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Imitation: Some Theoretical Issues

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IMITATION: SOME THEORETICAL ISSUES

by

Charles Richard Spates

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Submitted to the
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of the
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Charles Richard Spates
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INTRODUCTION

Although research on imitative behavior dates back to early in this century (Watson, 1908a), most of the progress in the experimental analysis of imitative behavior and observational learning (Ulrich and Mountjoy, 1972; Mussen, Conger and Kagan, 1969) has occurred in the last forty years. Perhaps the most influential research, in terms of frequency of citation, is that of Miller and Dollard (1941), Baer and colleagues (1964; 1967) and Bandura and his associates (1963; 1969). The Miller-Dollard analysis follows the behaviorist model laid down by Hull (1929). Bandura calls his outlook the "socio-behavioristic approach" (1963) or the "social learning theory approach" (1969), whereas Baer and his colleagues represent the operant school of thought (Skinner, 1953).

This paper will review selected examples of research by Miller and Dollard, Bandura, and some recent experiments in the operant analysis of imitation. The reviewer will attempt to show the greater experimental power and the theoretical economy of an operant interpretation of imitation as opposed to the interpretations of Miller-Dollard and Bandura.
A few studies by Miller and Dollard will serve to illustrate some of the early research on imitation. These scientists performed studies which clearly made attempts at understanding the conditions responsible for imitative behavior, in contrast with earlier work which sought to determine if imitative behavior occurred (Woodworth, 1922; McDougall, 1908) or its developmental onset (Jersild and Holmes, 1935).

The strategy followed by Miller and Dollard in their animal research was to formulate hypotheses, in accordance with their theoretical viewpoint, concerning the conditions influencing human imitation. They then attempted to duplicate those conditions in the animal laboratory. The critical question, as they saw it, was whether the conditions responsible for human imitation could be met in experiments with laboratory rats. From their past experience, they concluded that rats could meet all of the conditions for learning required by the Hullian theoretical model: they possessed drive, responded to cues, and could be rewarded by substances such as food and water. In particular, rats had previously performed successfully in various discrimination learning studies, and imitation, according to Miller and Dollard, was a form of discrimination learning in which the cue was the behavior of a second organism.

In the initial experiment of the series, rats were taught a simple black/white discrimination in a T-maze, and rewarded with food for correct choice responses. When these subjects had mastered the dis-
crimination they were designated "leader" rats. Then, naive ("follower") rats were placed in the maze behind a leader, near the choice point of the T-maze. If the follower performed the same choice responses as its leader (imitated the leader), it received food reward. A second group of follower rats ("non-imitators") was trained to choose the goal box opposite to that chosen by the leader. A control procedure determined whether imitators and non-imitators had learned to respond to the black/white choice point cues or to the behavior of the leader. Two more groups of leaders were trained, one to turn consistently right and the other consistently left. The black and white choice point cues were absent. An imitator or non-imitator was then placed in the T-maze behind one of these new leaders. With the black and white cues absent, the only cue available to the follower was the behavior of the leader.

The results demonstrated that a "follower rat would reliably imitate the behavior of a leader when food reward was made contingent upon such performance". Furthermore this behavior was shown to be a function of the "leader" rats' behavior as opposed to any other environmental cue. A subject which was trained to go consistently in one direction in the T-maze, when placed behind a "leader" rat, effectively ignored the behavior of the leader and consistently went in the direction appropriate to its training. On the first day, there was no reliable difference between the (imitators and non-imitators) groups. On the twelfth day of training, the difference was of a magnitude to be expected by chance less than one time in a thousand. Thus the different conditions of reward produced a reliable difference between the two groups" (Miller and Dollard, 1941 p.111).
As an extension of the experiment just described a second study was designed to test whether generalization of imitation to new leaders would occur. A group of black rats was trained, as leaders (the leaders of the first experiment were white rats), to go consistently to the right arm of the T-maze and the follower rats of the previous experiment were placed behind the black leaders. (Only one leader rat and one follower rat were in the T-maze at any given time.) Miller and Dollard found that, "...the tendency to imitate, learned in the situation in which white rats were used as leaders, generalized so that it immediately appeared in the new situation in which black rats were used as leaders" (Miller and Dollard, 1941 p.114).

The third experiment in this series proposed to test for the "generalization from one drive to another. The animals used in previous experiments had been trained using food rewards. Perhaps the followers smelled the food in the correct goal box and went toward it and therefore these studies demonstrated only the exquisite olfactory mechanisms of the subjects. Miller and Dollard's third experiment probably contributed more to this question than to the notion of generalized drives, but, as the concept of drive was one of the components of their theoretical system, they conceived of the experiment as illustrating a theoretical point. This experiment employed water instead of food rewards and replicated the results of the first experiment, thus showing that the behavior of the leader rats, and not olfactory cues from food, was sufficient to control the choice behavior of the follower rats.

Prior to these studies, research on imitation with animals had
consisted mainly in attempts to demonstrate that animals could be
trained to imitate. Miller and Dollard's contribution was their
systematic attempt to identify and manipulate the conditions neces­
sary to observe and control imitative behavior. Following the re­
search methods of the time, they employed group experimental designs
(which often obscure important information about the behavior of
individual subjects) and a theoretical framework that included the
positing of internal, inaccessible factors such as drive and drive
reduction. The former factor should perhaps be viewed in light of
the available research methods and the latter as superfluous theo­
retical constructs.

Criticisms of this earlier position taken by Miller and Dollard
have suggested that little research has been stimulated as a result
of their 1941 publication; reportedly, their theory "accounts more
adequately for the expression of previously established matching
responses than for their acquisition" (Bandura, 1971). Also the
argument has been put forth that these studies are mere demonstra­
tions of place learning rather than actual imitation; that a light
or some other stimulus object could easily have produced the same
behavior in the follower subject and no new behavior was acquired
by the imitators (Bandura, 1969).

It is often fashionable among critics of a particular view­
point to retrospectively attack the earlier positions taken by per­
sons entertaining differing and sometimes opposing views. Many
times these criticisms are constructive in that they assist in the
better acquisition of information regarding a topic. At other times
they are not so constructive and in fact attempt at demolishing one
theory only to replace it with another theory which could not have
existed without the background work provided by the predecessor.

The reasons for this kind of destruction in "science" are not clear,
and much could be gained from the former approach.

Miller and Dollard did in fact make a significant contribution
to the ongoing tradition of research in imitation. Their contribu-
tion is reflected by the fact that they have been referenced by many
contemporary writers in the field e.g. Gerwitz and Stingle 1968;
Bandura and Walters 1963; Staats 1969; McLaughlin 1971. The benefit
to be derived from such a suggestion to the contrary are not readily
apparent. However the suggestion that their theory appears to ac-
count more adequately for some other kind of behavior or that it
demonstrates only a given type of behavior, could be constructive.

It should be acknowledged, though, that these criticisms are made in
light of more contemporary research and that prior to the publication
of these studies (Miller and Dollard, 1941) there had been little or
no analytical study of the topic. The series of studies represented,
then, the first serious attempt at uncovering a here-to-fore un-
touched area. That refinement of methodology has produced further
gains, should only have been expected.

Miller and Dollard have been credited as being one of the direct
predecessors of present day operant researchers. Similarities do
exist between these two schools of thought. The basic constructs for
Miller and Dollard analysis (Hullian model, Hull, 1929) are drive,
cue, response and reward. A response is made because of certain drive
(not always identifiable), in the presence of a certain cue and is
rewarded with something which reduces the drive state. For operant
analyses the necessary constructs are descriptively similar.

From an operant viewpoint, behavior is analyzed in terms of a three-term paradigm; $S^D \rightarrow R \rightarrow S^R$. $S^D$ represents a discriminative stimulus; $R$ signifies the response and $S^R$ denotes the reinforcing stimulus. The operant approach eliminates the concept of drive, defines reward empirically, and places primary causal emphasis on stimuli that follow the response.

Both Miller and Dollard and operant investigators regard imitation as a type of discrimination learning. It will aid later discussion to give a somewhat detailed exposition of the way in which persistent discriminative behavior comes about according to the operant paradigm. Consider a pigeon observed to peck a green disc but not a disc of any other color. Further suppose that, on the particular occasion when the pigeon is observed, no reinforcement appears to be forthcoming for the pecking. The features of this performance that require explanation and (1) the pecking response itself, (2) the fact that the pecking is confined to a green disc, and (3) the fact that sustained pecking occurs in the absence of reinforcement. One possible analysis of this arrangement is as follows: The pigeon learned to peck the disc through a process called shaping. The experimenter selectively (differentially) reinforced responses from the pigeon which successively approached the disc. This brought the pigeon in the general vicinity of the disc. Next the pigeon was again differentially reinforced for head movements in the direction of the disc, culminating in a pecking response. The second feature of this arrangement could easily have occurred by the experimenter reinforcing the pigeon for pecking only when the green light is on.
If it pecked when the light was not on or when another colored light came on, the response would not be reinforced. Thus the subject learned to peck only when the green light was present. The third feature probably occurred via a simple procedure whereby, once a stable rate of pecking ensued, the pigeon was required to emit two responses to receive reinforcement instead of the usual one. By gradually extending the number of required responses, before the delivery of reinforcement, it is possible to maintain large numbers of pecking responses with minimal reinforcement. The following studies will utilize this concept of discrimination training in the analysis of imitative behavior.
Miller and Dollard pointed out that "Certain difficulties lie in the way of an experimental study of the learning of imitation. Older human subjects are very sophisticated, having already learned a great deal about imitation as a result of their past experience under the conditions of socialization" (Miller and Dollard, 1941, p.98). "The disadvantage is that they have already had experience with imitation, so that the problem becomes not how the first tendencies to imitate are learned but how tendencies already present may be progressively altered by additional experience" (Miller and Dollard, 1941, p.98). In order to study the acquisition of imitation as a response class, as well as the acquisition of particular responses through imitation, it is desirable, therefore, to use subjects who have not had a prior history of reinforcement for imitative behavior. Only such naive subjects permit the isolation of important experimental variables contributing to imitation. Moreover, the range of new responses that can be taught to non-imitative subjects experimentally is virtually limitless. Very young infants (Ulrich and Hunt, 1968) and non-imitative retardates (Lovaas et al., 1967; Baer, Peterson, and Sherman, 1968) provide just such subject populations.

A study by Ulrich and Hunt (1968) on language acquisition illustrates the use of infant subjects to study imitation. A six-month old infant was taught, through the use of standard operant reinforcement methods, to imitate a variety of sounds modeled by the experimenter. Another example is a program, based on operant principles, for teaching infants and toddlers to talk that was developed by the staff of the
Kalamazoo Learning Village (Arnette, Spates, and Ulrich, 1971; Ulrich, Louisell, and Wolfe, 1971). The program first taught the children to imitate gross motor movements, so as to establish an initial reinforcement history for imitation. Then simple sounds like those Van Riper (1972) has found are easiest for an infant to imitate were modeled and progressive approximations to the modeled sounds were reinforced.

A recent development in research on modeling and imitation has been concerned with imitation as a generalized response class (Peterson, 1968). Imitative behavior is viewed as responding under the control of discriminative stimuli, but "what is indeed curious is the fact that although only a few responses may enter into a contingent relationship with a stimulus, a large number of responses which do not have such a relationship are influenced by the same stimulus" (Peterson, 1968). In other words, after reinforcement for the imitation of relatively few different responses, the subject will imitate other responses. This tendency to imitate unfamiliar or unreinforced responses is called Generalized imitation and has been the subject of several experiments.

In an early experiment on the topic (Baer and Sherman, 1964), a talking puppet modeled three responses and subjects' imitations of these responses were reinforced on an FR:1 schedule. (Normal children were used as subjects.) A fourth response was modeled by the puppet as well, but subjects' imitations of the fourth response were never reinforced. Nevertheless, subjects consistently imitated the fourth response, so long as imitations of the first three
responses were reinforced. When reinforcement for the first three imitative responses was withdrawn, the rate of imitations declined together for all four responses. Thus, the four imitative responses appeared to be members of the same generalized imitative response class. This demonstration has been repeated subsequently (Baer, Peterson and Sherman, 1967; Peterson, 1965, 1967; Lovaas, Berberich, Perloff, and Schaeffer, 1966; Steinman, 1970).

The next step taken by Baer, Peterson and Sherman (1967) was to try to condition this generalized imitative response class in previously non-imitative subjects. The subjects were retarded children. They were taught, by a combination of "instigating" (Bandura, 1969, p.143) and operant discriminative conditioning procedures, to imitate several motor responses modeled by the experimenter. Because the subjects were non-verbal, the responses to be imitated were confined to gross motor acts like tapping the table, ringing a bell, and putting on a hat. After the experimenter had modeled a response sequence, if the subject did not spontaneously imitate the experimenter forcibly moved the subject through a matching response sequence, and reinforced, with food, completion of the sequence. After a time the experimenter began to fade out his mechanical assistance, allowing discriminative control of imitative responding to shift to the social stimuli provided by the experimenter's modeling behavior. After several imitative response sequences had been trained in this way, the children began to imitate other responses as soon as the experimenter modeled them, without requiring the experimenter to move their limbs forcibly.
through the correct motions. Such spontaneous imitations were initially always reinforced, but eventually new imitative responses which had never been trained or reinforced were performed so long as other imitative responses were reinforced. Thus, the experiment demonstrated that a generalized imitative response class not existing in the repertoire of completely naive subjects, could be developed gradually by reinforcing several specific imitative responses.

When reinforcement was no longer given contingent on correct imitations, but instead was presented at irregular intervals throughout the session, independently of the subject's behavior, all imitations declined in rate. When the reinforcement contingency was reinstated for some imitative responses, all imitations reappeared. This study, then, confirmed the phenomenon of generalized imitation, extended it to a new population (non-verbal retardates), confirmed the importance of contingent reinforcement in generalized imitation, and suggested sufficient conditions for the establishment of generalized imitation.

In another series of experiments, Peterson (1968) attempted to broaden or narrow the scope of generalized imitation, that is to add or remove responses from the generalized imitative response class. "Such knowledge could be useful to the educator, who is interested in building new response systems, and to the clinician, who may want to break up certain kinds of behavioral organization" (Peterson, 1968).

The initial experiment of the series attempted to remove a response from the subject's imitative repertoire. The subjects were
the retarded children used in the previous experiment (Baer, Peterson, and Sherman, 1967). In the first, called "massed evocation", the experimenter modeled one of six responses while saying, "Do this." Whether the subject imitated or not, after 30 seconds the experimenter repeated his demonstration. He did not reinforce the subject's imitations at any time. This procedure continued until the subject failed to imitate on ten consecutive 30 second trials. The result was the reduction of imitations to the model's behavior.

The second procedure, called "interspersed evocation", was similar to the first in that the experimenter again modeled responses while saying, "Do this." However, most of the modeled responses were taken from a new list of twelve different responses, and the subject's imitations were reinforced. Following each second or third reinforced imitation, a response from the original list of extinguished imitations was modeled. Imitations of this response went unreinforced, as before. The results of this second, interspersed evocation, procedure resembled the results from the experiment by Baer, Peterson and Sherman (1967) on generalized imitation. That is, so long as some interspersed imitative responses were reinforced, previously extinguished responses recovered and were consistently emitted although never reinforced. The results of Peterson's experiment suggest that reinforcement of some interspersed imitative responses is sufficient to maintain the strength of generalized imitation. The experimenter suggested an additional factor which might account for the continued presence of non-reinforced imitative be-
behavior. This factor may be called the dimension of 'similarity of behavior between the child and model'.

In a subsequent experiment in this series, Peterson looked more systematically into the importance of similarity in defining the imitative response class. Some might argue that a "natural" response sub-class exists based on similarity to the behavior of the model. Perhaps it was this resemblance of the subject's behavior to modeled behavior which accounted for the impossibility of eliminating selected interspersed responses from the imitative repertoire. In this experiment, a generalized imitative response class was established by the customary method of reinforcing most imitations while allowing a few to go unreinforced. In addition, however, some non-matching responses were established; after the experimenter had modeled certain responses, he mechanically forced the subject's limbs into non-imitative positions. A specific non-imitative response was established to each of a set of response demonstrations by the experimenter. No reinforcement was given for these responses by the subject. Next, the experimenter interspersed social stimuli for imitative responses with stimuli to which non-imitative responses by the subject had been established. Finally, he applied the massed evocation method to the non-imitative responses. The result was that "Without exception, these (non-imitative) behaviors extinguished under massed evocation but were readily performed when interspersed among reinforced imitations" (Peterson, 1968).

It appears, then, that non-reinforced non-imitative responses are as easily maintained as non-reinforced imitative responses, so
long as they are interspersed with other, reinforced responses to form a functional response class. This finding contradicts suggestions (of Baer et al., 1964, 1967) that there is something especially reinforcing about matching the behavior of a model which serves to maintain the non-reinforced imitations in a generalized imitative response class.

The last study of this same series (Peterson, 1968) investigated further the possibility that imitative and non-imitative responses may be members of the same functional response class. The procedure was the same as in the previous experiment for establishing both imitative and non-imitative classes of behavior. Stimuli for non-imitative responses were interspersed between stimuli for imitative behavior. However, reinforcement was contingent only upon the imitated responses. Non-imitative behaviors, as before, continued to occur. After stabilization of responding had been obtained, reinforcement for the imitative behaviors was discontinued, with a resultant decrement in both imitative and non-imitative behavior. Again reinforcement was provided contingent upon imitative behavior with increases in both classes. The results indicate that "imitative behaviors may also be members of an even larger response class which includes non-imitative behaviors as well" (Peterson, 1968).

The conclusions suggested by this series of experiments are that any responses shaped and brought under discriminative control of social stimuli provided by the experimenter's behavior may form a functional class. It is, presumably, the fact that the responses...
were trained in the same experimental situation that gives them their functional unity. Thus, we must distinguish two "levels" of stimulus control acting at the same time. (1) Individual imitative (or non-imitative) responses are controlled by the specific discriminative social stimuli supplied by the experimenter's modeling behavior of the moment (including instructions). (2) At the same time, the functional unity of the class of responses is controlled by the general discriminative stimuli of the experimental situation. The unitary character of the functional response class so established appears similar to the unitary response classes established by second-order schedules of reinforcement (Kelleher, 1966, in Honig, 1966). The further fact that imitative responding generalized to responses that had not been trained in the experimental situation supports the other conclusion, that intermittent reinforcement of some members of the imitative response class is sufficient to maintain the strength of all members of the class.

A study by Steinman (1970b) sheds further light on these two "levels" of stimulus control and the general notion of social control of imitative behavior. In this experiment an attempt was made to examine closer the variables responsible for the occurrence of non-reinforced imitations in generalized imitation research. The variables investigated were the effect of verbal instructions, and the experimenter as a discriminative stimulus. A special procedure was used for determining the extent to which an adequate discrimination was formed. Six female subjects were trained in imitation by two experimenters. Experimenter 1 modeled only responses which
if imitated received reinforcement \((S^D)\). Experimenter 2 modeled only responses which never received reinforcement if imitated\((S^A)\). Two kinds of experimental trials were used throughout various portions of the experiment. The first, called a "single presentation trial", represented the usual procedure for generalized imitation research in which the experimenter models a response preceded by the command 'Do this', and reinforces the occurrence of the correct imitation. In this experiment, however, the experimenter left the room approximately 10 seconds after modeling a response whether or not the subject had made a response.

The second kind of trial, called a "choice trial", required the simultaneous presence of both experimenters. One experimenter said "Do this" and modeled a response; the second experimenter immediately followed this presentation with "or do this" and modeled another response.

The experiment was divided into six phases in the following fashion: Phase A consisted of single trial presentations including both \(S^D\) and \(S^A\) presentations; phase B consisted of both single and choice trials. Choices were between \(S^D\) and \(S^A\) responses. Phase C was identical to phase A. Phase D included verbal instructions to the subjects suggesting that they not perform the responses which did not get reinforced. Each experimenter instructed one half of the six subjects. The purpose of this phase was to determine if the subjects could discriminate between the reinforced and un-reinforced presentations. Phase E contained instructions suggesting that it didn't matter if the subjects performed responses which were not reinforced, i.e. "It's up to you...if you want to do the ones you get beads for, that's fine". For phase F, no special instructions were given and both experimenters were present. Single presentation trials were utilized in phases C,D,E, and F.
Results indicated that for phase A (singly presented $S^D$ or $S^A$ modeled stimuli) subjects imitated both reinforced and non-reinforced responses at optimum capacity, barring one subject on one occasion. During phase B where both a choice was given and single presentations were presented the subjects, when given a choice, decreased their imitations of $S$ stimuli. For singly presented trials $S^D$ and $S^A$ responses both maintained their optimum occurrence (again barring one subject). Phase C, for most subjects, replicated the findings in phase A. Phase D for virtually all subjects saw a decline in the number of $S^A$ responses imitated. During phase E there was greater variability; the $S^A$ imitations of most subjects declined at an accelerated rate. Phase F saw all subjects return to the initial optimum performance level for both $S^D$ and $S^A$ imitations.

These results suggest that the controlling features of generalized imitation are strongly tied to the conditions under which the behavior was modeled and reinforced. During the choice trials the $S^D$ and $S^A$ models were presumably more easily discriminated. Adding verbal instructions to single presentations also made the models more discriminable. The instructional manipulations produced results which were consistent with an earlier finding by Steinman (1970a). The idea of setting events, in the control of imitation, has been further explored by Peterson and Whitehurst (1971). Particular attention was given to the effects of experimenter absence and other factors which might decrease the performance of imitative behavior, e.g. extinction, DRO, etc. As a setting event, experimenter absence produced the most obvious decrement in imitative performance (Peterson and Whitehurst, 1971).
A remaining question concerns the boundaries of generalized imitative response classes. In the experiment by Baer, Peterson and Sherman (1967) cited earlier, the investigators found that the generalized imitative response class established by reinforcing imitative gross motor responses of nonverbal retardates did not generalize to verbal responses. The subjects had to be taught to make some imitative verbal responses before generalization to imitation of other verbal responses occurred. Risley (1968) has obtained similar results.

On the basis of these findings, Garcia, Baer, and Firestone (1971) hypothesized that the responses that form a generalized imitative response class must bear a topographical similarity to one another. Four lists of responses were constructed, the responses in each list being grouped together on the basis of the experimenters' judgement of their topographical similarity to one another and their topographical dissimilarity to responses in the other lists. The groups of responses so formed were labeled "small motor", "large motor", "short vocal", and "long vocal". Nonverbal, non-imitative retardates were trained first to imitate responses in one of the two motor response classes (small motor responses were trained first in three of the subjects and large motor responses in the fourth subject), and generalization of imitation to untrained responses in the same topographical class was tested, along with generalization to untrained responses in the other three classes. Next, the subjects were trained to imitate responses in the other motor response class (large motor for the three subjects, small motor for the fourth), while imitations of the first group trained were maintained by continued interspersed presentation and reinforcement training.
Again, generalization to imitation of untrained responses in all four topographical classes was tested. Finally, two subjects were trained to imitate short vocal responses and tested for generalization to imitation of the untrained vocal, as well as motor, responses. The results were that generalization of imitation was always confined to "the topographical type of imitation currently receiving training or having previously received training" (Garcia et al., 1971, p. 101). In no case did subjects generalize to imitations of topographical responses of a kind not yet trained. For example initial training in imitating small motor responses led to generalized imitation of other small motor responses, but not large motor nor vocal responses. Subsequent training in imitating large motor responses led to generalized imitation of both types of motor responses, but not vocal responses. Still later training in imitating short vocal responses led to generalized imitation of other short vocal responses, but not long vocal responses.

The results suggest that the scope of generalized imitative response classes established by imitative training is limited to topographies similar to those actually trained and does not extend to untrained responses that are markedly different in topography.

Based on these and other findings several applied operant studies have been performed which utilized the tendency of imitation training to generalize. Guess et al. (1968) established the use of the plural morpheme in the speech of a severely retarded girl. Verbal imitation was shaped prior to the experiment in the previously mute subject. Following this pre-experimental shaping, reinforcement was presented contingent upon correctly imitated verbal responses which corresponded to ac-
tual items presented, correctly labeling the items in singular or in plurals. This procedure resulted in a generalization of plural morpheme usage to new items without further direct training on these items. Next a reversal was instituted in which reinforcement was made contingent upon usage of the plural morpheme for singular items (incorrect grammatically). A reversal in the behavior of the subject resulted. Plural morphemes were applied to items presented in singular fashion. A replication procedure resulted in the recovery of the original plural usage for items presented in trios and to words in the English language which follow exceptions to the use of the plural morpheme /s/, i.e. man when presented in multiples resulted in "mans". A second portion of the study consisted in an error analysis of the subject's responses while learning the plural morpheme usage. Results indicated that the subject had much more difficulty with words having a terminal vowel requiring a /z/ ending instead of the /s/, like "tree".

Results of the previous study provided the basis for an experiment by Sailor (1971) in which an attempt was made to determine the effects of differential reinforcement on the acquisition of allomorphs by retarded subjects. In condition 1, subject 1 was trained on the use of the /z/ allomorphic ending, and probed for generalization to words requiring the /s/ allomorph. Generalization occurred if the subject applied the allomorph which received training to the probe word, producing a grammatically incorrect word. Subject 2 in this same condition was trained on the /s/ ending and probed for generalization to words requiring the /z/ allomorph. For both subjects generalization from the training list of allomorphs did occur. In condition 2, the situations were reversed and subject 1 was trained on /s/ ending words
while subject 2 was trained on the /z/ allomorph which had not received training (/s/ or /z/). Again generalization resulted and "Data from both subjects lent clear support to the expectation that productive allomorphs of the plural morphological class can be taught, using reinforcement procedures, to a retarded child such that he will generalize from a specific allomorphic response class to the entire morphological class regardless of appropriateness to the dictates of English common usage" (Sailor, 1971, p. 310).

Several conclusions may be drawn from this line of operant research. The implicit significance of imitation is the potential for generating new behaviors in an observer without necessitation of conventional shaping procedures, thus "generalized imitation" or "generalized response class" (Baer and Sherman, 1967). This generalized tendency appears to be organized in one respect around topographically distinct subclasses (Garcia et al. 1971). Some contingent reinforcement is necessary for maintenance of imitation. Experimenter presence is a significant variable in the control of imitative behavior (Peterson and Whitehurst, 1971). And finally that "instructional variables......are operative within the procedures used in generalized imitation research " (Steinman, 1970).

As with Miller and Dollard, operant research on imitation has not gone without critical reviews. The following section will entertain many of these major criticisms; the section begins with a brief introduction to the theoretical framework from which they are drawn.
SOCIAL LEARNING THEORY: THEORETICAL ISSUES

Consider a modeling situation like that studied by Bandura and others. A 5-year-old child, afraid of rabbits, is to be cured of his fear by "modeling therapy". The therapist selects one or more children to act as models; their essential characteristic is that they do not behave fearfully toward rabbits. The child passively observes the models interacting fearlessly with a rabbit for several sessions, and then later in the absence of the models, is asked to approach the rabbit. Suppose that the therapy is successful, and the child approaches much closer to the rabbit after therapy than before, perhaps even touching and handling the rabbit for the first time.

According to Bandura, operant analysis cannot explain the success of treatment.

"It is difficult to see how this scheme is applicable to observational learning in which an observer does not overtly perform the model's responses during the acquisition phase, reinforcers are not administered either to the model or to the observer, and the first appearance of the acquired response may be delayed for days, weeks, or even months. In the latter case, which represents one of the most prevalent forms of social learning, two of the three events (R—S^R) in the three-term paradigm are absent during acquisition, and the third element (S^R) or modeling stimulus is typically absent from the situation in which the observationally learned response is performed." (Bandura, 1969, p.127)

Bandura further states that the,

"Skinnerian interpretation of modeling phenomena accounts satisfactorily for the control of previously learned matching responses by their stimulus antecedents and their immediate consequences...(but) it fails to explain how a new matching response is acquired observationally in the first place." (Bandura, 1969, p.127)
Bandura's criticism overlooks the importance operant theory attaches to the organism's learning history, and ignores the distinction between the separate (although related) processes involved in shaping responses, bringing responses under discriminative control by S^D's, and developing sustained responding under infrequent reinforcement. (See page 7 of the present paper). He asks that an operant account of imitation explain, all in one breath, the acquisition of motor responses, the acquisition of the tendency to imitate, the imitation of responses in the absence of reinforcement either for the model or the imitator, and the emission of imitative responses on subsequent occasions when the original discriminative stimulus for imitation (the model's behavior) is lacking.

In the example described, we assumed that the subject did not imitate the models' behavior while observing them during treatment sessions. However, the acquisition of responses hardly seems at issue. The five-year-old child already has in his repertoire the responses of walking, approaching objects, and handling objects. It is not clear, then, that the subject had to acquire any novel or original responses during therapy, and so it does not seem that operant theory need account, for "how a new...response is acquired observationally." As Bandura notes, discriminative stimuli for imitative behavior were present during modeling therapy. Various studies have established that models will be most effective as discriminative stimuli if (1) there is more than one model (Bandura and Menlove, 1968), (2) they are selected from the subject's peer group (Epstein, 1966), and (3) they are of the same sex as the subject (Bandura, Ross, and Ross, 1963; Maccoby and Wilson, 1957). A gene-
ral rule is that the models will be most effective if they are associated with "predictable contingencies of reinforcement for the subject." (Bandura, 1969, p.136) This usually means that the model will be, or will closely resemble, a person who has been a source of reinforcement for the subject in the past or for the imitation of whose behavior the subject has, in the past been reinforced. Under these conditions, the model's behavior will most readily qualify as a discriminative stimulus for imitation. However, Sherman and Baer (1969) have shown that subjects will imitate models who are not same-sex peers, provided the subjects have had an extensive prior history of reinforcement for imitation. That is, subjects will imitate unfamiliar models if the act of imitating has become a "generalized response class," and unfamiliar models have become "generalized discriminative stimuli."

Bandura's further point, that imitation occurs even when reinforcers are not administered to either the model or the subject, is often true. However, it is misleading. Most children by the age of five have had an extensive history of imitating others and being occasionally reinforced for their imitations (Miller and Dollard, 1941). The very intermittency of reinforcement for imitative behavior should insure that imitation is a persistent behavior, and will occur on occasions when there is little possibility that either model or subject will be reinforced. Moreover, there is often "intrinsic" reinforcement for imitation that does not depend on the mediation of a reinforcing agent (such as an adult) so that many apparent examples of imitation in the absence of reinforcement might better be viewed as examples of imitation independent of socially mediated reinforcement. For example, if a child sees
other children handling a ball, and imitates their behavior by approaching the ball and handling it, the tactile, and other intrinsic stimulation from interacting with the ball may be sufficient reinforcement for the imitative response. The child should be more likely to imitate similar behavior (i.e., handling objects) on subsequent occasions (e.g., when the child models are petting rabbits) even though no mediating reinforcing agent such as an adult is present. This tendency to imitate should be especially strong if the child models behave as though they were "enjoying themselves." The subject's past history will have taught him that, when other children are engaging in an activity and "enjoying themselves," he too, will find intrinsic reinforcement in the activity. (The imitative response of course precedes all possibility of reinforcement, so the occurrence or non-occurrence of reinforcement on the occasion to be explained, viz., a child's imitative approaching or handling a novel object, is irrelevant. The problem is to explain how this generalized tendency to imitate came about through the child's earlier reinforcement history. This is identical to the problem involved in accounting for any observed instance of human operant responding, for any observed instance precedes the reinforcement which may or may not ensue).

The study by Steinman (1970b), discussed earlier, offers an account of imitation without reinforcement administered to the model or observer. The reader will recall that in this study, one experimenter never reinforced the occurrence of imitative behaviors, yet the subjects continued to imitate the behaviors that she modeled. It was not until other "setting events" (verbal instructions) were altered that the imi-
tative behavior ceased. Steinman suggests a type of social control of imitation which the subject brings with him to the experimental situation, viz. his past history of "obedience", is responsible in part for this continued performance. In short, it is precisely this issue of the continued occurrence of non-reinforced imitation, to which much operant research has been directed (Brigham and Sherman, 1968; Steinman, 1970a; Boyce and Steinman, 1970; Lovaas et al., 1966; Metz, 1964).

Bandura's final criticism relates to the issue that there are no S^D's present when the subject's imitative response is emitted and this seems to violate the conditions necessary for discriminative responding according to the operant paradigm. It will be assumed here that reference is being made to the original modeling cues; the model's behavior. Certainly Bandura (1969) acknowledges the presence of some S^D's in the following passage:

"...after adequate language development is achieved, people rely extensively upon verbal modeling cues for guiding their behavior. Thus, for example, one can usually assemble relatively complicated mechanical equipment, acquire rudimentary social and vocational skills, and learn appropriate ways of behaving in almost any situation simply by matching the responses described in instructional manuals. If the relevant responses are specified clearly and in sufficient detail, verbally symbolized models may have effects similar to those induced by analogous behavioral displays." (Bandura, 1969, p.145).

In our initial example we observed these "verbal cues" being administered to the phobic child. Furthermore, Bandura, (1969) in his experiments on delayed imitation verbally instructs the subject to emit certain responses. There are, however, circumstances under which no verbal instructions are experimentally administered. In one study by
Bandura (1969) subjects, after having observed a modeled performance, were simply led into an adjoining room containing toys similar to those used by the model. It was found that subjects who had observed the modeled performance, emitted significantly more "imitative responses" than a control group. Under such circumstances it can be argued that the subjects' behavior came under the control of a specific setting event in the experimental situation. The toys could have easily served as the appropriate S^D's for this situation.

So, although the models are not present to act as controlling stimuli in the final test, verbal and situational S^D's are available to guide the subject's imitative performance. [However, it should be remarked that where discriminative stimuli (models and verbal instructions) are held constant throughout the course of treatment, and reinforcers are presented to the observer for approach responses, as in studies on "guided participation," modeling therapy is far more effective (Blanchard, 1969)].

Perhaps the issue to which Bandura addresses himself is the following: How are we to explain the fact that the verbal S^D's guiding the subject's imitative performance are effective on the post-test, but not on the pre-test? Apparently the intervening modeling treatment, in which the subject observed, but did not overtly imitate, the models' behavior, contributed to the greater effectiveness of the verbal instructions supplied by the experimenter-therapist on the post-test. Bandura appears to be responding to this question in the following theoretical statement:

"...observational learning entails symbolic coding and central organization of modeling stimuli, their representation in memory, in verbal imaginal codes, and their
subsequent transformation from symbolic forms to motor equivalents...because of the inferential nature of these basic processes, functional (i.e., operant) behaviorists are inclined to consider them of limited scientific interest. However, modeling phenomena must be analyzed in terms not only of response-selection variables but also of their mediational determinants before the necessary and sufficient conditions for modeling can be specified accurately." (Bandura, 1969, p.127).

It is true that operant behaviorists have difficulty attaching precise meaning to such terms as "symbolic coding", "central organization of modeling stimuli", "representation in memory", "verbal and imaginal codes", and "transformation from symbolic forms to motor equivalents". But perhaps the general gist of Bandura's contention will be granted: Successful delayed imitation requires mediating responses between the subject's observation of a model's behavior and his imitation of that behavior at a later time. In the human case, the mediating stimuli are likely to be verbal.

Skinner (1957) provided a framework for the operant analysis of delayed imitation through verbal mediation. For present purposes, the essential features are as follows (the reader should consult Skinner, 1957, for the arguments supporting these statements): (1) Verbal humans have a strongly conditioned tendency to describe (tact) significant stimuli in their environment, even when there is no audience (other than themselves) to hear them. (2) Verbal responses may come under the control of any stimuli present at the time they are emitted. It is not necessary that reinforcement occur in order for emitted verbal responses to come under the current environmental stimuli; a past history of reinforcement for discriminative verbal behavior is sufficient to establish the tendency for verbal responses to come under en-
vironmental control. (3) Verbal stimuli may act as effective "instructional" stimuli for human behavior. Verbal responses emitted by an individual himself may serve as instructional stimuli controlling his own subsequent behavior. (4) Verbal stimuli from many sources may summate to evoke relatively weak behavior.

These "theorems" of Skinner's assessment of verbal behavior appear sufficient to account for the occurrence of delayed imitation. The fearful child subject observed a child model petting a rabbit. This is surely a significant event for the subject, and he describes (tacts) it, perhaps only "to himself". Several exposures to the model strengthen the subject's tendency to say to himself something like, "That boy is petting the rabbit. He isn't afraid". (He may even say, "That boy is just like me.") These verbal tacts by the subject come under the control not only of the child model's behavior, but also of other stimuli in the observed situation, e.g., the room in which the model is petting the rabbit, the rabbit itself, etc. On a subsequent occasion, the subject is placed in the room containing the rabbit, and finds himself saying (to himself), "The other boy petted the rabbit. Boys my age aren't afraid of rabbits. I'm not afraid of the rabbit." At the same time, the experimenter-therapist is giving the subject verbal instructions to approach and touch the rabbit. The self-supplied verbal stimuli summate with the experimenter's verbal stimuli, and the child successfully approaches the rabbit.

In one experiment designed to answer questions relating to these issues Gerst(1971) employed a very creative experimental design requiring subjects to behave in one of several ways while observing a
modeled performance. The subjects were told to either "summarily label" it, "imaginably code" it, "verbally describe" it, or "count to the beat of a metronome." The results indicated that for subjects who "summarily labeled" the essential features of the modeled performance, delayed reproduction was superior to the other three groups. The group which counted beats, conversely reproduced fewer (significantly) responses.

This operant account of delayed imitation is not offered as an exercise in "hand waving". It presupposes many verbal processes, and so far only scant experimental evidence is available to support the claim that these processes conform to the simple three-term operant paradigm (most of the necessary experiments simply have not yet been done.) Unquestionably a long learning history is required to condition verbal responses and grammatical forms, to establish a strong and almost "irresistible" tendency to describe significant events in the environment, to establish a "learning set" such that only one or a few "trials" are sufficient to create a relatively lasting connection between environmental stimuli and the verbal responses in whose presence they originally occurred, the establishment of instructional control, and so on. Nevertheless, nothing in the account violates known facts, nor does the account call upon unobserved processes or entities such as "central organization of modeling stimuli" or "memory".

The criticisms offered by Bandura would appear to be inapplicable to the kind of immediate imitation provided by most of the operant studies cited. The subjects were usually required to reproduce the modeled behavior so rapidly as to preclude any necessity for the "re-
tentional" or "organizational" or even the "verbal coding" processes offered by Bandura. Indeed they resembled more closely the "echoic" verbal behavior described by Skinner (1957). Rather, Bandura's analysis seems peculiar to situations requiring delayed imitation and his criticisms of the operant approach are drawn from this position. The analyses provided by the operant researchers were directed at immediate rather than delayed imitation. This is not to suggest that a different set of principles is necessary to account adequately for delayed imitation. As observed, by extending the operant analysis of verbal behavior, delayed imitation can, at least theoretically, be accounted for with the added feature of theoretical economy.
SUMMARY AND CONCLUSION

Imitation describes the behavior of one organism when the occurrence of that behavior is determined topographically by the behavior of another organism, such that the two behaviors produce similar stimuli in the eyes of a third person. The sense recepticles used by the second person in reproducing the stimuli generated by person A are usually those involving vision, hearing and/or kinethesis.

The significance of imitation as a process is the general tendency of an organism possessing such an ability to demonstrate new behaviors without the necessity for potentially long-term shaping or trial-and-error learning. This short-cut learning occurs ostensibly as a result of the appropriate modeling stimuli being available to the subject. It is possible, using this approach to the acquisition of new behavior, to teach subjects very complex skills in the absence of differential reinforcement.

This tendency to imitate rests on the subject's ability to (1) observe the behavior of a model as well as (2) his own behavior and (3) to produce a correspondence between the two. This correspondence entails the production of behavior which is similar in topography to that from the model. These pre-requisites are important considerations since they suggest that a subject must be capable of producing the behavior or the fractional components thereof. The imitator is either reproducing behavior he has already acquired or "re-ordering" the fractional components of behaviors existent in his behavioral repertoire. In fact it is believed that much of language learning occurs through this fashion (Staats, 1969).
As stated in the introduction, the development of research on imitation has been relatively slow. An attempt has been made to trace the major trends of research with a learning-theory orientation from Miller and Dollard (1941) to Gerst (1971). Included in this review have been representative samples from animal research, studies of generalized imitation, and the outlook associated with delayed imitation. In the last fifteen years much headway has been made toward identifying the critical variables in the acquisition of imitation. The most productive approach has been the operant model that is unencumbered by theoretical constructs referring to unobservable processes and entities, as well as the misconceptions about human behavior implicit in colloquial language. The principal conclusion to be drawn is that the operant model, a model which has been successfully applied to areas such as education (Michael, 1967), mental health (Allyon and Michael, 1959; Ulrich, 1968), social psychology (Ulrich and Mountjoy, 1972), and clinical treatment (Nurnberger and Michael, 1970), shows the greatest promise for extending scientific knowledge of the factors responsible for imitation.
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