined by incidental variables. Furthermore, we can assume that tacts, specific to the context, will also be potentiated by the context: If a woman is tipping a bellhop with a $5 bill, a wide variety of tacts will be potentiated, including, perhaps, *woman*, *bellhop*, and *five dollars*. Countless other discriminative responses will be potentiated by the setting as well, including, perhaps, *rich,*

[6]In some respects this account is compatible with relational frame theory, for many autoclitic frames are relational in nature. Most verbs specify relations, as the terms *transitive*, *intransitive*, *locative*, and *dative* suggest. Multiple exemplar training is central to both accounts. Whether they are compatible in other respects I cannot say. I am attempting to provide interpretations of moment-to-moment fluctuations in stimulus control of verbal behavior, which are a different level of analysis from the higher-order response classes of relational frame theory.

generous, kind, grateful, or *self-important, servile, haughty*, *hypocritical*, etc. At any moment, the number of possible courses an utterance might run is incalculable. We assume, for the sake of a consistent account, that there are subtle variables that determine which responses are strongest at any time.

Unfortunately, beyond this point our account becomes ever more speculative. The emission of an effective response requires extremely rapid shifts in stimulus control over the frame and variable terms. For example, the frame, *The X gave the Y to the Z*, must be interwoven with the tacts that *X, Y*, and *Z* represent in this example. Since X, Y, and Z are variables, they do not have invariant phonemic properties, so it is unclear what stimulus properties control the shift from one term to the next. To state the problem more explicitly, if *to* is at least partly under intraverbal control of *gave*, why does it not occur immediately following *gave* rather than following a word (i.e., the variable *Y*) that it may never have followed in the past and which, therefore, exerts no intraverbal control over it at all? It is clear that the variable *Y* should not, by itself, evoke *to*.

But variable terms must have invariant properties, or the problem facing the speaker would be insurmountable. In fact such terms do have invariant properties, albeit non-phonemic ones. Consider the analogy of a man who repeatedly dines at a cafeteria with a buffet table. Every day he walks from one end of the table to the other, and at each station he selects an item: a beverage, some bread, a salad, a main dish, a dessert. He steps to the right, surveys the items, selects one, steps to the right, surveys the items, and so on, and at length, he emerges at the end of the buffet with, perhaps, a unique meal every day. His progress from station to station is the frame, the items he selects from the respective displays are the variable terms, and the meal is the novel outcome. We have no trouble accounting for this sequence of behavior, for at every transition in the performance there are invariant relationships between events. It is true that the chosen entrée may differ from day to day, but the selection always terminates with placing an item on the tray. That is the stimulus that controls stepping to the right. The act of successfully selecting has invariant properties even though the items selected do not.

Analogously, in the frame *The X gave the Y to the Z*, the variable term *Y* may differ from occasion to occasion, but all instances take time to utter, and they all consist of a verbalization, and they all involve discriminative behavior (commonly a tact) with respect to the variable term. Even the most general of these properties of a response might account for some variance. If we substitute a nonsense word for *Y*, or even a non-vocal buzz, a listener is likely to interpret a relevant utterance better than if *Y* is omitted entirely. *The doctor gave the bzzzt to the patient* is likely to be more acceptable to a listener than *The doctor gave the to the patient*, and we can assume that there is a corresponding advantage for the speaker as well. That is, in the former example, the frame retains its function, merely leaving the listener wondering what it was that was given to the patient, whereas the latter, if uttered fluently, without pausing for the missing variable, is bewildering.

In addition to simply making noise and filling time, variable terms may have invariant prosodic properties. The variable terms in autoclitic frames tend to be stressed: *The king gave the sword to the duke*; *the apprentice gave the wrench to the plumber*; *the mailman gave the letter to the doctor*. Prosody plays many roles in verbal behavior, and one of those roles may be to mark transitions in autoclitic frames.

Finally, variable terms in autoclitic frames have characteristic roles. The tacting of an item is doubtless a discriminable event in any case, but the tacts in particular frames are distinctive. In the frame *X gave the Y to the Z*, *X* is a giver, *Y* a thing given, and *Z* a receiver. The very concept of a "role" suggests that discriminative responses to one role will differ from discriminative responses to another role. To the extent that there are distinctive responses to such roles, these responses may serve as controlling stimuli for transitions in autoclitic frames. That is, the speaker may respond to his own discriminative responses to his own verbal behavior as he speaks. In summary, I am suggesting that the rapid shifts in stimulus control characteristic

of fluent verbal behavior pose a formidable challenge to our interpretive accounts but not, I think, an insurmountable one.

Conclusion

The apparent inability of behavior analysts to account, in detail, for structural regularities in language has encouraged the pursuit of competing explanations that make little reference to stimulus classes, response classes, or principles of behavior. Nevertheless, behaviorists are perhaps unique in having analytical tools to determine units of behavior (Skinner, 1935), and when applied to verbal behavior, these tools permit us to identify extended units that correspond roughly to those embraced by the essentialist concept of grammatical sentence. But the overlap is not perfect. Behavioral units are dynamic, flexible, and context dependent, and they embrace units ranging from speech sounds, gestures, and phrases to sentences, anecdotes, and memorized speeches. The function of verbal behavior is to affect the listener in characteristic ways, and units are functionally complete when they have done so.

I have pointed out some variables that may help us understand the behavior of the speaker of autoclitic frames, but I have not attempted to explain how such frames have the characteristic effects that they do on the listener. Novel examples of variables in autoclitic frames commonly alter the repertoire of the listener with respect to the "subject" of the frame. Although I am do not fully understand how this happens, I am persuaded that the listener is active and that any long-term effect on his repertoire is a joint product of the verbal stimulus and the echoics, elaborations, imagery, and other behavior in the listener. The listener is not a bowl into which verbal behavior is poured but a chef who whips together his ingredients and bakes them into a new confection.

Extended units of verbal behavior pose a formidable interpretive challenge; because listeners tend to punish repetition, and because verbal behavior is sensitive to so many concurrent variables, units are seldom repeated. However, a complete account of the interweaving of tacts and autoclitic frames will go a long way toward achieving an adequate interpretation of such extended units.

References

Akhtar, N., & Tomasello, M. (1997). Young children's productivity with word order and verb morphology. *Developmental Psychology, 33*, 952-965.

Cameron-Faulkner, T., Lieven, E., & Tomasello, M. (2003). A construction based analysis of child-directed speech. *Cognitive Science, 27*, 843-873.

Catania, A. C. (1973). The concept of the operant in the analysis of behavior. *Behaviorism, 1*, 103-116.

Chomsky, N. (1959). Review of Skinner's Verbal Behavior. *Language, 35*, 26-58.

Donahoe, J. W., & Palmer, D. C. (1989). The interpretation of complex human behavior: Some reactions to Parallel Distributed Processing. *Journal of the Experimental Analysis of Behavior, 51*, 399-416.

Donahoe, J. W., & Palmer, D. C. (2004). *Learning and complex behavior*. Richmond, MA: Ledgetop Publishing (Originally published in 1994).

Fadiga, L, Craighero, L., Bucchino, G, & Rizzolatti, G. (2002). Speech listening specifically modulates the excitability of tongue muscles: A TMS study. *European Journal of Neuroscience, 15*, 399-402.

Fernald, A., & Hurtado, N. (2006). Names in frames: Infants interpret words in sentence frames faster than words in isolation. *Developmental Science, 9*, F33-F40

Fowler, H. W. (1965). *Modern English usage* (2nd ed.). Oxford: Oxford University Press.

Goldberg, A. E., Casenhiser, D. M., & Sethuraman, N. (2004). Learning argument structure generalizations. *Cognitive Linguistics, 13*, 289-316.

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

Hickok, G, Buchsbaum, B, Humphries, C., & Muftuler, T. (2003). Auditory-motor interaction revealed by fMRI: Speech, music, and working memory in Area Spt. *Journal of Cognitive Neuroscience, 15*, 673-682.

Levin, B. (1993). *English Verb Classes And Alternations: A Preliminary Investigation.* Chicago: University of Chicago Press.

Palmer, D. C. (1991). A behavioral interpretation of memory. In L. J. Hayes & P. N. Chase (Eds.), *Dialogues on verbal behavior* (pp. 261-279). Reno, NV: Context Press.

Palmer, D. C. (1998). The speaker as listener: The interpretation of structural regularities in verbal behavior. *The Analysis of Verbal Behavior, 15*, 3-16.

Palmer, D. C. (2003). Cognition. In K. A. Lattal & P. N. Chase (Eds.), *Behavior theory and philosophy* (pp. 167-185). New York: Kluwer Academic/Plenum.

Palmer, D. C. (2005). Ernst Moerk and the puzzle of zero-trial learning. *The Analysis of Verbal Behavior, 21*, 9-12.

Palmer, D. C., & Donahoe, J. W. (1992). Essentialism and selectionism in cognitive science and behavior analysis. *American Psychologist, 47*, 1344-1358.

Paulesu, E., Frith, C. D., & Frackowiak, R. S. J. (1993) The neural correlates of the verbal component of working memory. *Nature, 362,* 342-344.

Place, U. T. (1981). Skinner's Verbal Behavior II, what is wrong with it. *Behaviorism*, *9*, 131-152.

Skinner, B. F. (1935). The generic nature of the concepts of stimulus and response. *The Journal of General Psychology, 12*, 40-65.

Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.

Stemmer, N. (2004). Has Chomsky's argument been refuted? A reply to Skinner, Cautilli, and Hantula. *The Behavior Analyst Today, 4*, 376-382.

Tomasello, M. (1992). *First verbs: A case study of early grammatical development.* Cambridge: Cambridge University Press.

Tomasello, M., Akhtar, N., Dodson, K., & Rekau, L. (1997). Differential productivity in young children's use of nouns and verbs. *Journal of Child Language, 31,* 101-121.

Tonneau, F. (2001). Equivalence relations: A critical analysis. *European Journal of Behavior Analysis*, *2*, 1-33.

Whitehurst, G. J., Ironsmith, M., & Goldfein, M. (1974). Selective imitation of the passive construction through modeling. *Journal of Experimental Child Psychology, 17*, 288-302.

Wodehouse, P. G. (1934). *Right ho, Jeeves*. London: Penguin Books.

Wodehouse, P. G. (1937). *Code of the Woosters*. London: Penguin Books.

Wodehouse, P. G. (1963). *Stiff upper lip Jeeves*. London: Penguin Books.

Wright, A. N. (2206). The role of modeling and automatic reinforcement in the construction of the passive voice. *The Analysis of Verbal Behavior, 22*, 153-169.