On the Operant Conditioning of Complex Behavior

KURT SALZINGER, Ph.D.

Despite the fact that behavior theorists have for a long time been talking of classes of stimulus and response (Skinner, 1935), critics have continued to berate them for their interest in the performance of "a particular response in the presence of a particular stimulus" for their supposed assertion that all is learned is a discrete response," quote from a recent paper concerning learning theory and psychotherapy (Breger & McGaugh, 1965). Although this constitutes a basic misunderstanding of recent learning theory, Rachman and enck (1966), in a reply, chose to disregard the notion of working with specific responses on the basis that they are more accurately measurable, without pointing out that free operant responses typically occur as classes and that, indeed, behavior theorists and behavior therapists who worked with such classes of responses (see Krasner & Ullmann, 1965; Ullmann & Krasner, 1965). That one can now the acquisition, maintenance, and extinction of behavior through well isolated, well restricted, and easily measurable responses is accepted history by now perhaps only Breger & McGaugh, 1965, disagree) and what we must do at this time is concentrate on more complex behavior.

Having worked on instatement of speech in speech-deficient children (Salzinger, Feldman, Cowan, & Salzinger, 1965; Salzinger & Feldman, 1966), acquisition of grammar in normal children (Salzinger, Salzinger, & Hobson, 1966), on the controlling aspects of grammar in adults (Salzinger & Eckerman, 1967), and on the deterioration of speech in a characteristic we have come to call communicability (Hammer & Salzinger, 1964; Salzinger, Portnoy, & Feldman, 1964a, 1966). I have found it impossible to ignore the problem attendant on the complexity of verbal behavior. At the same time, it is worthwhile noting that the fact that responses are not independent of each other has been demonstrated for the simplest responses—bar pressing in learning experiments, frequency of seeing curves in psychophysics—as well as for the most complex behavior—speech (Salzinger, 1962); that operant conditioning affects response classes and that these classes change character as a function of change in reinforcement contingencies and differences in reinforcement history has also been shown in simple bar pressing (Antonitis, 1951; Herrick, 1964; Notterman & Mintz, 1966) as well as in complex speech behavior (Salzinger, 1967).

In view of the above, it might be useful to explore some of the ways in which complexity of behavior generally manifests itself. Although the term complexity is often referred to the controlling function which stimuli have over responses (simple or complex) as in Ferster and Skinner's (1966) experiment on arithmetic behavior, where chimpanzees learned to respond to the stimulus property of numerosity, we shall talk here only of complexity as manifested in the interrelationship of responses.
We have already referred to the first of these complexities, namely, response class and the related concept of response generalization. In a series of experiments Portnoy & Salzinger, 1964; Salzinger & Pisoni, 1958, 1960, 1961; Salzinger, Portnoy, & Feldman, 1964b) done in the context of analyzing how the interviewer influences the verbal behavior of the interviewee, we have found that the reinforcement of a response like “I am happy” caused an increase in frequency of occurrence of other members of that class of self-referred affect, like “I am sad,” “I am angry,” “I loved it.” In other words, the phenomenon of response generalization is such that reinforcement always affects classes and not just individual responses. The composition of these classes must always be carefully checked for their precise membership, particularly when experimenting with verbal behavior of adults who have a very long reinforcement history (Salzinger, Portnoy, Zlotogura, & Keisner, 1963). Responses the experimenter reinforces and responses which are conditioned do not necessarily belong to the same response class.

A second kind of complexity is introduced by response classes of a somewhat larger size. To the outside observer these response classes appear to be quite obviously based upon rules. Thus the “rule” for imitation is similarity between one’s own response and that of another organism; the rule for sentence type is a grammatical one or a series of these having to do with the arrangement of words and phrases. What must be realized with respect to behavior amenable to description by rule is that it in no way proves that behavioral control inures in the rule. Lashley’s (1951) argument against the association chain theory was based in part on the fact that verbal behavior is emitted too rapidly for each word to be a stimulus for the next one; by that same reasoning verbal behavior is emitted too fast for it to be controlled by verbal rules.

A third source for response complexi-
ty is the unit size of the response. Response unit size, like response class, must be defined on a functional basis. While a single sound may constitute the length of a response in one context, a number of sentences may have this function in another. Thus, several sounds, syllables, words, or sentences may function as one unit when those smaller responses come to be controlled by a reinforcement contingency which requires them to occur in a chain.

A fourth way in which response complexity manifests itself is in terms of the emission of one response producing a change in a situation, providing the subject with the opportunity (SD) of making a much larger number of different responses than before that response had been made. Thus a child who is conditioned to play next to other children places himself in a situation where he can make a large group of new responses which will be positively reinforced by the other children.

The fifth way in which response complexity is manifested is in terms of response incompatibility. The conditioning of one response may come to suppress another one merely because it has a greater response strength and because the two cannot be emitted at the same time or place. Thus one can control violent behavior in a child by reinforcing that child to stay away from others. A problem arises when that response is extinguished in the process of reinforcing more social behavior. This particular complexity suggests that the method of extinction may in the course of behavior therapy actually produce the conditions for behavior as maladjusted as the behavior being extinguished. A person whose “running-from-people” behavior is distinguished in the course of behavior therapy may very well, when confronted with them, become violent, on the simple assumption that his running-from-people behavior had been an avoidance response learned in the face of the aversive stimu-
on resulting from being violent with people.
The sixth complexity of behavior stems from the fact that the same response may function as an operant and a respondent. An interesting research question is whether a response, take for example a tic, known to be conditioned as a respondent—perhaps as a result of some traumatic condition—can be extinguished by means of a purely operant procedure. Is this what happened in the experiment done by Yates (1958)?

In behavior therapy these are the complexities that must be dealt with. A child who has no speech must be trained to acquire language, and the complexity of the latter requires that we complete an analysis of it which will allow us to train such children in the most efficient way possible; and that in turn requires that we analyze speech into response units and response classes and the dependencies among the classes. We cannot any longer simply accept the notion that shaping of complex behavior is an art, nor can we assume without further study that employing the general notion of imitation only is the royal road to the instatement of new responses. Assuming that a child does generalize enough so as to have a response class in his repertory which can be described as generalized imitation (see, e.g., the interesting studies by Beer & Sherman, 1964; Lovaas, Berberich, Perloff, & Shaeffer, 1966; Metz, 1965) is not enough to explain the apparently rapid acquisition in normal children of what for the lack of a better term we can call sentence frames and what the psycholinguists have called structure. It is interesting, in this regard, to note that Bregar and McCaugh (1965) claim, basing their arguments largely on those proposed by Chomsky (1959), that language acquisition and therefore an important area of behavior therapy cannot be explained by behavior theory since human beings “internalize a complex set of rules (grammar) which enable them to both recognize and generate meaningful sentences involving patterns of words that they may never have used before [p. 343].” “The internalization of a set of rules” has become, among many psychologists, an acceptable way of talking about the acquisition of language. In relation to that, Miller (1965) presents the argument that the very large number of possible combinations of words in the production and comprehension of sentences makes “concepts borrowed from conditioning theory seem not so much invalid as totally inadequate [p. 299].” He goes on to say that “what we have learned are not particular strings of words, but rules for generating admissible strings of words [p. 299].” Later he says: “No careful schedule of rewards for correct or punishments for incorrect utterances is necessary. It is sufficient that the child be allowed to grow up naturally in an environment where language is used [p. 302].” These arguments can of course be countered in a number of ways. The term “rule” itself requires explanation, not to speak of the term “naturally,” for interestingly enough the rule does not imply that the speaker is capable of making a verbal statement of how to emit a sentence but rather it is inferred from lawfulness of behavior and said to be essential to explain the complicated and “productive” (newly generated) behavior when a person emits a sentence in correct grammatical order despite the fact that he had not been specifically taught that sentence. Yet, the behavior theorist has not found it necessary to explain the acquisition of complex behaviors, as in the cases of the many schedules of reinforcement (Ferster & Skinner, 1955) and in the acquisition and maintenance of multi-operant repertories (Findlay, 1962), in terms of rules, although the description of a schedule lends itself to being described by rules. It is interesting to note here that the rule-conscious (r-c) psychologist in fact maintains that animals cannot have language
they cannot emit rule-governed be-

behavior. It is worthwhile to reiter-

ate here that the rule is an inference

and therefore an illustration of com-

plex behavior in animals which could be

examined by rules would require that the

psychologists give up the notion of

rules or that they accept the idea that

rule-governed behavior can be condi-

tioned by the usual operant techniques.

A recent paper by Goldiamond (1966)

presents an interesting analysis, in terms

of operant conditioning, of the notion of

rules in perceptual behavior. Findley

(1962), working with animals, condition-

ed what he called "groves," that is, a series

of responses including at any given stage

of choice of several responses (each on

one intermittent schedule of reinforce-

ment). Each of these choices might then

et the occasion for the emission of one

subsequent response (on some reinforce-

ment schedule) or for another set of re-

sponse choices (each possibly on a differ-

ent reinforcement schedule), and so on.

It turns out that these very complicated

series of responses, which may at least in

principle be viewed as similar to the

emission of a series of words in a sen-

tence, were more easily conditioned than

the long serial chains where only one re-

sponse could be emitted at each link of

the chain. What the r-c psychologists

have thought of as the ultimate complica-
tion requiring the notion of rule—namely, that novel response combina-
tions must be allowed for in the emission

of a sentence—is exactly what makes

for greater ease of conditioning in ani-

mals. The emission of this series of re-

sponses, like the emission of words in a

sentence, has consequences (by way of

both primary and secondary reinforce-

ments) for each of the responses and for

the series as a whole. It is these different

consequences which might in face be

viewed as related to differences in "mean-

ing." "Pass the sugar" as opposed to

"pass the salt" is an obvious example of

this. It is clear therefore that behavior

theory should be able to shed some light

on the problem of the acquisition of

language.

It might be well at this point to men-
tion some of the verbal behavior data

which originally gave rise to the notion

of rules to explain what the child ac-
quires when he learns to speak. The ob-

ervation is actually quite straightfor-

ward, and has been made by at least three

independent groups of investigators

(Braine, 1963a; Brown & Fraser, 1964;

Miller & Ervin, 1964), who systematically

observed the early combination of

words into utterances in normal chil-

dren, and was also found in our labora-

tory in the course of conditioning a

speech deficient child to talk (Salzinger,

Feldman, Cowan, & Salzinger, 1965).

When children first combine words they

have two response classes—one class

variously called "pivot words" or "opera-

tors" consisting of a few high frequen-

cy words and restricted in position in the

utterance, and another class variously

known as the "X class" or "nonopera-

tor" class and consisting of the remainder

of the child's vocabulary.

These facts have led to the notion that

the child must have learned a rule rather

than responses, particularly because il-

ustrations can always be found of word se-

quences in the child's verbal behavior

which no adult is likely to say, that is,

sequences which are "original."

Let us look at an example of a two-

word sequence consisting of pivot and

X class. I have had occasion recently to

observe the process of language acqui-
sition, in my 18-month-old daughter

who has begun, after some practice in

simply naming objects and people in her

environment, that is, after learning to

tact (Skinner, 1957), to combine words.

One day, some 5 minutes after my wife

had left the apartment and Meryl had

said "Bye-bye Mommy," Meryl turned
to the baby sitter and said "Mommy
This particular sequence of events has the properties of a "new" response which r-c psychologists call "productive"; in addition, it might also be viewed by them as an example of an utterance produced by what they call a misformation rule, from the "Bye-bye Mommy" utterance to the "Mommy bye-bye" utterance. The r-c psychologists have claimed that the transformation rules, that is, from a kernel structure to, say, a passive negative query, are a necessary simplification which allows one to rearrange words rather than having to state an independent rule for rearrangement of every possible structured sentence. This kind of formulation depends on the assumption, however, that words somehow always occur to a subject in the same "structure" originally and that only after they have occurred that way are they transformed into the desired structure. Such a structure appears to be a hypothetical construct not amenable to empirical investigation; on the other hand, in examining the environmental contingencies surrounding Meryl's two-word utterance, we have what appears to be a more reasonable explanation. The word "Mommy" occurs quite frequently in Meryl's behavior repertoire since it probably has one of the longest reinforcement histories in her life. Thus one would expect it to occur on the basis of frequency of reinforcement alone; in addition, however, since "Mommy" regularly leaves shortly after the baby sitter arrives, the baby sitter might well have been the stimulus for the word "Mommy"; since "Mommy" has been reinforced more frequently than "bye-bye," one would expect "Mommy" to occur first simply on the basis of response strength. Finally, the word "Mommy" can be said to be the discriminative stimulus (when emitted in the presence of the baby sitter) for the response "bye-bye" (Meryl has said "bye-bye" to Mommy quite often), thus accounting for the new word order "Mommy bye-bye." While this explanation is clearly post hoc, it does make available an alternative explanation to the one based on a transformation grammar and one which could in fact be tested out. This explanation also has the virtue of including among the variables controlling the emission of the responses the environmental stimuli and thus includes some of the subject matter under the heading of meaning. An explanation for the emission of verbal responses which is based solely on grammar is obviously incomplete and possibly quite wrong.

The above example allows for the illustration of one other aspect of verbal behavior which r-c psychologists think only rules can explain, and that is the phenomenon of placing related words in the same position of a frame. Thus Meryl has learned to say "Daddy bye-bye," simply placing "Daddy" in the same position of the "______ bye-bye" frame as "Mommy." This kind of replacement of the members of the same response class (Salzinger, 1967) by each other has of course been discussed by Braine (1963b) in terms of contextual generalization and by Jenkins (1965) in terms of a mediational model, and is in fact handled quite well by learning theory in general. The reader is also referred to Staats and Staats (1963) for a similar discussion of grammar and learning theory.

In our work with a speech deficient boy, we (Salzinger, Feldman, Cowan, & Salzinger, 1965) were able not only to gain control over the emission of single word responses to specific physical stimuli along certain dimensions (colors, numbers, and letters) and to objects in general in the child's environment, but also to introduce a sentence into the repertoire the boy after he had learned to say quite a large number of tacts, on basis of imitation training. Using a (M & M's) as a reinforcement, the examiner required the boy to say the word "candy" in a sentence; emission of
"candy" alone had been previously heard. The subject was alternately to say "give me candy" or "I want y." When he had learned to say "give me candy," it was decided to repeat this sentence. Thus having intro-
duced a sentence into his repertoire, now had the opportunity of moni-
toring his use of this sentence frame in situations outside the experimental m. What is probably more interest-
ing, we also had the opportunity to serve the use of the "gimme——"
me with a whole series of new words which were emitted without the addition-specific reinforcement of these combinations. Examples of some of the early "spontaneous" responses are given below: "gimme office," "gimme wait," "gimme see 'a' broken toilet," "gimme ght it" (meaning, let me tighten it), "gimme man fix 'a' light 'a' broken" and in one of his more poetic remarks, 'gimme no more cloudy again." It is perhaps most interesting to note here that
the boy's verbal behavior showed two effects: (a) the placement of not only one word but sometimes whole strings of words into the X-class position of the frame, with the major structure within that position being quite simply the order-
ing of responses in terms of what appears to be their relative strengths, and (b) the use of all the words and word strings within his repertoire before going on to make use of a new frame in which the various words could then be tried out. This point was borne out by additional data, not reported in this paper.

SUMMARY AND IMPLICATIONS

I have tried to point out the impor-
tance of investigating the complexity of behavior for behavior therapy by showing that, certainly in the case of verbal behavior, one has to condition particular kinds of responses rather than merely illustrating that a convenient response can be conditioned. I then briefly reviewed the approach of the rule-conscious psyc-
chologist toward this complexity and re-
jected his approach because it includes explanatory terms which themselves are in need of explanation. Further, I showed how a functional approach to the acquisi-
tion of language, whether in normal or speech deficient children, can provide us with information about how or what is acquired when a child learns to speak.

I would like to suggest, in addition, that although it has become clear that one can use imitation training and shaping procedures to condition speech, that these procedures must be made explicit par-
ticularly in the conditioning of speech beyond that of single words. Finally, in the production of speech beyond the single word level, it is important to con-
sider using the relative strength of extern-
al stimulus control over the single re-
sponses to condition "sentence" behavior.

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