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Verbal Behavior

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A behavioral interpretation of language differs from the many alternative approaches to the topic by restricting its analytical tools to those that have emerged from experimental analyses *and to nothing else*. Therefore in this chapter I will discuss language as behavior and with a few exceptions will limit myself to those topics to which the principles of behavior are relevant. I will assume that my reader is a behavior analyst who wishes to review the assumptions, the analytical units, and the technical vocabulary that have become standard in the field as well as to explore some of the ways in which the topic poses special conceptual challenges to a behavior analytic account. I will make no attempt to review the vast literature on language, even within a behavior analytic perspective, lest there be space for nothing more. The reader primarily interested in language acquisition can find many suitable resources, but I particularly recommend, Horne and Lowe 1996, Locke 1993, Novak and Pelaez 2004, Schlinger 1995, and Tomasello 2003, 2008. In the past two decades the behavioral approach to teaching children with language deficits has flourished, and the associated literature is now substantial. I will cover none of this work; the reader can find good overviews elsewhere, written by scholars with greater expertise (e.g., Carr and Miguel, 2012, degli Espinosa 2011, Greer and Ross 2008, Sundberg 2008). The success of such work provides a kind of validation of the approach, but in contrast, I will identify topics where the behavioral account is weakest and most speculative, for the adequacy of such an account cannot be evaluated simply by rehearsing its strengths. Consequently, this chapter will be like a photographic negative of other behavior analytic overviews; I will cover familiar topics lightly, or not at all, but will discuss in greater detail tentative interpretations of thorny empirical problems about which there is as yet no consensus within behavior analysis, because I think such topics will be of greater service to the likely reader.

On the grounds of consistency and conceptual adequacy, I will take Skinner's interpretation of verbal behavior as a foundation (Skinner 1957). I will discuss alternative perspectives within behavior analysis only in passing, but I will point the reader to other sources for more complete treatments. Following Skinner, I will adopt the term *verbal behavior* as an alternative to *language* in order to emphasize the restricted domain of the discussion. I will occasionally use familiar terms such as *word, sentence, noun,* and *verb,* but I do not intend them to be taken as behavioral units or as technical terms in the analysis. I will confine most of my examples to vocal and written English, but only for the purpose of illustrating an interpretive approach. The details of any interpretation of verbal behavior will vary from one verbal community to another and

will even vary within verbal communities from one speaker to another. Nevertheless, I believe that all such interpretations will have many common features, and it is the goal of this chapter to identify them.

I will open the chapter by defining the domain of interest and offering some reasons to consider verbal behavior special. I will then briefly summarize some technical terms that have become standard in the field and will point out the implications of a behavioral interpretation for the everyday notions of reference, meaning, and truth. Next, I will challenge the reader to consider what I regard as the central puzzle of verbal behavior, namely, its abundant structural regularities that seem to be devoid of function. I devote the remainder of the paper to an attempt to show how the tools of the behavior analyst can be deployed to provide at least the outline of a solution to this puzzle: The concepts of multiple control, joint control, automatic shaping, and autoclitic frames are identified as versatile and powerful interpretive tools. I then offer the conditioning of the behavior of the listener as not only one of the most commonplace effects of verbal behavior but one for which we can, in the present state of science, offer only the most tentative of accounts

Definition of verbal behavior

As a first approximation, we may adopt Skinner's definition of verbal behavior as behavior whose consequences are mediated by other organisms, organisms whose behavior, in this respect, has been conditioned specifically to reinforce the behavior of the speaker (Skinner 1957). This is a descriptive definition, not a prescriptive definition (Palmer, 2008), and therefore has fuzzy boundaries: Once acquired, verbal behavior can be emitted under many conditions, even in the absence of a listener. Moreover, the speaker can be, and usually is, also a listener to his own verbal behavior. One important source of reinforcement for verbal behavior is the effect on the speaker himself in problem solving, recall, and subsequent verbal behavior. Finally, many electronic systems and devices from automated telephone systems to notepad computers can now respond appropriately to some verbal responses, but the engineering of such devices is functionally analogous to conditioning the behavior of a listener. Nevertheless, Skinner's definition captures the generalization that verbal behavior arises in communities that maintain contingencies of reinforcement for behavior that reflects conventional but arbitrary relationships between behavior and its consequences, and if it violates these conventions, it ceases to be effective.

Because the relationship between verbal behavior and its consequences is solely a matter of convention, the magnitude of a verbal response is usually wholly unrelated to the magnitude of its effect. A whispered command can set armies in motion, and a skilled orator can whip a crowd into a frenzy. A religious tract on roll of parchment can affect the behavior of millions of worshipers over thousands of years. Perhaps as a result, verbal behavior, in all of its forms, tends to consist of highly efficient, small magnitude responses. Speakers typically utter several words per second, and can do so for hours at a time with little fatigue. Thus the ratio of reinforcement to effort can be immense, and even trivial reinforcers can be sufficient to maintain verbal behavior in strength.

Consequently, elementary speech sounds commonly recede to the simplest forms that can be discriminated by the verbal community. They can be chained and permuted to generate countless discriminable units of behavior lasting no more than a fraction of a second. Thus verbal behavior is commonly fast, flexible, and powerful.

The physical substrate of vocal behavior

Verbal behavior in its modal form, that is, vocal behavior, is distinctive by its sheer complexity, the number of muscle groups recruited, and its competition with reflexive behavior. Uttering even the simplest of verbal operants requires the finely coordinated action of diaphragm, intercostal and abdominal muscles, larynx, oral cavity, velum, tongue, lips, and the muscles of the throat (Lieberman, 2006). Speaking must then be coordinated with the competing functions of respiration and ingestion, with their associated reflexes of breathing, coughing, sneezing, salivating and swallowing. Thus articulation alone, to say nothing of the temporal arrangement of verbal operants, is an engineering marvel.

Languages of the world vary considerably, not just in vocabulary, but in articulatory character. Relative pitch plays a strong role in some languages, a minor role in others. Most language families use some idiosyncratic speech sounds not found elsewhere. Xhosa and some other Bantu languages, for example, employ a variety of click consonants, most of which can be executed without the participation of subglottal mechanisms. Moreover, even within members of a verbal community, the physical articulation of speech sounds differs somewhat from one speaker to another (Nearey 1980). Different configurations of articulators can produce the same speech sound; that is, they will produce speech sounds indiscriminable to a listener in that verbal community. It is clear then, from both the variability of the practices of different verbal communities and the variability in articulation from speaker to speaker, that vocal verbal behavior is operant behavior, shaped by experience.

But a complete account of vocal behavior must consider the competing demands of other processes. For most languages, speech sounds occur only during the expiration phase of breathing. Vocalization requires maintaining fairly constant air pressure in the lungs, which is incompatible with normal patterns of respiration. Specifically, unlike normal breathing, speech is characterized by rapid inspiration and prolonged expiration (Lieberman 2000). Typically, the cycles of inspiration and expiration coincide with extended verbal units (usually sentences). Since such units can vary greatly in length, the depth of inspiration must be determined, at least roughly, before the unit is uttered. In order to maintain steady subglottal air pressure, the intercostal and abdominal muscles must initially work against the elastic recoil of the distended lungs, but after the lungs contract to their resting volume, they must work in the other direction to contract the lungs still further until the verbal unit is completed and inspiration can occur again. The capacity to make the full range of human speech sounds depends further on an elongated pharynx, the configuration of the rib cage, the shape of the oral and nasal cavities, and a highly flexible tongue. Presumably, the ability to temporarily subordinate the demands of respiration to that of speech is another example of an evolutionary adaptation that

permits speech as we know it (Lieberman 2006). Thus, as a physical act, speech is behavior, a highly complex behavior that depends in part on distinctive anatomical characteristics, some of which are shared by our closest relatives, some of which are found only in humans.

Analytical units of verbal behavior

Starting from the axiom that language is behavior, Skinner (1957) identified ways in which concepts derived from the behavioral laboratory were relevant to language. To avoid the surplus connotations of existing terms, he coined new terms for the various classes of behavior that emerged from his analysis. His terms have become part of the technical vocabulary of the field, and for that reason I briefly review the major ones here. However, the reader should be warned that the purpose of the terms is simply to identify types of controlling relationships for purposes of understanding the provenance and dynamic properties of verbal behavior. There is no point to classification for its own sake. Moreover, pure examples of Skinner's verbal operants are rare outside the laboratory or educational setting; almost all verbal behavior is under multiple control, and almost all verbal behavior requires a complex interpretation.

The mand

The mand is a verbal response that leads to a characteristic reinforcing consequence: If, when water deprived, saying *Water!* has led to getting water, the verbal response will be under control of water deprivation and would be classified as a mand. A phrase or clause, such as *Please pass the salt,* could be a mand if it were acquired and emitted as a unit.

Mands are functional in that they extend the reach of the speaker in myriad ways, but they also play an important role in the transmission of cultural practices. Listeners typically acquire fine-grained differentiated responses, each under the control of distinctive verbal stimuli: *Raise your hand; Push the handle down; Add a teaspoon of vanilla; Walk forward two steps; Knit two, purl two;* and so on. Such an atomic echoic repertoire confers a distinctive advantage: An indefinitely large number of permutations of behavior can be evoked in a single trial by the presentation of corresponding stimuli. Mands, in the form of instructions, can thus short-circuit the long process of shaping through successive approximations. When one person acquires an adaptive pattern of behavior, possibly through long and difficult experience, that pattern can rapidly diffuse throughout a verbal community through instructed behavior. (Skinner 1963, 1969, called such instructed behavior *rule-governed behavior* to distinguish it from *contingency-shaped behavior*, that is, behavior shaped through successive approximations to a final form. See Palmer 2012 for an extended discussion of the various types and uses of atomic repertoires. By *atomic repertoire* I mean a set of fine-grained units of behavior, each under control of a distinctive stimulus, which can be evoked in any permutation by the arrangement of corresponding stimuli. Skinner (1957) used the term interchangeably with *minimal repertoire*, but I prefer the former, as it emphasizes the combinatorial power of such a repertoire.)

The echoic

An echoic response is a vocal or subvocal response that is formally similar to a prior vocal stimulus, for example, repeating the name *Jones* upon being introduced to him. Rehearsing a telephone number in the interval before dialing it would be an example of self-echoic behavior. The echoic is conceptually trivial, and Skinner (1957) devoted only a few pages of his book to the topic, but it is of great importance in human affairs: Echoic behavior is a second illustration of an atomic repertoire. Children presumably acquire an atomic echoic repertoire implicitly through response differentiation: *big* not *bag*; *cap* not *tap.* As a consequence, we can usually repeat novel words or expressions at once, without shaping. Thus echoic responses serve a simple but important function: They transduce verbal stimuli into verbal responses. As a result, they facilitate the rapid transmission of effective response forms throughout a verbal community.

Textual behavior

Textual behavior is analogous to echoic behavior, but the antecedent stimulus is visual rather than auditory. The antecedent stimulus is commonly a text, but it can take other forms such as hieroglyphs, pictograms, the dots and dashes of Morse code, smoke signals, semaphore flags, and so on. Like echoic behavior, textual behavior is commonly covert; only rarely do adults read aloud, except when they are reading to an audience. Textual behavior is another example of an atomic repertoire. Novel verbal responses can be induced in a reader simply by a novel arrangement of letters. Whereas auditory stimuli are only rarely preserved in recordings, textual stimuli tend to endure indefinitely and can therefore affect many readers over long periods of time. Consequently texts are especially influential in transmitting cultural practices.

The intraverbal

The intraverbal is a verbal response occasioned by a prior verbal stimulus that lacks point-to-point correspondence with that stimulus. This is the standard definition of the term, but if it is to serve an explanatory function, the term must be subject to the further qualification that the control of the response by an antecedent verbal stimulus arises from a history of contiguous or correlated usage. That is, the antecedent verbal stimulus must be a discriminative stimulus, not merely a prior stimulus. This qualification is not always honored in the discourse of behavior analysts, but the term is useless if it embraces all behavior that indirectly follows from a prior verbal stimulus. Thus, the reply *144* in response to *12 times 12* is an intraverbal; *…and seven years ago* in response to *Four score ...* is an intraverbal, but for most people the reply *1722* in response to *41 times 42* is not an intraverbal, even though it is, in a sense, occasioned by the prior verbal stimulus, for, with very rare exceptions, there is no history of contiguous or correlated usage. The verbal stimulus occasions mediating behavior that in turn occasions the response *1722.* Among other possibilities, the mediating behavior may consist of a set of operations with a paper and pencil, the manipulation of a calculator, or merely some overt or covert verbal responses. Without the mediating behavior, the target response would have almost no strength at all. Answers to questions are seldom directly evoked by the question itself, and conversation is only rarely so banal as to be directly under the control of antecedent remarks. In short, to call something an intraverbal is to assert, or assume, a

history that is sufficient to *explain* the strength of the verbal operant at the moment that it occurs. Without the qualification of contiguous usage, or correlated usage, the term embraces a heterogeneous grab-bag of behavior and serves no explanatory function at all.

Some intraverbal control is established, not by strictly contiguous usage, but by correlated usage. The stimulus *bull* will increase the probability of saying *cow*, and *leash* may occasion *dog*, but we seldom say, or hear, *bull-cow* or *leash-dog*. But terms that are occasioned by a common context will typically be intraverbally related, as suggested by word-association experiments and priming experiments to be discussed later.

We speak of *an intraverbal* as a type of operant when the response is conspicuously under the control of an antecedent stimulus, but *intraverbal control* is a more important concept, for it presumably varies continuously; moreover, it must be virtually ubiquitous in verbal behavior. We can assume that every reinforced utterance establishes some measure of intraverbal control among terms in the verbal stream and between those terms and any verbal antecedents. Thus intraverbal relations are likely to contribute some measure of control to most utterances, however slight. Skinner (1957) devoted just a few pages to the intraverbal, but its contributions to the moment-to-moment control of verbal behavior must almost always be considered. We will see later that intraverbal control will emerge as an important concept in the sequential ordering of verbal operants (i.e., "grammar").

The tact

As defined by Skinner, a tact is a verbal response "evoked (or at least strengthened) by a particular object or event or property of an object or event" (1957, 82). The tact embraces the traditional concepts of labels, names, and descriptions, but is not restricted to them. When one answers a telephone, the remark *It's for you* can be a unitary response to the state of affairs, but we would not ordinarily call this a "description." Verbal communities tend to maintain appropriate stimulus control of tacts by supplying generalized reinforcement or punishment for conformity to or deviations from the norm: *No, that's not poison ivy; it's woodbine.* Because the reinforcement is generalized, the tact tends to be "objective" in the sense of being relatively free of special motivating variables. Objectivity is important to the verbal community. The boy who cries *Wolf*! is punished, whereas the rider who warns that *The British are coming!* is given a hero's welcome. When additional motivational variables come to bear, tacts can become distorted, to the detriment of listeners. The speaker may engage in wishful thinking, exaggeration, or outright lies.

The autoclitic

A clitic is a standard grammatical term meaning a word or fragment whose pronunciation depends on words that precede or follow it. Of the technical terms introduced by Skinner (1957), the last that we will review here is the *autoclitic*, which he defined as verbal behavior that alters the listener's response to other verbal behavior of the speaker. Apart from this common property, it is a heterogeneous category

encompassing function words, such as *and, but,* and *through;* qualifiers, such as *some* or *all*; inflections and grammatical tags, such as markers of possession and grammatical tense; negation, assertion, and predication; mands on the listener, such as *note that*...; tacts of response strength, such as *I hesitate to say that*...; and other remarks about one's own verbal behavior, such as, *I have already pointed out that*.... Although autoclitics are clearly central to the puzzle of verbal behavior, the topic is too broad to be covered here, and with the exception of autoclitic frames, I refer the reader to Skinner (1957) for further discussion.

A verbal operant composed of alternating fixed and variable terms is called an autoclitic frame (Skinner 1957) or an intraverbal frame (Palmer 1998): *If X, then Y; X gave the Y to the Z; X promised Y that Z; On the X; In front of X; The boy's X.* In each case, some term entails one or more variable terms that play distinctive roles in the expression. Prepositions, and possessives invariably require such variables, and verbs often require several. In a random sample of 200 verbs, 88% occurred in characteristic frames (Palmer 2007). Much of the novelty in verbal behavior arises from the interweaving of relatively fixed intraverbal frames occasioned by one feature of the context with variable terms provided by other features of the context. A context that brings to strength the word *give* typically entails a giver, a recipient, and something given. These terms are woven together in one or another autoclitic frame.

Function, not structure

These verbal operants are not essences. If a garbled attempt to repeat a foreign phrase lacks formal similarity, is it *really* an echoic? The question is not worth debating. Once we understand the relationship between behavior and its controlling variables, we need not waste time quibbling about terminology. We speak of *a* mand, *a* tact, or *an* autoclitic as labels for certain words, expressions, or frames, but each term entails a relationship between an utterance and its controlling variables. No dictionary could specify the type of verbal operant of a word. First, verbal operants do not necessarily correspond with words; second, the form of a word by itself is not a verbal operant. The word *water* could be a mand, tact, echoic, textual, or transcription, depending on its controlling variables. Thus the form of a verbal response plays only a secondary role in a behavioral interpretation; function is paramount.

The sentence

The sentence is not a technical term in behavior analysis. Skinner used the term liberally in his text, but informally. After reviewing traditional definitions, he concluded that the term was too heterogeneous to warrant a behavioral translation (1957, 354). Nevertheless, a behavioral analysis must accommodate the orderliness to be found in strings of verbal operants. Speech frequently consists of fragments, discontinuities, and erratic intrusions that would be difficult for any grammarian to parse into sentences, as traditionally conceived, but order remains, and we must account for it, even if our analytical unit does not correspond to the traditional term. To illustrate the point, put your finger at random on any page of text. Then look at windows of varying widths

around the point you have selected, and read them to a patient listener. For example, if you selected the word *page* in the previous sentence, you might select the window yielding, *random on any page of text look at windows of.* In almost every case, the exercise will yield strings that the listener reports as gibberish. Most of the exceptions (but not all) occur when our window captures a string conventionally called a sentence. That is, strings of words conventionally called sentences will be effective on listeners in a way that arbitrarily chosen sequences of verbal behavior will not. This observation offers a behavioral alternative to the grammatical definition of a sentence. As a first approximation, we may define a sentence as a sequence of verbal responses that effectively controls the behavior of the listener. When supported by the context, phrases, gestures, and single words can be functionally complete in the sense of being effective to a listener, e.g., *There; Not today; Next to the Jeep*. When the context exerts no relevant control, only more elaborate strings will be effective on a listener; these more closely correspond to the traditional concept of "complete sentence." That is, the verbal response by itself has to be sufficient to effectively control the behavior of the listener: *I put the keys there; I don't want coffee today; I left the folding chair next to the Jeep.* On the other hand, some "complete sentences," traditionally defined, are not functionally complete by themselves. Riddles, anecdotes, and limericks must be emitted in full before they are effective, whatever their grammatical structure. Thus the behavioral unit, so defined, does not correspond to the traditional unit, but it appears to capture much of the behavioral regularity of interest.

Verbal behavior has at least two kinds of effects on the listener, and both are relevant in determining whether a verbal string is functionally complete. The first effect is easily understood: a behavioral "sentence" exerts immediate discriminative control over the listener's behavior. But verbal behavior also may have latent effects on the repertoire of the listener. 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:

> 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. (Palmer 2007, 168)

It is important to note that the conditioning permits the effect to be long delayed. That is, we might not respond with respect to the boy's bicycle until we get home from a trip, but in the interim we can be said to "know the fact that it is blocking the driveway" and can

measure this knowledge in a variety of ways. Thus we must include such effects in our behavioral definition of sentence:

> 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." (Palmer 2007, 168)

Such conditioning is perhaps the most important function of verbal behavior, but how verbal behavior brings it about remains a formidable challenge. I will return to this challenge later.

On reference, meaning, and truth

A distinctive feature of a behavioral interpretation of verbal behavior is that no role is played by certain conventional concepts, among which are *meaning*, *reference*, and *truth*. From a behavioral perspective, these concepts become superfluous once the relationship between a response and its controlling variables is established. *The old man is snoring* could be an echoic, a textual response, an intraverbal, or several tacts in an autoclitic frame, or it could be the result of randomly drawing words from bins labeled *noun, adjective, article,* and so on. Stripped of its controlling variables, the string has no meaning at all. We can impute a meaning, but only by inferring a plausible set of controlling variables. Thus if the phrase is an intraverbal, there is no point in asking what the referent of *old man* is, or whether the statement is true. Likewise, there is no point in puzzling over paradoxes, such as *This statement is false.* When the variables responsible for the statement are analyzed, it becomes clear that *false* is not a tact, and there is no autoclitic of assertion. Any tendency to be baffled arises from considering strings of words as independent objects, not as products of behavior. We can dispose of these troublesome terms by analyzing the relevant behavior in other ways.

The structural complexity of verbal behavior: The puzzle of lawful novelty

Following Skinner (1957), I devoted the previous sections of this chapter to showing how principles of behavior can be recruited to organize our understanding of verbal behavior, but in the remaining pages I will discuss topics at the fringes of our understanding. The adequacy of a behavioral account will ultimately rest upon our ability to interpret such phenomena.

Verbal behavior poses a special challenge to the behavior analyst, and indeed to the scientist of any other persuasion, for it often entails patterns of responses that have never been emitted before but which nevertheless serve an adaptive function in the particular context in which they occur. Moreover, other patterns, seemingly equally

plausible, are commonly rejected by members of a verbal community. Consider the following examples (adapted from Pinker 1994):

I gave the money to the campaign.
I gave the campaign the money.
I donated the money to the campaign.
I donated the campaign the money.

Native speakers of English typically find the first three examples "acceptable" but balk at the fourth. That is, although it is perfectly sensible, it "sounds odd;" they cannot imagine themselves or anyone else putting it quite that way. This judgment is but one of countless similar oddities that any scientific account must wrestle with. (See Chomsky 1965, 1975, 1980, and Pinker 1989, 1994 for many other examples.) It is surely not the case that people have uttered the fourth sentence and been punished for it. The absurdity of such a claim is exposed by noting that *money* can be changed to great number of other things, and the grammatical intuition remains. It is equally absurd to suppose that parents or teachers have inculcated a general rule about dative verbs, like *give* and *donate.* Hardly anyone is aware of the puzzle until it is pointed out to them. In the sequencing of verbal elements, people somehow pick up regularities that transcend particular examples. Strings of verbal responses are typically novel, but still orderly. Explaining orderliness amidst novelty is a challenge to the scientist, behaviorist or otherwise, but I will attempt to show that it is not insurmountable.

Language acquisition poses a problem even for commonplace remarks. Studies of parent-child interactions reveal that parents tend to fuss about the truth of a child's utterance, but shrug off deficits in grammar (e.g., Brown and Hanlon 1970, but see Schoneberger 2010). Moerk (1983), has shown that although children tend to get little formal instruction, their interactions with others are nevertheless densely packed with unstructured contingencies. However, even his analysis did not reveal evidence of the kind of detailed discrimination training necessary to establish fine-grained grammatical distinctions. Such considerations have fueled speculation that grammar—that is, regularities in the sequencing of verbal operants—is largely innate (e.g. Chomsky 1980, Fodor 1975, 1983, Jackendoff 2002, Pinker 1994, Gordon 1986). Every behavior analyst with an interest in language should read Chomsky's critique of Skinner's account and MacCorquodale's rebuttal. (Chomsky 1959, MacCorquodale 1970. See Palmer 2006 for an overview.) I have argued elsewhere that the nativist hypothesis is empty (Palmer 1986, 2000), but the formidable challenge of offering a substantive alternative account remains.

The additivity of stimulus control

The variables controlling verbal behavior almost never occur alone. Verbal responses may be partly under the control of an audience, motivational variables, and the context; in addition responses are often subject to intraverbal control or echoic control by

preceding verbal behavior. To illustrate the point Skinner proposed the following strategy for getting someone to say *pencil*:

> To strengthen a mand of this form, we could make sure that no pencil or writing instrument is available, then hand our subject a pad of paper appropriate to pencil sketching, and offer him a handsome reward for a recognizable picture of a cat … Simultaneously we could strengthen other responses of the same form by providing echoic stimuli (a phonograph in the background occasionally says *pencil)* and textual stimuli (signs on the wall read *PENCIL)*. We scatter other verbal stimuli among these to produce intraverbal responses: the phonograph occasionally says *pen and* ... and there are other signs reading *PEN AND,* ... We set up an occasion for a tact with the form *pencil* by putting a very large or unusual pencil in an unusual place clearly in sight—say, half submerged in a large aquarium or floating freely in the air near the ceiling of the room. We indicate our own audience-character as an English-speaking person by the simple device of speaking English. Under such circumstances it is highly probable that our subject will say *pencil.* (1957, 253-254)

Such a strategy would work, according to Skinner (1957), because stimulus control is additive. This has been shown to be true for reflexes (Sherrington 1906), conditioned reflexes (Pavlov 1927), operant conditioning (Wolf 1963) and for both operant and classical conditioning in a wide variety of preparations by Weiss and his colleagues (e.g., Emurian and Weiss 1972, Panlilio, Weiss, and Schindler 2000, Van Houten, O'Leary, and Weiss 1970, Weiss 1964, 1967, 1977) The additivity of stimulus control has profound implications for our understanding of verbal behavior and behavior generally.

The additive control of a single response by multiple stimuli, as in the example above, has been dubbed convergent multiple control. The converse—that is, the control of a variety of responses by a single stimulus—is called divergent multiple control (Michael, Palmer, and Sundberg 2011). A reddish brown dog might evoke any of a variety of responses such as *dog, Fido, here boy, Irish Setter, bird dog, shedding, goofy,* and so on. (The particular response usually depends upon convergent control by other variables.) Of course one typically remains silent upon sight of a dog, but data from priming experiments suggests that even if no response is actually emitted, a variety of responses are strengthened by the stimulus. Many different experimental procedures are used to study priming effects, but in a typical procedure, a word is flashed on a screen for a fraction of a second. Then a second word is presented, and the experimental subject must respond to it, perhaps by reading it aloud, or by judging whether it is an English word or not, and striking a corresponding key. The dependent measure is response latency, and the relevant finding is that latency to respond to the second word usually decreases when the words are intraverbally related. Thus in the pairs *Bread-Butter* and *Bread-Bottle*, responses are faster to *Butter* than to *Bottle.* (See Krisjánsson and Campana 2010, Neely 1991, and van den Bussche, van den Noortgate, and Reynvoet 2009, for reviews of this and a variety of other priming effects.) Of particular relevance to the present point, category terms like *Fruit* simultaneously potentiate a variety of exemplars

of the category, such as *Apple, Banana,* and *Orange.* The potentiation must be *simultaneous* because the second term of the pair cannot be predicted in advance. That is, when *Fruit* is displayed on a screen, one has no reason to expect that *Banana* will follow on that trial, as opposed to any other word; if potentiation occurs on separate trials for many exemplars of a category, we must assume that it occurs for them all on every trial.

The significance of such findings is that, in addition to overt behavior, our conceptual toolbox must include not just covert behavior but latent behavior as well—that is, behavior which has not actually been emitted but which is nevertheless fluctuating in strength according to variations in discriminative stimuli. If the single textual stimulus *Fruit* has a simultaneous potentiating effect on a number of mutually incompatible exemplars of the category, we can assume that during conversation, or when reading a text, when verbal stimuli may be presented at the rate of several words per second, the effect on one's repertoire over the course of a few minutes must be highly complex, with myriad responses fluctuating in strength. Only one response in any response system can be emitted, but the smoothness and orderliness of overt behavior masks bewildering complexity. (See Palmer 2009 for a fuller treatment of this topic.)

Consideration of changes in strength of latent behavior may seem out of place in a science devoted to measurable changes in observable variables, but an interpretation of much complex human behavior requires just such a consideration. Verbal, gestural, and physical prompts, the mainstays of many procedures in applied settings, tend to work for the very reason that the control supplied by the prompt supplements control by the task. A parlor game requires one player to provide a succession of faint hints until another player correctly guesses the target word. For example, *cherry tree, false teeth, Martha,* might be sufficient together to evoke *George Washington*, but no clue alone would do so. In problem solving and in recall, which I have argued is merely an instance of problem solving (Donahoe and Palmer 2004, Palmer 1991), the individual does something perfectly analogous: he prompts himself with a succession of supplementary stimuli each of which sums with prevailing stimuli until the target response is emitted (Skinner 1953). The game of "20 Questions" is a model: Is it an animal? Is it a mammal? Is it native to North America? Is it nocturnal? Each successive answer raises the probability of a narrower and narrower set of verbal responses until the answer is emitted as such. In recall we employ similar strategies: When trying to recall the name of an acquaintance, we rehearse the names of mutual friends, visualize the context in which we met them, go through the alphabet to provide formal prompts, and so on. The additive effect of stimuli on latent behavior is central to a behavioral interpretation of such everyday behavior.

The skilled use of multiple control distinguishes the work of the great writer, artist, and composer, as well as the poet and humorist. To open *Richard III,* Shakespeare might have written, *Everyone sure is pleased with King Edward, now that he's won the battle*, but he chose instead to write, *Now is the winter of our discontent made glorious summer by this sun of York*. The line is memorable because of the multiple interacting sources of control: The cadence; the thematic elements of winter and discontent; the intraverbal relation between winter and summer, summer and sun; the parallel between

winter and summer, war and victory; Edward as both the son of York and, metaphorically, the sun of York who brought the warmth of peace in time of war; the theme of discontent and Richard's jealousy. In addition, Shakespeare's contemporaries would likely have known that Edward's emblem was the sun and that the antithesis of the imagery was historically mirrored by the physical contrast between the hunchbacked Richard and the imposing Edward, England's tallest king. Such relationships do more than keep literary critics busy; they have complicated effects on listeners.

Humor often arises from bringing an unexpected secondary source of control to bear on a response that is strong for other reasons. The pun may be the lowest form of humor, but it illustrates the principle. In poetry, responses which would be semantically weak come to strength by their metrical and rhyming properties. In Lewis Carroll's *Jabberwocky*, rhythm and rhyme carry much of burden of establishing response strength, for the rest is nonsense embedded in autoclitic frames. The thumping rhythms of Poe's poetry are often more memorable than the imagery itself. Semantically esoteric poetry that lacks both rhythm and rhyme may be judged harshly by readers if secondary sources of control are ineffective for them.

Joint control

A special case of multiple control appears to be relevant to matching-to-sample, pattern recognition, and other tasks that entail a search among stimuli for those with particular properties. In such tasks the relevant stimulus will tend to evoke behavior that is already strong. Under such conditions we speak of *joint control* (Lowenkron 1991, 1998, Lowenkron and Colvin 1992; see degli Espinosa 2011, for an overview of the concept and a discussion of its application to children with autism). The subsequent jump in response strength may be discriminable, and if so, can control subsequent behavior. For example, when scanning a page in a telephone book for the name *McDermott,* we may read many items before encountering the name, but as soon as we do, we go no further. This is such a commonplace phenomenon that we are inclined to overlook the need for an explanation: We stop when we have found what we are looking for. But how do we *know* that we have found it? Lowenkron's answer is that the response *McDermott* is already strong in the context; when we encounter the name in a list, control by the text sums with control by these other variables, and the discrepancy in stimulus control signals that the item has been found. The effect is clearest when both sources of control are conspicuous. For example, suppose you are told to find the name in a book corresponding to the phone number 413-658-8819, a number that is wholly new to you. Simply scanning the page will not work because when the number is encountered, it has no special effect. That is, it is not "recognized" as the target number. The only source of control arises from the text itself, and that does not set it apart from any other number on the page. Of course, most of us have learned what to do in such cases: we rehearse the number as we search. This establishes a second source of control: Self-echoic control and textual control evoke the same topography of behavior only when the target number is reached. The onset of joint control, presumably causing a discriminable saltation in response strength, is sufficient to explain the selection response, and no other explanations have been offered. Lowenkron (1998) spoke of the joint control by exactly

two stimuli, but there is no reason to suppose that the effect is limited to such cases. That is, any time a new stimulus is encountered that adds to the evocative effects of existing stimuli, however many, the saltation in stimulus control may be discriminable.

Given the putative ubiquity of multiple control, it may seem implausible that the onset of joint control should be special. However, the claims are not incompatible. The onset of joint control is only useful to us in certain kinds of tasks, such as identity judgments, discrepancy judgments, matching-to-sample, recall, problem-solving, and other tasks in which recognition is required. I am suggesting that the effect of joint control is conditional upon such tasks. That is, we learn to exploit the onset of joint control only in certain contexts; it is not an innate ability. Usually any shift in orientation is typically followed by stimulus change rather than stimulus identity. For example, if we look from one face to another in a crowd, or shift our gaze over any scene, we are accustomed to stimulus discrepancy. When stimulus discrepancy is the norm, seeing an identical stimulus from one glance to the next may be "surprising," hence more discriminable. For example, when we happen to look at identical twins, we are surprised; we experience a saltation in response strength rather than a decrement. Likewise, when we scan a list of telephone numbers, we are accustomed to a decrement in stimulus control, as each successive number evokes incompatible behavior. When two numbers are identical, or when a textual stimulus is supplemented by a self-echoic stimulus, the effect is in the opposite direction from the customary effect. Thus, our exploitation of joint control or multiple control may be restricted to contexts where discrepancy is the norm.

Automatic shaping

A distinctive feature of vocal behavior is that the behavior itself has stimulus properties that, under normal conditions, affect the speaker at least as faithfully and as promptly as they affect others. This feature is not shared by signing or other motor behavior: A manual sign looks somewhat different to an observer than to the person performing the sign. As a result, in order for a verbal community of signers to maintain sharp control over sign topography, the verbal community must shape the behavior of signers. However, much of the fine-grained shaping of vocal behavior can be accomplished without explicit shaping by other people. Children are commonly discriminating listeners long before they become articulate speakers. Toddlers with vocabularies of only a few words can understand complex commands that they cannot utter. That is, many verbal stimuli serve as discriminative stimuli for children who cannot yet formulate the responses that produce such stimuli. However, as their repertoire expands, and they begin to make such responses, they can tell whether they have done so correctly. That is, they can tell whether they have matched the normative practices of the verbal community by whether the stimulus properties of their own behavior exert appropriate stimulus control. In other words, they can recognize when they have matched (Baer & Deguchi 1986, Palmer 1996, Skinner 1957).

It is easy to demonstrate automatic shaping in an analog task: I programmed a computer so that each key produced a different tone, rather like the keys of a piano,

except that the order of position of the keys was unrelated to the pitch of the tones (Palmer, 1998) I then asked a naïve subject to play the tune, *Mary Had a Little Lamb*. As she had no experience with the device, her initial behavior was merely exploratory, but within a few minutes of working at the keyboard, she produced the tune with only one false note. The shaping was accomplished "automatically," that is, without any social reinforcement. Because the tune was familiar to her, she could instantly hear any discrepancy between her performance and the tune. Correct keystrokes were thus reinforced and incorrect ones punished. Needless to say, this process of automatic shaping would have been impossible if the tune had been unfamiliar to her. No doubt people learn to whistle through an analogous kind of automatic shaping, just as children learn to imitate the noises of motorcycles, trains, airplanes, with appropriate Doppler shift, all without explicit shaping by others.

I should emphasize that the reinforcement in the previous example was not the tune itself but evidence of matching. That is, the tinny sound of a computer playing *Mary Had a Little Lamb* is not a reinforcer for a typical adult, and it is implausible that my subject would have eagerly listened to the tune if it had been played by someone else. Rather, the demand to produce the tune established evidence of accomplishing the feat as a reinforcer. Thus, "recognizing the tune" was the reinforcer, not the tune itself. To make the point another way, if her random poking at the keyboard had accidentally produced the divine *Moonlight Sonata*, her behavior would have been punished, not reinforced, at least with respect to the task at hand. "Recognizing a tune" is a kind of pattern matching, and as I pointed out earlier, joint control is a possible variable controlling such performances. That is, the sound of the correct note would sum with the tendency to "sing" that note, presumably covertly. An incorrect note would be incompatible with our behavior.

Automatic shaping and grammar

The concept of automatic reinforcement is an important element of a possible behavioral resolution of the puzzle of structural regularities in verbal behavior (cf. Dohahoe and Palmer 2004, Palmer 1996, 1998). That children learn subtle features of their language without explicit instruction (e.g., Brown and Hanlon 1970) is not troublesome for a behavioral account. Automatic shaping may play an important role in the acquisition of a verbal repertoire for at least two reasons. First, it is instantaneous, unlike social reinforcement, which is usually slightly delayed. Second, it can occur virtually every time the child speaks. Contingencies of automatic reinforcement vastly outnumber those of social reinforcement.

To illustrate the power of automatic shaping, relative to social reinforcement, Silvestri, Davies-Lackey, Twyman, and Palmer (2000) conducted a demonstration that pitted the two sources of control against one another. This experiment has been replicated twice, with appropriate controls, once in English (Wright 2006) and once in Norwegian (Østvik, Eikeseth, and Klintwall 2012). The essential features were these: Young children took turns with the experimenter in describing a series of pictures. The experimenter consistently modeled a particular construction in the passive voice, namely,

the autoclitic frame *The X is being Y-ed by the Z*,. For example, one picture might occasion the response *The zebra is being painted by the peacock*, another the response *The elephant is being pulled by the mouse.* No constraints were imposed on the children, and no instruction was provided. If they used the active voice, some mild reinforcement was provided: the experimenter made an approving comment or gave the child a sticker. If they used the passive voice, no social reinforcement was provided. Nevertheless, all children in all three studies acquired all or part of the passive autoclitic frame and applied it to novel pictures. Since the frame was not initially in the children's repertoires, this extremely complex performance was presumably shaped by the reinforcing effect of conforming to a model. That the contingencies were effective in the face of explicit social and tangible reinforcement for using the active voice illustrates the strength of reinforcement by conformity with models. (See Goldberg, Casenhiser, and Sethuraman 2004 for an analogous example of the rapid acquisition of a nonsense frame through modeling.)

Autoclitic frames, novelty, and "grammatical intuitions"

These studies suggest a way of interpreting "grammatical intuitions" of novel strings that pose such puzzles to the scientist. It is true that most sentences are novel, but the autoclitic frames at the heart of sentences are not. We can assume that an autoclitic frame comes to strength in characteristic contexts; in the experiments on the passive voice, the context in which the passive frame was emitted and reinforced included a particular room, a particular person, and a picture of two animals interacting. The presentation of a novel picture and the attentive expression of the experimenter set the occasion for responding. The autoclitic frame came to strength, for, by hypothesis, it had repeatedly been emitted as a covert echoic in that context; then variable terms occasioned by the picture were interwoven with the frame, creating a novel sentence, perhaps never uttered before by anyone. Novelty lies in the combination of controlling variables for verbal behavior. The orderliness we speak of as "grammar" arises from the structure of autoclitic frames—that is, each element of the frame occurs in a fixed position relative to other elements. Our "intuitions" about the acceptability of certain constructions depends in part on whether we have acquired the corresponding autoclitic frame. Thus the verb *donate* occurs in fewer contexts than *give*, and it occurs in frames like *X donated Y to the Z*, but seldom, or never, in the frame *X donated Z Y.* In contrast, *give* occurs in both frames. So our "grammatical intuition" arises from the familiarity of the autoclitic frame, not from the novel string as a whole. Although this argument is post hoc, something of the sort must surely be true, for the terms *give* and *donate* are purely arbitrary. In principle, their functions could be reversed. (See Palmer 1998, 2007 for elaboration of these points.)

Rapid shifts in stimulus control in autoclitic frames

Thus the interweaving of autoclitic frames with other verbal operants occasioned by some context may be sufficient to explain the novelty of much verbal behavior, but much remains mysterious, for the interweaving of verbal elements requires rapidly shifting stimulus control. A child in the passive voice study is emitting sequences of the

form *frame-tact-frame-tact-frame-tact* (*The X is being Y-ed by the Z.*) The ordering of the frame itself was fixed, but how did stimulus control switch from the variables evoking the frame to the variables evoking the appropriate tact?

Although this is among the most commonplace of performances, it is surely one of the most formidable challenges to a behavioral analysis. That the general context is essentially constant over the time course of such utterances suggests that the controlling variables for transitions between verbal operants are to be found in the verbal behavior itself and perhaps in the speaker's discriminative responses to his own verbal behavior as it is being emitted. The plausibility of such a claim is supported by studies of delayed auditory feedback. Usually speakers hear themselves immediately and faithfully, but when such stimulation is electronically delayed by a fraction of a second, most people find it difficult to speak (e.g., Fabbro and Daro 1995). However, on the assumption that the sequence is novel, it cannot be the particular words that are controlling the transitions; the elements of the frame may be fixed, but the variable terms (*X, Y,* and *Z*) are not. Moreover, the variable terms themselves can differ considerably in form: In place of the variable term *pig,* a child might say *pig with a funny tail*, but the terms would serve the same function in controlling a transition in stimulus control. That is, the particular phonemes do not seem to be sufficient to control the next element in the string.

However, there is an important feature of speech that may be relevant to transitions in stimulus control, specifically, prosody. Prosody is the song of speech, its cadence and stress. Prosody serves several different functions in speech, such as determining emphasis, distinguishing questions, assertions, and exclamations, marking clause boundaries, and differentiating words. But another important function may be to mark transitions in autoclitic frames. In the passive voice examples, the stress falls on all of the variable terms; the elements of the autoclitic frame are unstressed: *The pig is being pushed by the rat*; or *The pig with the funny tail is being pushed by the rat.* It is possible, then, that for some autoclitic frames—perhaps all—prosodic cues become controlling variables for transitions between verbal elements for speakers themselves. The controlling stimulus may be the auditory property of the stress, the proprioceptive property of emitting stress, or perhaps the controlling variable that causes an element to be stressed at all. (See Palmer 1998, 2007 for a more extensive discussion of this topic.)

Conditioning the behavior of the listener

Conditioning the behavior of the listener is both the most commonplace of phenomena and the greatest puzzle (Palmer 2005, 2007, Schlinger 2008a, Skinner 1957). When we observe someone respond "144" to "What is 12 times 12?" we infer that they encountered the question before, responded correctly, and that some reinforcement followed. The conclusion is plausible, for most children have encountered this three-term contingency in grammar school. But it is easy to demonstrate the acquisition of novel verbal behavior in the apparent absence of contingencies of reinforcement: Make up some nonsense fact, and announce it to a group of people. For example, tell them that you were born on an island called Bingwich and that you plan to retire there as an ermine-robed emperor some day. Fifteen minutes later, a day later, perhaps a week later,

most of your audience will be able to report that "fact," including the name of the island. But how can *Bingwich* be in someone's repertoire *as a response* if they have never uttered the word before? The puzzle arises from the apparent absence of contingencies. To an observer, the listener appears to have emitted no behavior and to have participated in no contingencies of reinforcement. In many cases, mere exposure to verbal stimuli seems to be sufficient to effect an enduring change in human behavior. But this is untenable. This example illustrates, not just a change in the stimulus control of an existing response, but the establishment of a novel response at a future time.

The explanation, of course, is that the listener is not a passive vessel. The listener's repertoire changes only when he or she is "paying attention." The term is intuitively appealing but difficult to operationalize, as it seems to embrace, not just subtle orienting responses, but covert behavior as well. If we assume that attentive listeners engaged in covert echoic behavior at the time of your statement, much of the mystery dissolves. Your audience *has* emitted the response *Bingwich* before, at the time you presented it as a verbal stimulus. They were able to do so immediately, without shaping, because, as we have seen, echoic behavior is an example of an atomic repertoire. It is true that we must also infer that some reinforcement followed, but this is not implausible. Simply successfully following a speaker into a new domain is likely to be a conditioned reinforcer. We say we "get the point" when such a response evokes a wealth of other relevant behavior in our repertoire. This effect too is likely to be a conditioned reinforcer, for, in our experience, understanding is correlated with reinforcement, confusion with extinction. Compare those cases in which we are unable to echo the foreign phrase, the incomprehensible jargon, or the inarticulate mumbling of a speaker. By assuming that listening entails echoic behavior, we are able to begin to explain a great deal of human behavior, specifically, the acquisition of "information" simply by listening to others (Palmer 2005, Schlinger 2008b). The hypothesis that listening entails echoic behavior is supported by research on activity in the motor cortex (e.g., Fadiga, Craighero, Bucchino, & Rizzolatti, 2002, Watkins, Strafella, and Paus 2003, Wilson, Saygin, Sereno, & Iacoboni, 2004) as well as studies of auditory perception (e.g., Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). It is closely related to the motor theory of speech perception (Liberman, et al. 1967), a theory influential to the Soviet school of psychology. (See Žinkin 1968 for a review. See Horne and Lowe, 1996, for an analysis of the role of echoic behavior in the acquisition of listener behavior, tacting, and naming.)

The concept of echoic behavior implies a temporal order, with the listener following the speaker. This is plausible when the verbal response is novel, or is otherwise weak in the listener's repertoire, but often the listener speaks along with the speaker, or even a little ahead, as when the listener finishes the remark of a hesitant speaker or supplies a word for a fumbling one. Under many conditions an important function of speech is simply to set up conditions that induce verbal behavior in the listener. Evoking echoic behavior is an effective way of doing so, but not the only way. Listener behavior doubtless includes other relevant activities as well: cascades of discriminative responses, mnemonic strategies, elaborations, imagery, intraverbal chains, and so on. Echoic behavior is sufficient to establish a verbal response of novel

topography in one's repertoire, thereby disposing of the puzzle of the first instance, but all listener behavior must be considered if we are to have a comprehensive account.

Verbal stimuli sometimes alter the function of other stimuli (Schlinger and Blakeley 1987, Skinner 1957). If we are told to turn left when we come to a stone church, we are likely to do so. The church appears to have acquired discriminative control over turning left. But such an account is inadequate by itself, as it omits relevant mediating behavior: We turn left only if we are "paying attention," that is, responding discriminatively to the verbal stimulus and again to the buildings along the road. The importance of such behavior become clear when the example becomes more complex: If told to turn left at 82 Gower Street, we will do so only if we scrutinize the storefronts and engage in textual behavior as we pass along the street; the verbal stimulus does not magically endow the building with evocative control over our behavior. Thus, the phenomenon of conditioning the behavior of the listener is of central importance to human behavior, but unfortunately, our accounts of it remain highly speculative, owing to the inaccessibility of much of the relevant behavior.

Equivalence classes and relational frames

In this chapter I have neglected to discuss two major empirical threads within behavior analysis that are sometimes assumed to be central to an understanding of verbal behavior, or perhaps even to define behavior that is distinctively verbal. I speak of work on equivalence classes and relational frames. The reader can find good treatments of the former in Sidman (1994, 2000) and of the latter in Hayes, Barnes-Holmes, and Roche (2001). The important feature of such work is that subjects who are posed a series of analogical tasks can often generalize to novel tasks of the same sort without further training. Moreover, stimulus functions often transfer as well (e.g., Dougher, et al. 2007). However, the research paradigms that are used to study these phenomena typically study verbal subjects and measure just one bit of behavior (usually a keystroke or a mouse-click) terminating trials that can last many seconds and often feature complex and abstract stimuli. When subjects are forced to respond quickly, that is, within two seconds of stimulus presentations, subjects fail at the tasks (Holth and Arntzen 2000), suggesting that successful performance is at least partly under control of unmeasured events within the trials (e.g., Dugdale and Lowe 1990, Horne and Lowe 1996, Miguel, Petursdottir, Carr, & Michael, 2008, Randell and Remington 2006). Research with nonverbal subjects has met with little success and then only with the simplest of relationships and after prolonged training. When relationships are complex, even adult verbal subjects often fail at the tasks. These research preparations are important in themselves, but they may be too complex to shed light on fundamental processes in verbal behavior. Rather, they seem to illustrate contextually controlled problem solving: The phenomena of interest may arise from unmeasured verbal behavior or nonverbal mediating behavior that is conditioned during training.

Conclusion

I have reviewed some of the ways in which verbal behavior is distinctive. Although producing even the simplest of speech sounds requires precise coordination among disparate muscle groups, once a repertoire of such responses is acquired and brought under control of antecedent stimuli, a verbal repertoire can expand rapidly and indefinitely. Verbal responses usually require little effort but can have great consequences, not just for the speaker, but for the listener and the entire culture, because verbally-governed behavior can short-circuit the process of shaping by inducing critical variations in behavior in a single step. Novel forms of adaptive behavior sweep rapidly through verbal communities. Because speakers are also typically listeners, sharp stimulus control of response form can be maintained "automatically," that is, without instruction. As a consequence very slight differences in response topographies can yield different response classes that are respected by nearly everyone within a verbal community. Verbal behavior is so efficient that novel verbal responses can be acquired in the apparent absence of contingencies of reinforcement, an illusion that arises form the privacy of the listener's responses and the subtlety of the reinforcing consequences.

The task of the behavior analyst is to offer an interpretation of this remarkable kind of behavior using only the concepts and principles that have emerged from experimental analyses of behavior, that is to say, those concepts and principles to which this volume is devoted. The interpretive task is formidable, for much human behavior is covert, we seldom know much about the histories of our subjects, and verbal behavior is almost always under control of multiple stimuli. Nevertheless, following Skinner, I have tried to show that our interpretive and analytical tools are versatile enough to offer speculative accounts of even the most baffling of verbal phenomena. Restricting ourselves to behavioral principles imposes a cost; our task would be much easier if we could invoke lexicons, grammatical modules, syntactic assembly processes, and so on, but our restraint has one advantage, and it is an overpowering one: The principles of behavior are not hypothetical. It may be that we have not yet settled on a final statement of these principles, but the reliability and validity of the data from which they arise compare favorably with those of competing interpretations of verbal behavior. It is just this consideration that justifies the present approach.

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