THE RELATIVE EFFICACY OF VICARIOUS AND DIRECT REINFORCEMENT SYSTEMS ON TWO SOCIALLY-TRANSMITTED LEARNING TASKS

by

John Alan Dohme

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF PSYCHOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 7 0

THE UNIVERSITY OF ARIZONA

GRADUATE COLLEGE

I hereby recommend that this dissertation prepared under my direction by JOHN ALAN DOHME

entitled THE RELATIVE EFFICACY OF VICARIOUS AND DIRECT REINFORCEMENT SYSTEMS ON TWO SOCIALLY-TRANSMITTED LEARNING TASKS

be accepted as fulfilling the dissertation requirement of the degree of DOCTOR OF PHILOSOPHY

Glenn M. White July 22, 1970

Dissertation Director Date

After inspection of the final copy of the dissertation, the following members of the Final Examination Committee concur in its approval and recommend its acceptance:*

Ralph J. Wetzel Aug 3, 1970

William J. MacKinnon Aug. 3, 1970

Jerry C. Daniel Aug. 3, 1970

Ronald K. Pool Aug 3, 1970

*This approval and acceptance is contingent on the candidate's adequate performance and defense of this dissertation at the final oral examination. The inclusion of this sheet bound into the library copy of the dissertation is evidence of satisfactory performance at the final examination.

STATEMENT BY AUTHOR

This dissertation has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this dissertation are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: John Alan Dohme

ACKNOWLEDGMENTS

The author wishes to express his sincere appreciation to his dissertation committee for their genuine interest and valuable advice. Gratitude is expressed to Drs. Dennis Clark, Ronald Pool, Terry Daniel, Ralph Wetzel, and William MacKinnon for their suggestions and comments in the design of this study and the preparation of this manuscript. The author is particularly indebted to his chairman, Dr. Glenn White, for his valuable guidance, his untiring help, and particularly his continuing friendship.

Drs. Ralph Wetzel and R. A. Ruiz, members of the minor committee, offered the author continuing encouragement during the years of graduate study. Their knowledge and advice have been a source of ideas for which the author extends his sincere thanks.

A note of appreciation is extended to Sister Raymond Mary of Saint Cyril's School, not only for her cooperation in this study, but also for her sincere interest in the research design.

A note of thanks is also due Mr. Charles Davison for the design and construction of some of the research apparatus used in this study.

The author is also indebted to William Shakespeare who made the following quotation possible:

"I want that glib and oily art,

To speak and purpose not."

King Lear. Act I, Scene I.
Line 227.

TABLE OF CONTENTS

	Page
LIST OF TABLES	vi
LIST OF ILLUSTRATIONS	vii
ABSTRACT	viii
INTRODUCTION	1
METHOD	23
Subjects	23
Apparatus	23
Procedure	27
RESULTS	31
DISCUSSION	40
APPENDIX A: LETTER SENT TO PARENTS OF EXPERIMENTAL SUBJECTS	49
APPENDIX B: INSTRUCTIONS	50
APPENDIX C: RAW EXPERIMENTAL DATA	52
REFERENCES	55

LIST OF TABLES

Table		Page
1.	SUMMARY OF CELL MEANS	28
2.	ANALYSIS OF VARIANCE SUMMARY TABLE	34

LIST OF ILLUSTRATIONS

Figure		Page
1.	Summary of response means for each task under each reinforcement condition	32
2.	Direct reinforcement condition presented as a function of vicarious reinforcement condition	35
3.	Vicarious reinforcement condition presented as a function of response task	36
4.	Direct reinforcement condition presented as a function of response task	37

ABSTRACT

The research literature in experimental psychology has demonstrated that both direct and vicarious reinforcement have a significant effect on the transmission of imitation behavior. However, few research efforts have been directed to the interaction of vicarious and direct reinforcement in the acquisition of imitation behavior. Furthermore, the extant literature is difficult to interpret because of shortcomings in the definition and control of variables and because of the absence of an adequate theory of imitation learning.

The present study was undertaken to answer questions concerning the effects of direct and vicarious reinforcement on the acquisition of imitation behavior in children. Two standardized laboratory learning tasks were employed: a fatiguing performance task, turning a small crank handle, and a perceptual-motor learning task, tracking the target on a pursuit rotor. Third, fourth, and fifth grade male subjects were shown a film of a fourth grade male modeling the target behaviors--turning the crank at more than 120 rpm or maintaining stylus contact with the revolving target. Two schedules of vicarious reinforcement were used. In the high vicarious reinforcement condition, the model was reinforced

for every third second of criterion responding and in the low condition, reinforcement followed every eighth second. Then each observer performed the task which he had seen modeled. His performance was directly reinforced on one of the two schedules previously described. M&M candies constituted the reinforcers which were delivered to the subjects immediately after their performance.

The results demonstrated significant direct and vicarious reinforcement effects as well as a significant difference between the two tasks. The absence of any significant interaction effect suggests the utility of an additive reinforcement model. In other words, the effects of direct and vicarious reinforcement were independent and imitation behavior was greatest when both sources of reinforcement were maximized. These results were interpreted in terms of theories of imitation learning and suggestions were made for subsequent research.

INTRODUCTION

The concept "reinforcement" has proven useful both in behavior technology and in theories of behavior causation. Reinforcement is usually defined in terms of the function of some stimulus event: "A reinforcing stimulus increases the probability of that class of responses that immediately precedes it; the presentation of a reinforcing stimulus is a reinforcement (Kelleher & Gollub, 1962, p. 543)." A large body of evidence has been amassed over the past three decades which demonstrates that behaviors are often a function of their consequences. However, a strict operant analysis of reinforcement contingencies fails to fully account for the complexities of human behavior. For example, children may be observed to spend many hours engaged in "play" in the absence of any obvious reinforcing consequences. In fact, it may be difficult to coerce the child from the playground to the dinner table; a fact which raises some questions concerning the usual operant paradigm involving consumable reinforcement.

While the importance of reinforcement in behavioral technology is recognized by most learning theorists, some additional principles have been suggested to account for the acquisition and maintenance of responses in the absence of direct reinforcement contingencies. Albert Bandura has written a number of influential papers over the past decade documenting the importance of "observational learning" in which one organism acquires a response simply by watching another organism perform. Of central importance in Bandura's research is the fact that reinforcing consequences to the performing organism or model (_M_) affect the subsequent behaviors of the observing organism (_O_). In other words, it is possible to produce changes in the behavior of one organism by allowing it to observe the consequences of another organism's responses. Bandura has called this phenomenon "vicarious reinforcement."

Most of the research designs in which vicarious reinforcement has been employed have involved imitation of some aspect of _M_'s behavior, such that _M_ performs some target response which _O_ observes together with its consequences. Thus, _O_ learns not only the topography of the modeled behavior but also the consequences which are likely to accompany that behavior. The function of vicarious reinforcement is, therefore, to provide _O_ with information concerning the consequences of a given response under given conditions. When those consequences are positive, imitation behavior is likely to occur.

The utility of the concept, vicarious reinforcement, has been demonstrated in a number of research studies employing diverse measures of behavior. Relative to a neutral condition, observed reinforcement has altered motor responding

(Kelly, 1966; Flaningam, 1970), verbal conditioning (Kanfer, 1965; Marston, 1966), aggressive responding (Bandura, Ross, & Ross, 1963; Bandura, 1965), stringent standards of self-reinforcement (Bandura, Grusec, & Menlove, 1967), self-imposed delays of gratification (Bandura & Mischel, 1965), and moral behavior (Bandura & McDonald, 1963). However, while the empirical efficacy of vicarious reinforcement has been convincingly demonstrated, there remain several theoretical problems in the interpretation of imitation behavior.

Imitation has been explained by theories involving at least five different postulated mechanisms: 1) heredity, 2) cognitive mediation, 3) stimulus-response contiguity, 4) reinforcement, and 5) the interaction of cognitive contiguity and reinforcement (two-factor theory). While each of these theoretical positions has made some contribution to the field of observational learning, they all contain significant limitations. A brief review of the shortcomings of these explanatory mechanisms will point out the need to perform definitive research on the basic parameters of imitation learning.

Aristotle is credited with the statement that imitation is, ". . . In our nature (Butcher, 1922, p. 15)." Several nineteenth and early twentieth century authors, including Morgan (1896), McDougall (1908), and Tarde (1903) wrote in support of the contention that imitation is genetically based. For example, C. L. Morgan wrote, "The tendency to imitate is based on an innate constitutional bias to . . . gain satisfaction by reproducing what others are producing (1896, p. 173)." In critique, it may be noted that this hereditary explanation of imitation is based on circular reasoning. That is, the evidence cited by the aforementioned theorists in support of their contention that the "imitative tendency" is inherited is the very imitative behavior which they were purporting to explain. Characteristically, the inheritance of imitation behavior was assumed on the basis of the early appearance of imitation in children in the absence of specific training. This assumption has the unfortunate effect of halting empirical investigation into the acquisition of imitation since its cause has been presumed to be explained.

Hereditary theories of imitation are not compatible with the empirical evidence concerning imitation behavior. If imitation is due to an hereditary mechanism, then the phenomenon should "mature" at about the same time for each member of the species and should produce stable responding thereafter since genes are presumed to mediate behavior through the growth and development of the nervous system. However, research has demonstrated that imitation is not a reliable phenomenon even within a single species. For example, Miller and Dollard (1941) noted that the child learning a language often evidences particularly refractory errors despite many opportunities to observe the performance of a model. These authors concluded that, ". . . There is no general unlearned capacity to imitate (1941, p. 206)." Thus, hereditary theories lack logical consistency and empirical support, and they have no important contemporary proponents.

Cognitive mediation theories treat imitation as the result of symbolic representations of observed behavior. In other words, observation is translated into an "internal representational model" which serves to guide subsequent imitation behavior. The major proponents of this viewpoint, Piaget and Aronfreed, employed very different conceptual models but made many of the same assumptions. Piaget (1951) attributed the acquisition of imitation to a "reflexive schema" which is triggered by social stimuli. In this respect, Piaget's theory is much like hereditary theories in that it treated imitation as a "built in" (reflexive) propensity which is released (triggered) automatically. In his theoretical writings, Piaget (1951) concentrated on the development of imitation behavior over time and related its development to the increasing complexity of other "cognitive" functions.

Aronfreed (1969) theorized that observed behaviors are "stored" in "cognitive templates" which are acquired by means of vicariously experienced emotional states. Templates which are accompanied by positive emotions (e.g., "warmth") are more likely to be acquired than templates paired with neutral or negative states. Subsequent imitation behavior is said to be guided by these cognitive templates.

In the broadest sense, both theories conceptualize the acquisition of imitation in terms of a classical conditioning model in which the conditioned stimuli are cognitive mediating events resulting from observation of the modeled behavior, and the unconditioned emotional reflex is an innately reinforcing function of the autonomic nervous system.

These theories are open to a number of criticisms. Piaget's theory was based on protocols gathered from his systematic observations of a small number of children. Since only selected protocols have been published, the reader is unable to judge the representativeness of Piaget's evidence. Furthermore, the crucial prediction that a theory must make is when imitation will and will not occur. Piaget (1951) said that the acquisition of imitation in children is based on reflexes; a child who observes another child crying will himself begin to cry. However, everyday observation tells us that in some instances crying will be imitated and in others, it will not. Watson (1925) noted that, ". . . The crying of one infant in a nursery will . . . not set off the rest of the children (p. 310)." If this theory cannot predict when imitation will take place and when it will not, it is simply a post facto description of the increasing complexity in childrens' imitative behaviors over time.

While Aronfreed's (1969) theory is more explicit in specifying the characteristics of the cognitive template which stores representations of the modeled behavior, it is also unable to predict which modeled behaviors will be imitated at what time. The cognitive template is said to store the "structure" of the modeled behavior rather than an exact photographic replica. Since Aronfreed (1969) does not explicitly define what is meant by the structure of a behavior, any imitative behavior may be subjected to a *post facto* analysis in terms of its "structure." Furthermore, cognitive templates are said to be acquired as the result of *M*'s affective responses which are contiguously associated with the modeled behavior. Therefore, any evidence for the acquisition of imitative responding in the absence of model affectivity would tend to disconfirm the theory. Such evidence is clearly available in studies by Sheffield and Maccoby (1961) in which college students learned to dismantle part of an automobile by observing a dispassionate adult model, and by Bisese (1965) in which college students altered their judgments of the lengths of lines after being informed that the judgment of a model, whom they could not see, was correct. Thus, the theories which explain imitation as the result of affectively conditioned cognitive representations suffer from inadequate definition of the mediating mechanism and from evidence which is open to alternative explanations.

Imitation behavior has also been explained on the basis of the temporal contiguity of stimuli. The basic model for this explanation derives from Pavlov's (1927) study of stimulus association which came to be called "classical" conditioning. As applied to imitation, contiguity theory holds that the stimulus events which comprise the modeled behavior become associated with some response on the part of the observing organism. The response made by O may be either an ongoing motor act or a cognitive representation. Holt (1931) advanced a theory which proposed that imitation results from the contiguous association of stimuli observed in M's performance and proprioceptive stimuli from O's motor behavior. Holt's theory is quasi-neural in that it proposed that the association between observed stimuli and proprioceptive feedback takes place in the motor tracts. "Therefore by Pavlov's law . . . the incoming excitation will find outlet along the tract just used by the random impulses, that is, will go back to, and will further contract, the very muscle from which it came (1931, p. 38)." Aside from its naive conception of the nervous system, this theory suffers one serious drawback. Once the imitation behavior has been elicited, Holt's theory predicts that it will continue *ad infinitum*. In other words, the theory contains no provision for the interruption of proprioceptive "reflex circles" once they have been set into motion.

A more recent contiguity theory of imitation was published in 1961 by Sheffield. Sheffield's theory is more nearly an explanation of the results of a study he performed for the U.S. Air Force than it is a formal theoretical statement. That research project focused on the best means of training Air Force personnel in complex sequential tasks such as repairing the distributor from an internal combustion engine and assembling a complicated wastegate motor. The training method selected was a film-mediated model who performed the task one segment at a time in order that observers might model his behavior.

Sheffield's theory was based on one factor: the contiguity of stimuli in space and time. "A fundamental assumption underlying all of the theoretical considerations is that learning *per se* requires only association by contiguity (1961, p. 14)." According to this theoretical model, perceptual responses involved in observing modeled behavior produce "central" representations which are stored until some subsequent time when they serve as "cues" for matching responses. In other words, Sheffield seems to be saying that observing modeled behavior produces a "mental" picture of that performance which is automatically stored in *O*'s "memory" and which is available to guide subsequent matching behavior whenever *O* is "ready to" perform or "wants to" perform the imitative response. This sort of crude description of imitation combined with the absence of definitions of relevant concepts such as "central response" or "memory" renders this theory difficult to subject to empirical test.

Sheffield's research study generated results which he interpreted as supporting his theory. His Boston University undergraduate subjects did learn the complex assembly and disassembly task after viewing the film. However, their performances evidenced strong practice effects. The average percent of correct responses on a manual assembly task after one practice trial was about 15 percent whereas it rose to about 80 percent after three practice trials. Since Sheffield's theory does not take performance into account, it is unable to predict these results. Furthermore, the theory does not take into account the complexity of the modeled task. While the ability of Sheffield's subjects to assemble and disassemble a wastegate motor after two trials was impressive, it is doubtful whether they would have been able to disassemble and assemble the Pentagon after viewing a film of that task.

Although Sheffield's theory does not take reinforcement effects into account, his volunteer subjects were paid for their three-hour participation; hence, reinforcement effects and "demand characteristics" (Orne, 1962) cannot be ruled out of the results. No control group was employed in his research design; therefore, it is impossible to determine exactly how effective the filmed model was and to what extent the subjects could have performed the task without observing the film.

While the factor contiguity does play an important role in two contemporary theories of imitation, the models which have made use of this factor exclusively have not generated convincing research data nor do they have many contemporary proponents.

Theories of imitation have also been based on the concept reinforcement. The publication of Social Learning and Imitation by Miller and Dollard in 1941 represented the first series of empirical studies dealing with imitation. Following the Hullian tradition, Miller and Dollard (1941) conceptualized imitation as the result of four factors: drive, cue, response, and reward. According to this formulation, all learning is initiated by some unsatisfied drive state which impels the organism to action. This action is maintained until some response produces a reinforcer which satisfies some biological need and terminates the drive state. The function of the cue stimulus is to signal when a given response will be reinforced. In imitation behavior, *M*'s responses serve as cues which occasion *O*'s matching responses. Thus, for imitation to occur, *O* must be deprived of something, observe *M* perform the modeled response, match that response with his own behavior, and be reinforced in a way which reduces his deprivation.

In critique of this theoretical viewpoint, it may be noted that O must perform the imitative response and be reinforced for his performance before imitative behavior has been explained. In other words, the theory may be able to account for the maintenance of imitative behavior but it cannot predict its initial acquisition. Furthermore, the theory is unable to explain imitation which occurs in the absence of an unsatisfied drive state. If a young child were to observe his older brother playing "choo-choo" with a wagon and if he were to take up the game upon his brother's leaving, what drive state is being expressed, the "play" drive or the "locomotive tendency"?

Gewirtz (1969) has advanced a reinforcement theory of imitation derived from Skinnerian rather than Hullian assumptions. His theory has the advantage of explaining the acquisition of imitative responding as well as its maintenance. The Gewirtz theory is based on the operation of direct reinforcement contingent on O matching M's responses. His analysis treats imitation behavior as a general class of operant response which is maintained by intermittent reinforcement. In other words, "The first imitative response must occur by chance, through direct physical assistance, or through direct training (with shaping or fading procedures applied by a reinforcing agent to occurring responses) . . . . After several imitative responses become established in this manner, a class of diverse but functionally equivalent behaviors is acquired and is maintained by extrinsic reinforcement on an intermittent schedule (Gewirtz, 1969, p. 142)." Evidence for the Gewirtz theory comes from studies performed by Lovaas (1966) and by Baer (Baer & Sherman, 1964; Baer, Peterson, & Sherman, 1967). For example, Baer, Peterson and Sherman (1967) trained three institutionalized retardates to match behaviors modeled by an adult. These subjects were selected because of their zero baseline rate of imitation prior to the study. Direct consumable reinforcement for some matching responses preceded by "Do this" was sufficient to maintain matching of other behaviors which were not reinforced.

There are two major weaknesses to the Gewirtz theory. The usual Skinnerian paradigm, discriminative stimulus--response--reinforcer, is usually restricted to the case where all three elements are present at the same time. However, in Gewirtz' analysis, the discriminative stimulus may be temporally separated from the matching behavior and the reinforcer by a considerable period of time. For example, a child may see a film depicting another child modeling a behavior which is not appropriate at the time such as sliding down a snowy hill on an innertube when it is summertime outside. If _O_ imitates that behavior during the first snow of the following winter, the Skinnerian model has to account for the "storage" of the discriminative stimulus.

A more serious objection concerns the generality of the modeling phenomenon. If imitation is indeed a "generalized operant" supported by intermittent reinforcement, then reinforcing some imitative responses explains the maintenance of the whole behavioral class. However, this analysis does not delimit the phenomenon by explaining which behaviors will not be imitated. In other words, if imitation is a general class of reinforced operants, then why don't children imitate every behavior they see modeled?

The reinforcement theories of imitation have the advantage of strong research support and a conceptually sound theoretical basis but they lack specificity in predicting which modeled behaviors will be imitated. While theories explaining imitation as the result of reinforcement alone may contain operational weaknesses, the concept "reinforcement" has proved useful in other theoretical positions which postulate the interaction of reinforcement with stimulus contiguity.

Two-factor theories were authored to correct some of the shortcomings of previous models by specifically focusing on the acquisition of imitation behavior, i.e., the first matching response. Mowrer (1950; 1960) suggested that imitation results from a combination of respondent and operant conditioning principles. Mowrer used the term "imitation" to refer to matching responses which are supported by direct reinforcement, but this analysis suffers the same drawback which applies to the Miller and Dollard (1941) model. The imitation behavior must be performed and reinforced before it has been accounted for. In "vicarious learning," as posited by Mowrer (1950; 1960), _O_ experiences the reinforcement contingency of _M_'s behavior "vicariously" or "autistically" via a kind of classically conditioned emotional response. Then, through higher order classical conditioning, the vicariously experienced reinforcement becomes attached to proprioceptive feedback from the matching behaviors produced by _O_. In other words, observing another organism's performances being reinforced elicits an emotional reflex which is, in itself, reinforcing. Subsequently, this emotional reflex becomes contiguously associated with imitative responding and, thus, reinforces matching responses.

In critique of Mowrer's position, it may be noted that his account of "vicarious learning" does not explain the initial acquisition of autistic reinforcement. That is, he does not specify whether the "emotional reinforcer" is an innate propensity of organisms or whether it is, itself, classically conditioned. Since the presence of this "autistic" reinforcer is not explained theoretically but rather is inferred from the matching response, it is circular to say that it causes the matching response. More important is the fact that, since the explanation of the acquisition of imitative responding is based on higher-order classical conditioning involving proprioceptive feedback, the imitative response is not explained until it has been performed. Thus, Mowrer's theory does not offer any substantial improvement over theories based on reinforcement alone.

An alternative two-factor theory of imitation was proposed by Bandura as early as 1959 but more thorough accounts of this theory appeared in 1965 and 1969. Bandura's model differentiates between the acquisition of the modeled response and its subsequent performance. The theoretical model may be represented as a kind of S-S-R contiguity in which the complex matrix of stimuli provided by M's responses come to be contiguously associated with "symbolic mediating responses" which represent them in O's cognitive response system. Subsequently, these symbolic mediating responses may serve as discriminative stimuli which occasion matching behavior which is supported by reinforcement. In other words, M's responses produce cognitive images through stimulus contiguity and those images, in turn, are capable of occasioning the same behavior on the part of O.

While Bandura's theory offers the advantage of explaining the acquisition of imitative responding, its utility is limited by a methodological problem. In practice, the existence of the symbolic mediating responses has been inferred from the imitative behaviors which they are purported to explain. The one exception to this limitation is an article by Bandura, Ross, and Ross (1963) in which children were questioned concerning the modeled behavior in a post-experimental interview. Subjects who had seen M's behavior punished (vicarious punishment) were sometimes able to accurately describe the modeled behavior even though they had not imitated it. In other words, the existence of the symbolic mediating responses was verified by O's verbal responses in the absence of imitative behavior. However, the theory does not provide an explanation of the translation of symbolic mediating events into verbal equivalents. As long as the presence of symbolic mediating events must be inferred from some response which is, itself, subject to alternative explanations, there is a danger that these hypothetical events are simply a post facto description of imitation learning rather than an empirical explanation.

Although the theoretical underpinning of Bandura's theory may be open to question, his model has served to generate a great deal of research. This body of evidence has been summarized in a recent review by Bandura (1969). One criticism which may be levied on these studies is that they have characteristically employed modeled behaviors which are complex and, therefore, difficult to interpret. For example, several studies by Bandura (Bandura, Ross, and Ross, 1963; Bandura, 1965) focused on the social transmission of "aggressive" behaviors to young children. Filmed adult models were shown striking inflatable dolls with sticks. Then children who had observed the film were given the opportunity to play with various toys including the "Bobo" doll and a stick. Bandura (1965) found that when the adult model was reinforced immediately after his performance, children were more likely to imitate his "novel aggressive responses" than if he was punished. In interpreting these results, one might ask whether vicarious reinforcement for "aggression" produces a general motivation for "aggressiveness," a specific motivation for "aggressiveness" of the type modeled, or a higher probability of striking other objects without a concomitant change in the individual's affective state (i.e., "hatred" or "anger"). In other words, the behavior being transmitted is open to a number of interpretations, a fact which adds to the difficulty in evaluating Bandura's theory.

The "Bobo doll" studies are open to an additional criticism. Since the subjects' baseline rate of "aggressive" behaviors was not measured, the modeling procedure may have merely occasioned responses already in _O_s' repertoires. This issue is of theoretical importance since, if _M_ simply provides discriminative stimuli which cue responses already in _O_'s repertoire, then the Miller and Dollard (1941) model can account for Bandura's results. On the other hand, if the behaviors transmitted to _O_ are initially acquired by observation, then Bandura's theory receives support.

In summary, all the extant theories of imitation contain methodological or theoretical omissions or weaknesses which render them less than fully adequate in accounting for imitation behavior. By the same token, empirical research on imitation behavior has often lacked adequate control conditions and has characteristically employed behaviors which are subject to alternative explanations. Thus, what are needed are carefully controlled empirical studies employing clearly defined tasks which will shed some light on the basic theoretical issues in imitation learning. For example, research has shown the importance of direct reinforcement (Baer, Peterson, and Sherman, 1967) and of vicarious reinforcement (Bandura, 1965) in producing imitation but few designs have directly compared the two reinforcement processes in the same study. Bandura's (1965) study did involve both direct and vicarious reinforcement but, since they were employed in different phases of the design, their effects could not be compared. An unpublished study by Bisese (1965) did test the interaction of direct and vicarious reinforcement in a line-judging task using college students as subjects. However, Bisese's design involved differential contingencies for direct and vicarious reinforcement such that the two modes of reinforcement produced different behaviors. Thus, it was not possible to determine which source of reinforcement was more influential in producing imitative behavior or to ascertain in what way they interacted.

Further study of various schedules of direct and vicarious reinforcement in imitation is also needed, especially in regard to a comparison between the two modes of reinforcement in terms of reinforcement density. Bandura (1970) noted, "Research is lacking on the behavioral effects of discrepancy between magnitude of observed and experienced outcomes (p. 9)." It would be informative to employ several schedules of direct reinforcement and several schedules of vicarious reinforcement in the same research design to attempt to answer this question.

An additional shortcoming in the imitation learning literature is that no study has compared multiple clearly-defined tasks in the same design. If theories of imitation are to be valuable predictive instruments, they should apply to many different modeled behaviors. Thus, it would be informative to know whether vicarious reinforcement effects generalize across tasks in the same way that direct reinforcement effects do. In other words, it would be interesting to know what kind of interaction obtains between direct and vicarious reinforcement schedules across different types of tasks.

It would also add to our knowledge of the parameters of imitation learning to make use of standardized laboratory tasks with clearly-defined dependent variables. If two or more tasks could be measured using the same response index, it would facilitate between-response comparisons as well as aiding the assessment of the interactions which might obtain between the type of task selected and the schedule of direct and vicarious reinforcement employed.

The present study was designed to investigate some of these basic parameters of imitation learning. Two levels of direct reinforcement were combined with two levels of vicarious reinforcement across two different motor tasks in a 2 X 2 X 2 factorial design. The two tasks had in common a rotary motion of the subject's preferred hand. A cranking task involved turning a small crank handle at 120 rpm or more. A pursuit task involved tracking a one inch target revolving at 15 rpm. In each task, the dependent variable was the proportion of the two-minute test interval that the subject performed the criterion response. Thus, the present study provided for a comparison of the efficacy of imitation learning on two different clearly-defined tasks.

The reinforcers employed in this study were M&M candies which were made contingent on criterion performance of the task. Two levels of direct reinforcement were used: One reinforcer for every third second of criterion responding (an FR-3 schedule*) and one reinforcer for every eighth second of criterion responding (an FR-8 schedule).

The same two schedules were used in the vicarious reinforcement phase of the design. That is, M was reinforced for every third second of criterion responding (FR-3)

---

*. These two schedules are not fixed ratio in terms of the frequency of responses per reinforcer but rather in terms of the duration of criterion responding per reinforcer. In other words, every third second of criterion responding was reinforced rather than the usual definition of every third criterion response. This is not the same as an FI-3 schedule in which a correct response will be reinforced only after three seconds have elapsed.

or for every eighth second of criterion responding (FR-8). The model's performance was presented on film.

Each O was shown a one minute film of M performing one of the two tasks on either the high or the low vicarious reinforcement schedule. Then he was given two minutes to perform the task he had observed. His criterion responses were reinforced on either the high or low direct reinforcement schedule. The observer's responses were recorded in terms of the percent of the two minute test interval in which he met the response criterion.

It was hypothesized that in both tasks: 1) the high level of direct reinforcement would produce more criterion responses than the low level, and 2) the high level of vicarious reinforcement would produce more criterion responses than the low level. No predictions were made concerning the differences between tasks or the various interaction effects because of the exploratory nature of the present study.

METHOD

Subjects

The subjects (Ss) for the present research design were obtained through the cooperation of Saint Cyril's Elementary School in Tucson, Arizona. The 72 Ss were male third, fourth, and fifth grade students. Thirty-five Ss came from the third grade, 25 from the fourth grade, and 12 from the fifth grade. The population sampled was restricted to males since previous studies indicated that there may be pervasive sex differences in imitation learning, but at this writing, the nature of these differences is unclear. Bandura, Ross, and Ross (1963), Bandura (1965), and Bandura and Kupers (1964) found male Os to be superior imitators whereas Baer and Sherman (1964) and Rosenblith (1959) noted better imitation learning in female Os.

A letter explaining the purpose of the study was sent to the parent of each prospective S one week before the experiment was run in order to secure parental permission to use the children as Ss. A copy of that letter may be found in Appendix A.

Apparatus

Two manipulanda were employed in this research design. A standard Lafayette pursuit rotor was used in the rotary pursuit task and a 13" X 11" x 7-5/8" wooden box with a small crank handle with a 1-9/16" throw protruding horizontally near the top of the box served in the cranking task. A Standard electric clock calibrated to the nearest thousandth of a minute was used to record the dependent variable--the proportion of the two minute test interval that S performed the criterion response.

M&M candies were used as reinforcers in this study. A two-tone chime served to signal both vicarious and direct reinforcement to O. Timing of the reinforcement schedules was controlled by a unijunction transistor timer designed especially for this study. In the high reinforcement condition, the timer rang the chime and advanced the M&M counter at the end of every three seconds of criterion responding (the FR-3 schedule). In the low reinforcement condition, the chime and counter were operated every eighth second of criterion responding (the FR-8 schedule). In the pursuit task, input to the reinforcement timer was provided by S touching the stylus to the revolving target. In the cranking task, the crank handle was attached to a small A.C. generator which operated a 4,000 ohm relay through a choke-input half-wave rectifier circuit. This circuit was adjusted so that the relay would close at speeds above 120 rpm and open at slower speeds. The normally open contacts of this relay provided the input to the reinforcement timer in the cranking task. In the vicarious reinforcement phase of the design, input to the reinforcement timer was provided by a manual switch operated by the experimenter (E). As O observed the film, E closed the switch whenever M's responding met the criterion.

Timing of the two minute test trials was controlled by a Gralab universal timer--the type commonly used in photographic darkrooms. This trial timer controlled the motor of the dependent variable clock as well as the motor in the pursuit rotor and the power supply for the reinforcement timer. In other words, it regulated all of the apparatus such that criterion responding before or after the two minute test trial had no effect on S's score or on the number of reinforcers he earned.

The apparatus was operated via a small console which contained the programming equipment, the M&M counter, and the switches which reset the timers and changed the trial condition. A manual push button was provided to ring the chime during the reinforcement demonstration phase of the instructions. A rotary switch was included to change the input to the reinforcement timer from the pursuit rotor to the crank box to the manual switch. The reinforcement timer was mounted on one end of the console so that its controls were easily accessible.

The films comprising the model stimuli were made using a fourth grade boy as M. This choice was based on an article by Hicks (1965) in which a peer model proved to be more effective than an adult and a male was more effective than a female in transmitting a socially-learned task to children. The model was trained until he was able to alternate between supra-criterion and sub-criterion responding at a verbal signal from E. Several one-minute films were made in which M alternated his responding every ten seconds. In other words, M maintained contact with the target in the pursuit task for ten seconds, "chased" the target without contacting it for ten seconds, and then reestablished contact. In the cranking task, M turned the handle at more than 120 rpm for ten seconds, slowed to less than 120 rpm for ten seconds, and then speeded up again. From these films, the best one-minute segment of each task was edited to produce the two model stimulus displays. The two films were constructed to be as alike as possible in that both employ the same M performing under the same general conditions with 50 percent of M's responses being below criterion and 50 percent above in alternate ten second sequences beginning with a supra-criterion segment.

The model stimuli were filmed on Kodachrome II super-eight film with a Bolex camera equipped with a zoom lens. A Bolex projector showed the films on a 30" X 24" piece of cardstock which served as a screen.

The experiment was conducted in a small room (about 6' X 8') which is part of Saint Cyril's School. The room was normally used each noon-hour to sell ice cream to students but was unoccupied for the rest of the day. One chair was provided for O to sit in while he watched the film. The manipulanda were placed on a desk and O performed the task while standing.

Procedure

Subjects were assigned to one of the eight treatment conditions randomly. (A diagram of the experimental design may be seen in Table 1, which summarizes the treatment means). Names of each third and fourth grade boy were obtained prior to the experiment and Ss were assigned to a treatment condition by drawing numbers representing treatment conditions from a hat. Since there were only 62 third and fourth grade boys in Saint Cyril's School, it was necessary to test several fifth grade boys in order to assign nine Ss to each treatment condition. Because of absences, only 60 third and fourth grade boys were tested and so 12 fifth grade boys were randomly assigned to the eight treatment cells to complete the design. Thus, each treatment cell contained nine boys randomly assigned from the pool of third, fourth, and fifth grade Ss.

Subjects were tested individually and an assistant was employed to oversee and organize the constant flow of Ss to and from the classroom. The experimenter called in each S by name, asked him to sit down, and read the pre-film instructions to him. (All of the instructions are presented

TABLE 1

SUMMARY OF CELL MEANS

Cell entries present mean percent of criterion responses.

		Task: Crank	Task: Pursuit	
High Vicarious	High Direct	81.26%	85.43%	69.70%
	Low Direct	46.33	65.80	
Low Vicarious	High Direct	42.91	67.06	49.72
	Low Direct	35.71	53.22	
		51.55	67.87	

High Direct Mean 69.16%

Low Direct Mean 50.26%

in Appendix B). In the three instances when S asked a question, the relevant part of the instructions was repeated. After reading the instructions, E turned off the overhead light and started the movie projector. While O was watching the film, E operated the push button which controlled the vicarious reinforcement received by O.

After O observed the film, E quickly readjusted the apparatus for the test phase of the design and then read the post-film instructions. The latter part of these instructions required that O stand before the manipulandum while E guided his grip on either the stylus handle or the crank handle. After starting O's task performance, E busied himself with the apparatus in the opposite corner of the room and refrained from watching O in order to minimize experimenter bias.

At the end of the two minute experimental period, E said, "Stop," and read the post-test instructions. The purpose of these instructions was to minimize communication between Ss concerning the nature of the task or the response criterion. While he was reading the instructions, E counted the number of M&Ms that S had earned and gave them to him in a Baggie. In the event that S had not won any M&Ms, and this occurred in 11 cases, E said, "I guess you didn't do very well since you didn't win any M&Ms, but here are some free ones for trying hard," and handed S about six candies in a Baggie.

Because of the difficulty which would be involved in changing films and manipulanda between Ss, all of the cranking-task Ss were run alphabetically by homerooms during a single day. The following day, the 36 rotary pursuit Ss were run alphabetically by homerooms. This procedure had the advantage of minimizing communication regarding the task which could take place outside the school and which, therefore, would be beyond the control of E's assistant and the teachers.

Correct adjustment of the vicarious and direct reinforcement schedules for each S was facilitated by the use of a checklist. This checklist also included reminders to reset the two timers, the clock, and the M&M counter and to rewind the film between presentations. Largely because of the use of a checklist, no experimenter errors occurred in the adjustment of the apparatus and no Ss had to be rejected because of equipment failures.

RESULTS

The dependent variable in this design is the proportion of the two minute test interval during which S met the response criterion. The raw scores were recorded to the nearest thousandth of a minute and then transformed into the percentage of the two minute interval that S met the criterion. (The raw experimental data are presented in Appendix C.) In other words, the transformed raw scores represent the percentage of the two minute interval that S spent in contact with the target in the pursuit task or turning the handle at more than 120 rpm in the cranking task. The mean percentage of time spent in criterion responding for each treatment condition is presented in Table 1. These data are also summarized in the form of a histogram in Figure 1.

A temporal response measure was chosen to facilitate a comparison between the two tasks. The idea of directly comparing two different tasks using a temporal measure of criterion responding was supported by Premack (1965) who stated, ". . . The criterion for between-response comparison is that all responses be measured by the same unit . . . . A little reflection will show that time, response duration, will fulfill the requirement nicely (p. 134)."

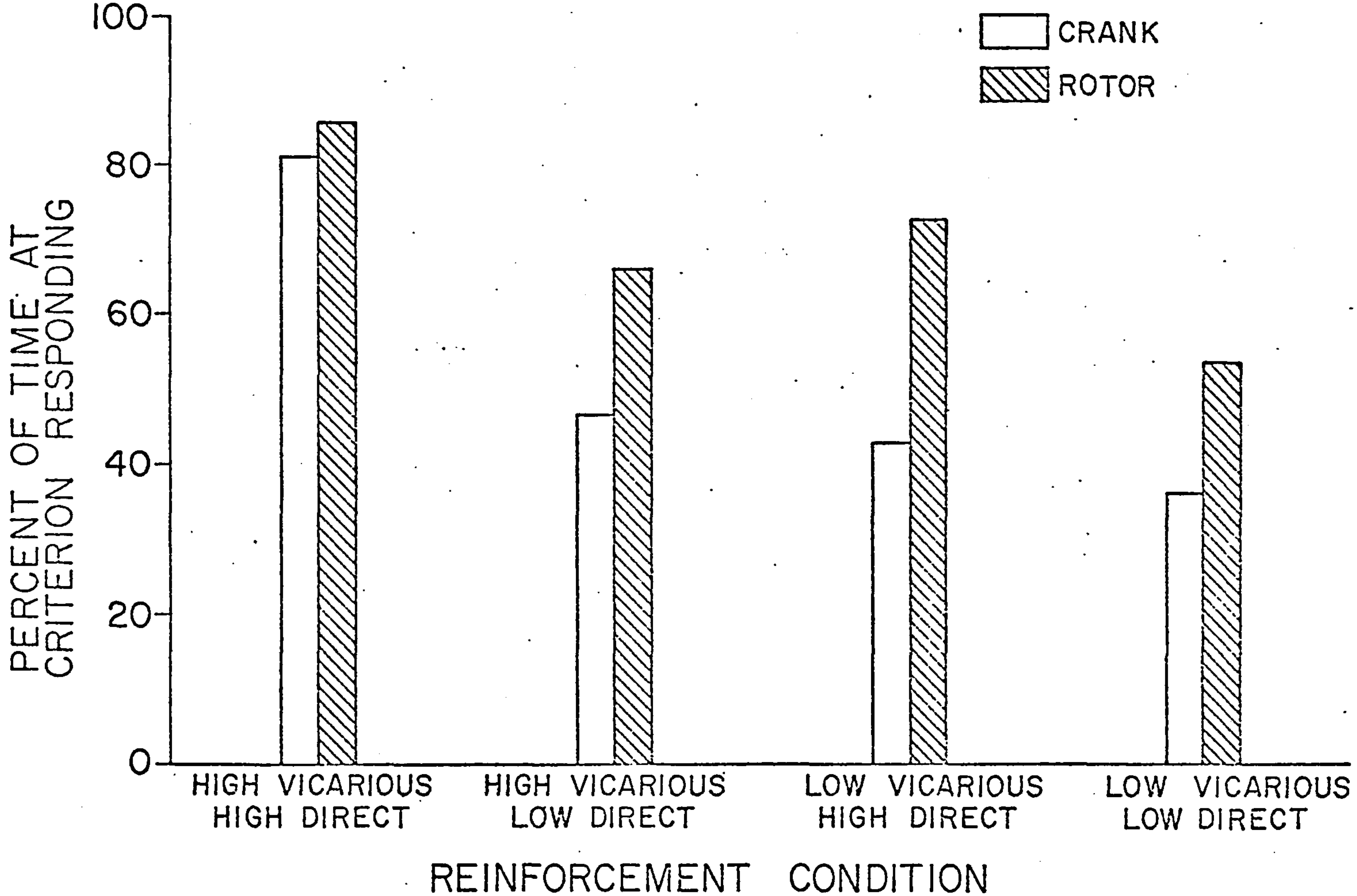

Fig. 1. Summary of response means for each task under each reinforcement condition.

The data were analyzed by means of a three-way factorial analysis of variance in which the main effects were task, level of vicarious reinforcement, and level of direct reinforcement. The analysis was performed using both the raw scores and the transformed percentage scores to serve as a check on the computational procedures. A summary of the analysis of variance for the transformed percentage scores is presented in Table 2. The task main effect is significant beyond the .025 level of confidence. In other words, a significant proportion of the total variance is caused by the fact that scores on the pursuit task are generally higher than scores on the cranking task. The direct reinforcement main effect is significant beyond the .01 level of confidence. That is, the FR-3 schedule was significantly better than the FR-8 schedule in producing high rates of response. The vicarious reinforcement main effect is also significant beyond the .01 level of confidence. In other words, Os who watched M perform on the FR-3 schedule were themselves better performers than Os who observed the FR-8 schedule.

None of the four interaction effects approach significance at the .05 level of confidence. The two-way interactions have been presented graphically in Figures 2, 3, and 4. Figure 2 shows the interaction of the direct reinforcement effect with the vicarious reinforcement effect. The probability that the magnitude of this interaction is due to chance alone is about .25. That is, there is a small

TABLE 2

ANALYSIS OF VARIANCE SUMMARY TABLE

Source	SS	df	MS	F	p
Total	75,645.9	71	-	-	-
Treatment	20,670.8	7	-	-	-
Vicarious Reinforcement (V)	7,186.0	1	7,186.0	8.37	$<.01$
Direct Reinforcement (D)	6,431.6	1	6,431.6	7.49	$<.01$
Task (T)	4,797.1	1	4,797.1	5.59	$<.025$
V x D	1,264.3	1	1,264.3	1.47	N.S.
V x T	365.8	1	365.8	<1	N.S.
D x T	84.3	1	84.3	<1	N.S.
V x D x T	541.7	1	541.7	<1	N.S.
Error	54,975.1	64	858.9	-	-

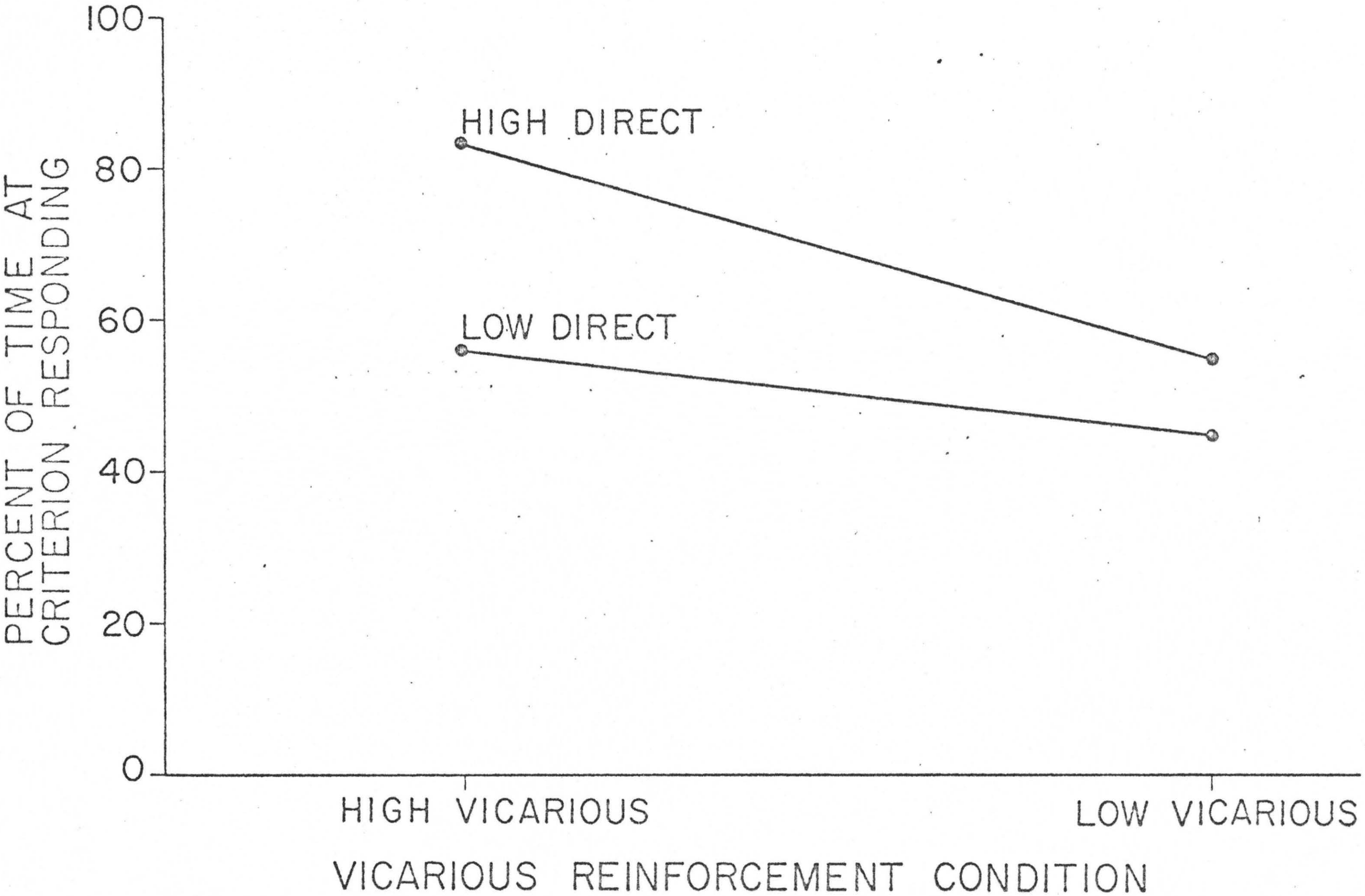

Fig. 2. Direct reinforcement condition presented as a function of vicarious reinforcement condition.

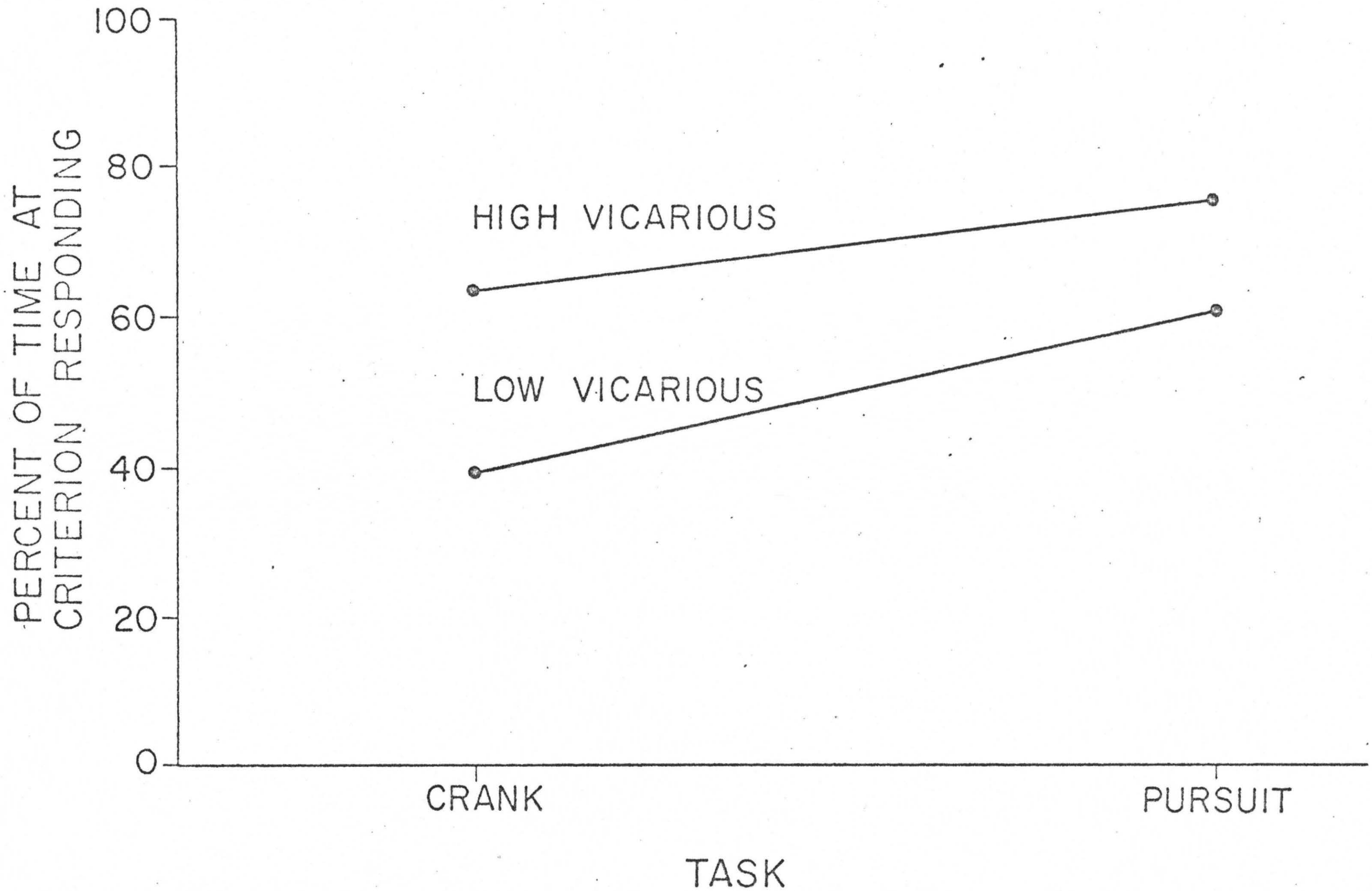

Fig. 3. Vicarious reinforcement condition presented as a function of response task.

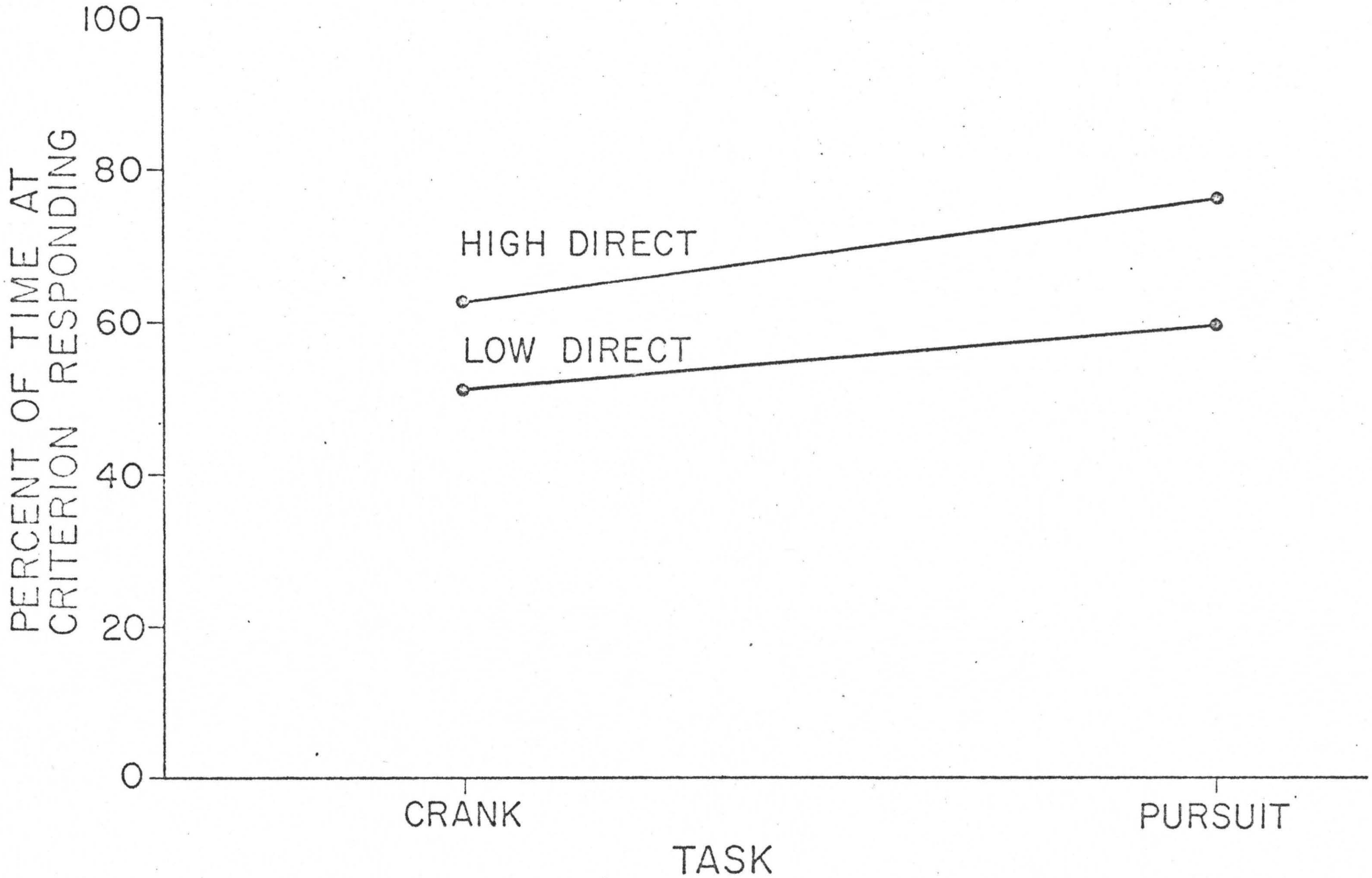

Fig. 4. Direct reinforcement condition presented as a function of response task.

tendency for the high direct reinforcement condition to show more variation across the two levels of vicarious reinforcement than the low condition, but this interaction is not significant.

Figure 3 presents the task effect as a function of level of vicarious reinforcement. This figure shows that the scores on the pursuit task were generally higher than the scores on the cranking task and that high vicarious reinforcement produced generally better performance than low vicarious reinforcement but that the two effects do not interact.

Figure 4 shows the task effect as a function of level of direct reinforcement. High direct reinforcement was generally more effective than low direct reinforcement and pursuit scores were generally higher than crank scores but the lines are essentially parallel demonstrating that the two effects do not interact.

The three-way interaction does not approach significance. This demonstrates that the nature of the interaction between vicarious and direct reinforcement does not vary across the two tasks.

Another way to conceptualize these results is in terms of the amount of variance in Ss' performances which is accounted for by the independent variables. The statistic omega-squared expresses the proportion of the variance in the dependent variable which is due to various levels of the independent variables. An estimation technique for this statistic is detailed by Hays (1963, p. 382). In the present study, the treatment variables accounted for about 20.5 percent of the total response variance. The treatment variance may be subdivided into 5.1 percent which is due to the difference between tasks, 7.2 percent which results from the direct reinforcement effect, and 8.2 percent which is due to the vicarious reinforcement effect. The four interactions do not contribute significantly to the total variance between groups of Ss.

DISCUSSION

The results of the present study suggest that both direct and vicarious reinforcement play an important role in imitation behavior. The hypothesis that the higher level of vicarious reinforcement would produce more imitation behavior than the low level across both tasks received support. The hypothesis that the higher level of direct reinforcement would produce more imitation behavior than the low level across both tasks was also supported.

That the two tasks differed significantly does not constitute a critical test of any theory of imitation since varying the parameters of either task would probably produce a change in the dependent variable. For example, if the pursuit rotor speed were changed from 15 rpm to 60 rpm and the cranking task were made less fatiguing, scores on the cranking task would probably have surpassed those on the pursuit task. What is of interest regarding the two tasks is that both direct and vicarious reinforcement produced the same direction and about the same magnitude of response change on both tasks. In other words, although the two tasks differed significantly from each other in terms of criterion responding, the effect of a denser schedule of both direct and vicarious reinforcement was to produce significantly more criterion responding on both tasks. Thus, the absence of a significant direct or vicarious by task interaction suggests that imitation learning may be a general phenomenon which cuts across dimensions of response differences.

The failure to find a significant direct by vicarious reinforcement interaction replicates similar findings in studies by Kanfer and Marston (1963), Bisese (1965), and Rosenbaum, Chalmers, and Horne (1962). These data suggest that an additive model best summarizes the concurrent effects of direct and vicarious reinforcement. That is, while direct reinforcement may be more efficacious in one design and vicarious reinforcement may account for more variance in another, performance is generally best when both sources of reinforcement are maximized. In the present study, the effects of direct and vicarious reinforcement were confounded, i.e., no _O_ performed the modeled task in the absence of direct reinforcement. However, studies which differentially assessed the effects of the two modes of reinforcement (Bandura, Ross, & Ross, 1963; Kanfer & Marston, 1963; Bisese, 1965) also suggested the efficacy of an additive model. Imitation behavior is most effectively produced by reinforcing _M_ for criterion responding and then reinforcing _O_ for matching _M_'s criterion responses.

The present study demonstrated the effectiveness of vicarious reinforcement in an imitation learning paradigm involving objectively defined tasks. Many previous experimental designs employed tasks which were neither clearly defined nor objectively measured. For example, Bandura, Ross, and Ross (1963) transmitted "aggressive behaviors" from an adult M to child Os. The modeled "aggressive behaviors" included striking an inflatable doll with a stick, sitting on the doll, and uttering distinctive verbalizations such as "Pow" and "Sockeroo." The childrens' tendencies to imitate the modeled behaviors were scored by two judges who observed the Os at play in a room containing several toys. Thus, the measure of imitative behaviors was simply an adjudged frequency count of the responses which appeared to each judge to be similar to the modeled behavior. Since the judges were aware of the experimental hypotheses being tested and since the experiment was conducted in a laboratory, questions of "demand characteristics" (Orne, 1962) and "experimenter bias" (Rosenthal, 1963) may be raised in the interpretation of the results. Furthermore, the question may be asked whether Os learned "aggressive behaviors" as a general class of operant response or whether they learned specific Bobo-doll-striking topographies. The very molar nature of the observed responses makes it difficult to answer questions of this sort.

In the present study, the fact that the dependent variables were objectively defined and automatically recorded lends credence to the generality of the imitation learning phenomenon. In other words, vicarious reinforcement accounted for a significant portion of the total response variance in two operationally defined tasks which are less subject to differences in interpretation than tasks involving "aggressive behavior" (Bandura, Ross, & Ross, 1963), "delay of gratification" (Bandura & Mischel, 1965), or "moral judgments" (Bandura & McDonald, 1963). Thus, the present study offers relatively unambiguous support for the effectiveness of vicarious reinforcement in producing imitation learning.

All of the treatment effects in the present study accounted for approximately 20.5 percent of the total variance in Ss' responses. The largest portion of that variance, 8.2 percent, was due to the vicarious reinforcement effect. This figure compares with about 18.9 percent of the variance which was due to vicarious reinforcement in Bandura's 1965 study and about 6.6 percent in Bisese's (1965) dissertation. Direct reinforcement in the present study accounted for about 7.2 percent of the total variance compared with about 3.4 percent in Bisese's study and virtually none in Bandura's. Although all three of these studies focused on direct and vicarious reinforcement effects, the above figures must be interpreted with caution since the aims of the three studies were quite different. However, it may be noted that in all three studies, vicarious reinforcement accounted for a larger portion of the total variance than did direct reinforcement. This fact suggests that imitation learning paradigms which made use of vicarious reinforcement may be relatively powerful means of producing behavioral change. This interpretation is bolstered by the fact that, in the present design, vicarious reinforcement was presented for only one minute while direct reinforcement was available for two minutes. Since the schedules of direct and vicarious reinforcement were identical, FR-3 and FR-8, twice as many direct reinforcers were available. Nevertheless, the vicarious reinforcement effect accounted for more variance than did the direct reinforcement effect.

The relative superiority of vicarious reinforcement in producing behavior change has been demonstrated in a number of studies (Berger, 1961; Hillix & Marx, 1960; Marlatt, 1968; Rosenbaum & Hewitt, 1966). Bandura (1970) attributed this finding to, ". . . The detrimental effects of interfering responses evoked by overt performance and associated consequences (p. 8)." In other words, Ss who are performing and being directly reinforced are slower to learn the reinforcement contingencies operating than observers (Kanfer, 1965) since their attention must be divided between their performance and its consequences. However, the present study calls this interpretation into question since all the Ss spent the same amount of time in observation and performance. Therefore, the relative superiority of vicarious reinforcement could not have been caused by performers attending to the task less than observers.

Bandura (1970) predicted that direct reinforcement would tend more than observational learning to facilitate the acquisition of motor tasks: ". . . Reinforced performance would probably prove more efficacious than observation alone, particularly in developing skills containing important motoric components (p. 9)." The relatively strong vicarious reinforcement effect in the present study does not support this prediction. Vicariously reinforced observation of a novel motor task accounted for more response variance than did directly reinforced practice. While the present study does not constitute a crucial test of Bandura's prediction, it does shed some light on the magnitude of vicarious reinforcement effects.

The present study was not designed as a critical test of a particular theory of imitation. However, the results do suggest that theories which do not take vicarious reinforcement to _M_ into account are overlooking a powerful determinant of imitation behavior. Only three major theories of imitation learning (Aronfreed, 1969; Mowrer, 1960; Bandura, 1965, 1969) do provide for vicarious reinforcement effects. Since Aronfreed's (1969) theory was not stated in a language which would lend itself to empirical confirmation or disconfirmation, and Mowrer's (1960) theory was unable to explain the first instance of imitation behavior, the results of the present design may be viewed as providing more support for Bandura's (1965, 1969) theory than to any other position.

However, since the present study provided no means of independently assessing the existence of the "cognitive representational stimuli" associated with observational learning, Bandura's general predictions concerning imitation learning received support but the postulated cognitive mechanism remains untested.

While the present study substantiated the effects of direct and vicarious reinforcement in producing imitation behavior on two laboratory tasks involving objective dependent variables, generalization from these findings is limited by several factors. The use of only two tasks limits the confidence with which one can say that imitation learning cuts across tasks. It would be informative to design research in which a large number of disparate tasks were compared using the same response measure to further test the adequacy of an additive reinforcement model.

By the same token, it would be informative to include additional levels of vicarious and direct reinforcement. In the present study, each S̲ was exposed to the effects of both direct and vicarious reinforcement. The inclusion of zero direct and zero vicarious reinforcement conditions in future research designs would permit a further comparison of the magnitude of the two effects.

The present study recruited S̲s from the third, fourth, and fifth grades. The original intention was to limit the subject pool to third and fourth grade students but absences necessitated the addition of 12 fifth grade males to complete the random assignment of Ss. Since the experimental tasks were chosen to tap the abilities of third and fourth grade Ss, the possibility existed that fifth grade Ss would be significantly better performers and, thereby, would raise the distributions of response times. A t ratio was calculated to compare the response times of the fifth grade Ss with those of the pooled third and fourth grade Ss. The outcome of that test indicated that there was no significant difference between the groups ($t = 1.27$, d.f. = 70, $t_{.05} = 1.99$).

Previous studies demonstrated the existence of widespread sex differences in imitation learning when children served as Ss. However, the direction of these differences is not clear. Bandura (1965) and Bandura, Ross, and Ross (1963) noted the superiority of male Os whereas Rosenblith (1959) and Baer and Sherman (1964) found greater imitation in female Os. Studies have also shown the sex of M may have a significant interaction with the sex of O in the transmission of sex-role appropriate behavior (Ofstad, 1967). It would be informative to replicate the present design including sex as an independent variable. Since many studies of imitation learning have focused on dependent variables which are culturally sex-related such as "aggression" (Bandura, Ross, and Ross, 1963), verbal behavior (Kanfer and Marston, 1963; Lovaas, 1966, Marlatt, 1968), and "social skills" (Baer, Peterson, and Sherman, 1967), disparate findings might be expected. Questions concerning sex differences in imitation learning might best be answered using objectively measured tasks which are equally unfamiliar to both sexes. It is suggested that the cranking and rotary pursuit tasks employed in the present study would facilitate such a comparison since both sexes are likely to have had some practice in revolving hand motions, but neither is likely to have performed on a pursuit rotor or to have rotated a very fatiguing crank handle at high speed for two minutes.

Future research might be profitably directed toward finding response dimensions along which differences are quantifiable and measurable. In other words, it would be informative to assess the efficacy of imitation learning designs across tasks which vary in terms of some quantifiable response measure. Studies directed to this problem would provide a great deal of information concerning the generality of the imitation learning phenomenon.

APPENDIX A

LETTER SENT TO PARENTS OF EXPERIMENTAL SUBJECTS

May 15, 1970

Dear Parents:

With the cooperation of St. Cyril's school, I am completing the research for my Doctoral Dissertation in Psychology. I am testing the utility of a short motion picture in teaching third and fourth-grade boys a simple motor task. Each child will see a 60 second movie of a fourth-grade boy performing the task and then each child will be given 120 seconds to perform the task himself. Correct performance will be rewarded with M&M candies which will be given to the child in a Baggie.

May I have your permission to include your boy in my research study on Monday May 25th and to give him the candies he earns in his performance of the task? If you object to your boy's participation in this study, please sign your name below and give this letter to your boy to leave with his homeroom teacher.

Sincerely yours,

John A. Dohme
Graduate Student in Psychology
The University of Arizona

____

APPENDIX B

INSTRUCTIONS

Pre-film

"Hi. Are you (child's name)? Good, I'm Mr. Dohme. Please have a seat. Do you like M&Ms? . . . Good. I'd like you to play a game for me and if you do it well, you will win some M&Ms. I'll give you the candies at the end of the game.

First, I'll show you a short movie of a fourth-grade boy playing the game. Then I'll give you a chance to play the game. You have to watch the boy in the movie very closely so that you can learn how to play the game. When you hear this bell (demonstration), the boy in the movie was doing it right and he got one M&M. Watch the movie very closely and see if you can learn how to do it. Remember, when you hear the bell, the boy in the movie was doing it right and he got one M&M."

Post-film

"Now I'm going to let you play the game. Do it as well as you can and when you do it right, the bell will ring. Every time the bell rings, you will get one M&M. I'll count the rings for you and give you the M&Ms when you are finished. Which hand do you write with? Okay, give me your hand and I'll show you how to hold it. (E places S's hand on the handle in a comfortable-looking manner. In the cranking task, the handle is positioned at the top of the swing and in the pursuit task, the stylus is positioned in contact with the target.) Now hold your hand this way and I'll tell you when to start and when to stop. Remember, keep playing until I say stop. Ready? Start . . . stop."

Post-test

"That was good, you won (number) M&Ms. When you go back to class, please don't tell any of the other kids about the game. I want them to learn the rules from the movie the way you did. After all the other children have had a chance to play, you may talk about it. Thank you and here are your M&Ms."

APPENDIX C

RAW EXPERIMENTAL DATA

S Number	S Initials	Time at Criterion	Percentage of Time at Criterion
Condition I-Cranking task, high vicarious, high direct			
1	P.K.	1.871	93.6
2	M.B.	1.957	97.9
3	S.M.	1.848	92.4
4	D.O.	1.481	74.1
5	J.G.	1.926	96.3
6	B.G.	1.024	51.2
7	M.S.	1.550	77.5
8	A.C.	1.792	89.6
9	R.C.	1.175	58.8
Condition II-Cranking task, high vicarious, low direct			
10	K.B.	1.643	82.2
11	B.D.	1.086	54.3
12	B.O.	0.000	00.0
13	T.P.	1.101	55.1
14	C.B.	0.266	13.3
15	D.B.	1.459	73.0
16	K.S.	1.828	91.4
17	M.H.	0.910	45.5
18	G.C.	0.044	02.2
Condition III-Cranking task, low vicarious, high direct			
19	L.B.	1.167	58.4
20	R.D.	0.011	00.6
21	H.M.	1.930	96.5
22	D.C.	0.538	26.9
23	J.D.	0.027	01.4
24	B.N.	0.418	20.9
25	M.S.	1.489	74.5
26	W.B.	0.586	29.3
27	R.C.	1.554	77.7

S Number	S Initials	Time at Criterion	Percentage of Time at Criterion
Condition IV-Cranking task, low vicarious, low direct			
28	M.A.	0.051	02.6
29	T.M.	0.082	04.1
30	M.W.	0.096	04.8
31	G.B.	1.896	94.8
32	M.C.	1.079	54.0
33	M.G.	1.685	84.3
34	K.C.	0.056	02.8
35	R.M.	0.248	12.4
36	R.R.	1.232	61.6
Condition V-Pursuit task, high vicarious, high direct			
37	J.R.	1.504	75.2
38	V.R.	1.252	62.6
39	A.W.	1.792	89.6
40	J.D.	1.833	91.7
41	T.P.	1.800	90.0
42	D.B.	1.798	89.9
43	T.M.	1.790	89.5
44	R.W.	1.782	89.1
45	R.H.	1.825	91.3
Condition VI-Pursuit task, high vicarious, low direct			
46	J.E.	1.025	51.3
47	F.L.	1.403	70.2
48	J.H.	1.391	69.6
49	S.J.	1.714	85.7
50	D.N.	1.100	55.0
51	J.N.	0.816	40.8
52	T.R.	1.480	74.0
53	M.M.	1.233	61.7
54	J.K.	1.678	83.9

S Number	S Initials	Time at Criterion	Percentage of Time at Criterion
Condition VII-Pursuit task, low vicarious, high direct			
55	M.B.	0.012	00.6
56	V.R.	1.785	89.3
57	B.S.	1.662	83.1
58	L.C.	1.946	97.3
59	R.G.	1.806	90.3
60	P.G.	1.819	91.0
61	R.P.	1.423	71.2
62	R.Z.	0.050	02.5
63	L.S.	1.566	78.3
Condition VIII-Pursuit task, low vicarious, low direct			
64	C.B.	1.848	92.4
65	C.R.	1.376	68.8
66	N.W.	0.115	05.8
67	P.E.	1.051	52.6
68	G.V.	0.824	41.2
69	A.E.	0.749	37.5
70	C.B.	1.732	86.6
71	J.K.	0.262	13.1
72	P.G.	1.620	81.0

REFERENCES

Aronfreed, J. The problem of imitation. In L. D. Lipsitt and H. W. Reese, Advances in Child Development and Behavior. Vol. 4, New York: Academic Press, 1969, pp. 210-319.

Baer, D. M., Peterson, R. F., and Sherman, J. A. The development of imitation by reinforcing behavioral similarity to a model. Journal of the Experimental Analysis of Behavior, 1967, 10, 405-416.

Baer, D. M., and Sherman, J. A. Reinforcement control of generalized imitation in young children. Journal of Experimental Child Psychology, 1964, 1, 37-49.

Bandura, A. Influence of models' reinforcement contingencies on the acquisition of imitative responses. Journal of Personality and Social Psychology, 1965, 1, 589-595.

Bandura, A. Principles of behavior modification. New York: Holt, Rinehart and Winston, 1969.

Bandura A. Vicarious and self-reinforcement processes. In R. Glaser (Ed.), The Nature of Reinforcement. Columbus: Merrill, 1970 (in press).

Bandura, A., Grusec, J. E., and Menlove, F. L. Some social determinants of self-monitoring reinforcement systems. Journal of Personality and Social Psychology, 1967, 5, 449-455.

Bandura A., and Kupers, C. J. The transmission of patterns of self-reinforcement through modeling. Journal of Abnormal and Social Psychology, 1964, 69, 1-9.

Bandura, A., and McDonald, F. J. The influence of social reinforcement and the behavior of models in shaping children's moral judgments. Journal of Abnormal and Social Psychology, 1963, 67, 274-281.

Bandura, A., and Mischel, W. The influence of models in modifying delay of gratification patterns. Journal of Personality and Social Psychology, 1965, 2, 698-705.

Bandura, A., Ross, D., and Ross, S. A. Imitation of film-mediated aggressive models. Journal of Abnormal and Social Psychology, 1963, 66, 3-11.

Berger, S. M. Incidental learning through vicarious reinforcement. Psychological Reports, 1961, 9, 477-491.

Bisese, V. S. Imitation behavior as a function of direct and vicarious reinforcement. Unpublished doctoral dissertation, Southern Illinois University, 1965.

Butcher, S. H. The Poetics of Aristotle. Fourth ed., London: Macmillan, 1922.

Flaningam, M. Influence of rest interval content on pursuit rotor learning and performance. Unpublished doctoral dissertation, University of Arizona, 1970.

Gewirtz, J. F. Mechanisms of social learning: Some roles of stimulation and behavior in early human development. In D. A. Goslin (Ed.), Handbook of Socialization Theory and Research. Chicago: Rand McNally, 1969, pp. 57-212.

Hays, W. Statistics. New York: Holt, Rinehart, & Winston, 1963.

Hicks, D. J. Imitation and retention of film-mediated aggressive peer and adult models. Journal of Personality and Social Psychology, 1965, 2, 97-100.

Hillix, W. A., and Marx, M. H. Response strengthening by information and effect on human learning. Journal of Experimental Psychology, 1960, 60, 97-102.

Holt, E. B. Animal Drive and the Learning Process. New York: Henry Holt, 1931.

Kanfer, F. H. Vicarious human reinforcement: A glimpse into the black box. In L. Krasner, and L. P. Ullmann (Eds.), Research in Behavior Modification. New York: Holt, Rinehart & Winston, 1965, pp. 244-267.

Kanfer, F. H., and Marston, A. R. Human reinforcement: Vicarious and direct. Journal of Experimental Psychology, 1963, 65, 292-296.

Kelleher, R. T., and Gollub, L. R. A review of positive conditioned reinforcement. Journal of the Experimental Analysis of Behavior, 1962, 5, 543-597.

Kelly, R. Comparison of the effects of positive and negative vicarious reinforcement in an operant learning task. Journal of Educational Psychology, 1966, 57, 307-314.

Lovaas, O. I. A program for the establishment of speech in psychotic children. In J. K. Wing (Ed.), Early Childhood Autism. Oxford: Pergamon, 1966.

Marlatt, G. A. Vicarious and direct reinforcement control of verbal behavior in an interview setting. Unpublished doctoral dissertation, Indiana University, 1968.

Marston, A. R. Determinants of the effects of vicarious reinforcement. Journal of Experimental Psychology, 1966, 71, 550-558.

McDougall, W. An Introduction to Social Psychology. London: Methuen, 1908.

Miller, N. E., and Dollard, J. Social Learning and Imitation. New Haven: Yale University Press, 1941.

Morgan, C. L. Habit and Instinct. London: E. Arnold, 1896.

Mowrer, O. H. Learning Theory and Personality Dynamics. New York: Ronald Press, 1950.

Mowrer, O. H. Learning Theory and the Symbolic Processes. New York: Wiley, 1960.

Ofstad, N. S. The transmission of self-reinforcement patterns through imitation of sex-role appropriate behavior. Unpublished doctoral dissertation, University of Utah, 1967.

Orne, M. T. On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. American Psychologist, 1962, 17, 776-783.

Pavlov, I. P. Conditioned Reflexes. London: Humphrey Milford, Oxford University Press, 1927.

Piaget, J. Play, Dreams and Imitation in Childhood. New York: Norton, 1951.

Premack, D. Reinforcement theory. In D. Levine (Ed.), Nebraska Symposium on Motivation: 1965. Lincoln: University of Nebraska Press, 1965, pp. 123-180.

Rosenbaum, M. E., Chalmers, D. K., and Horne, W. C. Effects of success and failure and the competence of the model on the acquisition and reversal of matching behavior. Journal of Psychology, 1962, 54, 251-258.

Rosenbaum, M. E., and Hewitt, O. J. The effect of electric shock on learning by performers and observers. Psychonomic Science, 1966, 5, 81-82.

Rosenblith, J. F. Learning by imitation in kindergarten children. Child Development, 1959, 30, 69-80.

Rosenthal, R. On the social psychology of the psychological experiment: The experimenter's hypothesis as an unintended determinant of experimental results. American Scientist, 1963, 51, 268-283.

Sheffield, F. D. Theoretical considerations in the learning of complex sequential tasks from demonstration and practice. In A. A. Lumsdaine (Ed.), Student Response in Programmed Instruction. Washington, D. C.: National Academy of Sciences--National Research Council, 1961, pp. 13-32.

Sheffield, F. D., and Maccoby, N. Summary and interpretation of research on organizational principles in constructing filmed demonstrations. In A. A. Lumsdaine (Ed.), Student Response in Programmed Instruction. Washington, D. C.: National Academy of Sciences--National Research Council, 1961, pp. 117-131.

Tarde, G. The Laws of Imitations. (Translated by E. C. Parsons.) New York: Holt, 1903.

Watson, J. B. What the nursery has to say about instincts. Pedagogical Seminar, 1925, 32, 293-326.