On the Difference Between Verbal and Nonverbal Behavior

A. Charles Catania

University of Maryland Baltimore County

Language theorists have often proposed lists of the defining properties of language. This account reviews some of these and offers as an alternative a three-item list consisting of instructional control, equivalence classes, and autoclitic processes.

The properties that define language have been a matter of controversy for centuries. Is language something unitary or is it made up of separate components that could exist independently? Is its structure determined by biological constraints or are its dimensions arbitrarily shaped by the features of particular environments? Is it peculiarly human or can it be demonstrated in other organisms? All these and many related questions are relevant to the definition of verbal behavior.

It is not possible within brief compass to consider exhaustively the varying accounts of language that have emerged in linguistics, psychology, philosophy and other disciplines, or to outline fully the empirical bases for the many properties that have been proposed as its distinguishing features. But the enumeration of its distinguishing features has been a favorite device of theoreticians of language and provides a convenient vehicle for reviewing some treatments. Our survey will include not only some lists proposing properties that define language but also some that itemize what language is not. But before we consider the lists, a few preliminaries are in order.

Language is behavior, and it can be argued convincingly that it is more appropriate to speak of verbal behavior than of language (e.g., Skinner, 1957). The former emphasizes that language is an activity, not a pos-

session. The vocabulary of the present treatment will necessarily be variable, however, because the vocabularies will typically be dictated by the terms in the lists to be considered. The vocabulary of communication, for example, involves some assumptions about what happens in a verbal episode that would not be implicit in a translation to the vocabulary of verbal behavior.

It will be important to distinguish problems of language function from those of language structure; for example, questions about the effects of a sentence upon a listener are different from those about whether the sentence is grammatical (Catania, 1973). We will be interested in both structure and function. We will be more concerned, however, with properties of language that can be characterized in behavioral terms than with topographical properties that have an obvious anatomical basis. Details of articulation, phonology, quality of voice and other properties that can be attributed to features of the human vocal apparatus are important, but for the present purposes a more significant concern is that of defining the functional units of verbal behavior.

Let us now turn to the lists. Miller (1965), in the context of the psycholinguistics that grew out of Chomsky's theories of generative grammar (Chomsky & Miller, 1963), offered seven propositions intended not so much exhaustively to define basic aspects of human language as to serve as reminders of neglected dimensions of language:

1. Not all physical features of speech are significant for vocal communication, and not all significant features of speech have a physical representation.

Preparation of the manuscript was supported in part by NSF Grants BNS82-03385 and BNS85-06724. An earlier version of this paper was presented in September 1983 as a contribution to the NICHD conference on developmental genetics and learning, Leesburg, VA. For reprints, write the author at the Department of Psychology-UMBC, 5401 Wilkens Avenue, Catonsville, MD 21228.

2. The meaning of an utterance should not be confused with its reference.
3. The meaning of an utterance is not a linear sum of the meanings of the words that comprise it.
4. The syntactic structure of a sentence imposes groupings that govern the interactions between the meanings of the words in that sentence.
5. There is no limit to the number of sentences or the number of meanings that can be expressed.
6. A description of a language and a description of a language user must be kept distinct.
7. There is a large biological component to the human capacity for articulate speech.

What are we to make of this list? The first characteristic is undoubtedly common to all varieties of behavior. Ethological releasers too are characterized by critical features, and the problem of defining classes of behavior is not confined to speech. Surely we would agree that while producing the same words the voices of two speakers can differ in many ways. Surely we would also agree that what we hear as particular phonemes can be produced in so many ways that we cannot define a characteristic physical structure. The problem, however, is not limited to the language domain; it arises in such phenomena, for example, as the constancy of a melody over transpositions of key and a variety of other perceptual constancies.

The next three items are concerned with meaning. "Inventor of the cumulative recorder" and "author of *Verbal Behavior*" do not have the same meaning even though they have the same referent; the word "extinguish" is understood differently if what is said to be extinguished is a response than if it is a fire or a population of dinosaurs; and additional information is needed to determine whether "They are controlling stimuli" is a sentence about environmental variables or about experimenters. The point of these three items is to suggest that language cannot be dealt with solely in terms of associations or stimulus-response connections of some sort. The first two make the point with respect to semantics and the last with respect to syntax. In various ways they each say that context matters in language. Few contem-

porary behavioral treatments, however, deal with the structure of language as arising merely from simple sequential dependencies created by conditioning, and these items, like the first, have parallels in nonverbal phenomena, where context also matters (it is implicit, for example, in the functional rather than topographical definition of operant classes).

The fifth item asserts that productivity, the generation of novel sentences or meanings, is a feature of language, but it is silent as to whether productivity is exclusive to language. That is just as well, because nonverbal behavior can be productive (e.g., Fentress, 1978; Catania & Cerutti, in press), and productivity therefore is not a sufficient defining property of language even though it might be significant in its contributions to important consequences of language. Just as a human may utter a sentence that has never been uttered before, a bird may fly a convoluted path that has never been flown before. The integration of the component responses of both performances involves complex coordinations; there is a grammar of flight as well as a grammar of language.

Even the quantitative problem of productivity has been exaggerated. For example, the number of possible ten-word utterances based on a vocabulary of two thousand words (Basic English has a vocabulary of 850 words) is 2×10^{13} . But allowing for fewer than sixty utterances per day, this is the number that would be uttered in a year by a population of one billion speakers of English (not far from the number in the present human population of the world). This example does not make allowances for variations in sentence length, but that variable is balanced by the fact that only a very small proportion of the possible utterances would qualify as grammatical or would approximate grammaticality closely enough to occur in human discourse. Thus, it is likely that novel sentences make up only a small part of human speech. This is not to say that productivity is unimportant; rather, it is to say that the nonproductive aspects of language must not be ignored even if they seem to hold little interest for psycholinguists.

Miller's sixth item has served as a rallying cry. It seems to resurrect the distinction between learning and performance, transformed to that of competence and per-

formance. For Miller, this is a call for the construction of performance models. In other words, it is a prescription for the student of language, and says little about language and language users. It is perhaps equivalent to saying that organisms should not be confused with their behavior. But we tend not to mix up responses like lever presses and key pecks with individual organisms like rats and pigeons, and we therefore should be able to distinguish particular utterances from properties of language that characterize populations of utterances.

And the seventh item is a truism. Human language is presumably a product of evolution. But we are given no hint by this item of where we might search for continuities with nonverbal behavior, or even of the possibility that human language is not an unanalyzable entity but rather a unique conjunction of distinct behavioral processes.

Miller's list identifies properties of language that have been overlooked in some earlier psychological treatments and acknowledges its complexities, but in the end it says little about what distinguishes verbal from nonverbal behavior. A more ambitious list is Hockett's (1958, 1960, 1963; cf. Linden, 1981; Paivio & Begg, 1981). His original list of seven design features of language has expanded to sixteen. Let us begin with the seven, noting that Hockett remarks of these seven properties that they "do not recur, as a whole set, in any known non-human communicative system, although individually some of them do" (Hockett, 1958, p. 574):

1. *Interchangeability*. The members of a language community can both transmit and receive; typically speakers can become listeners and vice versa.
2. *Specialization*. The effects of language are not physical consequences of transmitting; a spoken word is not analogous to a blow to the body.
3. *Displacement*. Language can refer to remote objects and events; we can speak of Thorndike and Pavlov without ever having seen either of them.
4. *Productivity*. Language allows both syntactic and semantic novelty; we can describe a bird with cocker-spaniel ears even if one has never existed.
5. *Cultural transmission*. Language is

maintained by instruction rather than by genetic variables; children learn the language of the community even if it is different from that of their parents.

6. *Arbitrariness*. The relation between signs and their referents does not depend on shared properties; the words "red" and "green" have no color.
7. *Duality*. Language is built of hierarchical elements such as phonemes, letters, syllables, and words; the units at one level are created by various arrangements of the units at another level.

As Hockett would agree, interchangeability and specialization are not restricted to phenomena of verbal behavior. Any interaction between organisms, including combat between members of different species, may involve reciprocity, and specialization in Hockett's sense is characteristic of many of the releasers studied by ethologists.

Displacement involves behavior with respect to events distant in time or space, and is involved in the study of remembering, whether verbal or nonverbal. What is remembered, however, is more accurately described as our behavior with respect to past events than as the past events themselves (e.g., Catania, 1984, Chapter 12). It is important that we are able to speak of absent and even of nonexistent things, but displacement can come about in varied ways and a taxonomy of the phenomena that qualify as instances would therefore be useful. The problem of saying what happens when we speak of remote events might be more easily resolved after we have dealt with the more fundamental one of saying what happens when we speak of current ones.

We have already spoken of productivity. It is sufficient to note here that novel utterances can come about as a consequence of novel combinations of environmental events. If a child has learned to call certain colors purple and certain creatures cows, it would be no surprise to hear the child say "purple cow" in the presence of a bovine of relevant color.

Cultural transmission does not demand elaboration. Arbitrariness and duality, however, are properties of language that are

not obviously shared by nonverbal behavior. They might therefore be regarded as the most significant items in Hockett's list. Arbitrariness might be a condition for the combining units that characterize duality, and language would at best be limited to a small vocabulary if it did not involve recombinations of a small population of units.

Hockett's later longer lists add some features specific to the vocal properties of human speech: the *vocal-auditory channel* (8); the *broadcast transmission* of vocal signals and as a corollary their directional reception (9); the *rapid fading* of these signals, with implications for channel capacity and for memory (10); and *complete feedback*, in that the speaker as well as the listener receives the signal (11). These features likely are phylogenetic in origin, but they call more for anatomical, audiological and phonological than for behavioral analyses.

Four of Hockett's five remaining features are derivative of those in the shorter list. The *semanticity* of language (12) is implicit in both arbitrariness and displacement. Its *discreteness* (13) implies distinctive features and is implicit in duality of patterning. The possibility of *prevarication* (14) depends on several of the other categories, and is not limited to verbal behavior (cf. Dawkins, 1976, Chapter 6, on deceptive mimicry). And *learnability* (15) is implicit in cultural transmission. The remaining feature, *reflexiveness* (16), states that language must allow communication about communication. A prerequisite for such a property of language is that language users be able to discriminate properties of their own behavior. This property is encompassed by autoclitic processes in the analysis of verbal behavior (Skinner, 1957) and by the concept of deixis in psycholinguistics (e.g., de Villiers & de Villiers, 1974). With respect to this property, we will here note only that both interchangeability (1) and the complete feedback (11) provided by the vocal modality may be essential to the evolution of reflexivity. We will return later to this property of verbal behavior.

The last of our sample of prior lists is Osgood's (1980), whose sixteen defining characteristics of language are supplemented by ten others that should not be regarded as defining criteria. Osgood's sixteen positive items partially overlap Hockett's.

Osgood distinguishes language in general from human language in particular. The former must involve:

1. *Recurrent events*. A language must consist of identifiably different and nonrandom forms.
2. *Reciprocality*. This item is equivalent to Hockett's interchangeability.
3. *Pragmatics*. Verbal behavior must have consequences; more specifically, it must affect other behavior, either verbal or nonverbal.
4. *Semantics*. The forms of the language must be nonrandomly related to their referents.
5. *Syntax*. The forms of the language must combine in orderly rather than random ways.
6. *Productivity*. This productivity is similar to Hockett's; Osgood emphasizes that the novel productions must satisfy the constraints of his first five items.

We have already dealt explicitly with most of these items, and the ones that remain are implicit in Miller's and Hockett's lists. The major difficulty is that semantics plays an important role and yet is undefined. Clearly there exist relations between language units and events in the world, but what does it mean for something to have a referent?

Beyond these properties of language in general, Osgood offers five structural and five functional characteristics specific to human language. Of the structural characteristics, all except item 10 are equivalent to items in Hockett's list:

7. *The vocal-auditory channel*.
8. *Broadcast transmission and directional reception*.
9. *Evanesence in time* (rapid fading).
10. *Integration over time* (presumably a consequence of 9).
11. *Prompt feedback*.

Integration over time is significant because of its implications for remembering. The beginning of a sentence is past when one hears its end, and yet one's response to the end may often depend on the beginning. Nevertheless, as demonstrated by the chimpanzee language of plastic chips developed by Premack (1970), at least some language functions can be established with nonhuman organisms when the language system does not impose a burden on remem-

bering. For this reason, integration over time qualifies as a property of human language but not as a defining property of language in general.

Osgood's five functional characteristics correspond to various items in Hockett's list or to derivatives of those items:

12. *Semantic arbitrariness*. Semantic units are not iconic.
13. *Discreteness of symbols*. Discontinuities mark the boundaries of semantic units.
14. *Hierarchical organization*. The embedding of units within units is directional; words are composed of phonemes, and not vice versa.
15. *Componential organization*. As in Hockett's duality, a unit at one level (e.g., a phrase) can be exhaustively decomposed into units at another level (e.g., words).
16. *Transferral via learning*. Human languages depend on cultural transmission.

In the remainder of his list, Osgood excludes the following ten characteristics as necessary defining properties of language:

1. *Propositionalizing*. Language does not consist of propositions; it does not depend on testability for truth or falsity.
2. *Prevarication*. Language does not imply a capacity for lying.
3. *Reflexiveness*. Language need not have language itself as a referent.
4. *Learnability*. Some languages may be learnable only by restricted populations or only at certain ages.
5. *Translatability*. A particular language need not be translatable into any other particular language.
6. *Particular selection and combination rules*. Syntactic and phonetic rules that are common to many human languages are nonetheless statistical rules rather than language universals.
7. *Progressive differentiation*. Languages change (as when words that more and more finely differentiate regions of the spectrum are added to a language) but human languages would remain human languages even if their evolution were halted.
8. *Least effort*. The inverse relation between size of language units and their frequency of use is a statistical proper-

ty of language that may sometimes be found in nonverbal behavior as well.

9. *Affective polarity*. Human languages are characterized by semantic polarity (e.g., good, strong, active versus bad, weak, passive) with unmarked positive and marked negative forms (e.g., happy, unhappy but not sad, unsad), but cases in which these polarities were eliminated or reversed would not then be disqualified as human languages.
10. *The greater diversity of positive than negative linguistic forms*. As for affective polarity, the elimination or reversal of these regularities of human languages would not be a disqualifying characteristic.

There is some consistency to the lists we have considered (e.g., Hockett and Osgood on productivity and on feedback) but there are also disagreements (e.g., Hockett and Osgood on prevarication and on reflexivity). We could now examine the various specific cases. A more appropriate way to conclude this survey, however, is with two more lists. The first and longer list (seven items) asserts what language is not; the second offers only three features of language as its critical properties. A brief consideration of some implications of those properties then brings this account to a close.

1. Language is not defined by its structure, syntactic or otherwise. Structure is a property that language shares with nonverbal behavior. Locomotion, for example, also has a grammar; the coordination of an insect's hind leg with its other legs, like the turn of a phrase in a sentence, occurs under constraints of context (e.g., Gallistel, 1980).
2. Language is not defined by productivity. Productivity occurs when different dimensions of behavior are jointly occasioned by different controlling events, as when a physical object determines the noun and an action determines the verb of a sentence. Productivity is to be understood in terms of novel conjunctions of events, but these events need not be verbal.
3. Language is not computation. This assertion is not intended as a restatement of the argument that verbal be-

havior is not generated as a sequence of stimulus-response units, although it is consistent with it. Rather, its point is that verbal behavior is not a product analogous to a calculated or derived solution to a problem. Language sometimes makes certain types of problem solving possible, but the utterance of a sentence is not a solution to a problem of expression. Rules are instances of behavior, but verbal behavior itself is more likely to be contingency-shaped than rule-governed (Skinner, 1966).

4. The discreteness and hierarchical organization of its units permits the generation of multitudinous verbal forms, but language is not defined by the sheer quantity of verbal units.
5. Displacement has significant consequences in human language but is not critical to its definition. It would be a serious deficit to be able to speak only of concrete objects actually present, but the speaker would remain a speaker of the language nonetheless.
6. Language is not a tool; it is not a vehicle of truth or an instrument of reason. This is not to deny that verbal behavior has consequences. Given the prevalence of the language of "using" words, however, it is useful to recall that words are instances of behavior.
7. Language is not communication; it is not a means of conveying or expressing ideas, feelings or emotions. The metaphor of communication is pervasive but misleading. It is embedded in everyday talk, as when we say that we "put ideas into words" or "get something across," or as when we speak of words as "carrying meaning" or writings as "packed with information" (cf. Lakoff & Johnson, 1980; Reddy, 1979). Yet "idea" and "meaning" are not well-defined terms, and even "information" rarely implies the quantifiable stuff of information theory. The magnetic patterns that correspond to a tape-recorded voice have no meaning unless someone listens to the recording; the meaning is not waiting to be released from the tape. If anything is transmitted in language, it is the verbal behavior

itself; in listening and reading our own behavior recreates some features of the verbal behavior of those who constitute our verbal community. In language, in other words, behavior replicates itself.

What then is special about language? Only a small proportion of the items in the several preceding lists are concerned with the functions of language, and even those that are so concerned sometimes deal with functions that are suspect (e.g., communicating). Let us therefore consider our final list:

1. *Instructional control.* The central function of language is instructional control: language is a way in which one organism changes the behavior of another. This function, captured by the distinction between rule-governed and contingency-shaped behavior (Skinner, 1966), implies that instructed behavior sometimes will be relatively insensitive to contingencies, or sensitive to contingencies only indirectly, through the mediation of verbal behavior.
2. *Equivalence classes.* Discriminative control is unidirectional: a stimulus sets the occasion on which responding may have consequences. For example, the relation between a red traffic light and stepping on the brakes is not reversible. That between the red light and the word "stop," however, is. Symmetries exist in the relations among verbal responses and nonverbal events. We can produce a pencil upon hearing the word "pencil" and we can produce the word "pencil" upon seeing this writing implement. These kinds of equivalences are what make verbal behavior symbolic. Unlike nonverbal events, verbal events function both as stimuli and as responses (lever presses and key pecks are not analogously interchangeable with lights and tones). Verbal behavior is characterized by and the concepts of meaning and reference are to be understood in terms of such equivalences (cf. Sidman, Rauzin, Lazar & Cunningham, 1982).
3. *Autoclitic processes.* Verbal behavior cannot exist in the absence of dis-

criminations of one's own behavior (the reflexivity of Hockett and Osgood; cf. Catania, 1980). Verbal behavior is autoclitic when it is built upon and modifies the effects of other verbal behavior (Skinner, 1957). For example, saying "I am reluctant to assert that" modifies the effects of saying "language is innate"; similar effects can be produced by inserting the word "not." This modifying autoclitic verbal behavior cannot occur unless the speaker can discriminate the conditions that control the utterance "language is innate." Because the important dimensions of words like "is" and "if" and "not" are autoclitic rather than logical, a propositional character of language based on functional rather than logical relations is implicit in autoclitic processes.

As has already been argued here, the simplest and most obvious function of verbal behavior is instructional control: one organism can, by talking to another, change the other's behavior. Language is a way in which one organism can make another do something. Once both organisms are talking, then one can instruct what the other says as well as what the other does (Catania, Matthews & Shimoff, 1982; cf. Lowe, 1979). Verbal behavior likely followed from the evolution of social control, in a progression from vocal releasers to varied verbal functions shaped by social consequences (Catania, in press). It is consistent with this view that instructed human behavior is insensitive to its environmental consequences, relative to behavior shaped by contingencies. When you do what you are told, your behavior is controlled by the instruction rather than by its natural consequences. Uninstructed behavior, not influenced by language, is most likely to be in close touch with environmental events (Matthews, Shimoff, Catania & Sagvolden, 1977.)

Instructions are conceived here more broadly than as statements of command or direction. Giving definitions and stating facts are instructions with respect to the listener's future verbal behavior. Speaking affects the behavior of others whether or not the speech has the grammatical character of the imperative.

The instructional characteristics of verbal behavior are not independent of equivalence classes and autoclitic processes. To the extent that instructional control allows interchangeability, the speaker will sometimes function as the listener and vice versa, and the evolution of equivalence classes will follow as a matter of course. Equivalence classes are linked to instructional control by way of the correspondences that must necessarily develop in the reciprocities of the speaker's and the listener's behavior. To establish correspondences between saying and doing is to establish equivalence classes (e.g., Paniagua & Baer, 1982).

Further, given that instructions may be repeated by a listener, listeners must discriminate themselves from others as the sources of verbal behavior. It is one thing to respond to what someone else has said; it is another to respond to one's own repetition of the other's utterance. Discrimination of the sources of instructional control may have marked the beginnings of autoclitic processes, from which follow those processes we speak of as metalanguage (language about language) and consciousness or self-awareness (cf. Jaynes, 1977).

Instructional control, equivalence classes and autoclitic processes are dimensions of verbal behavior that are ripe for behavior analyses. All are presumably products of the evolution of human behavior. Will it be possible to explore individual differences in susceptibility to instructional control, or in the breadth or number of equivalence classes that can be established, or in ranges or types of autoclitic processes? If such differences emerge, what will be their functional significance? Most important, to what extent will an analysis of such differences tell us something about the interdependence of these three dimensions of verbal behavior? Is any one a prerequisite for one or both of the others, or do all grow out of other more fundamental behavioral processes? The most substantial progress will be made when we can move on from analyses of these separate dimensions to analyses of their relations and interactions in developing and in established verbal behavior.

REFERENCES

- Catania, A. C. (1973). The psychologies of structure, function, and development. *American Psychologist*, 28, 434-443.

- Catania, A. C. (1980). Autoclitic processes and the structure of behavior. *Behaviorism*, 8, 175-186.
- Catania, A. C. (1984). *Learning* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.
- Catania, A. C. (in press). Rule-governed behavior and the origins of language. In C. F. Lowe, M. Richelle, D. E. Blackman & C. Bradshaw (Eds.), *Behavior analysis and contemporary psychology*. Hillsdale, NJ: Erlbaum.
- Catania, A. C., & Cerutti, D. (in press). Some nonverbal properties of verbal behavior. In T. Thompson & M. D. Zeiler (Eds.), *Analysis and integration of behavioral units*. Hillsdale, NJ: Erlbaum.
- Catania, A. C., Matthews, B. A., & Shimoff, E. (1982). Instructed versus shaped human verbal behavior: Interactions with nonverbal responding. *Journal of the Experimental Analysis of Behavior*, 38, 233-248.
- Chomsky, N., & Miller, G. A. (1963). Introduction to the formal analysis of natural languages. In R. D. Luce, R. R. Bush & E. Galanter (Eds.), *Handbook of mathematical psychology. Volume II*. New York: Wiley.
- Dawkins, R. (1976). *The selfish gene*. New York: Oxford.
- De Villiers, J. G., & de Villiers, P. A. (1974). On this, that, and the other: Nonegocentrism in very young children. *Journal of Experimental Child Psychology*, 18, 438-447.
- Fentress, J. C. (1978). Mus musicus, the experimental orchestration of selected movement patterns in mice. In G. M. Burghardt & M. Bekoff (Eds.), *The development of behavior: Comparative and evolutionary aspects*. New York: Garland.
- Gallistel, C. R. (1980). *The organization of action*. Hillsdale, NJ: Erlbaum.
- Hockett, C. D. (1958). *A course in modern linguistics*. New York: Macmillan.
- Hockett, C. D. (1960, March). The origin of speech. *Scientific American*, 203, 88-96.
- Hockett, C. D. (1963). The problem of universals in language. In J. H. Greenberg (Ed.), *Universals of language*. Cambridge, MA: The MIT Press.
- Jaynes, J. (1977). *The origin of consciousness in the breakdown of the bicameral mind*. Boston: Houghton Mifflin.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Linden, E. (1981). *Apes, men, and language* (revised ed.). New York: Penguin.
- Lowe, C. F. (1979). Determinants of human operant behaviour. In M. D. Zeiler & P. Harzem (Eds.), *Reinforcement and the organization of behaviour*. Chichester: Wiley.
- Matthews, B. A., Shimoff, E., Catania, A. C., & Sagvolden, T. (1977). Uninstructed human responding: Sensitivity to ratio and interval contingencies. *Journal of the Experimental Analysis of Behavior*, 27, 453-467.
- Miller, G. A. (1965). Some preliminaries to psycholinguistics. *American Psychologist*, 20, 15-20.
- Osgood, C. E. (1980). *Lectures on language performance*. New York: Springer Verlag.
- Paivio, A., & Begg, I. (1981). *Psychology of language*. Englewood Cliffs, NJ: Prentice-Hall.
- Paniagua, F., & Baer, D. M. (1982). The analysis of correspondence training as a chain reinforceable at any point. *Child Development*, 53, 786-798.
- Premack, D. (1970). A functional analysis of language. *Journal of the Experimental Analysis of Behavior*, 14, 107-125.
- Reddy, M. J. (1979). The conduit metaphor. In A. Ortony (Ed.), *Metaphor and thought*. New York: Cambridge University Press.
- Sidman, M., Rauzin, R., Lazar, R., & Cunningham, S. (1982). A search for symmetry in the conditional discrimination of Rhesus monkeys, baboons, and children. *Journal of the Experimental Analysis of Behavior*, 37, 23-44.
- Skinner, B. F. (1957). *Verbal behavior*. New York: Appleton-Century-Crofts.
- Skinner, B. F. (1966). An operant analysis of problem solving. In B. Kleinmuntz (Ed.), *Problem solving*. New York: Wiley.