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OBSERVATIONAL AND VICARIOUS INFLUENCES ON THE MOTOR PERFORMANCE OF SEVERELY RETARDED MALES

by

LARRY MICHAEL HARDY

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ABSTRACT

The effects of repeated presentations of observational and vicarious modeling procedures were evaluated on the performance of previously acquired motor behaviors with three severely retarded subjects. Male subjects were trained to emit different lever responses on a four-lever panel. They then participated in a two part, eight phase research program that employed a single-organism, combined multiple-baseline/reversal research design. During Part I, subjects were repeatedly presented with a model emitting specified lever responses and receiving no consequences for responding (observational paradigm) and, later, being reinforced with edibles for responding (vicarious paradigm). Increases in lever performance for modeled levers, indicative of a response facilitation modeling effect, were obtained with all three subjects, although differences were evidenced between subjects in the magnitude, consistency, and number of replications of the performance increases for the modeled levers. Vicarious modeling resulted in superior imitation with only one subject. In Part II, verbalizations by the model, specifying the response modeled and instructing the subject to attend and imitate, were added to the observational and vicarious modeling paradigms. Part II manipulations resulted in improved modeling performance for one subject. Little or no improvement in modeling performances were demonstrated for the other two subjects. Differences in research methodologies and subject histories between the present study and previous research

failing to demonstrate observational modeling are discussed as well as some practical considerations for the application of modeling procedures with the severely retarded and considerations for future research.

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Since the classic demonstrations by Fuller (1949), Greenspoon (1955), and Lindsley and Skinner (1954) of the applicability of operant conditioning principles and techniques in the analysis, control, and/or modification of human behavior, operant conditioning, as a research orientation and as a therapeutic method, has been successfully applied among diverse subject populations. Among others, normal children and adults, institutionalized and noninstitutionalized mentally ill and mentally retarded, and juvenile delinquents have all proven susceptible to operant conditioning programs. (Sample articles of some of the applications of operant conditioning may be found in Ulrich, Stachnik, and Mabry, 1966, 1970, and reviews by Bandura, 1969a, and Franks, 1969).

In the field of mental retardation, operant conditioning has proven to be remarkably successful in facilitating the acquisition and/or modification of behavior in subject populations that experts in the field would have said were impossible just a few short years ago (Martin & Lowther, 1972). For example, a series of research and program reports by Martin and associates have provided ongoing testimony of the successful application of operant conditioning principles and techniques (it's applied use called behavior modification) with institutionalized severe and profound retardates. Among the diverse behaviors that have been developed and/or modified within this subject population include various self-care and work skills such as grooming (Treffry, Martin, Samels, & Watson, 1970), dressing (Martin, Kehoe, Bird, Jensen, & Darbyshire, 1971), table manners (Martin, McDonald, & Omichinski, 1971), and bed making (Martin, England, & England, 1971); and self-injurious behavior (Martin & Treffry, 1970). As a consequence of the success of this ongoing project six "graduates" of the institutional operant conditioning program were placed in a community residence where even further startling gains in their behavior were reported (Martin & Lowther, 1972).

The preceding is just one example of the kind of success that has been reported in the use of behavior modification with the retarded. A review of procedures and developments of behavior modification in retardation may be found in Gardner (1971) and a detailed description of a behavior modification program at another institution (Faribault State Hospital, Minnesota) was recently described by Thompson and Grabowski (1972).

In reviewing operant literature in retardation, one may delineate two general procedures that have been successfully utilized in modifying the behavior of the retarded. One of these involves consistently consequating ongoing or free operant behavior of target subjects, positively reinforcing desirable behavior(s) and/or punishing undesirable behaviors (for examples see Martin & Treffry, 1970; Gardner, 1969). The other general procedure consists of instigating the subject in one way or other to emit specified behaviors and selectively reinforcing approximations that are progressively closer to the final desired behavior (for example, Martin, Kehoe, Bird, Jensen, & Darbyshire, 1971).

Altman and Talkington (1971) noted that research and programs for modifying behavior, as well as a growing recognition of the need for more effective and/or economical techniques to modify the behavior of retarded persons toward more adaptable social and vocational skills, has seen a tremendous surge in popularity during the last decade. They further noted that the one to one model, often associated with operant conditioning techniques requires large investments of time and personnel, a luxury which few institutions or rehabilitative facilities can easily afford. The authors suggested that modeling or observational learning techniques might have potential for teaching skills to such a population on a group basis.

This suggestion is supported by repeated demonstrations with nonretarded subjects that learning of various types can be facilitated through observations of either live or film mediated models. However, if modeling procedures are to be considered in the training of the retarded, such procedures should be subject to intensive experimental analysis. With this consideration in mind, the present study was designed to evaluate the potential of modeling procedures (of the observational and vicarious nature) as a means of facilitating behavioral change with the severely retarded, as well as to provide an evaluation of the effects of introducing verbal cues to the basic modeling paradigms.

CHAPTER II

REVIEW OF THE LITERATURE

Modeling, or imitation, may be said to occur when, as a result of observing a model emit behavior, the observer's subsequent behavior is affected such that it becomes more similar to the observed behavior of the model (paraphrased from Flanders, 1968).

The role of modeling influences on the acquisition, performance and/or modification of human behavior has been recognized and given a variety of theoretical or descriptive interpretations by many prominent writers of diverse psychological disciplines. Bandura (1969a) provided a brief summary of some of the types of theoretical interpretations of imitation including instinct theory, associative and classical conditioning theory, reinforcement theory, affective feedback theory, and contiguity-mediational theory. The interpretations of the processes involved in modeling vary considerably. However, the literature abounds with repeated empirical demonstrations of the phenomenon.

Although the phenomena of imitation has been clearly demonstrated, it has been subject to a variety of experimental training or testing situations and a variety of labels have been applied to the phenomena and the training situations by various authors leading to a degree of confusion in the literature. However, Flanders (1968) noted that, in general, an experimental test of any hypothesis or theory of imitative behavior is composed of at least one training phase (exposing the observer to the model's behavior and manipulating one or more independent variables) followed by or concurrent with at least one testing phase (measuring the effects of the varied treatments upon the observer's behavior). Flanders' review of research on imitation outlined four types of training situations that have been typically used in the study of imitation. These situations are composed of combinations of reinforcement or nonreinforcement contingencies that may be applied to either the model or the observer of both during training. On the basis of Flanders' outline three descriptive terms were constructed and will be employed in differentiating the modeling research.

(1) A "direct imitation" paradigm is one in which the general training situation involves a model emitting behavior in the presence of an observer (no explicit contingencies applied to model's behavior), and the observer's emission of imitative behavior in the presence of the model, and usually being contingently reinforced.

(2) An "observational" paradigm is one in which, in general, the observer is presented with the model emitting behavior (no contingencies applied to the model), and, at a later point in time, the observer is given the opportunity to emit imitative responses.

(3) A "vicarious" paradigm is one in which, in general, the observer is presented with the model emitting behavior that results in positive or negative consequences, and, at a later point in time, the observer is given the opportunity to emit imitative responses.

To date, most of the research on imitation that has been conducted with the retarded has utilized the direct imitation paradigm. This paradigm has been used extensively, although not exclusively by researchers of operant orientations in single-organism research designs.[1] The suggestion of Altman and Talkington (1971) of the potential of incorporating modeling procedures with retardates generally refers to the utilization of the observational and/or vicarious paradigms, the paradigms most frequently cited with nonretarded populations in Bandura (1969a).

The following review of the modeling literature will focus upon representative samples of research that have been conducted with both normal and retarded subject populations utilizing the three basic types of imitation or modeling paradigms previously outlined.

Direct Imitation Paradigms (Nonretarded and Retarded Subject Populations)

One of the "classic" articles on imitation that has utilized the direct imitation paradigm is that of Baer and Sherman (1964). In this study, reinforcers were arranged for normal children's imitations of three activities of an animated talking puppet, which served both as a model, and as a source of social reinforcement for imitating. A fourth response of the puppet was spontaneously imitated by the children, although that imitation had never before been reinforced. In addition, when reinforcement of the other three imitations was discontinued, and subsequently reinstated, the fourth "never reinforced" imitation also decreased and increased in strength. In short, the direct imitation paradigm was utilized to demonstrate (a) the reinforcement control over the occurrence of imitative responses for

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1. Descriptions of and rationales for single-organism designs may be found in Gelfand (1969, p.11-13), and Baer, Wolf, and Risley (1968).

which explicit contingencies were manipulated; and, (b) that once imitative behavior had come under the control of reinforcement variables, other imitations would be emitted even though no explicit contingencies had been arranged for their occurrence. This phenomena has been called generalized imitation.

Metz (1965) demonstrated the development of some imitative behavior in two autistic children who initially showed little or no imitative responsiveness to models. In this study, responses similar in topography to demonstrations by the experimenter were reinforced with "Good" and food. Metz found that after intensive training, several imitative responses could be maintained in strength even when not reinforced with food and that subjects had a higher probability of imitating new responses after training than before.

Lovaas, Berberich, Perloff, and Schaeffer (1966) used shaping and fading procedures[1] to establish imitative speech in two autistic children. They reported that as training progressed and more vocal behavior came under the control of the model's prior vocalizations, it became progressively easier to obtain new imitative vocalizations. In addition, when reinforcement was shifted from an imitation contingent schedule to a basically noncontingent schedule, imitative behavior deteriorated.

In this study generalized imitation was obtained, the model presenting Norwegian words interspersed with the English words for which the children were reinforced (the Norwegian words were never

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1. 'shaping' and 'fading' are described by Skinner (1953) and Terrace (1966) respectively.

reinforced when imitated). Brigham and Sherman (1966) reported similar findings with normal preschoolers who imitated nonreinforced Russian words which were interspersed among English words which were reinforced when imitated. The authors reported that generalized imitation occurred as long as the children were rewarded for English words that they correctly reproduced.

Baer, Peterson, and Sherman (1967) suggested that studies which have demonstrated imitation and generalized imitation indicate that for children with truly imitative repertoires, relatively novel behaviors could be developed before direct shaping merely by providing an appropriate demonstration by a model, and that some imitative responses can be maintained, although unreinforced, as long as other imitative responses are reinforced. They extended the generality of these findings by developing an imitative repertoire in three severely and profoundly retarded children. The subjects, who initially lacked an imitative repertoire, participated in the study in which imitative behavior was gradually developed by using methods of shaping and fading. As the subjects progressed in the training, the shaping and fading procedures were eventually discontinued and subjects imitated a number of diverse motor and verbal behaviors for food and praise. Two subjects acquired as many as 125 motor and vocal imitations in this study, and the sessions required to establish new responses steadily decreased as the training progressed. In addition, generalized imitation was also demonstrated with a number of unreinforced imitations which were interspersed among reinforced imitations. The emission of both types of imitative behaviors decreased when reinforcement was no longer contingent upon the imitative responses.

The authors noted that a major problem facing one attempting to develop an imitative repertoire in subjects is obtaining the initial matching responses. According to Baer et al. this involves bringing the subject under the instructional control of the experimenter's demonstration. They suggested that in order to establish this type of instructional control by demonstration, the subjects must either have or develop responses of observing their own behavior as well as the experimenter's behavior. As increasing numbers of a subject's behaviors come under instructional control of demonstration, additional behaviors not previously observed in the subject's repertoire become increasingly probable merely as a result of presenting an appropriate demonstration by a model.

Baer and associates accounted for the development of imitative behavior, and in particular, for the "generalized imitative" phenomena by the effects of conditioned reinforcement. Briefly, they suggested that as a result of the training procedures, topographical similarity between the subject and the experimenter eventually functioned as a discriminative stimulus with respect to reinforcement. Hence, similarity could be expected to take on a positively reinforcing function and would strengthen any new behavior that produced or achieved it.

This interpretation of the observed generalized imitation phenomena has been criticized by many researchers who have suggested alternative interpretations and have provided empirical data to support their suppositions. Basically, these criticisms suggest that generalized imitation reported by Baer et al. may have existed only because of the procedures used to study it. Investigations of specific variables that may have been responsible for the reported generalized imitation have indicated that social, as well as procedural aspects of the direct imitation paradigm employed by Baer and associates may have been the controlling factors of generalized imitation. That is, because nonreinforced imitations were interspersed among reinforced imitations they continued to be emitted by the subjects simply because the subjects failed to discriminate reinforced from nonreinforced responses (Bandura, 1969a; Gewirtz & Stingle, 1968; Parton, 1970).

Behavioral similarity as a conditioned reinforcer has been questioned by Peterson (1968) and Martin (1971) who demonstrated that nonimitative, nonreinforced behaviors could be maintained in the direct imitation paradigm when interspersed among reinforced imitations.

Experimenter variables related to the demand-characteristics of the experimenter's presence, or to the command "do this" (often utilized in the direct imitation paradigm), were suggested as controlling variables of generalized imitation (Peterson, Merwin, Moyer, & Whitehurst, 1971; Peterson & Whitehurst, 1971). Steinman (1970) suggested that availability of a reinforcible alternative response, may have made it more aversive for a subject to sit through an inter-trial interval without responding than to imitate a nonreinforced response.

As a result of these suggestions, modifications of the standard direct imitation paradigm to include choice trials (Steinman, 1970; Steinman & Boyce, 1971); explicit instructions either (a) not to perform the nonreinforced imitations (Steinman, 1970; Bufford, 1971), or (b) that imitation is not necessary (Waxler & Yarrow, 1971), have all been shown to decrease the performance of the "generalized" imitative responses. However, these considerations do not detract from the fact that the direct imitation paradigm has been utilized extensively and successfully in the training or motor and verbal skills with both retarded and normal subject populations.

A study by Paloutzian, Hasazi, Streifel, and Edgar (1971) showed that even novel social responses may be acquired by severely retarded subjects through utilization of the direct imitation paradigm. As a result of training, noted behavioral improvement in on-ward social behavior was observed in the target subjects.

A more recent study by Talkington, Hall, and Altman (1973) provided some evidence that severely retarded subjects might benefit from a direct imitation training procedure to develop behavioral skills more than through instructions and reinforcement of desired behavior. Using a pretest, posttest control group design, the authors pretested subject performance on a behavioral assessment test and placed subjects into one of three treatment conditions. Two of the treatment conditions involved training the subjects to follow verbal commands. One treatment consisted of presenting the subjects with a verbal command by the experimenter, the modeling of the desired behavior by a peer and the social reinforcement of appropriate behavior emitted by the subjects. The second treatment consisted of the presentation of verbal commands by the experimenter and the social reinforcement of appropriate responses made by the subjects. Subjects in the third condition, the control subjects, received no command following training. Significant differences were reported between the respective groups. The group receiving the modeling treatment was superior on test performance to the command-reinforcement group, who were in turn superior to the control group.

It appears on the basis of the research reviewed, that the direct imitation paradigm is, indeed, a beneficial procedure for the modification and/or development of behavioral skills, with both non-retarded and retarded subjects. However, the direct imitation paradigm, in and of itself, may not guarantee the desired behavioral change. Lovaas et al. (1966) and Baer et al. (1967) reported that, before the direct imitation paradigm can effectively be used to develop or modify behavior, some minimal imitative repertoire or prerequisite behaviors must either be present in the subject's repertoire, or shaped into his repertoire. The procedures of fading and shaping appear to have proven beneficial in this regard with retarded subjects.

As noted previously, imitation has been studied under paradigms other than the direct imitation paradigm. The next section will consider the research and findings of observational and vicarious paradigms with both nonretarded and retarded subject populations.

Observational and Vicarious Paradigms with Nonretarded and Retarded Subject Populations

Bandura (1969a) stated that one of the fundamental means by which new modes of behavior are acquired and existing patterns are modified is through modeling and vicarious processes. On the basis of research, conducted within the framework of social-learning theory, he suggested that virtually all learning phenomena resulting from direct experiences can occur on a vicarious basis through observation of other person's behavior and its consequences.

Bandura (1969a) pointed out three demonstrated effects that exposure to modeling influences may incur. Firstly, an observer may acquire new response patterns that did not previously exist in his behavioral repertoire. Demonstrations of this involve a model exhibiting a novel response which the observer has not yet learned to make and which he must later reproduce in substantially identical form. Secondly, observations of model's actions and their consequences to the performer may strengthen or weaken inhibitory responses in observers. These inhibitory or disinhibitory effects are evidenced when the incidence of imitative or matching behavior is increased generally as a function of having witnessed a model experience positive outcomes, and decreased by having observed a model undergo punishing outcomes. Finally, behaviors of others may serve as discriminative stimuli for the observer in facilitating the occurrence of previously learned responses. Response facilitation can be distinguished from the first two effects by the fact that no new responses are acquired, and the behavior is socially sanctioned, rarely, if ever, incurring punishment.

As Flanders (1968) noted, in imitation experiments modeling influences have been indicated by such measures as increased frequency of response, magnitude of response, and/or morphological resemblance of the observer's behavior to that of the model's. Experimental evidence of these influences in the modeling literature utilizing the observation and/or vicarious paradigms has typically been obtained using the pretest, posttest control group or posttest only control group designs.

Research with Nonretarded Subject Populations

The substantial body of research on observational and vicarious influences on behavior with nonretarded subjects has demonstrated that a variety of behaviors may be acquired and/or influenced under these paradigms, including, among others, stylistic response patterns (e.g. Bandura, Grusec, & Menlove, 1966), distinctive modes of aggressive behavior (e.g. Bandura, Ross, & Ross, 1961, 1963), standards of reinforcement and self-evaluative responses (e.g. Bandura, Grusec, & Menlove, 1967a; Bandura & Kupers, 1964; and Bandura & Whalen, 1966), moral judgement orientations (e.g. Bandura & McDonald, 1963), and self-imposed delay of gratification patterns (e.g. Bandura & Mischel, 1965).

Representative studies of research employing the observational paradigm with nonretarded subjects for the study of modeling influences on behavior are those of Bandura, Ross, and Ross (1961, 1963a). These studies examined the role of modeling on aggressive behavior with young children in a posttest only control group design.

In the 1961 study, two groups of children spent ten minutes in a room where they could observe the behavior of an adult model. One group saw the model attack an inflated "Bobo" doll, physically and verbally. The other group saw the model emitting nonaggressive play behaviors with a tinker-toy set. A third group of children had no model exposure. Subsequently, the children were permitted to play with the toys. The children exposed to the aggressive model emitted more physical and verbal aggressive responses during the play time than did the children in the other two groups.

Bandura, Ross, and Ross (1963a) compared the influence of an aggressive model observed "in person" with that of an aggressive model observed on film among four groups of twelve year old children. Four experimental conditions were employed in the study; (a) "live" adult model, (b) filmed adult model, (c) filmed cartoon model, and (d) no model. The procedure was similar to that of Bandura et al. (1961). All groups of children exposed to an aggressive model emitted more aggressive responses in the test situation than did the control (no model) group. In addition, the topography of many of the responses emitted by the children in the model groups was similar to that of the model. Thus modeling not only facilitated emission of aggressive behavior, but also effectively shaped the forms of the behavior emitted.

The preceding studies may be considered indicative of the types of positive modeling results that have been reported by a number of researchers that have utilized the "observational" paradigm where no explicit contingencies have been arranged for either the model's or observer's behavior. Replications of these results are reported by Flanders (1968) and, as summarized by Flanders, it has been demonstrated that observers, trained under nonreinforcement conditions (re models) have imitated more than controls exposed to no models. It may be concluded therefore, that observational training conditions are sufficient for producing at least some imitative behavioral dispositions (observer's tendency to imitate the model).

In addition, a number of studies have examined modeling influences with normal subjects within the vicarious paradigm, where contingencies were arranged to consequate the model's behavior. For example, Bandura, Ross, and Ross (1963b) assigned nursery school children to one of four treatment groups. One group observed an aggressive model who was rewarded for his behavior. A second group observed a model who was punished for his aggressive behavior. A third group observed a nonaggressive model, and a fourth group had no exposure to a model. In a subsequent testing situation the aggressive, model-rewarded group emitted more physical and verbal aggressive responses imitative of the model than did the group who saw the model punished or the control. Nonimitative aggression was also more prevalent in the model rewarded group.

Bandura (1965) obtained differential effects on children's imitative aggressive behavior during a postexposure test as a function of the reinforcement contingencies applied to the model's aggressive behavior. Children observed either a model rewarded, or punished or not consequated for emitting novel aggressive physical and verbal behavior while playing with a Bobo doll. Compared to the children in the model-punished condition, children in the model-rewarded and no-consequences groups performed a greater variety of imitative novel aggressive responses. However, with the presentation of highly attractive incentives contingent upon reproducing the model's responses, the previously observed performance differences were completely eliminated. It was suggested, on the basis of these results, that the contingencies administered to a model within the vicarious paradigm may function as a performance variable, and that observation of a model may be sufficient for the acquisition of novel imitative responses.

Similar findings on the differential effects of positive, negative or no consequences, as administered to a model's aggressive behavior, on subsequent imitation by observers have been reported by Walters and Parke (1964), and Walters, Parke, and Cane (1965). Bandura (1969a) noted that, when a model displayed punishable behavior, absence of anticipated adverse consequences increased transgressive behavior in observers to the same degree as witnessing a model experience rewarding outcomes. The findings of Bandura (1965) and Walters, Parke, and Cane (1965) suggested that nonreaction to formerly prohibited activities may take on, through contrast, positive significance. Further, he suggested that the effects of witnessed outcomes may therefore be determined to a large extent by the context in which the events occur and the customary sanctions associated with particular modeled response patterns.

The preceding studies have demonstrated vicarious influences primarily in relation to deviant or aggressive behavior. Thus, the positive reinforcement or no consequences for aggressive behavior may have resulted in disinhibitory effects (Bandura, 1969a) on the emission of "transgressive" behavior by the observers. Positive vicarious reinforcement effects on nondeviant imitative behavior, however, have been demonstrated by Bandura, Grusec, and Menlove (1967a) and Kanfer and Martson (1963) who reported vicarious reinforcement training to be more effective than nonreinforcement training in relation to the modeling of self-reward and verbal behavior respectively.

The vicarious paradigm has also proven to be effective in eliminating a number of undesirable behaviors presently within the subjects' behavioral repertoire. Specifically, a great deal of research has been directed towards the elimination of "avoidance" behaviors which have stemmed from "emotional" responses to feared objects or situations. Bandura (1969a) noted that emotional response patterns can be extinguished, as well as acquired on a vicarious basis. The "vicarious extinction" of fears and behavioral inhibitions has generally been achieved by having persons observe models performing fear provoking behaviors without experiencing aversive consequences. A review of such literature is provided by Bandura (1969a). Representative of research that has been conducted in this area are the studies of Bandura, Grusec, and Menlove (1967b) and Bandura and Menlove (1968). Bandura et al. (1967b) subjected four groups of children who emitted avoidance response to dogs to one of four treatment conditions. One group, while participating in a party situation, observed a "fearless" peer model emit approach responses and interactions with a dog. A second group, in a neutral context, observed the "fearless" peer model approach and interact with the dog. A third group merely observed the dog in a party context (no model), while a fourth group participated in the party context with no dog or model. It was hypothesized that fear-incompatible behavioral and/or emotional responses on the part of the subjects that might be emitted in the party context would facilitate subsequent fear elimination and approach responses to the dog or further enhance modeling effects. Results indicated that both modeling conditions resulted in increased approach to and interactions with the dog, relative to the other treatment conditions. In addition, no modeling differences were obtained as a result of the modeling context. The modeling procedures were reported to have also facilitated generalized approach responses to a 'nonexperimental' dog.

Bandura and Menlove (1968) replicated and extended the findings of vicarious extinction effects of modeling with dog phobic children noting that a multiple model and multiple situation procedure facilitated the emission of potential threatening actions on the part of the subjects more than the observation of one model in one situation. In addition, it was reported that live models were more potent in facilitating this behavioral change than filmed models.

In summary, research conducted with 'normal' (nonretarded) populations has demonstrated that modeling paradigms of the observational and vicarious nature can not only facilitate the acquisition and performance of both deviant and nondeviant behaviors, but can also effectively function in the elimination or extinction of undesirable response patterns.

The reviews of the modeling literature that have been cited (see also Bandura, 1969b) pointed out that within a given modeling paradigm a number of variables may operate that will determine the extent of the imitative performance of the observers. Simply exposing persons to distinctive sequences of modeled stimuli does not, in and of itself, guarantee that observers will attend to, recognize, or differentiate distinctive features of the model's responses (Bandura, 1969a). A number of "attention" controlling variables, some related to incentive conditions, others to model and/or observer characteristics, and still others to the modeling cues themselves, may well influence whether or not modeling stimuli will be observed, and, given the observation of a model, which stimuli will be ignored.

The research reviews on imitative behavior cited indicated that (a) observers more readily imitate models of higher status and competence, or who are purported experts or celebrities, (b) characteristics such as age, sex, social power, which are correlated with differential probabilities of reinforcement, influence the degree to which models, who possess these attributes, will be selected for emulation (results are not entirely consistent with regard to this general statement), (c) affective relationships between a model and observer have been shown to influence imitation (again, studies evaluating this variable have not yielded consistent findings), (d) the extent to which modeled patterns are reproduced is significantly influenced by observer characteristics such as dependency, self-esteem, level of competence, socio-economic and racial status and sex, and (e) observer behavior can be effectively enhanced through arrangement of appropriate incentive conditions (e.g. through the use of instructions specifying desired behavior and/or reward for reproduction of model's responses). Bandura (1969a) stated that incentive control of observing behavior can, in most instances, over-ride the effects of variations in observer characteristics and model attributes.

In addition to these attention controlling variables the regulation of the acquisition of modeled responses can be influenced, to some extent by stimulus input conditions (i.e. rate, distribution, number, and complexity of modeling stimuli presented to observers). Thus, if modeling stimuli are presented at a rate, or level of complexity that exceeds the observer's receptive capabilities, observational learning may be limited or fragmentary. Response matching may require repeated presentations of modeling stimuli. In addition, modeled characteristics which are highly discriminable can be more readily acquired than subtle attributes which must be abstracted from heterogeneous responses differing on numerous stimulus dimensions.

The preceding findings have generally been obtained in studies incorporating control group designs or comparative groups with normal subject populations, in which the only differences between the groups was in the level of the independent variable manipulated.

Research with Retarded Subject Populations

As is evident from the preceding sections of this paper, considerable evidence exists in support of the efficacy of modeling procedures utilizing the observational and vicarious paradigms as a means of facilitating behavioral change. Research has indicated that not only are a variety of diverse behaviors amenable to modeling influences, but that such influences may also be obtained among diverse nonretarded subject populations including nonretarded children (e.g. Bandura et al., 1961, 1963), college students (e.g. Masters & Branch, 1969) and adolescent delinquents (e.g. Sarasen & Ganzer, 1969).

In recent years a number of authors, including Altman and Talkington (1971) and Sprague (1970), have noted that modeling has too long and too often been ignored as an important variable in determining behavior of mentally retarded individuals, particularly in institutions where there is generally a void of appropriate models. Talkington and Altman (1973) stated that it has been traditionally accepted that many retarded persons are highly susceptible to the influence of others and depend heavily upon significant persons in their immediate environment for cues as to appropriate responses prior to action. If indeed such susceptibility exists, the authors considered that modeling might well be used to facilitate the upgrading of at least some social and perceptual-motor skills.

Because of the fact that modeling influences (re observational and vicarious paradigms) have received little empirical investigation with retarded populations, the few studies that have investigated the phenomena with retarded populations will be presented in considerable detail. Ross (1970) conducted a study with educable mentally retarded children in which she eveluated the effects on observational learning of attachment to a filmed model. Children observed a model emitting a variety of motor and verbal behaviors on video tape. The model was either previously associated with the donation of toys played with by the children prior to the experiment (experimental "attachment" group) or not associated with the donation of toys (control group). Additional experimental manipulations, designed to permit evaluation of the effects of instructions and individual versus group observation of the model subdivided the respective experimental groups as outlined in Figure 1. Intentional and incidental conditions were distinguished by the model's instructions or lack of instructions respectively, to observe and later model her behavior. Individual and group conditions were distinguished by the number of children present during the modeling and testing phases, the group conditions having three subjects present. Ross reported that subjects in the attachment condition learned and retained more of the behavioral repertoire of the model than control group(s). Significant differences in favour of the intentional as opposed to the incidental groups were reported on only three of nine dependent measures recorded, while individual versus group comparisons yielded significant results on only two of nine dependent measures, these favouring individual modeling.

Talkington and Altman (1973) systematically replicated the earlier works of Bandura, Ross, and Ross (1963) and evaluated the effects of film-mediated aggressive and effectual models on the behavior of retardates having high or low IQ's (50-79, 30-49, mild and moderate retardates respectively) in combinations with high or low chronological age (16-21 years, 8-15 years, respectively). Subjects were divided into twelve groups of twelve subjects each, three groups being formed on the basis of each possible combination of IQ and CA classification. For each IQ - CA category, one group of subjects was assigned to a different treatment condition. One group observed a three minute film of an aggressive model, hitting, kicking, slapping, and throwing a Bobo doll. A second group observed a three minute film of the same model cuddling, holding, kissing, and petting the Bobo doll (affectual model). A third group had no model exposure, but spent

Modeling Procedure	Model Relationship with Observer	
	Attachment	Nonattachment
	Application of Modeling Procedures	
Incidental (no instruction)	individual	individual
	group	
Intentional (instructions)	individual	individual
	group	

Figure 1. Summary of experimental treatments in Ross (1970).

three minutes in conversation. Each subject was subsequently placed in a test situation for a three minute period, which permitted interaction with a Bobo doll, although no explicit instructions to interact with the Bobo doll were given. Results of the study indicated that groups receiving the aggressive model treatment emitted significantly more aggressive responses in the test phase than either the affectual model group or the no model control group. No significant differences were obtained between groups exposed to the aggressive model with respect to IQ and CA. Over all the treatment conditions the low IQ groups demonstrated higher aggressive responding than the high IQ groups only at the high CA level, while the high IQ subjects demonstrated increased aggressive responding at the low CA level. In relation to affectual responding, no significant differences were obtained between the affectual modeling and control groups, although both groups emitted significantly more affectual responses than the aggressive model group(s). The results of this study suggested that film-mediated aggressive models exert considerable influence on the subsequent behavior of retarded subjects (within the range of retardation of the subjects studied), and thus the observational paradigm can influence the emission of certain behaviors.

Stephen, Stephano, and Talkington (1973) investigated the effects of different modeling mediums on the imitative behavior of institutionalized educable retardates. The study explored the relative effectiveness of film and live modeling procedures on the training on the use of a telephone. Groups of subjects were individually exposed to either a live or a video taped model demonstrating three components of the telephone task; identifying the parts of the phone, dialing the police, and taking a message. The task was demonstrated three times by the model(s), and after each demonstration the subjects were required to perform the task in an adjacent office upon the verbal directions of an interviewer. A control group had no model exposure and was required to perform the task three times. Results of the study revealed a significant difference between the model and control conditions, but not between the type of modeling condition (although the authors state that the live model did influence the subjects more than the filmed model).

One interesting aspect of this study was that the modeling and test phases were repeated three times, and although only group data was presented, the data revealed a significant difference over trials, especially in the modeled conditions. Even though significant differences were obtained on a group basis on the first trial between the model and control groups, one should not overlook the possibility that, for some subjects, it may be that modeling influences might not be evidenced until after the subject has been exposed to repeated trials of model exposure.

Research reports on modeling, utilizing the observational or vicarious paradigms, with the severely retarded are virtually non-existent, this writer being aware of only one published study (Altman, Talkington, & Cleland, 1972) in this area. Research on imitation with the severely retarded has generally employed a direct imitation paradigm, frequently presenting verbal instructions (e.g. "Do this") contiguous to each modeled demonstration and reinforcing appropriate imitative responses. Modeling research with normal children, as well as with educable retardates has frequently demonstrated imitative influences without explicit accompanying verbal instructions. However, as Altman et al. (1972) noted, there is currently no empirical evidence on the spontaneous imitative ability of severely retarded subjects.

Altman et al. (1972) conducted a modeling study with severely retarded subjects utilizing an observational paradigm. Using a post-test only control group design, retarded subjects were exposed to one of the following treatment conditions; group one observed a model perform a variety of motor behaviors with a chair for two minutes; group two received two minutes of verbal instruction in how to manipulate the chair (comparable to the model's behavior); while group three (control group) engaged in two minutes of small talk (i.e. received no behavioral instructions no model exposure). Subsequent to treatment, each subject was placed in the test situation for two minutes with the experimenter present, during which time the number of chair contacts and the time spent in chair contact were recorded. Results indicated no significant group differences on the dependent measures, offering empirical support for the suggestion of the nonimitative status of the severely retarded.

It was suggested by Altman et al. (1972), in light of the successful research reports on imitation that have been reported with the severely retarded, that both behavioral prompts (i.e. instructions and modeling) may be necessary to instigate imitation by this population.

Modeling in a vicarious paradigm with retardates was reported by Litrownik (1972) who examined the effects of a delay between observation of a model and opportunity to imitate. Groups of normal and moderately retarded children observed a film in which a model received three reinforcements while playing a dart game. The model emitted a variety of novel responses (four motor, four discriminable choice, eight verbal), while playing the game. Other groups of normal and retarded children observed a control film. Experimental groups (i.e. those observing the modeling film) either were given an opportunity to play the game immediately following observation of the film or were required to wait thirty minutes before playing the game. Control groups were given an opportunity to play the dart game immediately after observing the control film. Results indicated that groups in the modeling conditions emitting more modeling responses than the control groups, and no significant differences were reported between the normal and retarded subjects within the respective conditions. In addition, the immediate modeling groups emitted significantly more imitative responses than the delayed groups, although verbal imitations were lacking in all groups.

The results of Litrownik's study indicated that the vicarious paradigm could influence performance of nonverbal behaviors in moderate retardates to a degree not significantly different from normal children of equivalent mental age. In addition, the results suggested that the vicarious paradigm may be more effective when an immediate opportunity is provided to perform the observed behaviors of the model.

An interesting aspect of Litrownik's study is that it is one of the few modeling studies in which more than one subject participated in the observation and task phases simultaneously. Litrownik cited only two other reports of group applications of modeling procedures (Bandura, Grusec, & Menlove, 1967; and, Bandura & Menlove, 1968). Ross (1972) also employed a group application as one of the experimental conditions in her study, although, as noted previously, individual modeling procedures proved more effective on some dependent measures (primarily the verbal imitation).

In considering the findings of Litrownik (1972) and Ross (1970) one may suggest that group applications of modeling procedures may provide additional modeling cues to a given observer (over and above those provided by an experimental model). These additional cues could be provided by the performance of other observers participating in the test situation. The results reported by Ross (1972) do not suggest that observation of other observers emitting correct imitative responses facilitate individual performance any more than individual observation and testing. However, it may be that failure to emit imitative responses (particularly verbal) or the emission of non-modeled responses by other observers may interfere with the accurate reproduction of modeled behavior in an individual case. However, no systematic evaluation of this possibility has been made to date.

Finally, Kazdin (1973) examined the effects of vicarious reinforcement on the attentive behavior of educable mentally retarded subjects in a classroom setting. This study utilized a single organism design as opposed to the group designs incorporated in the modeling literature previously presented. Specifically, the effects of social reinforcement delivered to target subjects on the attentive behavior of adjacent peers was examined in a reversal design[1] in which two pairs of subjects were sequentially exposed to three experimental phases. These phases and the results of the study are depicted in Figure 2.

After baseline rates of attentive behavior of the respective subjects were obtained, praise was delivered to the target subject in each subject pair for attentive behavior. After a reversal phase, during which time praise reinforcement was suspended, praise was delivered contingently to target subjects for inattentive behavior. In the final phase, contingent praise for attentive behavior on the part of the target subjects was reinstated. Throughout the study, nontarget subjects received no direct reinforcers. The results indicated a vicarious reinforcement effect (see Figure 2). During the initial praise for attentive behavior to the target subjects, and the subsequent reversal, both the target and the nontarget subjects showed an increase in attentive behavior (relative to baseline performance), and a subsequent return to baseline performance respectively. However, when reinforcement for inattentive behavior was applied to the target subjects, nontarget subjects increased in the level of attentive

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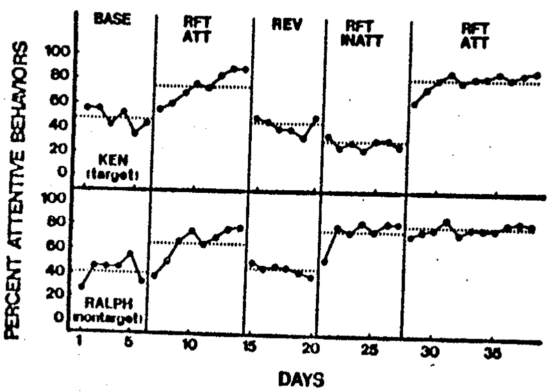
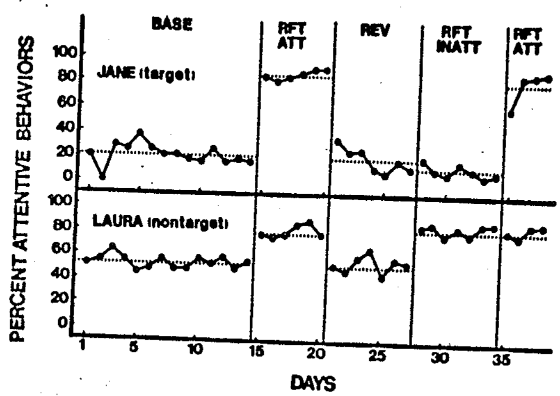
1. Descriptions of the single organism reversal design may be found in Baer, Wolf, and Risley (1968) and Gelfand (1969, p. 11-13).



Attentive behavior of Ken and Ralph across experimental conditions. Baseline—no experimental intervention. Reinforcement for Ken only for Attentive Behavior. Reversal-return to Baseline conditions. Reinforcement for Ken only for Inattentive Behavior. Reinforcement for Ken only for Attentive Behavior. (Means for each phase are represented by dotted lines.)



Attentive behavior of Jane and Laura across experimental conditions. Baseline—no experimental intervention. Reinforcement for Jane only for Attentive Behavior. Reversal-return to Baseline conditions. Reinforcement for Jane only for Inattentive Behavior. Reinforcement for Jane only for Attentive Behavior. (Means for each phase are represented by dotted lines.)

Figure. 2. Summary of experimental phases and experimental effects of Kazdin (1973).

behavior, which was maintained when the reinforcement contingencies were subsequently shifted back for attentive behavior for the target subjects.

Kazdin suggested that a nonreinforced observer may simply imitate the behavior of a model which led to reinforcement. This interpretation would appear to apply if one considered the initial baseline, reinforcement for attentive behavior and reversal phases of the study. Alternatively, the vicariously reinforced subject may have been affected by the cue value of the reinforcement to the target subject rather than responding to the contingent application of reinforcement to the target subject for a specific behavior. It should be noted that the praise given the target subject did not explicitly specify the type of behavior for which the subject was being rewarded. Thus the actual reinforcement contingencies of praise may have been ambiguous to the nontarget subjects and as a result, the adjacent peers may have responded more in line with their own past histories of reinforcement rather than to the actual behavior of the target peers.

Replications of this study including a verbal specification of the praise contingency may clarify the issue in this regard.

Theoretical Positions on Imitative Behavior

The occurrence of imitative behavior has been empirically demonstrated with both normal and retarded subject populations, under a variety of different training or observational situations. As noted previously, imitation has been subject to a variety of theoretical interpretations. However, this presentation will focus attention primarily on two theoretical positions of imitative behavior; reinforcement theory as represented by Gewirtz and Stingle (1968), and the contiguity-mediational theory as espoused by Bandura (1969a).

Reinforcement Theory

Many contemporary reviews and/or texts that discuss imitative behavior acknowledge the role of Dollard and Miller (1941) as providing one of the first interpretations in a reinforcement theory framework e.g. Bandura (1969); Flanders (1968); Gewirtz and Stingle (1968); and McGinnies (1970). More recent analyses and interpretations of imitation within the reinforcement framework have been provided by Baer and Sherman (1964) and Baer, Peterson, and Sherman (1967), and by Gewirtz and Stingle (1968).

Baer and associates suggested that the imitative behavior of a model acquires a conditioned reinforcement value as a result of an association between directly imitative responses and external reinforcement of those imitative responses. The conditioned reinforcement value of behavioral similarity was thus applied to account for the strengthening and for maintenance of further imitative responses (i.e. generalized imitation in the absence of extrinsic reinforcement. However, as noted previously, the empirical support, offered by Baer and associates, for this analyses of imitative and generalized imitative behavior has been questioned. Subsequent research has demonstrated that experimenter and procedural variables may well have been the controlling variables over the occurrence of generalized imitation, rather than the conditioned reinforcement value of behavioral similarity. Gewirtz and Stingle (1968) have noted that their approach to the analyses of imitation differs from that of Baer and associates. They suggested that the first imitative responses must occur either by chance or through direct training (this may involve the use of fading and shaping procedures). These imitative responses may then be strengthened and maintained by direct extrinsic reinforcement from environmental agents. Subsequently, once imitative responses have been established in this manner, a class of diverse but functionally equivalent behaviors is acquired and is maintained by extrinsic reinforcement on an intermittent schedule. Differences in response content are thought to play a minimal role as long as the responses were members of the imitative response class as functionally defined by the reinforcing agents.

Imitation is thus viewed as a functional response class under the stimulus control of model behavior and maintained by an intermittent schedule of external reinforcement. As reinforced imitative responses in the functional imitative class are diverse, and under intermittent reinforcement, discrimination between imitative behaviors that are reinforced and those that are not is unlikely to occur and some imitative responses that are never directly reinforced may persist, unless specifically punished or contingencies are arranged that may facilitate the discrimination between reinforced and unreinforced responses.

This analysis differs from that of Baer and associates in that Gewirtz and Stingle emphasized the entire S-R chain, of which all elements are maintained by terminal extrinsic reinforcement. (These elements could include the discrimination response and its assumed reinforcing value). The important distinction is that the environmental agency (and not the imitator) determines the occasion for reinforcement (observable, measurable, and controllable by a reinforcing agent).

Contiguity-mediational Theory

The interpretations of Baer et al. (1967) and of Gewirtz and Stingle (1968) of imitative behavior were based primarily upon the phenomena of imitation (and generalized imitation) as studied in the direct imitation paradigm. However, as is evident from the preceding literature review, imitation has been demonstrated to occur in other paradigms (i.e. the observational and vicarious paradigms where a model is observed emitting behavior, and at a later point in time, the observer is given the opportunity to imitate).

Bandura (1969a) suggested that the reinforcement theories of imitative behavior may account satisfactorily for imitation in the direct imitation paradigm. However, he suggested that the standard operant paradigm (S^D - R - S^R; where S^D denotes the discriminative modeled stimulus, R the overt matching response, and S^R the reinforcing stimulus) is not applicable to observational paradigms in which the observer does not overtly perform the model's responses during the "training" phase and/or reinforcers may not be administered to either the model or the observer. In addition, the first appearance of the observed behavior on the part of the observer may be in a situation which is delayed in time from the observation of the model, in a situation in which the modeled stimulus (S^D) is absent. Bandura also stated that the operant analysis also fails to explain how a new matching response is acquired observationally in the first place.

In response to these short-comings, Bandura proposed a contiguity-mediational theory to account for the imitative phenomena which occur in the observational paradigm. Matching behaviors were said to be acquired by an observer through simple exposure to a model's response, independent of the observer's overt response or of its reinforcement. The author assumed that stimuli from the model's behavior elicit perceptual responses in the observer that become associated on the basis of temporal contiguity. After repeated contiguous association these perceptual responses come to form verbal or imaginal representations of the stimuli involved. These representational or symbolic systems mediate response retreival and reproduction in that they provide cues which elicit, or that are discriminative for overt responses corresponding to those of the model. Thus, according to Bandura (1969a), it is primarily on the basis of stimulus contiguity and symbolic mediation that imitative behaviors are acquired.

The rate or level of observational learning was considered to be determined by a variety of perceptual, motor, cognitive, and incentive variables. Included under such categories were setting conditions (e.g. the saliency and complexity of modeling cues), the availability of necessary component responses in the observer's behavioral repertoire, and overt and covert rehersal of the matching responses. Recent elaboration of this position stressed the importance of symbolic coding processes in terms of their meaningfulness, rehersal, and retreivability for the observer in the acquisition and retention of modeled behavior in the observational paradigm (Bandura and Jeffery, 1973; Bandura, Jeffery, & Bachicha, 1974). However, Bandura assumed that the performance of imitative behaviors, once they are learned and retained, was primarily governed by extrinsic, self-administered, or vicariously experienced reinforcing events.

Discussion

Although it is not the primary purpose of this paper to argue, compare and/or criticize the theories of imitative behavior that have been briefly presented, a few comments do appear in order which have some pragmatic value in the application or analysis of imitative paradigms with humans, and especially with retarded populations.

First, Gewirtz and Stingle (1968) have attempted to extend their interpretation of imitative behavior to the observational and vicarious paradigms. Because extrinsically reinforced imitative performance (reinforcement on an intermittent schedule) is likely to characterize a child's experience in life settings prior to his exposure to a model in observational research designs, intermittent reinforcement can account for the imitation of both the reinforced and nonreinforced responses of the model. The task facing the child in the observational paradigm is not to learn the responses per se. Rather, the observer must "learn to learn" through exposure to a model's responses and the consequences they incur (i.e. to learn the rules of the game re probabilities of reinforcement). The authors have suggested that novel responses emitted by a model may, in fact, be present in the observer's behavioral repertoire as a function of his experiences prior to the experimental situation.

Secondly, as footnoted by Gewirtz and Stingle, there is a sense in which all organisms must somehow bridge the gap between relevant experience and later response, although the means whereby this is accomplished is not always obvious. Theoretical approaches may differ not only on the means by which they explain this gap-bridging, but also on the utility of even postulating such processes, particularly since measures utilized in experimental research do not (or are not) measure(s) of those processes per se, but of phenomena from which those processes are inferred (i.e. measurements of behavior). Therefore, Gewirtz and Stingle suggested that on a pragmatic level, research should be directed towards the exposition or search for relevant functional relationships between independent variables and response classes. The theorizing of unobservable and "unmeasurable" internalized processes, no matter how appealing or plausible, may be gratuitous or even detrimental to the task at hand.

Summary and Conclusion

The 'State of the Art' of Modeling

The direct imitation paradigm has been successfully employed with both normal and retarded subject populations to increase both motor and verbal imitative behaviors. However, it appears that in order for the direct imitation paradigm to most effectively influence the occurrence of imitative behavior, some observer prerequisite skills are necessary. With low grade retardates, for example, the direct imitation paradigm was effective only after initial imitative behavior was obtained through the use of shaping and fading procedures (Lovaas et al. 1966; Baer, et al. 1967). In addition, the use of verbal instruction, combined with the direct imitation paradigm may be the most efficient procedure to produce imitation, at least for the most severe ranges of retardate subjects (Baer et al. 1967; Lovaas et al. 1966; Talkington et al. 1973).

Modeling paradigms of the observational and vicarious nature have been successfully employed to produce prosocial, deviant, and nondeviant behaviors with nonretarded subject populations. Further, it has been demonstrated that the vicarious paradigm may be more influential in obtaining modeling effects than the observational paradigm. Although various characteristics of the model and observer may influence the extent of the modeling influence in a given paradigm, the establishment of appropriate incentive conditions (such as instructions) and/or reward for reproduction of modeled behavior may override the effects of these various characteristics.

The available research on the use of modeling paradigms of the observational and vicarious nature with retarded populations is limited. However, there have been demonstrations of modeling influences with the moderate or educable ranges of retardates with motor and verbal behaviors (Kazdin, 1973; Litrownik, 1972; Ross, 1970; Stephen et al. 1973; Talkington & Altman, 1973). To date, there appears to be no demonstrations of such modeling influences with severe and profound retardates. The forementioned studies that have reported modeling influences with retardates, have obtained their positive results generally by employing a vicarious paradigm, and/or through the use of instructions to observe and reproduce the model's behavior. No systematic evaluations have been reported comparing the relative effectiveness of the observational and vicarious paradigms with the retarded.

<u>Modeling Research with the Severely Retarded: Some Considerations</u>

The present paucity of published research on modeling influences with the retarded (and with the severely retarded in particular) may simply be due to the fact that researchers often fail to report 'nonsignificant' findings. It is quite probable that researchers other than Talkington and Altman (1973) have conducted modeling research with the severely retarded but, as noted by Sterling (1959), research in which statistical tests are used are seldom published if not significant. As noted previously, modeling studies have typically used control group designs which foster statistical analysis.

Failure to demonstrate observational modeling influences (e.g. Talkington & Altman, 1973) with the severely retarded may be due to a variety of reasons. First, it may well be that the observational paradigm alone is insufficient to influence the subsequent behavior of the severely retarded observer(s). The addition of verbal directives (a suggestion of Talkington & Altman, 1973) or the introduction of a vicarious paradigm or combinations of these two manipulations may be all that is required to produce or enhance modeling influences. Yet no reported study has examined the effects of these or other possible manipulations with the severely retarded.

Secondly, a single-exposure to a model may be insufficient to produce modeling influences with severe retardates. But this does not negate the possibility that modeling influences might develop or become apparent upon repeated exposure of an observer to a model's behavior with at least some subjects.

A single-organism research design which fosters an ongoing analysis of behavioral change with repeated demonstrations of effects, if they occur, may be beneficial in determining the influence of modeling procedures and/or of the manipulations that may initiate or enhance modeling influences.

Thirdly, an unfortunate omission in most of the research on modeling influences with the retarded has been the failure to determine or report the imitative behavioral repertoires of the subjects prior to experimentation. It may well be that in order to be influenced by an observational or vicarious paradigm, a retarded observer must have had some previous exposure to imitative training of some sort, be it to establish a functional response class (Gewirtz & Stingle, 1968), or in order to come under the instructional control of the model's behavior (Baer et al. 1967). As Gewirtz and Stingle (1968) noted, observational or vicarious paradigms may simply present to an observer indications of probabilities of reinforcement for imitative behaviors developed and maintained prior to an experiment.

As Bandura (1965) observed, observational learning effects demonstrated in experimental work may simply reflect prior instrumental learning, for which the requisite control conditions cannot be practically implemented. Thus, considerations for implementations of modeling paradigms might best be based on the present imitative abilities of a given subject rather than on an IQ classification.

As the direct imitation paradigm has been successfully employed in developing initial imitative repertoires with the severely retarded, it seems desirable to evaluate the potential of observational and vicarious paradigms to facilitate behavioral change in the severely retarded.

CHAPTER III

STATEMENT OF THE PROBLEM

An eight phase experimental program, incorporating a single-organism, combined multiple-baseline/reversal design, was used to evaluate the effects of repeated applications of modeling procedures on the performance of previously acquired motor behaviors with severely retarded males.

The purpose of Part I was to evaluate the effects of (a) the repeated presentation of a model emitting one of four alternative lever-press responses and receiving no consequences for this behavior (observational paradigm), on the subsequent lever performance of the subjects, and, (b) the repeated presentation of a model emitting one of four alternative lever-press responses and being contingently reinforced for that behavior (vicarious paradigm), on the subsequent lever performance of the subjects. Exposure to the vicarious paradigm followed exposure to the observational paradigm.

The purpose of Part II was to evaluate the effects of the addition of verbal directives by the model to the modeling procedures in the observational and vicarious paradigms on the lever performances of the observers.

Additional information on the retention of possible modeling influences over various time intervals was also obtained.

CHAPTER IV

METHOD

An Overview

Subjects were trained to emit four types of lever responses and received repeated applications of observational and vicarious modeling procedures during the experimental sessions in an eight phase experimental program. Experimental sessions consisted of two, five minute task segments (opportunities for the subject to emit lever responses), separated by a five minute play period and a subsequent two minute observation period (exposure to a model emitting a specified lever response). Subject performance during the second task segments of the experimental sessions was evaluated to determine "immediate" modeling effects. Subject performance during the first task segments (prior to model exposure) was evaluated to determine retention of modeling effects over time periods separating consecutive experimental sessions and session days.

The independent variables manipulated in the study were (a) the behavior of the model during the observation period of experimental sessions, (b) the contingencies of reinforcement applied to the behavior of the model, and (c) the verbal behavior of the model during the observation period. Specifically, the first independent variable was the presentation of a model emitting specified lever responses during the observation period, receiving no explicit reinforcement contingent on lever responses (observational paradigm). The second independent variable was the presentation of explicit reinforcement contingencies for the model's behavior during the observation period (vicarious paradigm). Finally, in Part II the use of verbal directives on the part of the model was implemented in the observational and vicarious paradigms.

The dependent variables were (a) time of lever contact per lever in each session segment, and (b) response frequency on each lever per session. Lever contact was defined as any physical contact on any part of a lever by a subject that could result in a lever response if sufficient directional force were applied by a subject.[1] A lever response was operationally defined as the movement of a lever a sufficient distance to depress a microswitch, activating an electrical counter.

Subjects

Three institutionalized severely retarded males, Ralph, Calvin, and Darrin, were selected to participate as subjects. Brief summaries of their diagnosis and IQ levels are presented in Table 1. The subjects were residents of Spruce Cottage, a self-contained unit of the Manitoba School, a provincial institution for the retarded located in Portage la Prairie, Manitoba. Subject participation was determined by the performance of eligible subjects during the preexperimental training phases of the study. Eligible subjects were required

1. Touching only the "underside" of a lever (i.e. the side opposite the spring mechanism) could not possibly result in a lever press and was not included in the definition of lever contact.

Table 1

Summary of Subject Characteristics [a]

	Chronological Age	Diagnosis	Psychological Assessment[b] Mental Age	IQ
Ralph	15 yrs.	- mental retardation due to physical agent (premature birth) - cerebral palsy - left side hemi-plagia	2 yrs. 8 mos.	23
Darrin	13 yrs.	- encephalopathy due to trauma or physical agent (car accident at age 3)	3 yrs. 1 mo.	30
Calvin	14 yrs.	- coarctation of the aorta; narrowing of part of the aortic arc.	Estimate severe retardation (could not or would not complete test items)	

a) based on institutional records

b) Stanford-Binet Intelligence Scale

to have previously participated in direct imitation training programs that had been conducted in Spruce Cottage and to have demonstrated an imitative repertoire in this imitation paradigm.

Apparatus

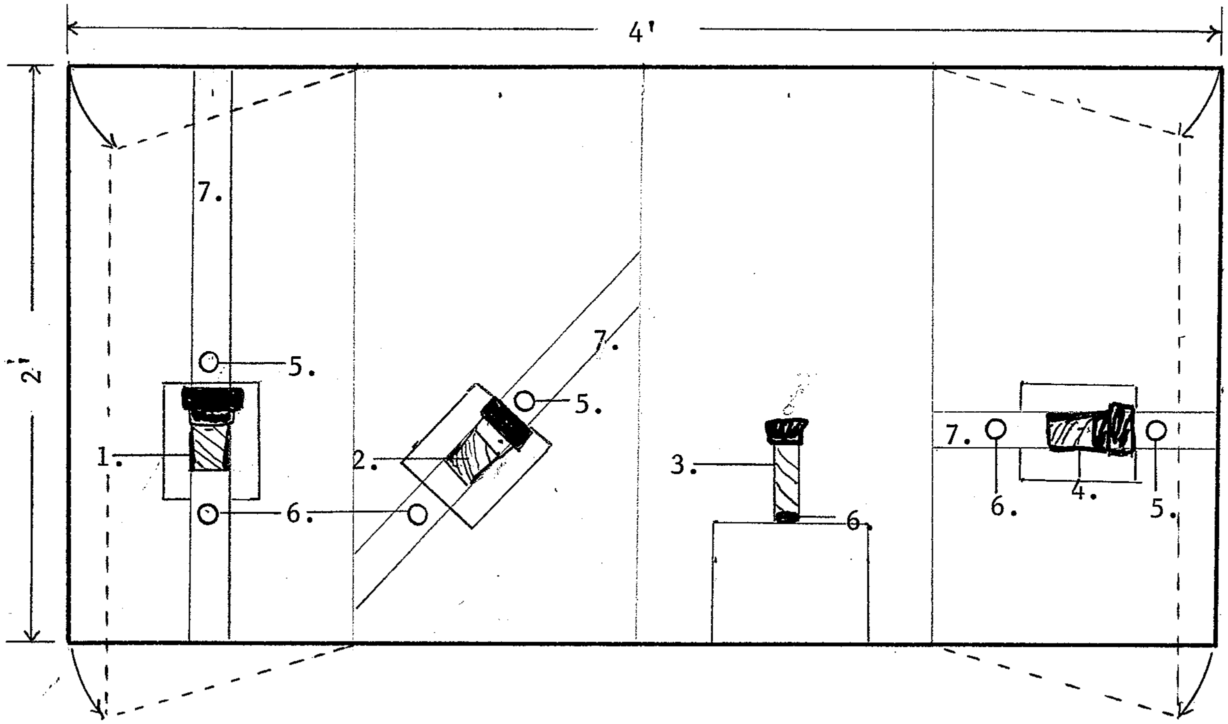
The research apparatus consisted of a four-lever response panel (see Figure 3). Each lever protruded approximately seven inches from the panel surface and transversed a distance of six inches. From a resting position a force of approximately two pounds was required in order to move the respective levers. The response panel was mounted within a small room-like enclosure measuring 4 ft. by 4 ft. by 6 ft., designed to eliminate extraneous visual and auditory variables (the learning cube or cubicle). The manipulanda were wired to Leigh-High Valley electrical programming equipment which monitored session time and recorded the number and type of lever responses that were emitted.

Four stop watches were used to time lever contact on the respective levers.

An automatic reinforcer dispenser was attached to the outer side of the cube, which, when manually operated (depression of a button switch), dispensed an edible (M & M's) into a cup located on the inside wall of the learning cube.

A variety of toys (coloring books and crayons, magazines, cars, toy telephones, etc.) were located in the session room. The subjects were permitted to play with these toys at specified times.

The learning cube was situated in a research classroom of the



KEY

1. "up-down" lever (red)
2. "diagonal" lever (blue)
3. "back-forth" lever (green)
4. "side-to-side" lever (yellow)
5. coloured cue lights; constant illumination
6. response completion indicator lights
7. coloured tape

Figure 3. Four-lever response panel.

cottage. The programming equipment was located in an adjacent observation room. One way mirrors permitted undetected observation of the classroom from the observation room. The back of the learning cube had a 2 ft. by 4 ft. 'window' and was placed up against a one-way mirror, thus permitting observation of the subject in the cubicle.

Preexperimental Procedures

Prior to the experiment, four eligible subjects were required to participate in two preexperimental phases. During the first phase, subjects were trained to emit the different lever responses, their performance during this phase determining their eligibility for further research. In the second phase, individual stability criteria, based on the performance of the respective subjects on each lever, were determined.

General Session Procedure

Sessions during the preexperimental phases were five minutes in duration. The experimenter brought a given subject into the session room, engaging the subject in conversation and interacting in a generally 'friendly' manner. The experimenter showed the subject the toys, telling him that the toys were for him, but that before he could play with them, he must first wait in the "house" (the learning cubicle) because the experimenter had some work to do. The subject was then placed in the cubicle and seated in a chair facing the apparatus. The experimenter left the cubicle, shutting the door, and provided no instructions as to the expected behavior of the subject in the cubicle. The experimenter then left the classroom, entered the observation room, and turned on the programming equipment. The subject was left undisturbed in the cubicle for the duration of the session, after which the experimenter turned off the programming equipment, re-entered the session room, removed the subject from the cubicle and told him that he could come out and play with the toys. Any candy that had been delivered to the subject during the session that had not been consumed was removed from the cube and given to the subject during the play period.

During the play period the experimenter refilled the candy dispenser and adjusted the lever partitions (when necessary) and maintained an on-going conversation with the subject, avoiding reference to the subject's behavior in the cubicle. The subject was left alone during the play period for approximately two minutes during which time the experimenter went to the observation room, recorded the data and reset the programming equipment.

If additional sessions were conducted during a given time period, the experimenter returned to the session room, told the subject that it was time for him to go into the "house" again for awhile, and repeated the session procedure. If no additional sessions were conducted, the experimenter returned the subject to the ward.

Specific Procedures

Response shaping (subject selection). Subjects were individually trained to perform the respective lever responses during five minute sessions which were conducted two to three times per day. Training on each lever was subject to a minimum of two and a maximum of six training sessions. Each lever was trained separately, the remaining levers being covered by cardboard partitions. For a given training session, the subject was led by the experimenter into the learning cube (in which one lever was exposed), and was seated in front of the apparatus.

During the first training session on the first lever trained, the subject was physically guided in performing the desired response and reinforced with an edible for approximately every three responses. For all subsequent training sessions, including the first training sessions on "new" levers, no physical guidance was given to the subject for at least thirty seconds, and the first spontaneous response observed on the lever was reinforced. After the first training session, the subject was reinforced on a fixed interval of eight seconds for responding on the respective levers, and was left undisturbed in the cube.

Subjects were required to emit spontaneous lever responses within thirty seconds of the initiation of two consecutive training sessions for each of the four levers, and maintain responding at some rate during the five minute training session(s). Failure to meet this criterion resulted in deletion of one of the eligible subjects from the research program.

<u>Stability criterion determination</u>. Stability criterion sessions were five minutes in duration and were conducted during the morning, afternoon, and/or evening, depending upon the availability of the subjects. During a given time period, four five-minute sessions

were conducted with a given subject, successive sessions being separated by a five minute play interval. Within each four session block, a different lever was presented to the subject during each session, the order of lever presentations being constant for all subjects. Responding on a given lever was reinforced with an edible on a fixed interval of eight seconds. The response frequency and time of lever contact were recorded for each session.

Stability criterion sessions were conducted for a given subject until each lever has been exposed to that subject for ten sessions. The stability criterion measure was calculated for that subject based on the subject's performance on each lever during the last four, four-session blocks.

This measure was based on the percentage of the total time of lever contact during a four session block for each lever (dividing the contact time for a given lever by the total time of lever contact for all four levers). The maximum variability (i.e. the range between the highest and lowest measures) and the average variability[1] obtained on the most variable lever for this measure specified the acceptable limits of variability in performance during experimental phases. If one assumes that during this phase of the

1. Average variability was calculated by adding the differences obtained for a given response measure on a given lever for the last four sessions with that lever, and dividing the sum by the number of difference scores obtained.
Thus, for example, if consecutive scores on a given response measure for the most variable lever performance were .60, .75, .70, and .60; the sum of the differences would be (.75 - .60) + (.75 - .70) + (.70 - .60) = .15 + .05 + .10 = .30; and the average variability would be .30 ÷ 3 = .10. The range of variability would be (.75 - .60) = .15.

study the variables influencing the behavior of the subject on a given lever were as constant as possible across session blocks, then the variability obtained across session blocks for the performance measure may well have specified the acceptable limits of variability when influences resulting from experimental manipulations were constant.

Thus, for a given subject, stability in performance during experimental phases would be obtained when the variability in the respective measure fell within the limits specified for the most variable lever performance in four consecutive sessions. The obtained stability criterion measures for the respective subjects are presented in Table 2. Summaries of averaged session performance on the respective levers for the three subjects are presented in Table 3.

Experimental Procedures

General Experimental Procedures

Experimental sessions. Throughout all experimental phases, each subject participated in a maximum of three experimental sessions on each experimental session day. Experimental sessions were conducted during the morning, afternoon, or evening periods, no subject participating in more than one experimental session during each respective period.

Each experimental session was divided into three segments and two five-minute play periods.

(1) The first session segment consisted of a five minute task period during which time the subject was seated in front of the

Table 2

Subject Stability Criteria for Percent of Total Contact Time per Lever [a]

Subject	Average variability	Range of variability in performance scores
Ralph	.03	.06
Calvin	.02	.04
Darrin	.03	.07

a) based on subject performance during the last four sessions of pretraining for each lever.

Table 3

Average Lever Performances per Session During Stability Criterion Sessions [a]

Lever[b]	Subjects		
	Ralph	Calvin	Darrin
	Contact Time[c]		
Red	267	274	278
Blue	225	287	292
Green	212	284	288
Yellow	230	284	293
	Response Frequency		
Red	390	225	296
Blue	356	180	163
Green	216	227	284
Yellow	313	114	309

a based on subject performance during the last four sessions of pretraining

b levers are designated by color

c maximum contact time per session was 300 seconds apparatus, all four manipulanda being exposed. The subject was alone during this segment and received no explicit reinforcement for responding. Following this segment the subject was removed from the cubicle and permitted to play with toys in the session room for five minutes, after which the second session segment was introduced.

(2) The second session segment consisted of a two minute observation period during which time the subject was seated behind the cubicle, the interior of the cubicle visible to the subject. The model was present in the cubicle during this segment emitting the behavior specified in each experimental phase. (In "no model" phases, the play time was extended for approximately three minutes, after which the subject immediately participated in the third segment.)

(3) The third segment consisted of a five minute task period as described in (1), and was followed by five minutes of play time, after which the subject was removed from the session room.

Session procedure. At the start of each session, the experimenter brought a given subject into the session room engaging the subject in friendly conversation. The subject was shown the toys and told that they were for him to play with, but that before he could play with them he would have to wait in the "house" because the experimenter had some work to finish. The experimenter then placed the subject in the cubicle and closed the door, leaving the subject alone in the cubicle. The experimenter returned to the observation room, turned on the programming and recording equipment and monitored the session, and recorded lever contact time.

Upon completion of the first five-minute task period, the experimenter shut off the programming and recording equipment, re-entered the session room and removed the subject from the cubicle telling him that he could go and play with the toys. A cup containing three to four M & M's was made available to the subject at the play table.

During the play period the experimenter remained in the vicinity of the subject for approximately two minutes, and carried on a conversation with the subject, avoiding any reference to the subject's performance in the cube. The experimenter then left the subject briefly, returned to the observation room to record the data and reset the programming equipment. The experimenter then returned to the session room, and, while conversing with the subject, proceeded to move one corner of the cubicle approximately two feet from the wall. A stool was then placed between the cubicle and the wall and the subject was told, in a pleasant manner, that he could sit in the "waiting" chair. The experimenter then lifted the subject onto the chair, told the subject to wait, and enclosed the subject by opening the cubicle door so that it touched the wall. The experimenter then entered the cubicle, sat in the experimental chair, and proceeded to respond as specified in each experimental phase. During this time no verbalizations were made by the model to the observer unless specified in the respective experimental phase(s).

Upon completion of the observation period, the experimenter left the cubicle, drew back the door enclosing the subject, removed the subject from the waiting area, pushed the cubicle back up against the wall, and repeated the procedure as specified above for the first task period.

Part I: Experimental Phases and Specific Modeling Procedures

Phase A. First baseline. Baseline sessions with all levers exposed were conducted to provide an index of subject performance against which subsequent modeling influences were evaluated, and to determine which of the four lever responses would be modeled by the experimenter.

This phase was in effect until stability in the subject's performance was obtained or until fifty sessions had been conducted. The most preferred lever (i.e. the lever obtaining the highest percentages of responses and lever contact time at stability) during baseline was designated as R_0 and was not modeled during the subsequent experimental phase.[1] The designation of the order of modeling of responses on the other three levers was determined by a random drawing of identical slips of paper from a box upon which the lever descriptions were written.

For the purposes of this presentation, R_1 will designate the first modeled lever, R_2 and R_3 the levers designated for subsequent modeling.

During baseline sessions, the subject did not participate in

1. The possibility was considered that a given subject might emit all or most of his responses on one lever during baseline. Subsequent modeling of the 'preferred' lever might not result in modeling effects simply because the subject previously responded at asymptote levels prior to modeling, or if modeling effects were obtained, they might not be replicable on less preferred levers.

the observational segment of the experimental sessions, but was provided with a three minute extension of the play period (which followed the first task segment), after which the second task period was initiated.

Phase B. Observational paradigm. During the observational segments of the experimental sessions in this phase of the study, the model sat in the task chair in the learning cube, and emitted responses on the lever designated R_1 for a given subject at a constant rate of approximately one response per second. The model continued to emit R_1 responses in this manner during the observation periods of consecutive experimental sessions until stability in subject performance during the second task segment was obtained (minimum of ten experimental sessions) or a maximum of twenty experimental sessions was conducted.[1] Upon fulfilling either of these two criteria, the experimenter proceeded to model R_2 and then R_3 lever responses, until the same criterion for termination of each of these subsequent manipulations was met. Upon completion of the latter two manipulations, the next experimental phase was introduced.

Phase C. Second baseline. Baseline sessions as described in Phase A were reintroduced and were in effect for a given subject until stability in performance was obtained during the second task segments of the sessions or a maximum of fifteen sessions had been conducted.

1. The minimum of ten experimental sessions per manipulation was proposed in order to provide assessment of the durability of modeling influences given the obtainment of stability during the initial sessions of a given manipulation. The maximum of twenty experimental sessions per manipulation was governed by considerations of subject and experimenter availability for the research program.

This latter criterion was introduced in Phase C for Calvin and Darrin and in Phase E for Ralph as a result of the subject's previous baseline performances and considerations of subjects and experimenter availability for the research project.

Phase D. Vicarious paradigm. During the observational periods the model emitted responses on the lever designated R_1 (from the 2nd baseline) at a constant rate of approximately one response per second, and received response contingent reinforcement on a fixed interval of eight seconds schedule. Candy reinforcement was administered by the model who depressed a dispenser button which was hidden from the view of the observer (subject). The candy was removed immediately after the modeling period by the model.

Procedures for replications on R_2 and R_3 and progression to the next phase of the study were as described in Phase B.

Part II: Experimental Phases and Specific Modeling Procedures

Phase E. Third baseline. Baseline sessions and procedures were reintroduced as described in Phases A and C, with procedures for progression to the next phase as described in Phase C.

Phase F. Observational paradigm with verbal directives. During the observational periods of the experimental sessions, the model emitted the appropriate lever responses (as determined from Phase E, third baseline), following the same procedures as outlined for the observational paradigm (Part I, Phase B). In addition, however, the model emitted verbal responses every ten seconds while emitting lever responses, indicating the type of lever response being emitted (e.g. "up-down!", "on the red lever!", etc.) as well as instructions for the subject to observe (e.g. "watch me!") and imitate (e.g. "do this").

Procedures for replications on R_2 and R_3 and/or progression to the next phase of the study were as described in Part I, Phase B.

Phase G. Fourth baseline. Baseline sessions and procedures were reintroduced as previously described.

Phase H. Vicarious paradigm with verbal directives. Reinforcement of model responding on appropriate levers (as designated in Phase G, Fourth baseline) was the same as described for the vicarious paradigm (Part I, Phase D). However, the addition of verbal responses (as described in Part II, Phase F) every ten seconds was implemented.

CHAPTER V

RESULTS

For each segment of the experimental sessions, two measures of the subjects' behavior were recorded; (a) time of lever contact per lever, and (b) response frequency per lever. The first measure was recorded with four stop watches by the experimenter, the second was recorded automatically with electrical counters, wired to the respective levers.

Interobserver reliability (I-O-R) measures were determined for recorded contact time by obtaining measures of contact time from independent observers during a sample number of sessions during Part II of the study. I-O-R's were calculated by dividing the smaller of the two records of contact time for a given lever in a given session by the larger record of contact time. A total of 22 I-O-R's were so calculated for the three subjects, and averaged I-O-R's of .99, .98, and .97 were obtained for measures of contact time with the respective subjects.

The primary dependent measure used to assess modeling influences in the study was the percent of total lever contact time for each lever per session. This performance measure was obtained for each experimental session segment by dividing the time of lever contact obtained for each lever during a given session by the sum of lever contact times recorded for all four levers. This measure was selected over response rate or the percentage of total responses per lever because of the greater variability in response frequency between the respective levers obtained during pretraining, and during the study itself.

The effects of the application of modeling procedures on a subject's performance on the respective modeled levers were evaluated in relation to the subject's performance on the respective levers during the sessions preceding the modeling of a given lever.[1] In each modeling phase, a subject's performance on a modeled lever was examined for all sessions of modeling for that lever with emphasis placed on the first session following observation of a model and the last five sessions of modeling.

Part I

Ralph

Data summaries presented in Figure 4 indicate that increases over baseline levels in percent of total contact time were obtained with Ralph for each of the three modeled levers (see Figure 4, Phases A & B). However, in each modeling segment of Phase B, the first session of modeling on the respective levers yielded relatively weak performance increases. Comparisons of Ralph's averaged performance during the sessions immediately preceding the application of modeling procedures with the three respective levers (R_1, R_2, and R_3), and the first session after modeling for each lever, reveal changes of 9%, 10%,

1. Although the present study incorporated specific baseline phases (Phases A, C, E, & F), subject performances during these phases was evaluated to determine modeling effects on the first modeled lever (R_1). Subject performance on R_2 during R_1 modeling was considered as the baseline for R_2 for determining subsequent R_2 modeling effects in a multiple-baseline design, and so forth.

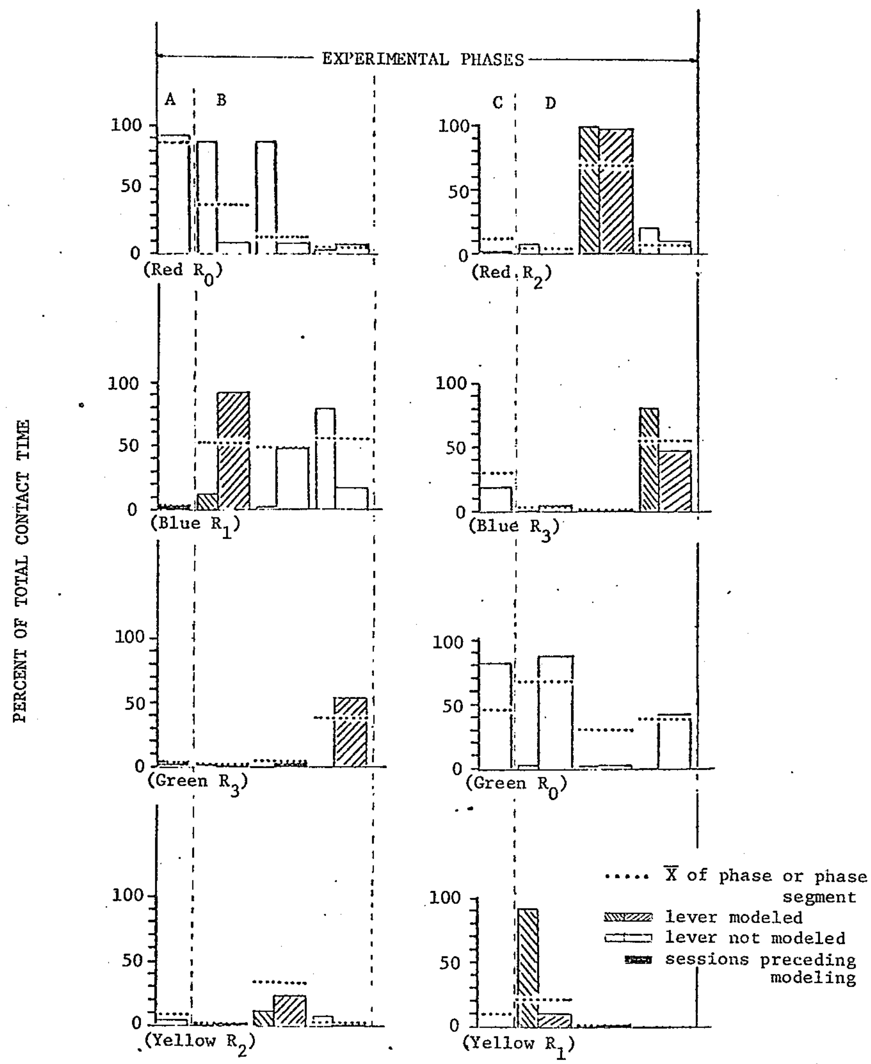


Figure 4. Summary of Ralph's lever performances during Part I experimental phases. [For baseline phases (Phase A and C) the averaged percent of total contact time obtained for each of the coloured levers during the last five sessions is presented. For the observational and vicarious modeling phases (Phase B and D respectively) the histograms represent individual lever performances for the first session of modeling of R_1, R_2, and R_3 (▧), and the averaged lever performances for the last five sessions of modeling of the three modeled levers (▨)].

and -5% in percent of total contact time respectively. Noticeable increases in this performance measure were obtained during subsequent sessions of modeling for the respective modeled levers.

Comparisons of Ralph's averaged lever performance between the respective baseline sessions and the repeated modeling sessions for the three modeled levers reveal increases during modeling of +49% for R_1, +32% for R_2, and +33% for R_3 (see Figure 4). Figure 4 also presents the averaged performance levels for percent of total contact time during the last five sessions of modeling for R_1, R_2, and R_3. These averages represent increases above the preceding baseline levels of +88% for R_1, +28% for R_2, and +49% for R_3.

Figure 5 reveals the daily variability in the levels of percent of total contact time for modeling sessions with Ralph. However, the percentages of contact time for the three modeled levers were above the average of respective baseline sessions for 94% of the modeling sessions for R_1, 85% of the sessions for R_2 and 70% of the sessions for R_3. Moreover greatest increases in percent of total contact time were obtained after repeated exposures of the model to the subject for each modeled lever.

During R_1 modeling sessions, Ralph's average lever contact time for R_1 was 137 seconds per session, an increase of 125 seconds per session over the baseline session average. An average lever response frequency of 217 R_1 responses per session, obtained for R_1 modeling sessions, represented an increase of 204 responses per session over the R_1 baseline average.[1] For R_2, averages of session

1. For summaries of Ralph's averaged lever contact times and response frequencies for the respective levers across the experimental phases see Appendix Table A and Table B respectively.

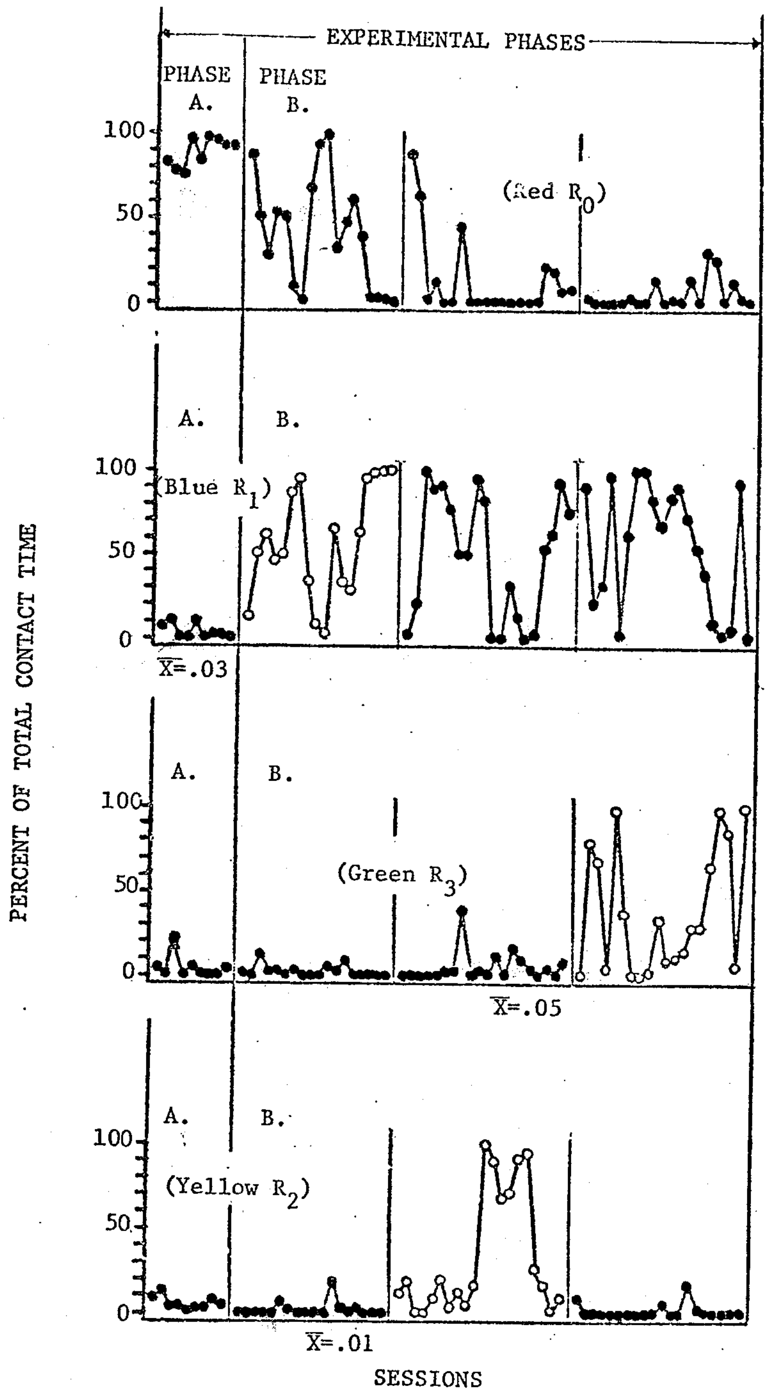


Figure 5. Percent of total contact time per lever for Ralph across Phase A (baseline) and Phase B (observational modeling) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

performance during R_2 modeling sessions show 77 seconds per session of R_2 contact time and 84 lever responses per sessions, increases of 73 seconds per session and 77 lever responses per session over the baseline averages. During R_3 modeling sessions, average R_3 lever contact time and R_3 response frequency were 96 seconds per session, and 50 lever responses per session respectively. These averages represent increases of 85 seconds per session and 45 lever responses per session over the preceding baseline session averages.

Vicarious paradigm. Dramatic increases in percent of total contact time were obtained with Ralph during the first modeling session in the vicarious modeling paradigm for all three of the respective modeled levers. Figure 4 (Phases C & D) indicates that, for the first session after modeling of the respective levers, increases in percent of total contact time of +81%, +95%, and +79% were obtained for R_1, R_2, and R_3, respectively. Averaged performance levels for all modeling sessions with the respective levers show an increase above the respective baseline mean of +11% for R_1, +64% for R_2, and +54% for R_3. During the last five sessions of modeling for the respective levers, averaged performance indicates a decrease in R_1 performance to the preceding baseline level. The other two modeled levers remained above baseline levels, R_2 by +93% and R_3 by +46% of total contact time.

Figure 6 indicates the sessional variability in Ralph's percent of total contact times for the modeled levers in the vicarious paradigm. The initial increases in performance for all modeled levers were transient, with decreases in lever performance occurring within

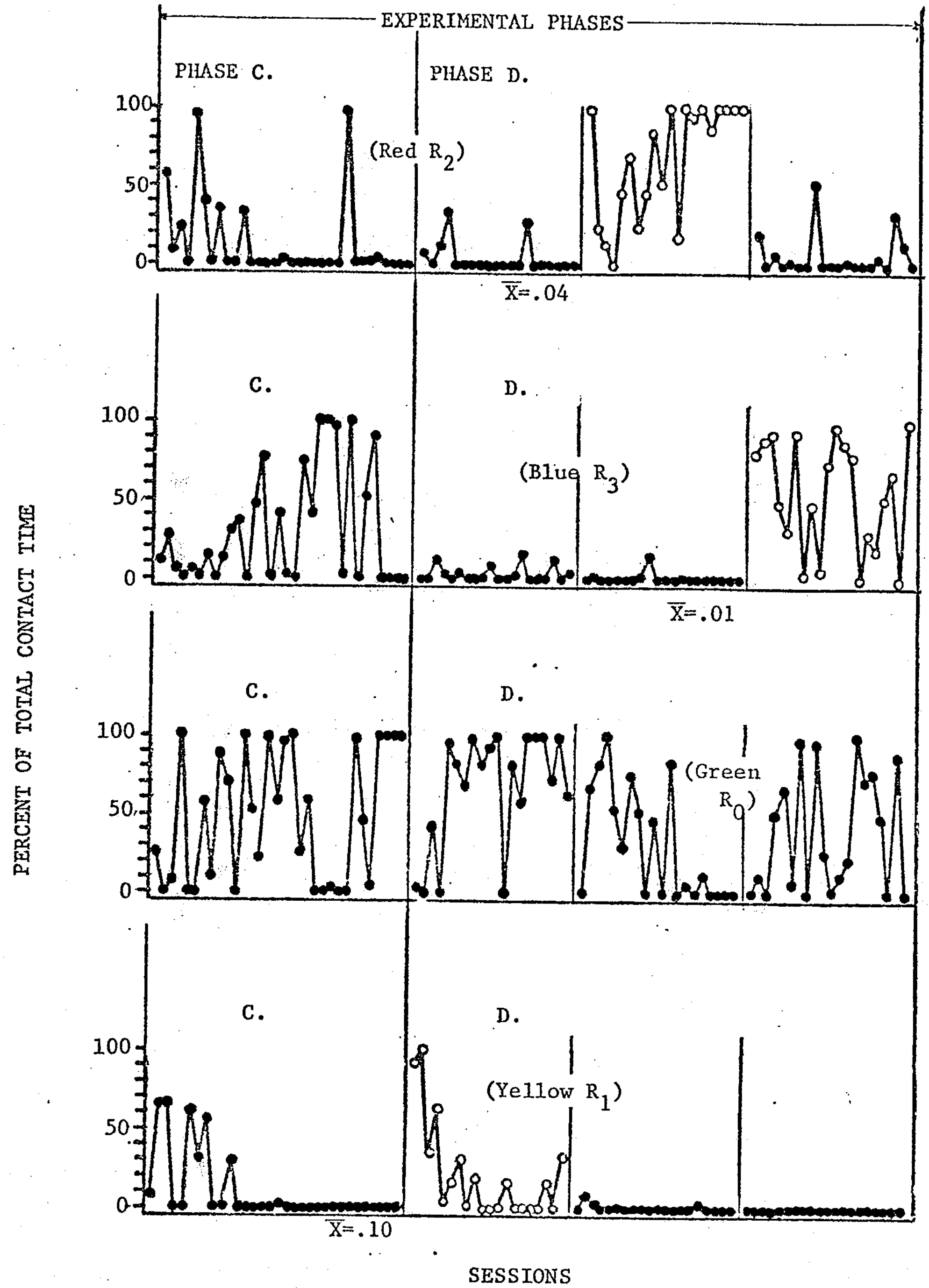


Figure 6. Percent of total contact time per lever for Ralph across Phase C (baseline) and Phase D (vicarious modeling) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or a phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

four sessions of modeling. However, subsequent performance increases are evidenced for levers R_2 and R_3. During the respective modeling applications, increases in performance above the baseline averages were obtained for 50% of the modeling sessions for R_1, 95% of the sessions for R_2, and 90% of the modeling sessions for R_3.

For R_1 modeling sessions, the time of R_1 lever contact averaged 40 seconds per session, an increase of 23 seconds per session over the baseline average. Sessional lever response frequencies for R_1 averaged 38 responses per session during modeling, 25 response per session over the baseline average. Averages of R_2 contact time and lever response frequency for R_2 modeling sessions were 175 seconds per session and 225 lever responses per session, increases over the baseline average of 171 seconds per session and 220 lever responses per session respectively. For R_3, Ralph's contact time and lever response frequency averaged 132 seconds per session and 90 lever responses per session. These averages represent an increase of 130 seconds per session of contact time and 88 lever responses per session over baseline averages.

Calvin

Observational paradigm. Compared with Ralph, the second subject demonstrated relatively small increases in the percent of total contact times for modeled levers in the observational paradigm. Figure 7, Phases A and B indicate that increases in percent of contact time over preceding baseline session averages were evident for two levers, during the first session of modeling for the respective levers.

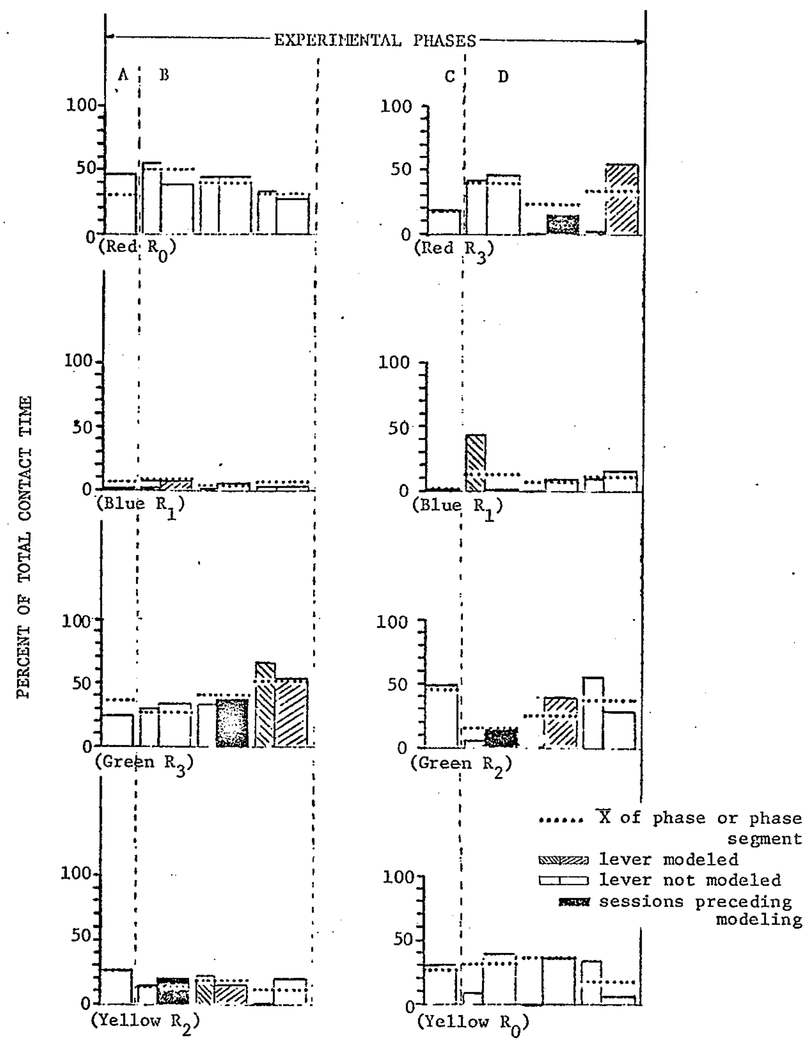
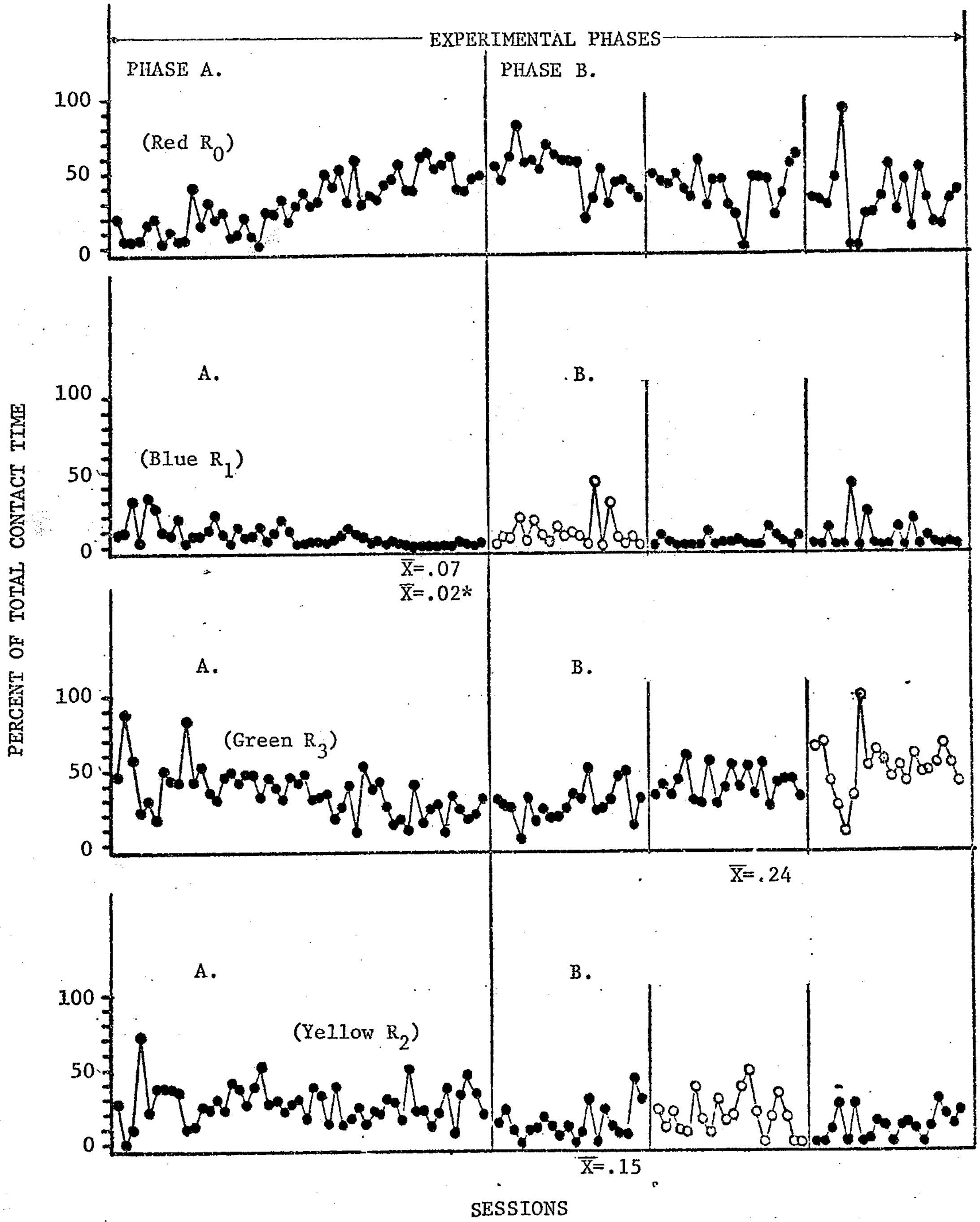


Figure 7. Summary of Calvin's lever performances during Part I experimental phases. [For baseline phases (Phase A and C) the averaged percent of total contact time obtained for each of the coloured levers during the last five sessions is presented. For the observational and vicarious modeling phases (Phase B and D respectively) the histograms represent individual lever performances for the first session of modeling of R_1, R_2, and R_3 ( ), and the averaged lever performances for the last five sessions of modeling of the three modeled levers ( )].

An increase of +49% was obtained for R_2, and an increase of +13% was obtained for R_3. Lever R_1 performance was -6% below the baseline average for the first modeling session.

A comparison of overall averages obtained during modeling sessions for the respective levers with the respective baseline sessions, reveal an increase in performance for all three levers during modeling. Figure 7 (Phases A & B) shows an average sessional increase in the percent of total contact time of +2 percent, +5 percent and 11% for R_1, R_2, and R_3, respectively during modeling. The minimal increase obtained for lever R_1, however, was based on the subject's performance during 50 baseline sessions in Phase A. Figure 8 shows the initial variability of baseline performance for R_1 during Phase A and the relative stability in performance obtained during the last twenty sessions. A comparison of modeling performance on R_1 with baseline performance during the twenty baseline sessions preceding modeling reveals an average increase in the percent of total contact time for R_1 of +7 percent. Moreover 70% of sessions during modeling of R_1 yielded contact time measures above the averaged baseline performance obtained during the last twenty sessions of R_1 baseline.

Figure 8 also shows the variability in Calvin's sessional lever performances with the repeated application of the observational modeling procedure for R_2 and then R_3. Increases in percent of total contact time for the modeled levers relative to the respective baseline session averages were obtained for 65% of modeling sessions for R_2 and 85% of modeling sessions for R_3.



* average of last 5 sessions

Figure 8. Percent of total contact time per lever for Calvin across Phase A (baseline) and Phase B (observational modeling) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

For the last five sessions of modeling for each of the three levers, R_1 performance averaged +7 percentage points above the average of the last 20 R_1 baseline sessions; R_2 performance averages decreased to the premodeling baseline levels and R_3 performance averaged +13% above the baseline average.

Average R_1 contact time and lever response frequency for R_1 modeling sessions was 31 seconds per session and 18 lever responses per session.[1] These averages indicate an increase over the 50 baseline session averages of 4 seconds per session and 5 lever responses per session (21 seconds per session and 11 responses per session if compared with the average of the last 20 R_1 baseline sessions in Phase A). For R_2 modeling sessions, R_2 contact time averaged 59 seconds per session, 15 seconds per session above the R_2 baseline session average. Lever response frequencies averaged 24 lever responses per session for R_2 modeling, an increase of 4 responses per session over the R_2 baseline average. A decrease from baseline in averages of R_3 contact time and lever response frequency was obtained for R_3 modeling sessions. Averages of 113 seconds per session of contact times and 65 responses per session were 10 seconds per session and 34 responses per session under the baseline average.

Vicarious paradigm. With the application of vicarious modeling procedures, Phase D, a dramatic increase in percent of total contact time was obtained with one lever, R_1, during the first session of modeling (see Figure 7, Phases C and D). This increase in performance of 42 percent above the R_1 baseline session average.

1. For summaries of Calvin's averaged lever contact times and response frequencies for the respective levers across experimental phases see Appendix Table C and Table D respectively.

Although no initial increases in percent of total contact time were evident in Figure 7 (Phases C and D) for levers R_2 and R_3, overall averages of Calvin's lever performances during the respective applications of modeling procedures indicate increases in percent of contact times for all three modeled levers. Figure 7 shows sessional performance increases averaging +11% of total contact time for R_1, +11% for R_2, and +10% for R_3. Also evident in Figure 7 is the return to baseline session levels for R_1 contact times percentages during the last five modeling sessions. However, during the last five modeling sessions for R_2 and R_3, performance increases over baseline levels of +24% and +26% of contact time are indicated for the respective levers.

Figure 9 reveals the variability across sessions in Calvin's performance during vicarious modeling with the respective levers, although increases in percent of total contact time are noticeable with levers R_2 and R_3 during the latter sessions of modeling. Increases in the percentage of total contact time over corresponding baseline averages are evident for 70% of R_1 modeled sessions, 70% of R_2 modeled sessions, and 65% of R_3 modeled sessions.

An average of 16 seconds per session of R_1 contact time was obtained for R_1 modeling sessions with a corresponding average of 13 R_1 lever responses per session; an increase of 12 seconds per session and 11 responses per session over the R_1 baseline session average. Lever R_2 contact times during R_2 modeling averaged 65 seconds per session, 32 seconds per session above the baseline average. Correspondingly R_2 response frequencies increased over baseline averages by

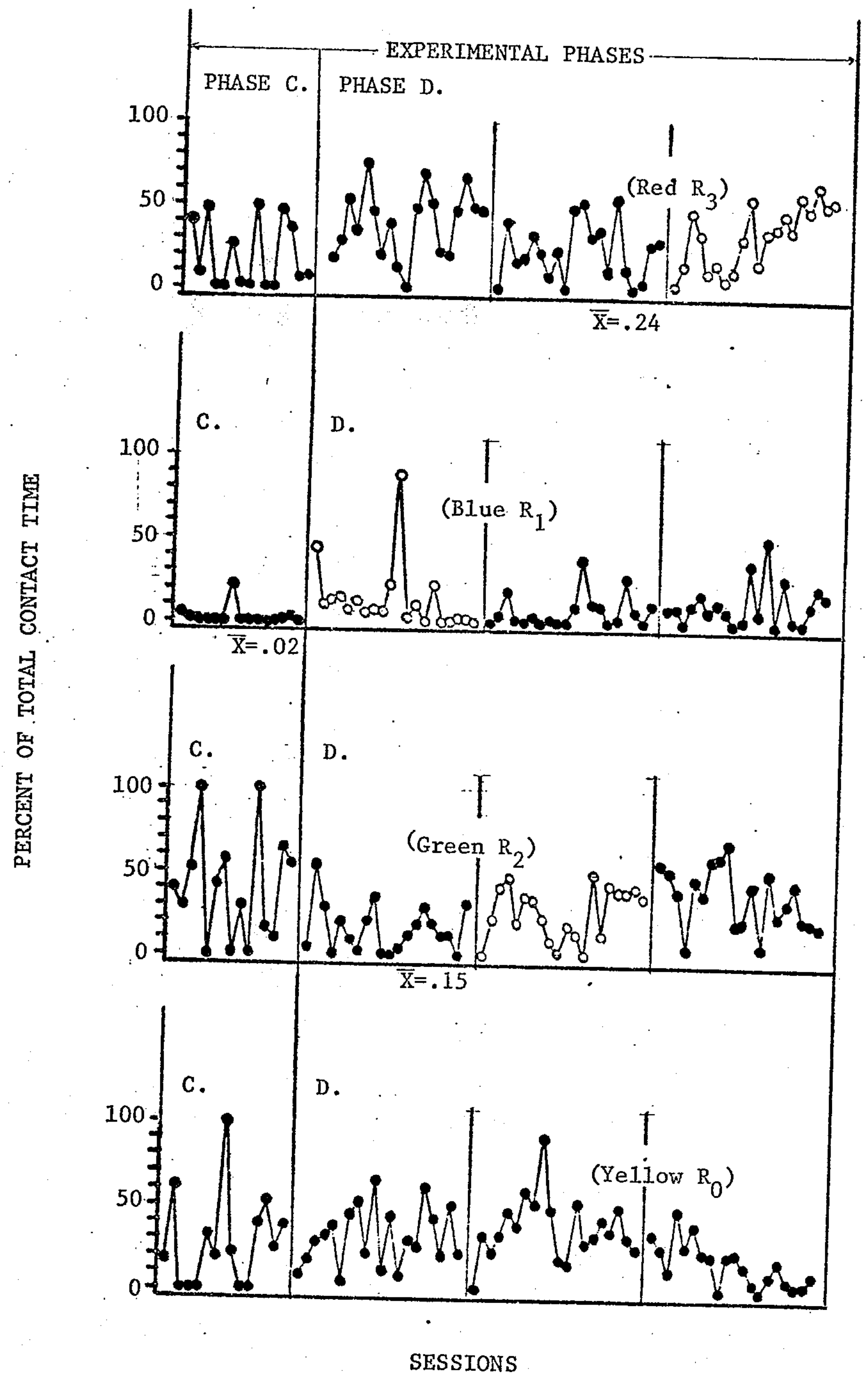


Figure 9. Percent of total contact time per lever for Calvin across Phase C (baseline) and Phase D (vicarious modeling) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

22 responses per session to an average of 41 lever responses per session. During R_3 modeling sessions, Calvin's average lever contact time was 127 seconds per session, an increase of 36 seconds per session over the R_3 baseline average. An average lever response frequency of 83 R_3 lever responses per session represented an increase of 44 responses per session over the R_3 baseline average.

Darrin

Observational paradigm. The third subject demonstrated relatively large increases in percent of total contact time during modeling sessions on only one of the three modeled levers, lever R_1 (see Figure 10, Phase A and B). An increase of 33 percentage points above the average of the preceding baseline sessions in the percent of total contact time was obtained with R_1 during the first modeling session. A small increase in the percent of total contact time was demonstrated during the first modeling sessions for R_2, 4 percentage points over the last preceding baseline session average. A decrease of -1% below the baseline average was obtained in percent of total contact time for lever R_1 during it's first modeled session.

A comparison of the overall averages for baseline and modeling sessions in the observational paradigm reveals sessional increases in the averaged percent of total contact for two modeled levers; +22% for R_1 and +4% for R_2 (see Figure 10). A decrease averaging -6% below baseline levels is evidenced for R_3. In addition, during the last five modeling sessions, R_1 performance averaged +71% over the baseline mean and R_2 performance averaged +2% over the R_2 baseline mean. Averages

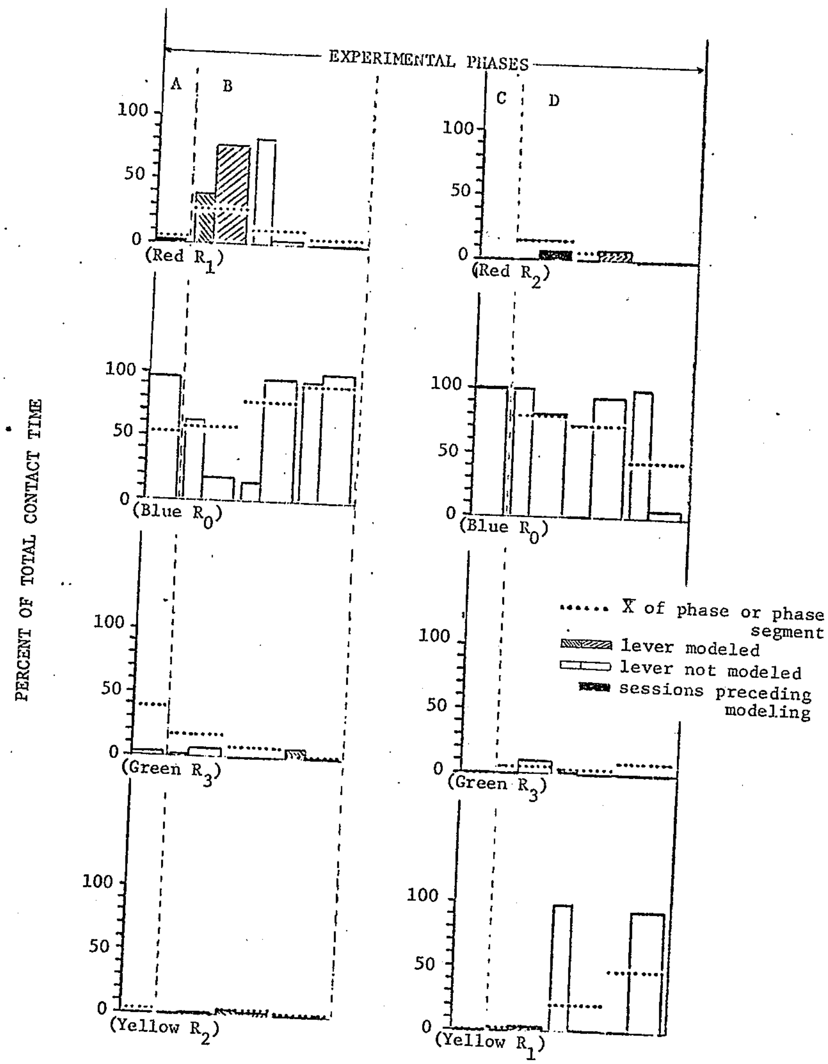


Figure 10. Summary of Darrin's lever performances during Part I experimental phases. [For baseline phases (Phase A and C) the averaged percent of total contact time obtained for each of the coloured levers during the last five sessions is presented. For the observational and vicarious modeling phases (Phase B and D, respectively) the histograms represent individual lever performances for the first session of modeling of R_1, R_2, and R_3 ( ), and the averaged lever performances for the last five sessions of modeling of the three modeled levers ( )].

of percent of total contact time for R_3 show a 8% decrease from the baseline level during the last five sessions of modeling.

Figure 11 shows the gradual increases in magnitude for percent of total contact time with lever R_1 over modeling sessions, and the weak, inconsistent influences obtained for R_2 and R_3. Sixty percent of R_1 modeling sessions yielded R_1 performances above the baseline session average. Thirty percent of R_2 modeling sessions yielded R_2 performances above the baseline and no performance increases above the baseline average were obtained for R_3.

For R_1, during modeling sessions, Darrin's R_1 lever contact time averaged 86 seconds per session, with an R_1 response frequency averaging 102 lever responses per session.[1] Increases over baseline averages for R_1 during modeling sessions were 79 seconds of contact time per session and 93 lever responses per session. During R_2 modeling sessions average R_2 contact time and lever response frequency were 11 seconds per session and 15 lever responses per session respectively. These averages represent increases over the baseline session averages of 11 seconds per session and 15 responses per session. For R_3, averages of session performance during R_3 modeling sessions show 11 seconds of R_3 contact time per session and 6 lever responses per session, decreases of 17 seconds per session and 11 responses per session from the baseline averages.

<u>Vicarious paradigm</u>. No increases in percent of contact for

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1. For summaries of Darrin's averaged lever contact times and response frequencies for the respective levers across the experimental phases see Appendix Table E and Table F respectively.

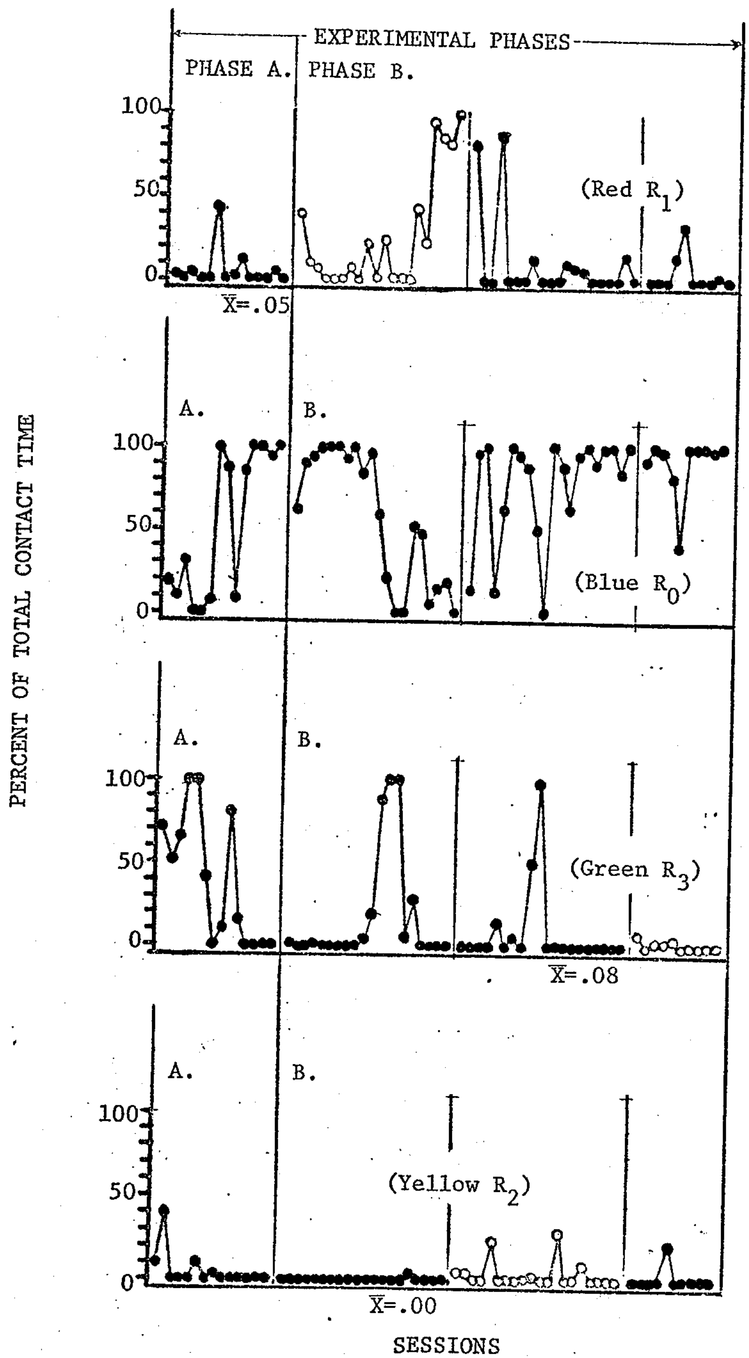

Figure 11. Percent of total contact time per lever for Darrin across Phase A (baseline) and Phase B (observational modeling) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

modeled levers during the first modeling session were demonstrated by Darrin during applications of the vicarious modeling paradigm (Phase D). Overall baseline and modeling session averages indicate small performance increases of +2% for R_1 during modeling and +6% for R_3 during modeling (Figure 10). Lever R_2 averages show a decrease from baseline of -9% for R_2 during modeling. For the last five modeling sessions averages of total contact time percentages indicate a performance increase of +3% for R_1, and a decrease of -8% and -3% for R_2 and R_3, respectively.

Figure 12 indicates the lack of any consistency in performance increases for any of the levers modeled during this phase of the study. Only 10% of R_1 modeling sessions, 15% of R_2 modeling sessions and 20% of R_3 modeling sessions yielded performance measures above baseline levels.

Average of contact time and response frequencies for the modeling sessions of R_1, R_2, and R_3 respectively show contact times of 5 seconds per session, 14 seconds per session, and 24 seconds per session. These averages indicate increases from preceding baseline averages of 5 seconds per session for R_1, and 16 seconds per session for R_3, and a decrease of 31 seconds per session for R_2. However, the averages for R_1 and R_3 were based on performances during only one of ten modeling sessions for R_1 and four of fifteen modeling sessions for R_3. Average lever response frequencies during modeling were 9 responses per session for R_1, 13 responses per session for R_2 and 23 responses per session for R_3. Increases over baseline averages of 9 responses per session and 16 responses per session were obtained

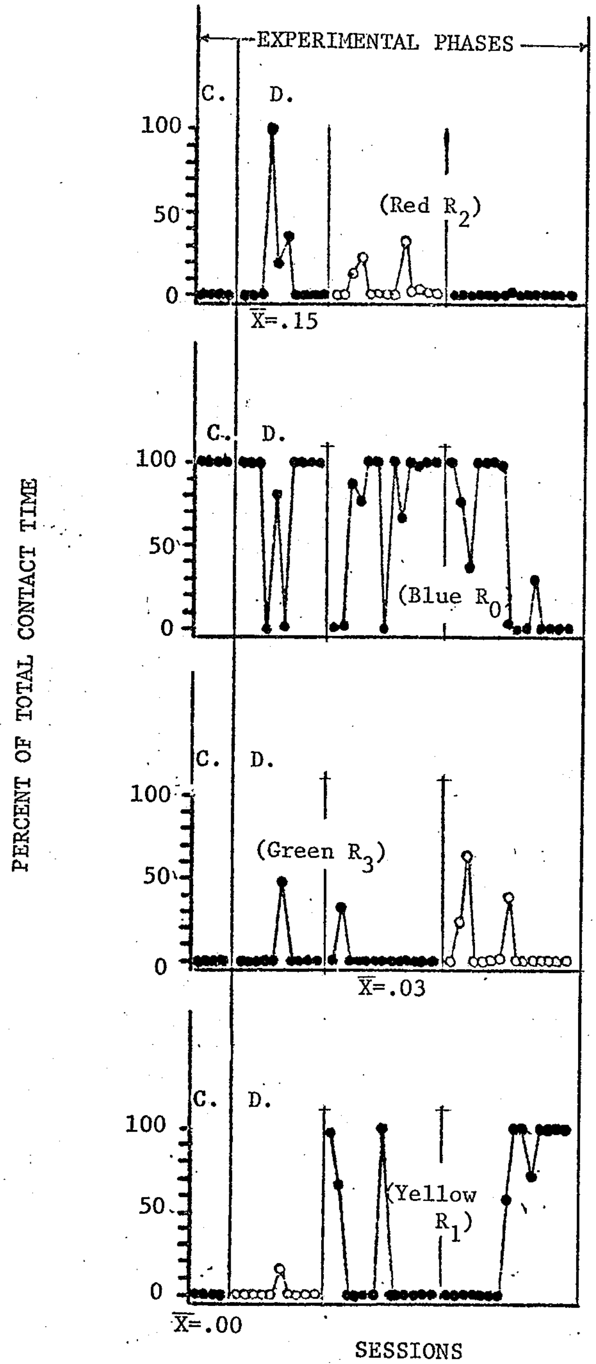

Figure 12. Percent of total contact time per lever for Darrin across Phase C (baseline) and Phase D (vicarious modeling) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

for levers R_1 and R_3 respectively and a decrease of 37 responses per session was obtained for R_2.

Part II

Ralph

Observational paradigm with verbalizations. During Phase F sessions, subjects were exposed to an observational modeling paradigm during which the model emitted verbalizations indicating the response modeled.

Ralph clearly demonstrated increases in percent of total contact time during modeling on all three levers so modeled. Figure 13 (Phases E and F) presents, graphically, increases in percent of total contact time obtained for each modeled lever during their first session of modeling. Increases above baseline averages of +94% +35%, and +97% were obtained for R_1, R_2, and R_3, respectively. Overall averages for modeling sessions with the respective levers show a slight weakening in the strength of the performance increases, R_1 averaging +86% above the baseline mean; R_2 $\pm$31% above the baseline level; and R_3 averaging +89% above the baseline average. Averages of the last five sessions of modeling reveal R_1 to be +78% above the averaged baseline session level; R_2 to be +27% above baseline, and R_3 to be +80% above baseline.

Figure 14, however, attests to the overall consistency of the increases in percent of total contact time for the modeling with levers R_1 and R_3. Both levers show a large divergence from a steady pattern of performance for only one session of the respective modeling

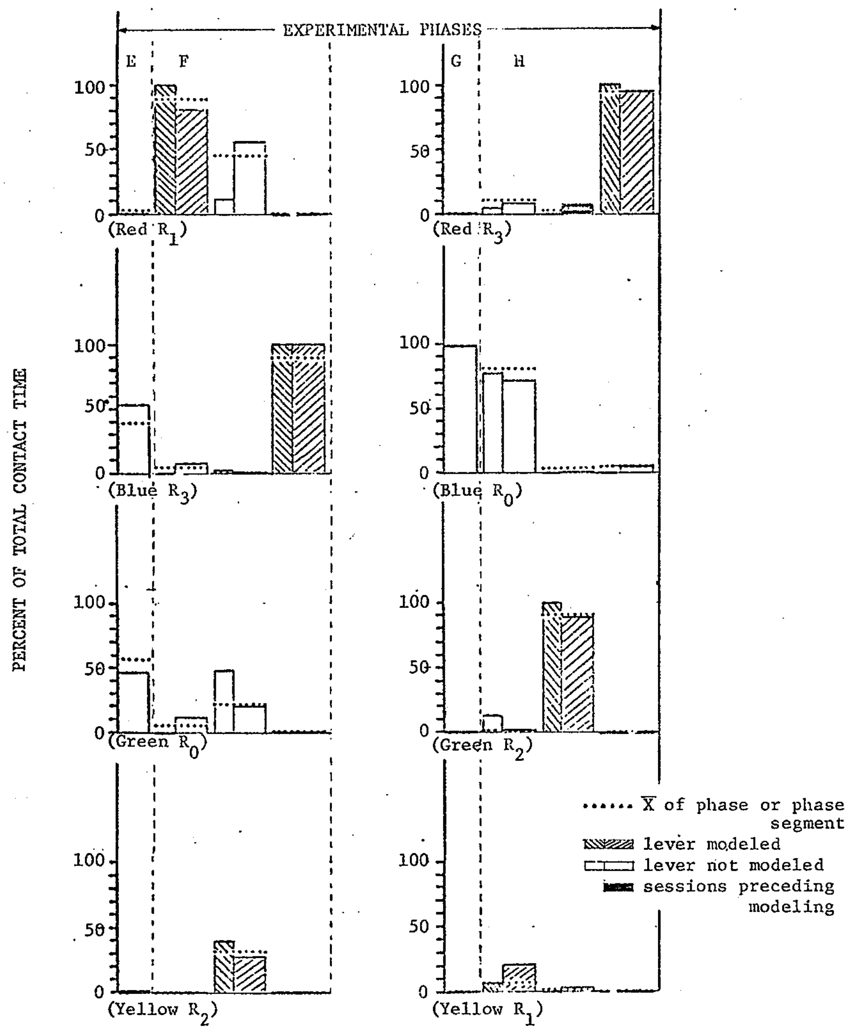

Figure 13. Summary of Ralph's lever performances during Part II experimental phases. [For baseline phases (Phase E and G) the averaged percent of total contact time obtained for each of the coloured levers during the last five sessions is presented. For the observational and vicarious modeling with verbalizations phases (Phase F and H, respectively) the histograms represent individual lever performances for the first session of modeling of R_1, R_2, and R_3 ( ) and the averaged lever performances for the last five sessions of modeling of the three modeled levers ( ).]

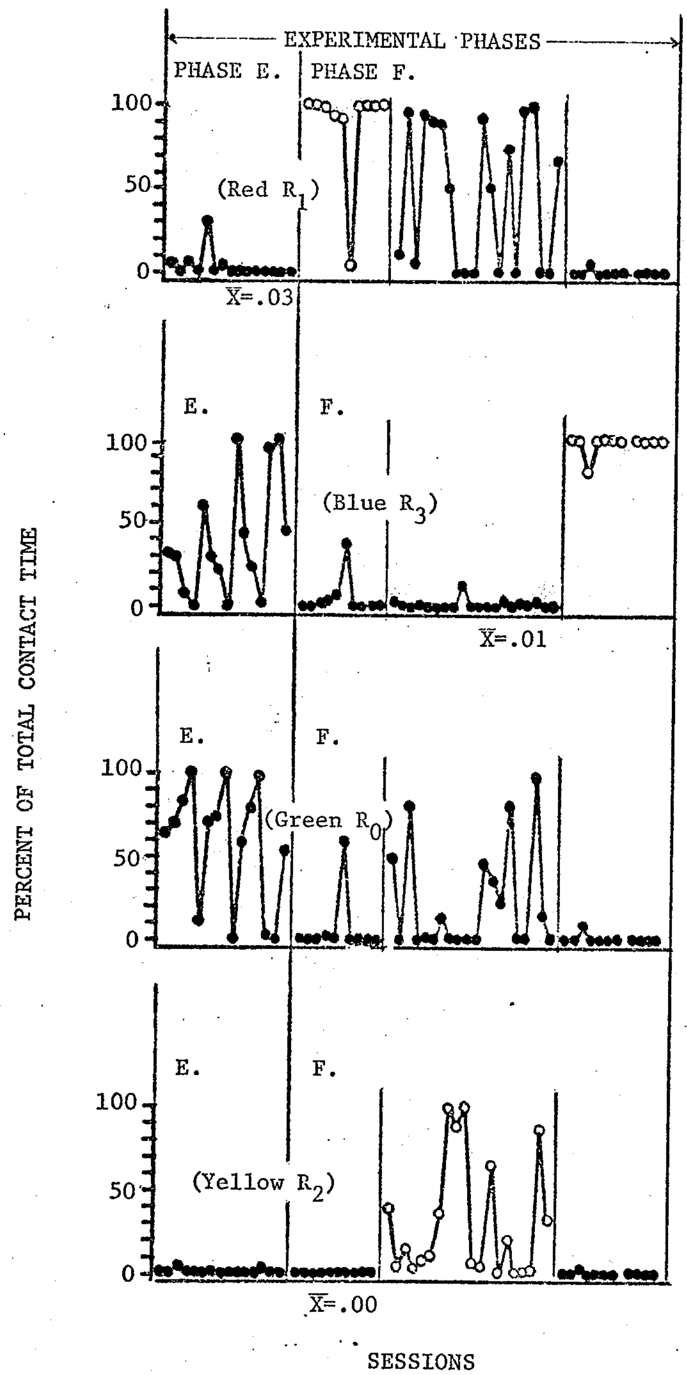

Figure 14. Percent of total contact time per lever for Ralph across Phase E (baseline) and Phase F (observational modeling with verbalizations) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

segments. Performance increases above baseline levels are apparent for 100% of R_1 modeling sessions and 92% of R_3 modeling sessions. Although inconsistencies in the magnitude of the increases in performance are apparent for R_2 (see Figure 14), the percent of total contact times during R_2 modeling are above the overall averages of the preceing baseline sessions on 85% of the modeling sessions.

Average contact time for the modeled levers during their respective modeling sessions was 242 seconds per session for R_1, 80 seconds per session for R_2, and 224 seconds per session for R_3. These averages represent increases per session over the respective baseline averages of 238 seconds for R_1, 80 seconds for R_2, and 218 seconds for R_3. Average lever response frequencies during the respective modeling sessions of 232 responses per session for R_1, 47 responses per session for R_2, and 283 responses per session for R_3, represent increases per session over baseline averages of 228 responses for R_1, 47 responses for R_2, and 280 responses for R_3.

Vicarious paradigm with verbalizations. Similar findings were obtained with Ralph in Phase H, the application of the vicarious modeling paradigm with model verbalizations. Compared with the averaged R_2 lever performance for baseline sessions, an increase of +99% in the percent of total contact time was obtained for the first session of R_2 modeling. An average modeling session increase in R_2 lever performance of +92%, and of +87% for the last five modeling sessions were also demonstrated by Ralph. Ralph's lever performances for R_3 during modeling revealed a first session increase of +97% above the baseline average. The overall modeling session average and the average for the last five modeling sessions for R_3 showed increases of +90% and +95% for percent of total contact time respectively.

Increases in performance above baseline averages were obtained for 100% of R_2 modeling sessions 100% of R_3 sessions (see Figure 15).

Relative to the R_1 baseline average, an increase in percent of total contact time of +6% was obtained for R_1 in the first modeling session. The overall average of R_1 modeling performances presented in Figure 13 reveals an increase of +7% above baseline session average. A stronger performance increase, averaging +20% above baseline was obtained for the last five sessions of R_1 modeling. Lever performance on R_1, for which performance increases became most apparent during the latter modeling sessions, were above the average of the preceding baseline sessions on 50% of the modeling sessions (see Figure 15).

Lever contact time per session during modeling averaged 17 seconds for R_1, 179 seconds for R_2, and 231 seconds for R_3. These averages represented increases over baseline averages of 17 seconds per session, 177 seconds per session, and 227 seconds per session for R_1, R_2, and R_3 respectively. Lever response frequency averages per session of 5 responses for R_1, 100 responses for R_2, and 194 responses for R_3, were obtained for the respective modeling sessions, indicating increases from the respective baseline averages of 5 responses per session for R_1, 98 responses per session for R_2, and 190 responses per session for R_3.

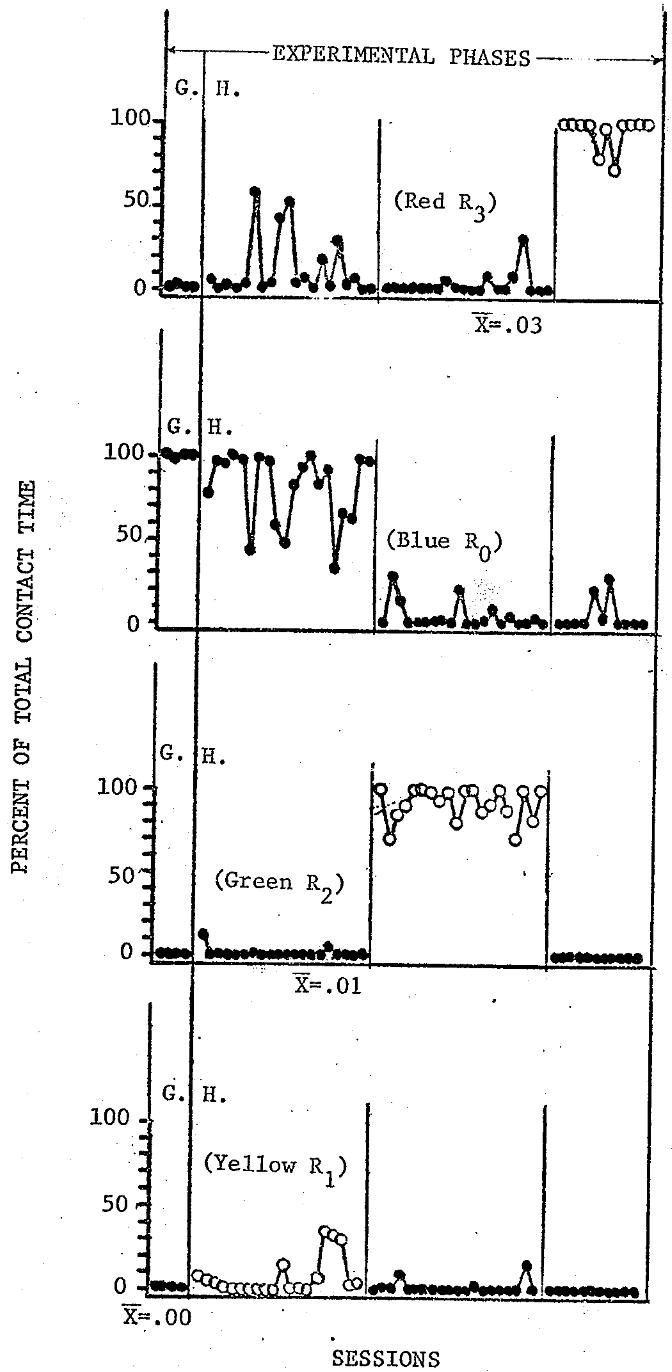

Figure 15. Percent of total contact time per lever for Ralph across Phase G (baseline) and Phase H (vicarious modeling with verbalizations) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

Calvin

Observational paradigm with verbalizations. In Phase F, Calvin's lever performances demonstrated increases in percent of total contact time during modeling, although considerably smaller than Ralph's, on all three modeled levers. Increases in the percent of total contact time are clearly evident for R_1, R_2, and R_3 during the first modeling sessions as compared to the average performance obtained in the last five sessions of the immediately preceding baselines (see Figure 16, Phases E and F). Performance increases of +9%, and +4%, and +16% in percent of total contact time are indicated for the three modeled levers respectively.

Comparisons of the overall modeling performance average with the baseline average for the respective levers show increases, in percent of total contact time, of +6% for R_1, +16% for R_2 and +4% for R_3.

Based on Calvin's averaged lever performance during the last five modeling sessions for R_1, R_2, and R_3, increases above baseline levels in percent of contact time of +14% and +24% were obtained for R_1 and R_2 respectively. However, R_3 averaged performance indicated a decrease of -9% from the baseline performance average. Figure 17 presents the individual session performance of Calvin during this phase of the study. Most consistent increases in percent of total contact time during modeling were obtained with R_2. Although there was variability in the magnitude of the increases during modeling of R_2, the percent of lever contact was above the overall baseline average for 90% of the sessions. The percent of lever contact time

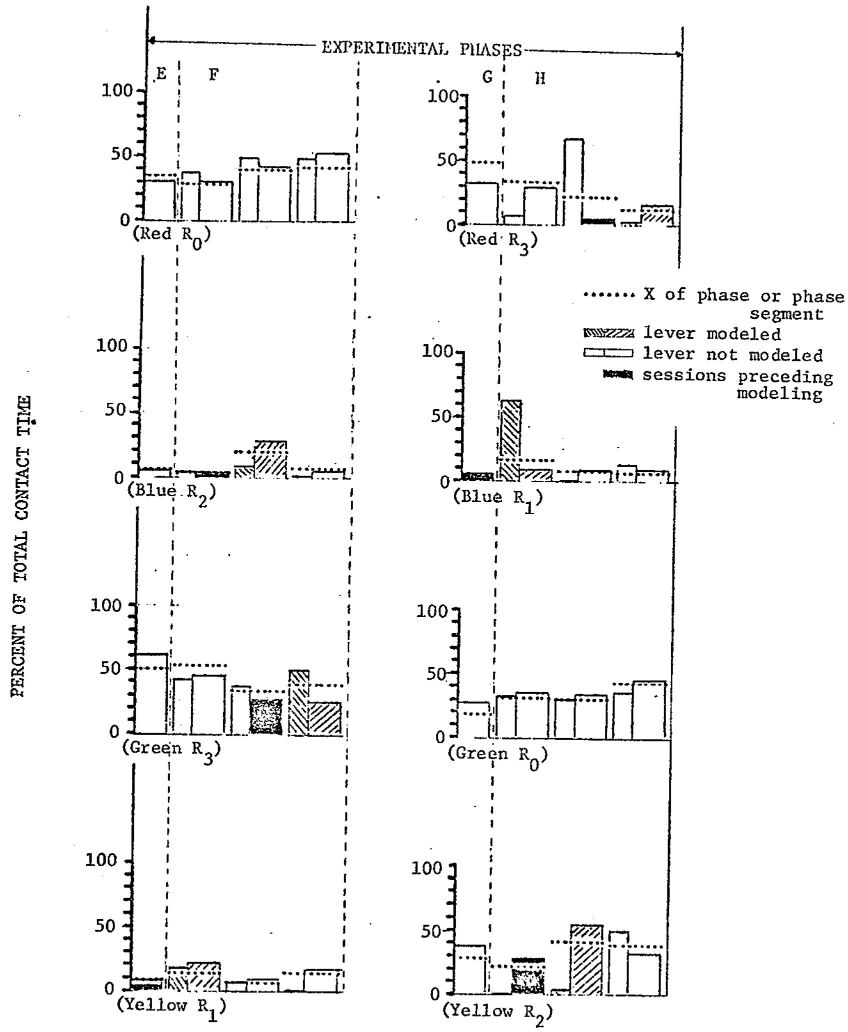

Figure 16. Summary of Calvin's lever performances during Part II experimental phases. [For baseline phases (Phase E and G) the averaged percent of total contact time obtained for each of the coloured levers during the last five sessions is presented. For the observational and vicarious modeling with verbalizations phases (Phase F and H, respectively) the histograms represent individual lever performances for the first session of modeling of R_1, R_2, and R_3 (□) and the averaged lever performances for the last five sessions of modeling of the three modeled levers (□).]

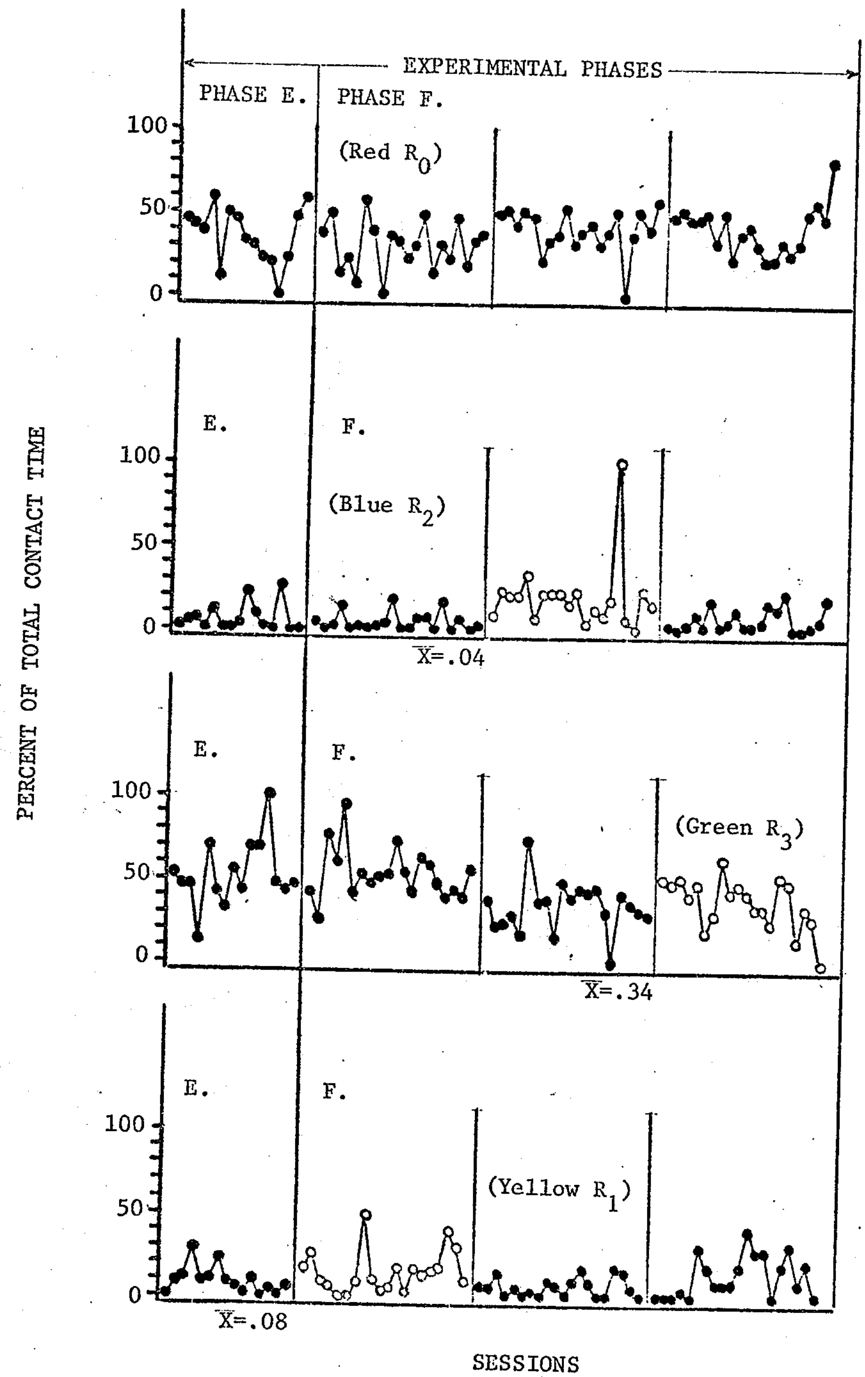

Figure 17. Percent of total contact time per lever for Calvin across Phase E (baseline) and Phase F (observational modeling with verbalizations) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

was above overall baseline performance for 55% of the modeled sessions with R_1 and 55% of the modeled sessions with R_3, although a general decrease in the percent of lever contact time is evident for R_3 during the latter modeling sessions.

For R_1 modeling sessions, the time of R_1 lever contact averaged 51 seconds per session, an increase of 28 seconds per session over the baseline average. Sessional response frequencies for R_1 averaged 27 responses per session, 8 responses per session over the baseline average. Averages of R_2 contact time and lever response frequency for R_2 modeling per session were 60 seconds and 87 responses, increases over baseline averages of 47 seconds per session and 73 responses per session respectively. For R_3, Calvin's R_3 contact time and lever response frequency averaged 127 seconds per session and 101 responses per session. These averages represent an increase in R_3 contact time of 7 seconds per session over the preceding baseline session average, and a decrease of 11 responses per session.

Vicarious paradigm with verbalizations. Calvin's performance during the last two phases of the study, the fourth baseline phase and subsequent introduction of the vicarious paradigm with verbalizations, demonstrated increases in percent of total contact time during the first session of modeling for one lever (R_1) (see Figure 16, Phases G and H). This increase was +51% above the average baseline performance. The first modeling session for R_2 and for R_3 showed decreases in performance of -17% and -10% respectively.

Overall averages for modeling sessions reveal increases in percent of total contact time for two levers during modeling. An increase of +11% over the averaged baseline session level is indicated for R_1. The average lever performance for R_2 modeling showed a +20% increase over baseline average. A decrease in performance averaging -10% was obtained for R_3 contact time percentage during modeling sessions.

For the last five sessions of modeling with R_1, R_2, and R_3 respectively, averaged performance levels for percent of total contact time were above the averaged baseline performance levels for two levers. Figure 16 (Phase H) shows R_1 to be above its averaged baseline performance by +4% and R_2 to be +33% above its preceding baseline session average.

Although overall averages of baseline and modeling suggest that increases in percent of total time were evident only with R_1 and R_2, the daily session performances presented in Figure 18 show a gradual decrease in percent of contact time over baseline sessions and a gradual increase, although variable in magnitude in Calvin's lever performance during R_3 modeling over sessions. The trend of increased performance over modeling sessions is also evident during modeling for R_2.

If overall modeling session performance averages are considered against the 7% average of total contact time percentage (based on the last five of the R_3 baseline sessions), R_3 modeling performance shows an increase over baseline of +5% in terms of the overall modeling session average as well as the average of the last five modeling sessions.

Figure 18 shows the percent of total time of lever contact to

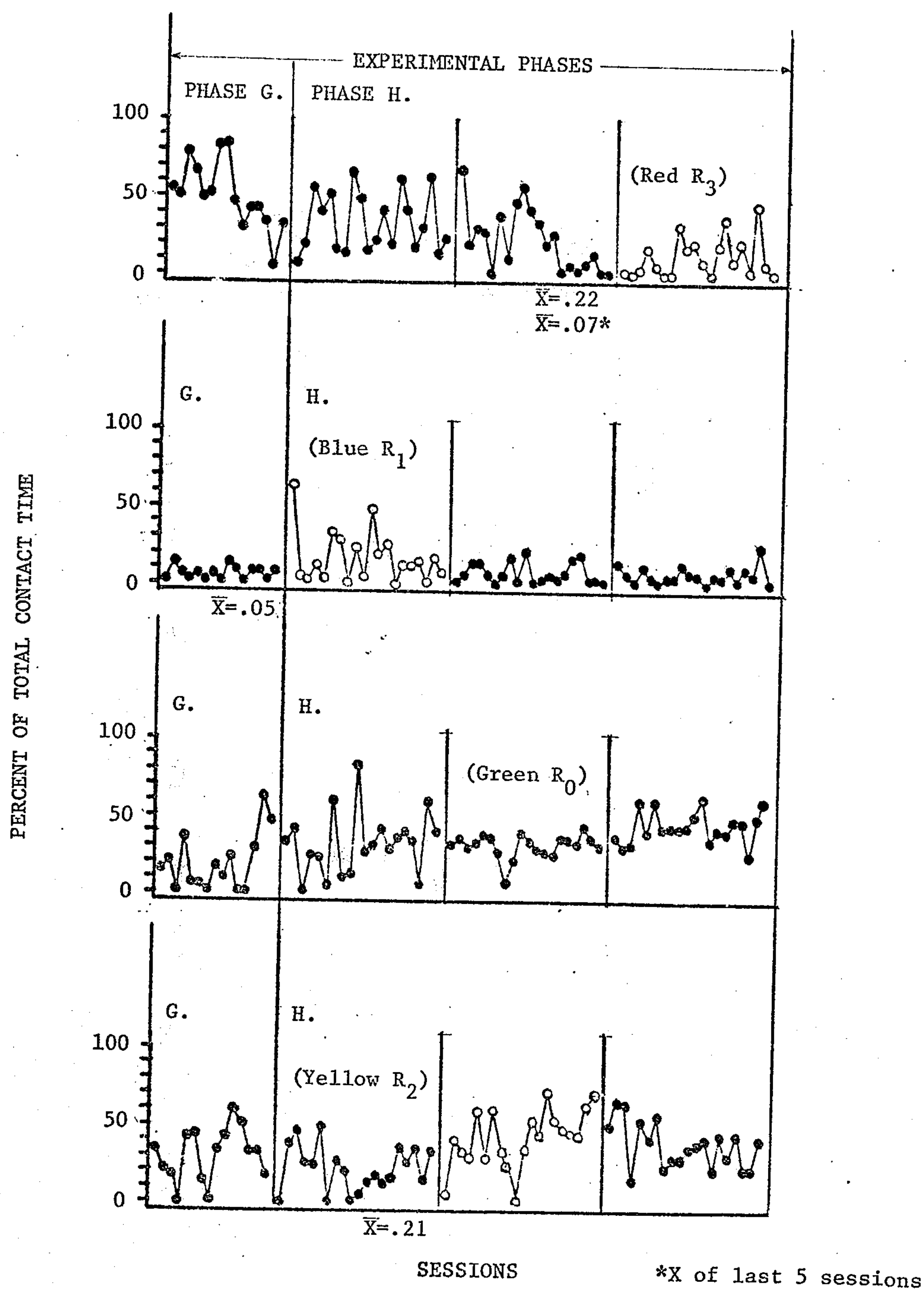

Figure 18. Percent of total contact time per lever for Calvin across Phase G (baseline) and Phase H (vicarious modeling with verbalizations) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

be above average baseline levels on 65% of sessions for R_1 and 90% of sessions for R_2 when the respective levers were modeled, and only 15% of sessions for R_3 when modeled.

For the lever R_1, Calvin averaged 54 seconds of contact time per session during modeling, an increase of 43 seconds per session over the baseline average, and, an average R_1 lever response frequency of 51 responses per session which was 42 responses per session above the baseline average. During R_2 modeling sessions, average lever contact time for R_2 per session was 141 seconds, 74 seconds per session above the R_2 baseline average. Lever R_2 response frequency averaged 45 responses per session for R_2 modeling sessions, a decrease of one response per session from the average baseline frequency. For lever R_3, averages of session performance during R_3 modeling revealed 37 seconds of R_3 contact time per session and 28 lever responses per session, decreases of 18 seconds per session and 20 lever responses per session from the preceding baseline session averages.

Darrin

Darrin, the third subject, demonstrated an inconsistent increase in percent of total contact time during modeling during Phase F with lever R_1, with the magnitude of the increases variable over sessions (see Figure 19, Phases E and F, and Figure 20). Figure 19 and Figure 20 show that no increases in lever performance were obtained on any modeled lever for the first session of modeling. Lever R_1 performance over modeling sessions indicates an overall session increase in performances averaging +7% over the baseline average and

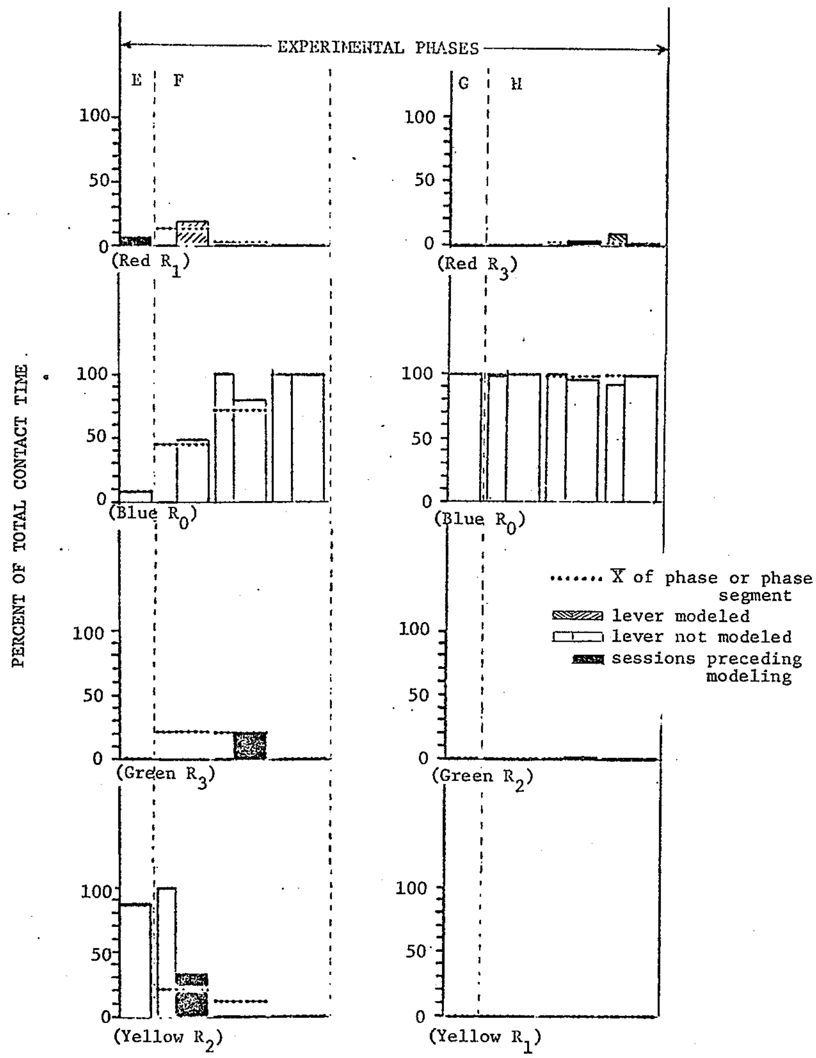

Figure 19. Summary of Darrin's lever performances during Part II experimental phases. [For baseline phases (Phase E and G) the averaged percent of total contact time obtained for each of the coloured levers during the last five sessions is presented. For the observational and vicarious modeling with verbalizations phases (Phase F and H, respectively) the histograms represent individual lever performances for the first session of modeling of R_1, R_2, and R_3 (▧) and the averaged lever performances for the last five sessions of modeling of the three modeled levers (▨).]

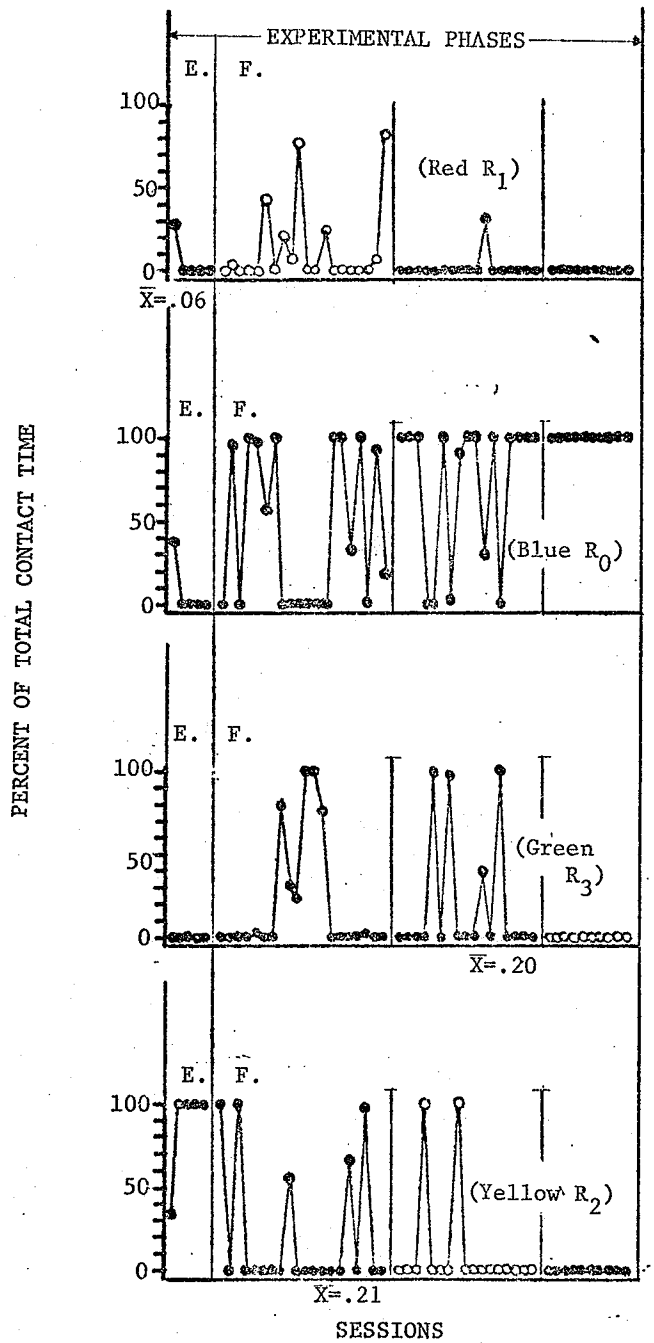

Figure 20. Percent of total contact time per lever for Darrin across Phase E (baseline) and Phase F (observational modeling with verbalizations) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

+11% increase in performance for the last five sessions of modeling. However, increases in R_1 lever performance occurred for only 35% of the modeling sessions. No replications of R_1 performance increases were obtained with R_2 or R_3. With the exception of a +6% increase in R_1 performance for the first modeling session, no other demonstration of increases in percent of total contact time during modeling with applications of the vicarious paradigm with verbalizations with Darrin (see Figure 19, Phase G and H and Figure 21). Rather, the subject consistently performed on the lever designated R_0.

During Phase F modeling sessions for the respective levers, average lever contact times per session of 42 seconds, 20 seconds, and zero seconds were obtained for R_1, R_2, and R_3 respectively. Only R_1 contact time during modeling was above the average baseline lever with an increase of 27 seconds per session. Corresponding lever response frequencies of 35 responses per session for R_1 during modeling, 18 responses per session for R_2 and zero responses per session indicated an increase from baseline averages only for R_1 with an increase of 20 responses per session. During Phase G the overall average of lever contact time and lever response frequency for R_1, R_2, and R_3 during their respective modeling sessions was 2 seconds per session and 1 response per session.

Summary

In Part I, increases in percent of total contact time for modeled levers were obtained with the repeated application of observational modeling procedures (Phase B) for all three subjects.

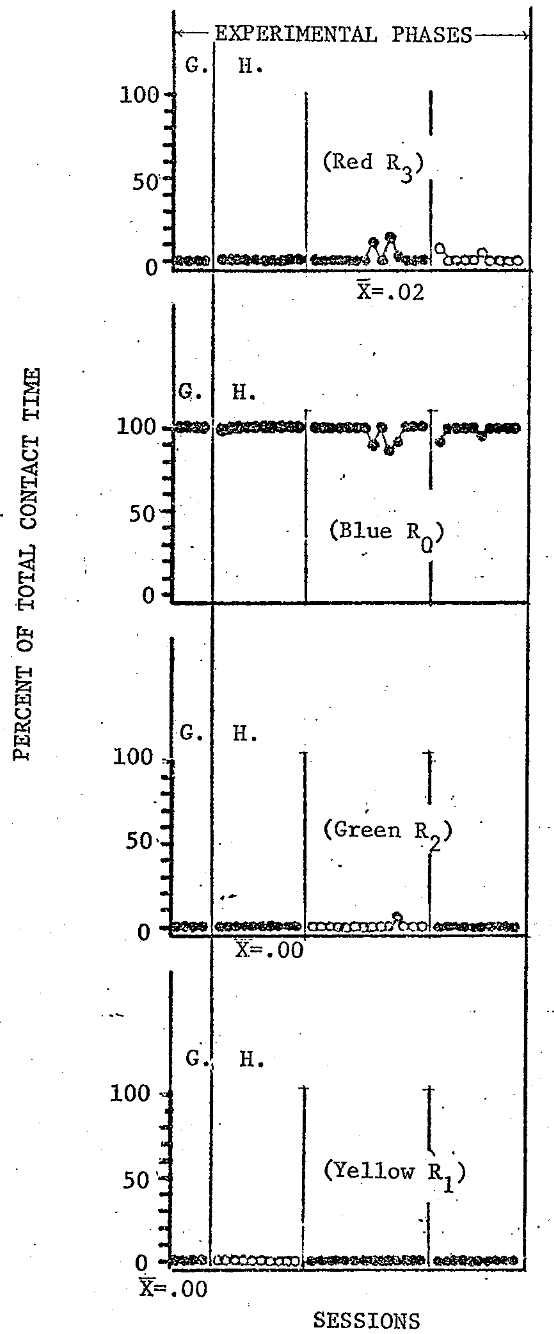

Figure 21. Percent of total contact time per lever for Darrin across Phase G (baseline) and Phase H (vicarious modeling with verbalizations) sessions. (Each graph represents the subject's performance on one of the four coloured levers. Open circle data points indicate sessions in which a designated lever was modeled, and the averaged performance obtained for a phase or phase segment preceding modeling for R_1, R_2, and R_3 is indicated.)

However, the magnitude, consistency, and number of replications of these performance increases during modeling sessions varied between subjects.

Increases in percent of total contact time for modeled levers during sessions in the vicarious modeling paradigm (Phase D) were obtained, with replications, for two subjects, Ralph and Calvin. Figure 22 summarizes the findings of Part I of the study.

In Part II, with the addition of verbalizations on the part of the model to the observational and vicarious modeling paradigms (Phases F and H, respectively) increases in the percent of total contact time for modeled levers were obtained, with replications with two subjects, Ralph and Calvin, although the magnitude of the increases differed between subjects. Summaries of the findings for Part II are presented in Figure 22. Part II manipulations resulted in distinguishable performance improvements for modeled levers (relative to Part I manipulations) for only one subject, Ralph. The performance improvements related to the consistency in the magnitude of the increases for percent of total contact time across sessions for two of the modeled levers in each modeling phase (R_1 and R_2 in Phase F, and R_2 and R_3 in Phase H).

The increases in percent of total contact time obtained during sessions for modeled levers throughout the study generally corresponded with increases in absolute lever contact time and/or increases in lever response frequency.

The retention or carry over of performance increases across sessions for modeled levers is apparent in all modeling phases

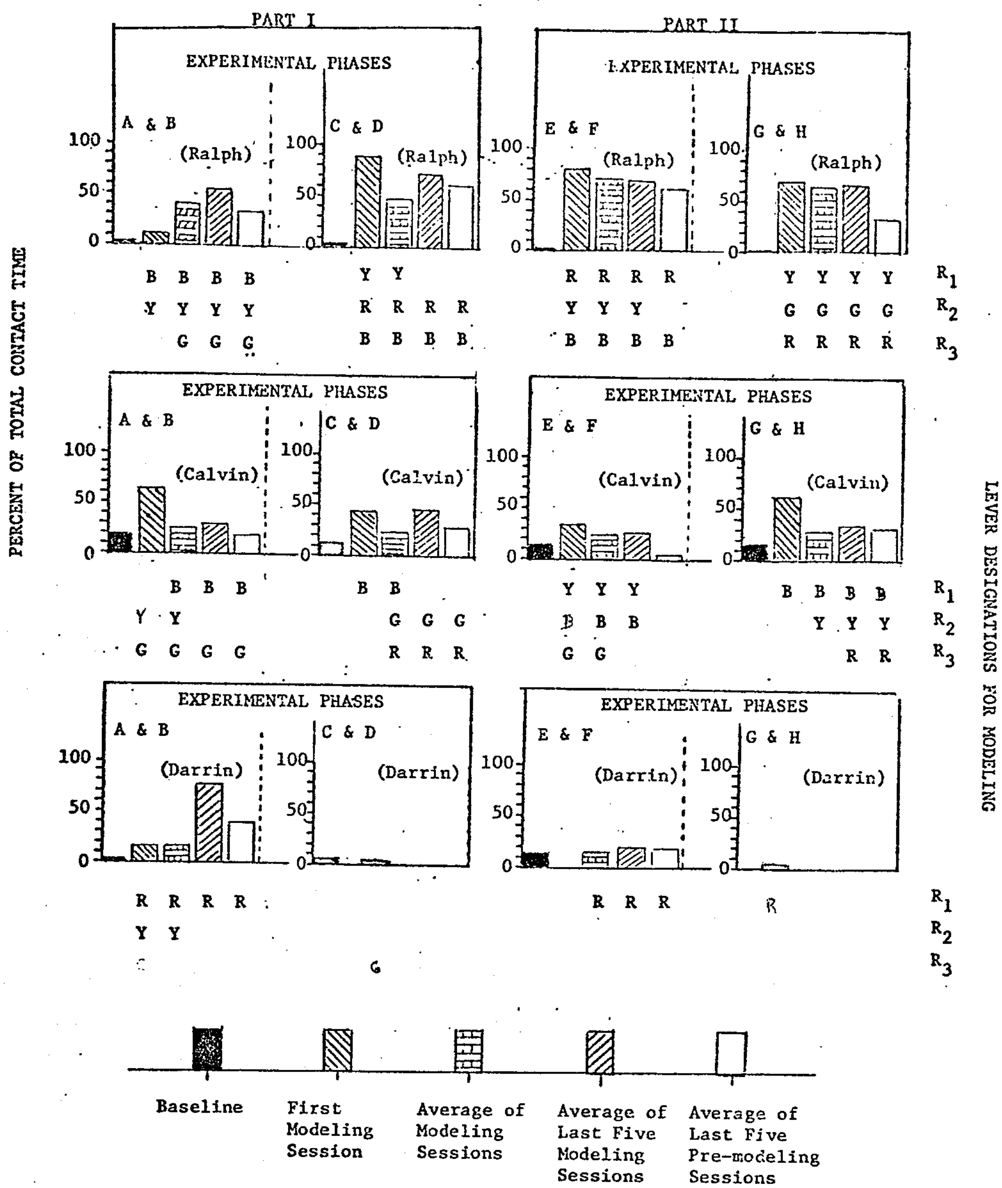

Figure 22. Summary of modeling influences demonstrated by Ralph, Calvin, and Darrin during Part I and Part II experimental phases. [The letters under each bar in a histogram indicate the levers (by the first letter of colours red, blue, green, or yellow) demonstrating and contributing to the depicted modeling performances. Baseline levels were obtained by determining the overall means of the average baseline levels for each modeled lever.]

(Phases B, D, F and H) for Ralph on levers for which performance increases are indicated during the last five modeling sessions, although the average magnitude of the retained increases are less than for corresponding immediate increases (see Figure 22).

Retention of performance increases for modeled levers across sessions are indicated for Calvin in Phase D and H, the vicarious paradigm, without and with verbalizations by the model. Carry over of "immediate" increases in percent of total contact time across sessions are indicated only for one lever (R_1) during only one phase (Phase B) with Darrin (see Figure 22).

CHAPTER VI

DISCUSSION

The modeling influence examined in the present study may be classified as a response facilitation effect. That is, the modeling procedures may be seen as ".... facilitating the occurrence of previously learned responses ...." (Bandura, 1969a, p. 120). This modeling effect was selected for study because of its amenability to replication in a multiple baseline design with a convenient and reliably recordable motor task. A response facilitation effect was evidenced in the present study by increases in lever performance from baseline levels during the modeling sessions for a given lever.

The results of the present study provided evidence that response facilitation modeling effects can be obtained with severely retarded subjects given the repeated application of modeling procedures in the observational and vicarious modeling paradigms. The study also demonstrated that the addition of verbalizations by the model, specifying the modeled behavior and instructing the observer to observe and imitate, may have little or no additional facilitating effect on the subsequent modeling performance of severely retarded observers.

The characteristics of the modeling effects varied between subjects during the respective modeling phases. This finding stresses the need for the consideration of individual differences in the applications and analyses of modeling procedures with the severely retarded.

A major finding of the present study was the demonstration of modeling in the observational paradigm with severely retarded subjects. Multiple-baseline replications of observational modeling were obtained with two subjects, Ralph and Calvin. Although the performance increases during modeling sessions were considerably smaller for Calvin than for Ralph, anecdotal observations of Calvin's behavior during sessions suggested the imitative nature of the performance increases that were obtained. During modeling sessions for a given lever, Calvin would frequently manipulate the modeled lever upon entering the cubicle. This initial lever contact was generally followed by a series of lever grabbing responses in a haphazard manner. Calvin was the only subject who spent most of his time of lever contact manipulating two or three levers simultaneously. In addition, he frequently exhibited bizarre behaviors (screeching, arm waving, rocking etc.) in the cubicle which interrupted his lever contact. These factors may have contributed to the small performance increases that are obtained with this subject for modeled levers.

Although Darrin demonstrated observational modeling on R_1, replications of R_1 modeling characteristics were not obtained with R_2 or R_3. However, during Phase F, a similar pattern of imitation was evidenced by Darrin for the model's verbalizations. This might be construed as evidence of the imitative nature of the R_1 performances in the observational paradigm, in spite of the fact that replications did not occur on R_2 and R_3. During Phase F, Darrin imitated the model's verbal behavior an average of 27 times during 7 of the 20 R_1 modeled sessions and an average of 6 times during two of the 17 R_2 modeled sessions and one of the 10 R_3 modeled sessions.[1] No instances of these imitative verbalizations occurred during any prior modeling phase, nor during any baseline phase in the study. This suggests that Darrin's imitation of the model's motor and verbal responses may have extinguished over sessions. It would appear that a lack of maintaining contingencies for imitative behavior may have resulted in the short lived modeling effects obtained with Darrin.

Although Altman et al. failed to obtain observational modeling with severely retarded subjects, such an effect was obtained in the present study. Both studies examined modeling effects on gross motor performance. Altman et al. evaluated the modeling of sitting in a chair, rocking in a chair, turning a chair over with ambulatory severely retarded children. It is quite probable that these behaviors were in most of the subjects' behavioral repertoires as over 50% of the control subjects emitted the behaviors in the study without any instructions to do so. Thus, both studies may be said to have studied a response facilitation modeling effect. However, the subjects employed in this study, although severely retarded, all had participated in direct imitation training sessions prior to the study and had demonstrated gross motor imitative repertoires for such behaviors as clapping hands, touching head, tapping a table, etc. The acquisition of this repertoire may have functioned to establish the prerequisites

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1. I-O-R's were determined for imitative verbalizations during Phase F sessions for 6 sessions that were tape recorded. An I-O-R of 91% was obtained by dividing the number of agreements between the experimenter and an independent observer by the total number of agreements and disagreements.

for subsequent observational modeling, possibly in the form of a functional imitative response class (Gewirtz & Stingle, 1968) or the development of instructional control by the model's behavior (Baer et al. 1967). No report on prior imitative repertoires or training of the subjects was provided by Altman et al., a deficiency common in the modeling literature.

In addition, the subjects in the Altman et al. study were exposed to the model for only one occasion. Repeated presentations of the model were made for each subject in the present study. During the observational paradigm, modeling effects for two of the subjects, Ralph and Darrin, were most apparent after repeated exposures to the model. Modeling effects were evaluated in comparison to the individual baseline performances of the respective subjects in the present study as opposed to the no-baseline group comparisons employed by Altman et al. These differences between the two studies may have contributed to the disparent findings.

In addition to the demonstration of observational modeling, two subjects, Ralph and Calvin, demonstrated modeling effects during the four modeling phases of the study. However, only one subject, Ralph, demonstrated clearly differential modeling effects during the respective modeling phases. The failure to obtain differential modeling effects indicative of superior modeling in the vicarious paradigm and in the modeling paradigms incorporating the addition of verbal instructions by the model with two of the subjects (Calvin and Darrin), indicates the lack of generality of these "performance variables" and suggests the need for additional refinements to the basic modeling paradigms in order to increase the behavior modification potential of modeling procedures with the severely retarded. Although all three subjects demonstrated increases in the probability of performance of the modeled levers as a function of observational modeling, the maintenance of this effect, or consistent increases in its size were generally not obtained for two subjects, Darrin and Calvin, respectively, during the subsequent modeling phases.

It may be that the establishment of explicit response identification behaviors in a severely retarded observer's repertoire, that could be emitted either during or immediately after the observation of a model's behavior, may facilitate subsequent modeling performance. Bandura and Jeffery (1973) and Bandura et al. (1974) reported facilitation in observational modeling of complex motor behaviors with college students who utilized "symbolic coding processes" during observation of a model's behavior and especially with those given an opportunity to rehearse their coded representations of the model's behavior after observing the model. With the severely retarded, one might simplify the "codes" to be utilized during the observation of a model to a tact identifying, in simple, direct terms, the behavior of a model (such as the "up and down", "red lever" descriptions of the lever response in the present study). Procedures might be arranged to explicitly determine the subject's tacting of a model's behavior during the period of observation of a model's behavior, or prior to engaging in the test situation.

Alternatively, on the basis of established behavior principles, the addition of explicit reinforcement contingencies (for the occurrence of imitative behavior) to the basic modeling paradigms may offer a reasonable and efficient behavior modification procedure that would not only increase the probability of the initial occurrences of the modeled behavior, but would ensure the maintenance of and/or facilitate increases in the magnitude of the modeling effect.

The present study, in demonstrating the occurrence of modeling with the severely retarded extends the generality of application of modeling procedures to a subject population for which this effect had not previously been obtained. However, the generality of the findings obtained in the present study may be restricted to severely retarded subjects demonstrating a direct motor imitative repertoire. Such a repertoire may be a prerequisite for observational modeling, and should be reported in future modeling research programs with retarded subjects.

Although obtained in a controlled laboratory situation, the findings of this study may provide relevant considerations for both professionals and paraprofessionals working with the severely retarded. It may be that "unexplainable" occurrences of socially undesirable behaviors such as foul language, intimidation, physical abuse, etc. by severely retarded individuals may simply reflect observational modeling on the part of a previously quiet, unseen, or unheard observer. The consistent emission of socially desirable behaviors by persons working with the severely retarded may facilitate the emission of such behaviors in this population.

Based on the results of this study one might suggest that modeling stimuli may serve two important functions that could have practical value for behavior modifiers working with the severely retarded. First, modeling procedures may be of value in programming for generalization of behavior, acquired by a retardate in a formal training situation, to the natural environment. The modeling of specified behaviors in the natural environment may function as a discriminative stimulus that may facilitate the emission of the previously acquired behaviors in this situation.

Secondly, modeling of desirable behaviors in the natural environment may increase the relative duration of emission of the modeled behaviors by this subject population. In ward situations where many retardates may be gathered in one place, the reinforcement of desirable behaviors such as appropriate sitting, toy manipulation, peer interaction, may be hampered because of brief durations of occurrence. They may simply go by unnoticed by staff or may not be reinforced because they may terminate before reinforcers can be administered. A procedure, such as modeling of the desired behaviors by ward staff that may function to increase the duration of behavioral emissions, thereby increasing the probability of reinforcement for the subjects would seem desirable. However, the applicability of such procedures in the natural environment with the severely retarded has yet to be determined.

In the present study, carry over of modeling influences to a later session were obtained for modeled levers for which immediate modeling effects were demonstrated. However, the average carry over effect was generally smaller than the averaged immediate effect. This finding extends the implication noted by Litrownik (1972) that, more immediate opportunities to perform observed behaviors should be provided for effective learning and resultant performance with the severely retarded.

The findings reported in the present study as compared to the findings of Altman et al. (1972) suggest the necessity for future research on modeling with the severely retarded. Such research might attempt to determine whether the direct imitation training histories of the respective subjects or variables associated with the differences in the research methodologies contributed to the present disparent findings.

Future research may also be directed towards an analyses of the effects of response coding of model behavior by severely retarded observers and/or of the effects of imitative response contingent reinforcement in the modeling paradigms, with particular emphasis on the replicability of modeling effects and their magnitude both within and between subjects.

Finally, the generality of behaviors amenable to modeling influences with this subject population may be extended with future demonstrations of the acquisition of novel responses by the severely retarded in a modeling paradigm.

REFERENCES

Altman, R., & Talkington, L. Modeling: An alternative behavior modification approach for retardates. Mental Retardation, 1971, 9, 20-23.

Altman, R., Talkington, L., & Cleland, C. Relative effectiveness of modeling and verbal instructions on severe retardates gross motor performance. Psychological Reports, 1972, 31, 695-698.

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

Baer, D. M., Wolf, M., & Risley, T. Some current dimensions of applied behavior analysis. Journal of Applied Behavior Analysis, 1968, 1, 91-97.

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. 1969a, Holt, Rinehart, and Winston, New York.

Bandura, A. The role of modeling processes in personality development. In Gelfand, D. M. (Ed.) Social learning in childhood; readings in theory and application, 1969b, Belmont: Brooks/Cole Publ.

Bandura, A., Grusec, J., & Menlove, F. Observational learning as a function of symbolization and incentive set. Child Development, 1966, 37, 499-506.

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

Bandura, A., Grusec, J., & Menlove, F. Vicarious extinction of avoidance behavior. Journal of Personality and Social Psychology, 1967, 5, 16-23 (b).

Bandura, A., & Jeffery, R. W. Role of symbolic coding and rehearsal processes in observational learning. Journal of Personality and Social Psychology, 1973, 26, 1, 122-130.

Bandura, A., Jeffery, R., & Bachicha, D. L. Analyses of memory codes and cumulative rehearsal in observational learning. Journal of Research in Personality, 1974, 7, 295-305.

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

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

Bandura, A., & Menlove, F. Factors determining vicarious extinction of avoidance behavior through symbolic modeling. Journal of Personality and Social Psychology, 1968, 8, 99-108.

Bandura, A., & 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., & Ross, S. Transmission of aggression through imitation of aggressive models. Journal of Abnormal and Social Psychology, 1961, 63, 575-582.

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

Bandura, A., Ross, D., & Ross, S. Vicarious reinforcement and imitative learning. Journal of Abnormal and Social Psychology, 1963, 67, 601-607 (b).

Bandura, A., & Whalen, C. Influence of antecedent reinforcement and divergent modeling cues on patterns of self-reward. Journal of Personality and Social Psychology, 1966, 3, 373-382.

Brigham, T., & Sherman, J. An experimental analysis of verbal imitation in preschool children. Journal of Applied Behavior Analysis, 1968, 1, 151-158.

Bufford, R. K. Discrimination and instructions as factors in the control of nonreinforced imitation. Journal of Experimental Child Psychology, 1971, 12, 35-50.

Flanders, J. P. A review of research on imitative behavior. Psychological Bulletin, 1968, 69, 316-337.

Franks, C. M. Behavior therapy; appraisal and status. New York: McGraw-Hill, 1969.

Fuller, T. R. Operant conditioning of a vegetative human organism. American Journal of Psychology, 1949, 62, 587-590.

Gardner, S. I. Behavior modification and mental retardation. Chicago: Aldine-Athorton, 1971.

Gardner, W. I. The use of punishment procedures with the severely retarded; a review. American Journal of Mental Deficiency, 1969, 74, 86-103.

Gelfand, D. M. (Ed.) Social learning in childhood: Readings in theory and application. Belmont: Brooks/Cole Publishing Co., 1969.

Gewirtz, J. L., & Stingle, K. G. Learning of generalized imitation as the basis for identification. Psychological Review, 1968, 75, 374-397.

Greenspoon, J. The reinforcing effects of two spoken words on the frequency of two responses. American Journal of Psychology, 1955, 68, 409-416.

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

Kazden, A. E. The effect of vicarious reinforcement on attentive behavior in the classroom. Journal of Applied Behavior Analysis, 1973, 6, 71-78.

Lindsley, O. R., & Skinner, B. F. A method for the experimental analysis of the behavior of psychotic patients. American Psychologist, 1954, 9, 419-420.

Litrownik, A. J. Observational learning in retarded and normal children as a function of delay between observation and opportunity to perform. Journal of Experimental Child Psychology, 1972, 48, 117-125.

Lovaas, O., Berberich, J., Perloff, B., & Schaeffer, B. Acquisition of imitative speech in schizophrenic children. Science, 1966, 151, 705-707.

McGinnies, S. E. Social behavior; a functional analysis. Boston: Houghton/Miffon, 1970.

Martin, G. L., & Lowther, G. Kin Kare: A community residence for graduates of an operant program for severe and profound retardates in a large institution. Paper presented at the International Symposium on Behavior Modification, Minneapolis, Minnesota, 1972.

Martin, G. L., England, G., & England, K. Use of backward chaining to teach bed-making to severely retarded girls. Psychological Aspects of Disability, 1971, 18, 35-40.

Martin, G. L., Kehoe, B., Bird, E., Jensen, V., & Darbyshire, M. Operant conditioning of dressing behavior of severely retarded girls. Mental Retardation, 1971, 9, 27-31.

Martin, G. L., McDonald, S., & Omichinski, M. An operant analysis of response interaction during meals with severely retarded girls. American Journal of Mental Deficiency, 1971, 76, 68-75.

Martin, G. L., & Treffrey, D. Elimination of self-destruction behavior and development of self-care skills of a severely retarded girl. Psychological Aspects of Disability, 1970, 17, 125-131.

Martin, J. A. The control of imitative and nonimitative behaviors in severely retarded children through generalized instruction following. Journal of Experimental Child Psychology, 1971, 11, 390-400.

Masters, J. C., & Branch, M. A comparison of the relative effectiveness of instructions, modeling, and reinforcement procedures for inducing behavior chance. Journal of Experimental Psychology, 1969, 80, 364-368.

Metz, J. Conditioning a generalized imitation in autistic children. Journal of Experimental Child Psychology, 1965, 2, 389-399.

Miller, M. E., & Dollard, J. C. Social learning and imitation. New Haven: Yale University, 1941.

Paloutzian, R., Hasazi, J., Streifel, J., & Edgar, C. The promotion of positive social interaction in severely retarded young children. American Journal of Mental Deficiency, 1971, 5, 519-524.

Parton, D. Imitation of an animated puppet as a function of modeling, praise, and directions. Journal of Experimental Child Psychology, 1970, 9, 320-329.

Peterson, R. F. Some experiments on the organization of a class of imitative behaviors. Journal of Applied Behavior Analysis, 1968, 1, 225-235.

Peterson, R., Merwin, M., Moyer, T., & Whitehurst, G. Generalized imitation: The effects of E absence, differential reinforcement, and stimulus complexity. Journal of Experimental Child Psychology, 1971, 12, 114-128.

Peterson, R., & Whitehurst, G. A variable influencing the performance of generalized imitative behaviors. Journal of Applied Behavior Analysis, 1971, 4, 1-9.

Ross, D. Effect on learning of psychological attachment to a film model. American Journal of Mental Deficiency, 1970, 74, 701-707.

Sarasen, I., & Ganzer, V. Developing appropriate social behaviors in juvenile delinquents. In Krumboltz, J., & Thorenson, C. (Eds.) Behavioral Counselling: Cases and techniques. New York, 1969.

Sidman, M. Tactics of scientific research. New York: Basic Books, 1960.

Skinner, B. F. Science and human behavior. Free Press, New York: 1953.

Sprague, R. L. Book review on Principles of Behavior Modification (Bandura, 1969a) in American Journal of Mental Deficiency, 1970, 75, 113-115.

Steinman, W. The social control of generalized imitation. Journal of Applied Behavior Analysis, 1970, 3, 159-167.

Steinman, W., & Boyce, K. Generalized imitation as a function of discrimination difficulty and choice. Journal of Experimental Child Psychology, 1971, 11, 251-265.

Stephan, C., Stephano, S., & Talkington, L. Use of modeling in survival skill training with educable mentally retarded. Training School Bulletin, 1973, 70, 63-68.

Talkington, L., & Altman, R. Effects of film mediated aggressive and affectual models on behavior. American Journal of Mental Deficiency, 1973, 77, 420-425.

Talkington, L., Hall, S., & Altman, R. Use of a peer modeling procedure with severely retarded subjects on a basic communication response skill. Training School Bulletin, 1973, 69, 145-149.

Terrace, H. S. Stimulus control. In W. H. Honig Operant behavior: Areas of research and application. New York: Appelton-Century-Croft, 1966.

Thompson, T., & Grabowski, J. Behavior modification of the mentally retarded. New York: Oxford University Press, 1972.

Treffry, D., Martin, G.L., Samels, J., & Watson, C. Operant conditioning of grooming behavior in severely retarded girls. Mental Retardation, 1970, 8, 29-33.

Ulrich, R., Stachnik, T., & Mabry, J. (Eds.) Control of human behavior. Glenview: Scott, Foresman, 1966.

Ulrich, R., Stachnik, T., & Mabry, J. (Eds.) Control of human behavior. Glenview: Scott, Foresman, 1970.

Walters, R. H., & Parke, R. D. Influence of response consequences to a social model on resistance to deviation. Journal of Experimental Child Psychology, 1964, 1, 269-280.

Walters, R. H., Parke, R.D., & Cane, V. A. Timing of punishment and the observation of consequences to others as determinants of response inhibition. Journal of Experimental Child Psychology, 1965, 2, 10-30.

Waxler, C. Z., & Yarrow, M. Factors influencing imitative learning in preschool children. Journal of Experimental Child Psychology, 1970, 9, 115-130.

Appendix: Table A

Average Lever Contact Times[a] for Sessions across Experimental Phases for Ralph

Lever[b]	Experimental Phases															
	A.	B. modeled lever			C.	D. modeled lever			E.	F. modeled lever			G.	H. modeled lever		
		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3
Red	237	115	38	15	24	4	175*	11	4	242*	131	1	2	27	4	231*
Blue	8	137*	108	139	54	5	2	132*	67	12	3	224*	202	195	10	16
Green	10	6	11	96*	88	123	64	98	133	16	48	1	0	2	179*	0
Yellow	14	4	77*	5	17	40*	2	0	1	0	80*	1	0	17*	2	0

Note: Maximum time: 300 seconds

a) seconds per session: rounded to whole numbers

b) designated by colour

* indicates lever modeled

Appendix: Table B

Average Lever Response Frequencies[a] for Sessions across Experimental Phases for Ralph

Lever[b]	Experimental Phases															
	A.	B.			C.	D.			E.	F.			G.	H.		
		modeled lever				modeled lever				modeled lever				modeled lever		
		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3
Red	339	104	60	17	29	5	225*	13	4	232*	141	1	2	16	4	194*
Blue	13	217*	143	185	41	5	2	90*	44	3	3	283*	94	100	6	14
Green	6	6	9	50	25	72	35	67	123	8	42	4	0	2	100*	0
Yellow	22	8	84*	4	13	38*	2	0	1	0	47*	1	0	5*	1	0

a) rounded to whole numbers

b) designated by colour

* indicates lever modeled

Appendix: Table C

Average Lever Contact Times[a] for Sessions across Experimental Phases for Calvin

Lever[b]	Experimental Phases															
	A.	B.			C.	D.			E.	F.			G.	H.		
		modeled lever				modeled lever				modeled lever				modeled lever		
		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3
Red	119	176	120	70	26	67	52	88*	90	105	143	133	86	89	55	37*
Blue	27[c] 10[d]	31*	9	15	4	16*	17	23	19	13	60*	21	11	54*	21	24
Green	144	93	123	113*	54	33	65*	81	126	180	120	127*	44	103	98	160
Yellow	109	44	59*	26	52	54	78	35	23	51*	19	42	64	67	141*	143

Note: Maximum time: 300 seconds

a) seconds per session: rounded to whole numbers

b) designated by colour

c) average of 50 sessions

d) average of last 20 sessions

* indicates lever modeled

Appendix: Table D

Average Lever Response Frequencies[a] for Sessions across Experimental Phases for Calvin

Lever[b]	Experimental Phases															
	A.	B. modeled lever			C.	D. modeled lever			E.	F. modeled lever			G.	H. modeled lever		
		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3
Red	86	56	60	28	5	31	39	83*	79	90	165	89	74	104	48	28*
Blue	13[c] 7[d]	18*	7	10	2	13*	9	28	19	14	89*	12	9	51*	18	12
Green	84	50	99	65*	43	19	41*	62	132	175	112	101*	46	117	101	165
Yellow	56	20	24*	14	14	17	37	17	19	27*	11	17	41	46	45*	20

a) rounded to whole numbers

b) designated by colour

c) average of 50 sessions

d) average of last 20 sessions

* indicates lever modeled

Appendix: Table E

Average Lever Contact Times[a] for Sessions across Experimental Phases for Darrin

Lever[b]	Experimental Phases																
	A.	B.			C.	D.			E.	F.			G.	H.			
		modeled lever				modeled lever				modeled lever				modeled lever			
		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3	
Red	7	86*	36	15	0	45	14*	0	15	42*	14	0	0	0	6	4*	
Blue	141	164	227	244	227	202	209	120	21	133	220	285	284	294	274	273	
Green	76	49	22	5*	0	16	8	24*	0	54	63	0*	0	0	1*	0	
Yellow	9	0	11*	6	0	5*	59	143	253	57	20*	0	0	0*	0	0	

Note: Maximum time: 300 seconds

a) seconds per session: rounded to whole numbers

b) designated by colour

* indicates lever modeled

Appendix: Table F

Average Lever Response Frequencies[a] for Sessions across Experimental Phases for Darrin

Lever[b]	Experimental Phases															
	A.	B.			C.	D.			E.	F.			G.	H.		
		modeled lever				modeled lever				modeled lever				modeled lever		
		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3		R_1	R_2	R_3
Red	9	102*	40	5	0	50	13*	0	15	35*	0	0	0	0	2	2*
Blue	158	243	247	237	227	217	179	116	21	117	185	256	284	297	263	284
Green	75	43	17	6*	0	14	7	23*	0	44	59	0*	0	0	0*	0
Yellow	10	0	15*	9	0	9*	61	124	253	44	18*	0	0	0	0	0

a) rounded to whole numbers

b) designated by colour

* indicates lever modeled