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HEART RATE AS A MINIMAL CUE FOR THE OCCURRENCE OF VICARIOUS CLASSICAL CONDITIONING

by
Diane Faye Kravetz

A dissertation submitted in partial fulfillment
of the requirements for the degree of
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Professor Robert B. Zajonc, Chairman
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ABSTRACT

HEART RATE AS A MINIMAL CUE FOR THE OCCURRENCE

OF VICARIOUS CLASSICAL CONDITIONING

by

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Chairman: Robert B. Zajonc

This study was concerned with the determinants of an observer's autonomic and cognitive responses in a vicarious classical conditioning situation, in which the observer's vicariously aroused emotional response becomes associated to formerly neutral stimuli. The study presented heart rate as a minimal cue of a model's unconditioned emotional response and investigated whether information about changes in heart rate of the model, interpreted by the observer as caused by either noxious or innocuous antecedents, is sufficient for producing vicarious conditioning effects. Also, the study examined the use of heart rate as a measure of vicarious conditioning effects.

Subjects "observed" a conditioning experiment but only had auditory access to this information. They heard stimulus and situational cues of the conditioning and a simulated heart beat of the model. Therefore, there were minimal direct cues of both the observed situation and of the emotional response of the model within that situation.

Forty-eight male subjects were randomly assigned to one of four conditions; audio tapes were used to present instructions and stimuli. In the experimental condition, subjects were led to believe that they were hearing the heart of another subject in an aversive conditioning experiment. Subjects heard the simulated resting heart rate of the model (72 bpm) and cues that were relevant for that condition, i.e., a tone CS, which was followed on conditioning trials by a 6-second burst of white

noise, presented as the sound of a shock machine, and by a noticeable 10-second increase in heart rate of the model.

Three control conditions were used: (1) a sensitization control, in which there was unpaired presentation of the CS and the UCS, shock followed by change in heart rate, (2) a condition in which there were no noticeable changes in heart rate following the shock, and (3) a condition in which the subjects were told that they were hearing the heart of another subject who was seeing a series of nonsense syllables; the white noise was presented as the sound of a slide projector.

Heart rate of subjects was recorded by an oscillograph and a post-experimental questionnaire was administered.

Results indicated no significant differences in tonic heart rate over the four conditions. However, a pronounced and significant decelerative cardiac response was found in the interstimulus interval (CS-UCS) and during UCS presentation during training trials of the experimental condition only. Inspection of the distribution of responses to the questionnaire revealed differences in response patterns between conditions, with the presence of shock being the most important factor.

These results support a conclusion that experimental manipulations, which established the observed situation as either aversive or nonaversive and which presented heart rate cues as consistent or inconsistent with the description of the experiment, had significant effects on physiological and cognitive processes. It is suggested that of the two cues presented, knowledge of the model's heart rate and of his shock, heart rate was the more important.

It was concluded that it is possible to obtain vicarious classical conditioning effects with minimal direct presentation of cues from the

observed situation and of the model's unconditioned emotional response. It appears that heart rate of the model was a salient cue about his emotional response and as such was the basis for the vicarious conditioning.

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CHAPTER I

VICARIOUS LEARNING: A REVIEW

Introduction

This study is concerned with the determinants of an observer's autonomic and cognitive responses in a vicarious conditioning situation. Specifically, the study investigates the effect of the presentation of heart rate as the only cue of the model's emotional response. This would determine whether heart rate of the model could be the basis of the vicariously instigated emotional response in the observer and, as such, be the basis for vicarious classical conditioning. This study also attempts to determine the relative salience of other cues in the observed situation for the observer's response and examines the use of heart rate as a measure of vicarious conditioning effects.

Most investigations of observational learning involve modeling effects, i.e., the observer witnesses behaviors of a model and produces matching behaviors. Relatively little work has been directed toward vicarious conditioning, wherein the observer's vicariously instigated emotional response becomes associated to cues in the observed situation. Only the second of these, vicarious conditioning, is based on the emotional response of the observer. Based on a review of empirical research concerned with vicarious learning and the relationship of classical and operant conditioning, it will be the contention of this chapter that research on modeling effects should investigate sources of these effects and determine when they are in fact vicarious in nature. It will also be suggested that vicarious classical conditioning offers a research paradigm for investigation of this

problem, and that vicarious emotional instigation may be an integral part of the modeling process.

Definitions of the Process

A discussion of the literature concerned with vicarious learning requires clarification of the term "vicarious;" there is no single approach at present that fully encompasses all the distinctions that can be made. It would seem prudent to begin with the stance taken by Bandura and his associates, as they have certainly contributed the major empirical work in this area and are most often cited as experts. In his most recent book, Principles of Behavior Modification, (1969a) Bandura reiterates his contention that the term "vicarious learning" can be applied to describe, analyze, and explain a range of behaviors often differentiated as identification, introjection, imitation, etc. His own research has demonstrated that one can acquire novel responses through observation of a model's performance of those behaviors, that one can acquire conditioned emotional responses by observing the emotional responses of others, and that one can have established behavioral patterns significantly altered through observation of the behavior of others. Bandura concludes that unless it can be shown that vicarious learning of different classes of matching behavior is governed by different variables, distinctions based on types of imitated responses are neither necessary nor useful. Bandura suggests that various types of vicarious learning are probably controlled by similar processes and principles; therefore, if the various responses are not based on fundamentally different learning mechanisms, distinctions are not required.

Therefore, Bandura subsumes all behavioral modifications that are the result of exposure to modeling stimuli under the term "vicarious learning" and defines a vicarious learning event as "one in which new responses are acquired or the characteristics of existing response repertoires are modified as a function of observing the behavior of others and its reinforcing consequences, without the modeled responses being overtly performed by the viewer during the exposure period. In demonstrating vicarious learning phenomena, it is therefore necessary to employ a nonresponse acquisition procedure in which a subject simply observes a model's behavior but otherwise performs no overt instrumental responses, nor is administered any reinforcing stimuli during the period of acquisition," (Bandura, 1965a, p. 3).

One difficulty with this approach is that Bandura is describing the acquisition of "matching responses" (see Bandura, 1969a, p. 119). Although the bulk of the research up to this time has used matching behaviors as evidence for the occurrence of vicarious learning and a similar position is taken by many (Allport, 1924; Ax, 1964; deCharms and Rosenbaum, 1960), it is not clear that all phenomena which are presently referred to as "vicarious" require similarity of response. For example, "vicarious" instigation may refer to the emotional response of one person being responsible for the emotional response in another (Berger, 1962). This definition and Berger's descriptive definition of vicarious phenomena, described below, do not require performance of matching behaviors by the observer.

Berger (1968) draws a distinction between a descriptive definition of vicarious phenomena and an "explanatory" definition of vicarious phenomena. From a descriptive viewpoint, vicarious phenomena refer to the func-

tional substitution of one or more parameters of the model's behavior for the corresponding parameters of the observer's behavior. That is, either the model's instrumental act, the model's expressive act, and/or the reinforcement administered to the model may act as sources of activation and learning for the observer. "Vicariousness," then, refers to the substitutability of different means for achieving activation of the observer and no assumption is made concerning underlying processes, nor are explanatory attempts required. Also, this model does not demand similarity between the response of the model and that of the observer.

According to Berger, an "explanatory" definition of a vicarious experience involves the process by which one person shares the experience of another; this experience by the observer of an aspect of the model's behavior serves as a cue for the observer's imitative behavior. Berger suggests that representational mediation is a major process only in this latter definition of vicarious.

Similarly, Aronfreed (1968) distinguishes between observational learning and vicarious experience. He defines observational learning simply as "the occurrence of learning through cognitive representation during the period of observation." The term "vicarious" is reserved for when an observer's affective experience or emotional state corresponds to the perceived affective state of another person. As will be discussed at a later point, Aronfreed does not feel that most of the research by Bandura and his associates meets his criteria of vicariousness.

The position taken in this chapter will be that, although a central process is probably involved in all forms of what is now called "vicarious learning," there are some basic differences in the observer-model system which should be acknowledged in the labels applied. Since much

of the research subsumed under this umbrella term does not meet requirements inherent in the term "vicarious," application of this particular term to all forms of observational learning obscures differences. Review of the empirical literature suggests several distinctions.

There is a large body of research concerned with what we shall call "observational learning." This term is best served by a combination of definitions by Bandura and Aronfreed; that is, the learning of responses which is instigated by observation of the behavior of another person and its reinforcing consequences, which occurs through cognitive representation of the observed situation, and which does not directly involve overt behavioral responses of the observer during the acquisition process. The behavior of the model may be equal or secondary in importance to the other cues in the stimulus field.

Within Bandura's terminology, this definition of observational learning would include: (1) modeling effects, the acquisition of novel response patterns through cognitive representation of the observed situation; (2) inhibitory and disinhibitory effects, the strengthening or weakening of established behavioral repertoires; (3) facilitative effects, the facilitating of the performance of established behaviors; (4) imitation, the production of matching behavioral responses; and (5) "vicarious" reinforcement, observation of rewarding or punishing consequences to a model. Here, we will also include Berger's definition of "vicarious" instigation effects, which does not require similarity between the behavior and emotion of the model and the observer.

Vicarious learning will be used as in popular usage, i.e., experienced by someone through his imagined participation in another's experience. When the shared experience is primarily emotional, this definition will

be the same as used by Aronfreed. It would also include Berger's "explanatory" definition and vicarious instigation of behaviors when they are based on this experiential process. Vicarious learning in this sense applies to vicarious conditioning effects, in which the vicariously aroused emotional response of the observer becomes associated to formerly neutral stimuli, and to the process of vicarious extinction, in which the observation of the model performing anxiety-provoking behaviors without adverse consequences decreases or eliminates a fear response in the observer. Each of these "vicarious" learning processes may involve the observer experiencing the perceived behaviors and/or affect of the model; however, we would need to establish similarity of responses between model and observer in order to define the learning process as "vicarious."

These distinctions would clarify future research directions and serve as the basis for investigation of the factors which determine the observer's cognitive, affective, and behavioral responses to the situation observed. The present study is an attempt in this direction.

Observational Learning - A Review of the Literature

An historical review of theories of imitation suggests that each major theorist did account for one of the conditions under which responses could be acquired through observational learning (Allport, 1924; Miller and Dollard, 1941; Mowrer, 1960; Skinner, 1953). However, none of these approaches encompasses all of the basic processes of observational learning, and therefore they are not able to specify the conditions which differentially affect this process and determine the various types of observational learning.

A theory of observational learning must be able to account for and differentiate between the acquisition and performance of novel responses,

as well as to spell out the conditions under which new behaviors are combined to produce novel response patterns and those under which established behavioral repertoires are significantly altered due to observational learning. Most theories are presently able to account for the restructuring of previously learned behaviors; it is not clear that any have satisfactorily explained the learning of novel responses through the observational learning processes. However, there are two major theorists who are presently attempting to develop such a theory, Bandura and Aronfreed.

Bandura

The most prolific researcher in this area is Bandura. He has also contributed the most encompassing reviews and analyses of previous work in observational learning and has incorporated a vast amount of experimental evidence in support of his own theory of vicarious learning (Bandura, 1962, 1965a, 1969a). He and his associates have produced an impressive amount of original research and have made the most significant contribution to both the understanding of the phenomenon and also to the demonstration of its importance and application both inside and out of the experimental laboratory. Since a comprehensive review of this literature is offered by Bandura in his most recent book, Principles of Behavior Modification, 1969, I will only highlight his theory and the research directions and endeavors which are most recent. My intent is to focus on the significant aspects of the theory so as to provide a basis for the conclusions and implications for research which will be offered in the last section of this chapter.

The development of Bandura's theory of observational learning is best reflected in a comparison of two books, each written with the purpose of reviewing and supporting developments in imitative learning research. The difference between Social Learning and Personality Development (Bandura and Walters, 1963) and Principles of Behavior Modification, (Bandura, 1969a, Chap. 3) reveals the increased sophistication and broadening utility of this theory of learning over the years. The empirical basis of this theory rests on an extensive series of studies which describe imitative behavior, the conditions under which it occurs, the mechanisms which establish, modify, and maintain it, and which defend the pervasiveness of imitative behavior and its important role in the understanding of social learning.

Bandura defines a vicarious learning event as "one in which new responses are acquired or the characteristics of existing response repertoires are modified as a function of observing the behavior of others and its reinforcing consequences, without the modeled responses being overtly performed by the observer during the exposure period." (1965a).

According to Bandura (1962, 1965a, 1969a), imitation is a form of associative learning and can be explained within a S-S contiguity paradigm. The important factor is the contiguous relationship between the stimuli in the environment and the observer's response to them. That is, during exposure, modeling stimuli elicit in the observer configurations and sequences of sensory experiences, which become centrally integrated and structured into perceptual responses. As a function of contiguous stimulation, an antecedent stimulus can acquire the capacity to elicit imaginal representations of associated stimulus events. Therefore, the modeled responses occur in the observer in cognitive, representational

forms, and representational mediators are thereby assumed to be acquired on the basis of a contiguity learning process.

Two representational systems are involved in this process, an imaginal one and a verbal one. Imagery formation occurs through sensory conditioning, wherein modeling stimuli elicit perceptual responses that become associated and centrally integrated on the basis of temporal contiguity. If these perceptual sequences are repeatedly elicited, a component of the stimulus field may then acquire the capacity to evoke images of the total associated stimulus event; these images may then serve to guide reproduction of the previously observed responses.

However, most cognitive processes that regulate behavior are primarily verbal. They facilitate coding, storage, and retrieval of information. Observational learning is also thus facilitated. Once verbal labels become associated with the visual stimuli, the observer acquires verbal equivalents of the model's behavior during the exposure period; such symbolization of the observed behavior allows the later performance of those behaviors to be controlled by covert, verbal self-instruction (Bandura, 1965b; Bandura, Ross, and Ross, 1963b; Bandura, Grusec, and Menlove, 1966). This process is then uniquely human and does not apply to lower animals.

Stimulus contiguity is a necessary but not sufficient condition for observational learning. It is necessary that the observer attend to the model's behavior and differentiate the important aspects of the modeled response. Bandura notes four additional factors to be considered: (1) the sensory and receptive capacities of the observer based on previous learning and experience in discriminative observation, (2) factors which affect retention of the original observation in symbolic form, (3) the observer's previous experience with the various components of the behav-

ioral sequence observed, and (4) incentive and motivational processes which influence whether the observer attends to the presented stimuli (Bandura, 1969a, pp. 136-143). These four factors are particularly important for the production of modeling effects, which involve the acquisition of novel response patterns.

In Bandura and Walters (1963), three general effects of observation involved in social transmission of instrumental responses are described; these are modeling effects, inhibitory and disinhibitory effects, and facilitation effects. All three types are examples of "no-trial" learning because the observer does not engage in overt responding throughout the learning process (Bandura, 1965a).

The first of these learning effects, modeling, requires the associative process described above and involves the acquisition of novel combinations of instrumental behaviors by the observer. This phenomenon has been well demonstrated (Bandura, 1962; Bandura and McDonald, 1963; Bandura and Mischel, 1965; Bandura, Grusec, and Menlove, 1966, 1967a; Bandura, Ross, and Ross, 1961, 1963a, 1963b).

There has also been a large body of empirical research which demonstrates inhibitory and disinhibitory effects (Bandura, 1962; Bandura, 1965b; Bandura, Grusec, and Menlove, 1967b; Bandura, Ross, and Ross, 1963a; Berger, 1961; Kanfer and Marston, 1963; Walters, Bowen, and Parke, 1963; Walters and Parke, 1965). Such vicarious reinforcement experiments involve reponse changes produced by the observed consequences to the model. It has been demonstrated that behavior can be effectively inhibited or disinhibited by showing a film of a model engaged in novel, aggressive behaviors which are either reinforced, punished, or unaccompanied by any consequences (Bandura, 1965b; Bandura, et al., 1963a; Walters and

Parke, 1964). Also, other studies have shown that modification of observer behavior can be enhanced through observing rewarding consequences or the absence of anticipated punishing consequences (Bandura, 1962; Bandura, et al., 1967a; Marston, 1965, 1966; Kanfer, 1965).

It has been found that exposure to modeled responses combined with reinforcement consequences to the model are generally more effective in producing response changes than the modeling procedure presented alone. Bandura (1969b) suggests several mechanisms which may be responsible for changes accompanying vicarious reinforcement procedures. The first is the information function of vicarious reinforcement. However, Bandura concludes that the information concerning the probability of attaining reinforcement that is obtained through observation of the model probably does not fully account for observed effects. Other sources of explanation are: (1) the stimulus enhancement effects of reinforcement; the provision of knowledge of controlling environmental stimuli and the direction of attention to these relevant stimuli, (2) incentive-motivational effects, whereby the anticipation of reinforcement serves a motivating function, (3) vicarious emotional conditioning effects, whereby observers note the affective reactions of the model to the environmental stimuli, become aroused by the emotional experience of the model, and produce the same emotional responses; these emotional responses of the observer can then become conditioned to the stimuli in the environment through contiguity, and (4) status of the model, which has been shown to significantly affect the extent of production of matching responses by the observer (Bandura and Walters, 1963; Flanders, 1968).

Facilitative effects are generally not concerned with novel responses nor with socially prohibited behaviors. Instead, they involve the dis-

criminative stimulus function of the model's responses which influence the occurrence of similar responses in the observer. The behavior of the model serves only as a discriminative cue for the observer and facilitates the performance of previously learned responses. The best example of this is the research by Miller and Dollard (1941). This social facilitation effect is influenced by observer characteristics, reinforcement contingencies, and the attributes of the model.

Vicarious emotional instigation

In addition to vicarious learning pertaining to instrumental behaviors, vicarious learning is also related to the acquisition of emotional responses. These two vicarious phenomena are separated by Bandura in all of his reviews of this literature. Bandura (1965a) states "findings based on vicarious classical conditioning may not be applicable to modeling processes involving instrumental classes of behavior." (p. 42). It is notable that most investigations of vicarious learning have been concerned with the acquisition and performance of instrumental behaviors; the learning of emotional responses through observation of emotional responses in others has been comparatively ignored.

Research in the area of affective learning in humans which occurs through vicariously aroused emotions has investigated two interrelated phenomena: (1) emotional responses of a model elicit emotional responses in observers, and (2) an observer's vicariously aroused emotional response may become associated to formerly neutral stimuli, i.e., emotional responses may become conditioned to either the behaviors of the model or to stimuli in the environment.

The first empirical examination of vicarious emotional arousal was conducted by Lazarus, Spiesman, Mordkoff, and Davison (1962). They found

that a motion picture depicting primitive puberty rites would elicit emotional responses in the observers of the film. Their interpretation of the physiological measure, galvanic skin response (GSR), which was used as an indicator of increased stress, was partially verified by the use of a mood check list and an interview questionnaire. In most reviews, this study and a modification of this study (Spiesman, Lazarus, Mordkoff, and Davison, 1964) are cited as the primary experimental examples of vicarious emotional instigation.

Vicarious conditioning of emotional responses

The most frequently cited study demonstrating the conditioning of vicariously aroused emotion is that of Berger (1962). In this study, Berger attempted to refine the concept of vicarious emotional instigation by suggesting the conditions under which it may be said that this phenomenon occurs. He combines this theoretical analysis with a demonstration of vicarious classical conditioning.

Berger defined vicarious instigation as the emotional response of an observer to his perception of the model's unconditioned emotional response. If the observer responds to the unconditioned stimulus only, or responds only to the model's unconditioned response, or responds in expectation of receiving the unconditioned stimulus himself, then the unconditioned emotional response of the model is not the significant factor for the observer's emotional response and vicarious instigation can not be said to have occurred. The vicarious classical conditioning paradigm as defined by Berger is illustrated in Figure 1: The model participates in a traditional aversive conditioning experiment, with a tone CS and a shock UCS. (1) illustrates the training procedure, which pairs the CS and UCS_m;

For the model:

CS = buzzer or tone

UCS_m = electric shock

UCR_m = unconditioned pain response to shock, e.g., arm movement

CR_m = conditioned pain response

(1) CS
\
UCS_m-----UCR_m

(2) CS---------CR_m

For the observer:

CS = buzzer or tone

UCS_o = unconditioned emotional response of the model, as inferred from observation of UCS_m and UCR_m

UER_o = unconditioned emotional response of the observer, measured by GSR or heart rate

CER_o = conditioned emotional response

(1) CS
\
UCS_m ---UCR_m
↓
UCS_o------UER_o

(2) CS ------ CER_o

Figure 1. Vicarious classical conditioning paradigm

(2) indicates the learned response to tone presentation after training. For Berger, the unconditioned emotional response of the model, as inferred by observation of the UCS_m and the UCR_m, is the basis for the observer's unconditioned emotional response; the UCS_m and the UCR_m must be the unconditioned stimulus for the observer within the paradigm (1). Again, (2) indicates the learned association between the CS and the unconditioned emotional response of the learner, in this case, the observer.

Since the model's emotional state can only be inferred from his responses, criteria which differentiate the unconditioned response from the unconditioned emotional response of the model would seem difficult if not impossible to establish. If the behaviors of the model had not previously been established as conditioned stimuli for the observer, vicarious instigation could not occur. However, it is important to determine whether the observer is responding to the stimulus events only on the basis of his own past experience, or whether the observer's emotional responses are elicited entirely by the performer's affective expressions.

In his experiments, Berger attempted to draw the above distinctions and also to demonstrate the conditioning of autonomic responses to previously neutral stimuli through observation. In his experiments, the model supposedly participates in an aversive conditioning experiment in which a formerly neutral stimulus (a buzzer) is presented and immediately thereafter the model exhibits pain cues (arm movement) ostensibly in response to the presentation of the unconditioned stimulus (shock). Presentation of shock was signified by light dimming. GSR was recorded as the measure of the observer's emotional response.

Four conditions were used to establish the required controls: (1) the observer was told that the model was receiving shock and the model

jerked his arm at the appropriate moments, (2) the observer was told that the model would make voluntary arm movements at specified times and would not be shocked, (3) the observer was told that the model would receive shock when the light dimmed but the model never moved his arm, and (4) there was no shock to the model nor arm movement by the model. The no-movement condition was the control for the unconditioned stimulus; the no-shock condition was the control for the unconditioned response.

The results of these experiments showed that the observer also began to exhibit emotional responses to the conditioned stimulus, even though he had not himself experienced the aversive stimulation. Berger found that the vicarious conditioning was neither solely the function of the arm movements nor the instructions concerning shock, nor did any subjects expect to receive shock themselves during the experiments. Subjects who observed the shock and arm movement condition showed a significantly higher degree of vicarious conditioning than did the other three groups.

Berger has demonstrated a very simple case of vicarious classical conditioning, in that arm movement is not a potent response and obviously is low in terms of previous association with pain and fear; therefore, the amount of emotional arousal that one would expect in an observer to this response alone would be minimal. As it is unlikely that either programmed arm movement or knowing that shock is traveling through a circuit would be potent conditioned stimuli in and of themselves, this experiment's ability to differentiate between responses to the unconditioned stimulus alone and the unconditioned response alone was highly predictable. This problem becomes more complex, however, with the use of more salient conditioned responses of the model.

There have been several extensions and modifications of this basic experimental design. Craig and Weinstein (1965) found that observation of a model experiencing repeated failure produced vicarious emotional arousal that could be conditioned to previously neutral cues. Craig and Lowery (1969) investigated heart rate and skin resistance changes in a vicarious conditioning experiment similar to Berger's. They measured the vicariously instigated autonomic responses of subjects who either (1) watched a confederate being shocked, (2) watched a confederate being shocked and they expected to be shocked themselves at a later time, or (3) watched a confederate as he moved his arm. Results indicated that both GSR and heart rate could be conditioned. The group that believed they would also receive shock had a significant increase in heart rate. However, the group that just saw arm movement or just watched someone else being shocked, although significantly different from the control group, produced heart rate deceleration.

Bandura and Rosenthal (1966) were also concerned with vicarious conditioning, but were interested in the variables that affect an observer's general arousal level and the effect this has on vicarious learning. In their experiment, they manipulated the emotional arousal of subjects both psychologically and physiologically by either the threat of undergoing the same aversive conditioning experience as the model or by injections of epinephrine. Their five conditions were (1) no injection-no threat of being shocked, (2) placebo injection, (3) placebo injection plus threat of aversive stimulation, (4) epinephrine-induced arousal, small dose, and (5) epinephrine-induced arousal, large dose. After varying the degrees of arousal, subjects then participated in a vicarious aversive conditioning experiment in which the model emitted pain cues in conjunction with an

auditory conditioned stimulus. GSR was recorded as a measure of autonomic response to the conditioned stimulus.

They found that the frequency of conditioned responses is a positive function of the degree of psychological stress, but that a monotonic decreasing function was found when, in addition to situational stress, subjects experienced increasing physiologically-induced arousal. Therefore, arousal is a significant determinant of either increased or disruptive effects on conditioning. One explanation of the effects during high physiological arousal is suggested in the post-experiment interviews with subjects. It appears that the effects on autonomic response may be mediated by self-generated thoughts which serve as competing responses in the experiment and thereby reduce the aversiveness of the vicarious situation.

The effect of vicarious arousal on the observer can be inferred from the physiological responses of the subjects, but also by the behavioral changes exhibited. DiLollo and Berger (1965) essentially replicated the Berger (1962) experiment using the same experimental conditions. However, reaction time, rather than GSR, was used as the measure of change. They found that the reaction time of shock-movement subjects was significantly faster than that of the other three groups (shock-no movement, no shock-movement, no shock-no movement), which performed at about the same level. These results were interpreted to suggest that exposure to the affective experience of others has activating effects on the observer's reaction time. They also concluded that these effects are achieved only in the presence of some corroborative evidence that shock is, in fact, being delivered, i.e., that there is a behavior change by the model and knowledge of shock.

Vicarious extinction

In addition to the modification of emotional responses which show an increase in the arousal level of subjects due to observation of the affective responses of others, there is a rapidly accumulating body of evidence that indicates that emotional response patterns can also be extinguished through the observation process. In these experiments, observers view models who exhibit anxiety-provoking behaviors without experiencing adverse consequences for this behavior. The assumption is that the arousal capacity of the threatening situation is extinguished and thereby both the motivation and controlling stimuli for the avoidance behavior are removed.

Bandura, Grusec, and Menlove (1967b) first demonstrated this phenomenon, using children who were afraid of dogs. In order to demonstrate that avoidance behavior can be extinguished vicariously, they presented the observers with a fearless child model who progressively participated in fear-provoking interactions with a dog. Under the assumption that elicitation of positive affect from the observers would facilitate this process by helping to counteract anxiety responses, they presented the modeled approach behavior in a highly positive context. A second group of children observed the same graduated performances of a model, but in a neutral context. A third group observed the dog alone in a positive context with no modeled approach behavior. A fourth group was neither exposed to the dog nor to the model, but just participated in positive activities. Post-tests for avoidance behavior by the observer children showed that children who observed the modeling of approach behaviors toward the feared object displayed a significantly greater amount of approach behaviors toward both the experimental dog and toward another unfamiliar dog than

did children in the dog exposure and positive context only conditions. However, positive context was not a significant factor for the approach behavior of the observers. Graduated performance by the model toward the feared object, with and without the positive context, were equally successful in promoting approach behaviors by observers.

That generalization of this experience would be facilitated by presentation of diverse models in a variety of situations, and that the level of emotional arousal of the observers would affect the degree to which their avoidance behavior would be modified, was tested by Bandura and Menlove (1968). Again, dog avoidance behavior was the target behavior for modification through vicarious extinction procedures. They found that multiple modeling was superior to the use of just one model and that modeling in both of these conditions was equally effective regardless of the original avoidance behavior of the observers.

The most extensive study to investigate this phenomena was performed by Bandura, Blanchard, and Ritter (1969) who examined the comparative efficacy of modeling and desensitization approaches for producing behavioral, affective, and attitudinal changes. As in the other extinction studies noted above, snake-phobic adolescents and adults were given an initial behavioral test to measure the strength of their avoidance tendency. Also, a fear inventory and several attitude rating scales were completed by all subjects. In general, all subjects were in some way significantly affected by this phobia in their daily lives.

Subjects were assigned to one of four conditions: (1) a self-administered symbolic modeling treatment, which involved both the use of a film with multiple models participating in graduated experiences with a snake, and also the application of relaxation techniques with the subject having

control over the speed of stimuli presentation, (2) a combination of graduated modeling and guided participation, wherein the model first demonstrated the approach behavior and then helped the subject to perform progressively more difficult approach behaviors themselves, (3) desensitization, employed in the traditional manner (Wolpe, 1958) with deep muscle relaxation paired with progressively more anxiety-provoking presentations of the feared object through imagination of that feared object, and (4) a control condition, which consisted of the behavioral and attitudinal assessment procedures only.

Using a behavioral test, consisting of a series of approach behaviors to the experimental snake and to an unfamiliar snake, and an arousal rating scale, they found that control subjects were unaffected by the measurement procedures, that symbolic modeling and desensitization produced significant reductions in avoidance behaviors, and that live modeling combined with guided participation eliminated snake phobias in almost all subjects. Results indicate that behavior was modified and that the anxiety-arousing properties of the phobic stimulus were significantly decreased, and that both symbolic modeling and desensitization produced favorable changes in attitudes toward snakes. The greatest changes in attitude were found, however, when modeling and guided participation were used. A one-month follow-up found that changes in behavior, attitudes, and affect were maintained.

In summary, the above suggests two major derivations from research on vicarious emotional instigation. First, it provides a model for vicarious emotional experiences; that is, when the emotional response of the observer is based on the observed emotional response of a model (Berger, 1962). Secondly, studies of vicarious classical conditioning suggest a model for

the learning and modification of emotions and attitudes, as internal responses are paired with external stimuli. Such an approach to the formation of attitudes is offered in an impressive discussion by Staats (1968) and is given support by the studies of the vicarious extinction of avoidance responses.

Role of central mediational processes in observational learning

Although recent analyses of modeling processes include the role of external stimulus control and the information value of outcomes of modeled behavior, there is increased concentration on the central mediational processes, i.e., self-generated stimulation assumed to be relatively independent of environmental control. This is reflected in the movement away from discussions of "imitation" and toward reference to "modeling" and "observational learning" and also in the increased attention given to "subprocesses" of modeling (Bandura, 1969a, pp. 136-143). Such an extension was necessary to include processes through which an observer exhibits imitative behavior based on his incorporation of various different behaviors exhibited by several models (Bandura, et al., 1963b), to handle vicariously learned generalization of classes of behaviors and generalized principles such as rules and morals (Bandura and McDonald, 1963; Bandura and Mischel, 1965), and to include self-control and self-evaluative mechanisms that are learned through observation only (Bandura and Kupers, 1964).

Although many questions concerning the process and conditions of observational learning remain unanswered, it is evident that mediational processes are of central importance. Strong support for a mediational hypothesis is offered by Bandura and Mischel (1965) who found that both live and symbolic models produced modifications in delay of reward behavior.

Bandura, Grusec, and Menlove (1966) found that imitation is facilitated by instructing subjects to verbally describe observed behavior during the exposure period. Imitation was significantly less for those subjects who only watched the film, and even less imitative behavior was produced by subjects whose symbolic representation of the observed behavior was impeded by the production of competing responses during exposure, i.e., subjects were asked to count quickly while watching the film.

Evidence of symbolic coding processes as used by subjects to store and program observed behavior was further demonstrated by Gerst (1969). He found that subjects who were told to code the responses they observed showed greater evidence of observational learning than control subjects who could not use a symbolic coding process. Also, difference in retention of matching responses varied among experimental subjects in terms of the type of coding system used.

Bandura and Menlove (1968) established that extinction is possible without the performance of a series of non-reinforced overt responses. They suggest that their results support a dual-process theory of avoidance behavior which, as described by Rescorla and Solomon (1967), states that peripheral conditioned responses and instrumental responses are mediated by a common central state.

The role of symbolic mediation is also evident in a number of vicarious instigation studies. DiLollo and Berger (1965) found that vicarious arousal occurred only when there was some evidence that shock was actually being administered to the model. This apparent influence of cognition could also account for the differences found by Berger (1962). Apparently, the information value of the behaviors was highly salient in both studies. Also, as noted earlier, competing cognitive responses were seen to have a

significant effect in impeding conditioning in physiologically aroused subjects (Bandura and Rosenthal, 1966).

The importance of cognition is also examined in a series of studies concerned with the interaction of cognitive and physiological factors. The most well-known study is that of Schachter and Singer (1962). They hypothesized that an emotional state is a function of physiological arousal and of a cognition appropriate to this state of arousal. Epinephrine was administered to some subjects and others received a placebo injection. Some of the epinephrine subjects were told what effects they could expect from the drug; others were given either misleading or no information. All groups were then placed with a confederate who exhibited either anger or euphoria. Behavioral and self-report indices of emotion were taken for all subjects. They found that given a state of arousal for which he has an explanation, an individual does not label his internal state in terms of alternatives available. However, if he is misinformed or uninformed, he will look to his external environment for an explanation of his state of arousal and thereby will be more susceptible to modeling influences.

This problem was further investigated by Schachter and Wheeler (1962). Whereas Schachter and Singer looked at the role of cognition in emotional responses, with arousal held constant, this latter study examined differences in arousal state, with cognitive events held constant. Subjects who were administered epinephrine were compared with subjects who were given a sympathetic nervous system inhibitor, chlorpromazine. They discovered that when all subjects were exposed to the same film, which was intended to be humorous, subjects who had received injections of epinephrine were more amused than placebo subjects, who in turn were more amused than sub-

jects who had received the tranquilizing drug. This study further supports the hypothesis that emotion is a function of physiological arousal and of an appropriate cognition.

The effect of autonomic responses on cognition was investigated in an ingenious manner by Valins (1966). He told a group of male subjects that they would be listening to their own heart rate as they viewed a series of slides of seminude females. In fact, however, all subjects heard a pre-recorded, simulated heart rate, which was slow for all subjects during presentation of some of the slides and was significantly faster during the remaining slides. Subjects were then given an opportunity to take pictures of the slides with them; this was used as a behavioral measure of attraction to the various slides. Valins found that ratings of attractiveness corresponded to the experimental manipulations of heart rate; that is, subjects favored pictures to which they had heard their heart rate increase over pictures to which their heart rate remained stable.

The above discussion supports two conclusions: (1) symbolic mediation is a central process in observational learning, and (2) physiological, cognitive, and behavioral aspects of observational learning are highly interrelated and interdependent. Bandura also uses the emphasis on centrally mediated processes to discount theories which rely exclusively on peripherally mediated feedback (Mowrer, 1960). However, he also uses this same argument to minimize the importance of the approach taken by Aronfreed. Briefly, Aronfreed suggests that affective states become conditioned to cognitive templates of a model's behavior and that imitative behavior is then controlled by affective feedback from intentions and from proprioceptive cues generated during performance of the overt act. Bandura summarily dismisses Aronfreed by stating that his conceptualization

is difficult to verify empirically. Bandura also argues that this theory does not account for behavior when reinforcers are not dispensed to the model or to the observer and also notes that most responses acquired through observation are not affectively significant to the observers.

Although Bandura has empirically described the conditions under which imitation may occur, he has not explained what intervenes between the stimulus and response in his contiguity-mediational theory. Although one may reasonably question some of the assumptions made by Aronfreed, there does not seem to be a sound basis for dismissing his theory at this time.

Aronfreed

Aronfreed (1968) suggests that cognitive representation is the primary mechanism for imitation. However, the process he supports gives a major role to the importance of affectivity. According to Aronfreed, the child's cognitive representation of the observed behavior acquires an affective value through the association of the observation of that behavior and its affective consequences for the child. This acquired affective value then becomes associated to the cognitive stimulus correlates of the child's own behavior. As the child's cognitive representation of the observed behavior acquires internal affective value, his own behavior becomes increasingly independent of external consequences. Through this process, many social stimuli may be effective in influencing a child's behavior due to their acquired affective value.

Basic to this theory is the assumption that affective changes can influence overt behavior. That internal affective changes produced through classical conditioning can influence overt behavior and that autonomic changes can be brought under the control of outcomes has been well documented and will be discussed in a later section. The importance of these

findings here is that since consequences of overt behavior can control peripheral autonomic changes, outcomes of a child's behavior related to changes in affect could have some control over the conditioning of that affective response to salient social stimuli within the reinforcing environment. Therefore, this process may lead to changes in affective states becoming conditioned to behavioral and cognitive correlates of a response which in turn could influence the probability of the future occurrence of that response. In summary, then, affective consequences of outcomes of overt behavior affect the cognitive components of that behavior and determine at least partially the process by which future stimulus situations affect specific forms of behavior.

Within this framework, Aronfreed defines imitation as "form of observational learning in which the child uses a representational model of the specific features or sequential structure of another's behavior" (1968, p. 76). The affective aspect of the observation, which may be inherent in the observed behavior or may be associated with components of the model's behavior that are established reinforcers for the child, may then become associated with its cognitive representation of the observed behavior.

Aronfreed suggests two characteristics of observational learning which underscore the significance of the role of changes in affective states: (1) a contiguity mechanism requires association between external stimuli and responses in the observer, either overt or covert; however, this alone does not account for the performance of future behaviors, since it makes no provision for affective control of behavior, and (2) observational learning is highly selective and persistent; therefore, one must assume that imitative behaviors are somehow inherently reinforcing,i.e., have

established affective value associated with cognitive representations of that behavior.

The above process does not necessarily involve a "vicarious" experience. The observed behaviors may arouse emotions in the child that are quite different than those exhibited by the model, and/or the reinforcement dispensed to the model may have a value for the observer which is independent of the model's behavior. Therefore, observational learning can successfully occur without the observer responding to cues indicative of the experience as perceived by the model. Observational learning only requires that an affective value become associated to the child's cognitive representation of the observed behavior.

Unlike Bandura, Aronfreed reserves the term "vicarious" for the child's affective response to his perception of the other person's experience. This conceptualization emphasizes the affective response of the observer and requires a similarity between the observer's affective state and the affectivity the observer perceives in the model's experience.

This definition of a vicarious experience is based on the importance of a conditioning mechanism which establishes the association between the social, expressive cues of the model and the direct emotional experience of the observer as he views the stimulus complex and corresponds to studies involving vicarious classical conditioning (Berger, 1962; Bandura and Rosenthal, 1966). However, these studies do not illustrate the relationship between vicarious experience and its control over instrumental, imitative behaviors.

Bandura assumes that observational learning can be based on the observer's vicarious experience of the reinforcement presented to the model. However, Aronfreed argues that it is not sufficient to demonstrate that

behavior of the observer has been influenced by the observed outcomes of the model; to establish the vicarious aspect of the learning process, there must be the requirement that the observer respond to the social cues which indicate the emotional experience of the model. Clearly, Bandura and his associates do not make this differentiation.

Aronfreed (1969) devotes his latest chapter on imitation to a defense of his own analysis by means of a detailed critique of Bandura's studies. Many of his criticisms are useful. First, Aronfreed suggests that the experimental situations used in many of Bandura's experiments are a source of generalized arousal, and situational constraints elicit behaviors which almost must be similar to modeled behaviors. A correspondence between the model's behavior and the observer's later performance is often inevitable and there is little requirement for fidelity between the behaviors observed and those performed. Also, Aronfreed is not convinced that novel behaviors are learned and suggests that it seems more likely that pre-established behavioral tendencies are elicited.

More important for Aronfreed, Bandura's experiments generally do not emphasize the affective experience of the model and the behavioral cues that are particularly relevant to that experience. Therefore, they cannot satisfy Aronfreed's definitional requirements that the observer's emotional response correspond to the perceived experience of the model.

Although Aronfreed's theoretical scheme is intuitively appealing and many of his criticisms of Bandura's studies are valid, there are several major difficulties with his approach, the most problematic being the lack of direct empirical tests of the theory. Although some studies have been done (see Aronfreed, 1969), they do not begin to answer questions concerning this theory's capacity to explain all forms of observational learn-

ing. Application of this approach to adult learning and the imitation of low valenced behaviors has yet to be empirically defended.

For the present, one highly important distinction made by Aronfreed should be considered in evaluations of research on observational learning; that is, the difference he draws between behaviors that occur as a result of observation of another person within a situation and those behaviors that are particularly due to observation of the emotional reaction of the model.

A review of both Bandura and Aronfreed leads to the conclusion that it will be equally difficult at this time for either one to verify empirically his theory concerning the internal, covert aspects of observational learning. Also, until an explanation of the relationship between incentives and the performance of imitative behaviors and other modeling effects is confirmed by empirical evidence, it does seem that Aronfreed's approach to the problem offers a constructive theory.

The relationship of operant and classical conditioning - implications for observational learning

Aronfreed should also be given credit for his inclusion of both peripheral and central events in his theory of imitation. As we are concerned with learning of both instrumental and autonomic responses through observational processes, it is important that we investigate the role of peripheral and central processes. It seems that in order to emphasize mediational processes and to discount theories that rely exclusively on proprioceptive feedback, Bandura has chosen not to investigate the role of proprioceptive feedback at all. However, a review of recent studies concerning classical and instrumental conditioning suggests the importance of the interaction of central and peripheral mechanisms in the understanding of observational learning.

This body of empirical evidence has been cited in discussions of vicarious extinction (Bandura and Menlove, 1968; Bandura, et al., 1969c) in support of the hypothesis that the primary mechanism of vicarious extinction involves extinction of mediating arousal reactions, which serve to motivate and control overt avoidance responses. Support for this assumption is derived from the dual-process theory of avoidance behavior which suggests that aversive conditioned stimuli elicit arousal reactions which have both central and autonomic components; these conditioned stimuli may also exert discriminative control over instrumentally learned behaviors through mediation of central, symbolic processes. Therefore, extinction of arousal significantly alters both motivational and behavioral components of the avoidance behavior. However, in addition to significantly contributing to an understanding of the effectiveness of vicarious extinction, there are broader theoretical implications which should be considered.

A clear and straightforward introduction to this literature is presented by DiCara (1970), in which he first explains the traditional view of conditioning processes. Traditionally, Pavlovian conditioning was thought to involve only visceral responses, which are controlled by the autonomic nervous system. These responses were defined as involuntary and thought to be only modified through classical conditioning procedures. On the other hand, voluntary, skeletal responses were thought to be controlled through instrumental or operant conditioning procedures. These two types of conditioning were always presented as distinct and separate processes, which operated through separate mechanisms and led to different types of learning. However, it now appears that in fact there is only one learning process and that both forms of conditioning are part of the same phenomenon.

In his article, DiCara described a large number of very convincing experiments conducted by Neal Miller and himself, which demonstrate that instrumental conditioning procedures can produce learning previously thought only to occur through classical conditioning. In their studies, curarized animals were used to control for visceral changes being influenced by subtle, skeletal movements, so that any changes found in heart rate, blood pressure, intestinal contractions, etc., were learned only through the autonomic system. Using either electrical stimulation of the brain as reinforcement or electric shock avoidance as reinforcement for correct autonomic response variations, they found that animals can learn visceral responses in the same manner that they learn skeletal responses. They found that instrumental learning of visceral responses follows the laws of skeletal instrumental training, using both curarized and noncurarized animals.

There have also been a number of experiments using human subjects that have demonstrated instrumental autonomic conditioning (Engel and Chism, 1967; Engel and Hansen, 1966; Hnatiow and Lang, 1965; Shearn, 1962). Kimmel (1967) summarizes this literature and concludes that autonomically mediated responses can be conditioned by instrumental procedures and states that this has been conclusively demonstrated.

However, there does not appear to be agreement as to the explanation of this phenomenon. Katkin and Murray (1968) offer four alternative explanations for instrumental autonomic conditioning: (1) an autonomic response may be an unconditioned response to an external source of stimulation, (2) an autonomic response may be an unconditioned response to an internal source of stimulation, (3) an autonomic response may be a conditioned response to an external source of stimulation, and (4) an autonomic

response may be a conditioned response to an internal source of stimulation (p. 53). Successful demonstration of instrumental autonomic conditioning must rule out these four possible explanations. An extensive review of instrumental conditioning of autonomically mediated behavior leads Katkin and Murray to conclude that only studies using curarized animals were able to convincingly demonstrate this phenomenon and rule out alternative explanations of either somatic or cognitive mediation.

Crider, Schwartz, and Shnidman (1969) suggest that peripheral and/or cognitive mediation hypotheses are not plausible alternative explanations. For example, they refute Katkin and Murray's conclusion that studies of instrumental heart rate conditioning with humans are inconclusive; they feel that there is no evidence of skeletal mediators in these studies (Engel and Chism, 1967; Hnatiow and Lang, 1966). In summary, they conclude that there is a lack of evidence for either cognitive or peripheral mediation and that "this control has been effected through the direct instrumental strengthening of the autonomic response itself" (p. 460).

It appears that at this time there is no conclusive evidence to support one or the other theoretical analyses of mediators and underlying factors in instrumental autonomic conditioning. However, for our purposes, it is best to follow the conclusion of Katkin and Murray who suggest that the need to demonstrate the pure phenomenon of instrumental conditioning of autonomic responses may be less important than to discover ways in which we can control "involuntary" behavior in humans. Rather than discounting effects of cognitive and somatic mediation, they suggest that control of autonomic activity should be investigated in terms of the various skeletal and cognitive mediators which are related to autonomic responses, using cognitive and somatic correlates to control autonomic behavior. This seems

to be the attitude of DiCara, who suggests that we use this new knowledge to modify problematic or disordered autonomic functions in humans. Within the framework of this paper, it appears that recognition of the phenomenon and its importance for social learning is more relevant and of more immediate concern than a discussion of the purity of the effect. That applications of reinforcement to instrumental behaviors may also condition autonomic functions is the important principle to which we must adjust our thinking and approach to observational learning.

In addition to demonstration of instrumental conditioning of autonomic responses, Pavlovian conditioning procedures have been shown to influence instrumental behaviors (Black, 1958, 1965, 1967). Solomon and Turner (1962) found that animal subjects can acquire discriminative instrumental responses without those responses being performed in the presence of discriminative stimuli. Curarized animals were used to prevent feedback from peripheral skeletal responses. In this study, animals first learned an avoidance behavior, bar pressing. They were then placed in a Pavlovian discriminative conditioning procedure (two tones, CS+ followed by shock, CS- not paired with shock). When returned to the bar-pressing situation, the animals retained previously established bar-pressing behavior to the original stimulus; however, they also exhibited bar-pressing behavior in response to presentation of the CS+ from the classical conditioning procedure.

Rescorla and Solomon (1967) suggest that this experiment demonstrates that emotional responses established through classical conditioning have motivational properties that can influence instrumental responding as motivators or reinforcers of instrumental responses. After an extensive review of studies which succeeded in controlling instrumental responding

through application of Pavlovian procedures, they conclude that autonomic and instrumental responding are related phenomena and, as such, both are mediated by a common central state. They also suggest that changes in that common central state are subject to the laws of Pavlovian conditioning.

This conclusion is highly significant for a theoretical conception of the processes of observational learning. There are two immediate implications of findings that classical conditioning procedures effectively influence instrumental behaviors and that operant conditioning procedures significantly influence autonomic responses.

The first application is to the theoretical separation of modeling effects and vicarious conditioning effects. "Findings based on vicarious classical conditioning may not be applicable to modeling processes involving instrumental classes of behavior" (Bandura, 1965a, p. 42). The above research would seem to recommend a re-evaluation of this conclusion. Observation of reinforcement may affect autonomic responses, i.e., emotional responses, and a vicarious classical conditioning procedure may affect the imitation of instrumental responses. In addition to lending support for Aronfreed's analysis, it does strongly encourage experiments and a theoretical scheme which combine vicarious emotional instigation, the conditioning of these emotional responses, and imitation and other modeling effects.

Such an approach would direct itself toward investigation of several important questions. It has been noted that responses of the observer during the exposure period have been generally ignored in the experimental literature (Berger, 1966; Berger, Irwin, and Frommer, 1970). In addition to the approach taken by Berger, who measured EMG activity during the

exposure period, one could also measure vicarious emotional instigation and its effect on modeling behavior. The more general question of the effect of arousal on imitation and a determination of which cues in the stimulus field are most salient for the observer could also be investigated by means of the methodology used in vicarious conditioning experiments. We could then distinguish when the affective behavior of the model is the most salient cue for future imitative behavior versus when the reinforcement administered to the model or other environmental cues are most salient for the observer response. Such an approach might also contribute valuable information concerning the differential processes involved in the acquisition and performance of these responses.

Secondly, Bandura (1969a) refers to the curare conditioning experiments as evidence that discounts theories which rely partly or exclusively on the functions of proprioceptive feedback (Mowrer, 1960; Aronfreed, 1968, 1969). "It would seem from these findings that the acquisition, integration, facilitation, and inhibition of responses can be achieved through central mechanisms independently of peripheral sensory feedback" (Bandura, 1969a, p. 131). A more careful examination of the article by Rescorla and Solomon (1967) indicates that their approach does challenge theories which rely exclusively on proprioceptive feedback in that they give major emphasis to the presence of a central state. However,their actual stated conclusion is that "concommitance observed between conditioned responses and instrumental responding is mediated by a common central state, and the changes in that state are subject to the laws of Pavlovian conditioning" (p. 178). That is, these central processes are reflected in either skeletal and/or autonomic changes. It is not clear from discussions of this research that learning can occur without modification of either conditioned responses or

instrumental responses; if the central state is reflected in either skeletal and/or autonomic changes, it does not logically follow that therefore neither one is required for learning. Also, none of the actual experiments which demonstrate this phenomenon promote change without modification of autonomic responses. Although these studies do demonstrate learning in the absence of skeletal responding and its correlated proprioceptive feedback, autonomic nervous system changes are basic to the observed results. The theoretical review briefly noted earlier also indicates that one can not firmly conclude at this time that autonomic changes in human subjects produced through operant conditioning procedures do not involve subtle somatic changes as well. Recent work involving electromyography (Berger, et al., 1970) also challenges a theory based exclusively on cognitive mediation. Therefore, a more appropriate conclusion based on this research is that in addition to the importance of central mediational mechanisms, reinforcement does have an effect on the response of the autonomic nervous system and these autonomic changes may affect future instrumental behaviors.

In retrospect, it appears that on a general level, Bandura's operational definition of what constitutes vicarious learning is a valuable one: "in demonstrating vicarious learning phenomena, it is therefore necessary to employ a nonresponse acquisition procedure in which a subject simply observes a model's behavior, but otherwise performs no overt instrumental responses, nor is administered any reinforcing stimuli during the period of acquisition" (1965a, p. 3). However, in light of the above research, it is apparent that this definition must be continually re-evaluated to include the processes of both somatic and autonomic responses which may occur during the acquisition period.

CHAPTER II

AN EXPERIMENTAL DEMONSTRATION OF VICARIOUS HEART RATE CONDITIONING: PROCEDURE AND METHOD

Purpose

The major conclusion of the previous review chapter was that the role of physiological and/or emotional changes should be given greater consideration in the study of observational learning processes. At present, research on vicarious learning of emotional responses offers some data on vicarious emotional instigation and on the learning of emotions and attitudes. However, this research also offers a paradigm for examining the role of vicarious emotional instigation in other forms of observational learning which involve learning of behavioral responses.

This paradigm is best described by Berger (1962), as he defends the necessity of differentiating between the effects of the various components of the observed situation. The method used in his experiment could be used, for example, to determine when the behavior of the model and/or his affective expression is the most important for the production of matching behavioral responses by the observer. This would involve monitoring of heart rate, skin resistance, respiration, blood pressure, muscle action potential (EMG), and the like.

The relationship of vicarious emotional arousal and modeling could also be investigated by exposing a subject to a procedure involving affective learning, i.e., vicarious conditioning, and also to a procedure involving the acquisition of instrumental behaviors, i.e., modeling. In effect, this approach would control the learning history of the observer

and determine the effect of one form of observational learning on another.

This approach would offer a means of studying the cognitive component of vicarious emotional instigation and the autonomic components of modeling. From a theoretical view, it would insure investigation of not only the cognitive aspects, but also of the autonomic and skeletal changes that occur during the acquisition and performance of observational learning effects.

Assuming the importance of vicarious emotional instigation for modeling effects, it is essential that future research efforts be directed toward greater understanding of this phenomenon. Toward this end, this present study sought to investigate several aspects of vicarious classical conditioning. If we are to establish which components of the observed situation are most salient for the observer's response, it is important to determine which cues may be the basis for the observer's inference of the emotional response of the model. A theoretical problem presented by Berger's analysis is whether we can differentiate between the observer's response to the unconditioned response of the model and his response to the inferred unconditioned emotional response of the model.

The present experiment was designed to investigate the above-mentioned problem and to evaluate the use of heart rate as a measure of vicarious conditioning effects. The major direction of this study is derived from other research on vicarious emotional instigation in which the overt behavior of the model provides the observer with information concerning the emotional state of the model. The attempt here will be to utilize a minimal cue of the model's unconditioned emotional response and to demonstrate that this minimal cue can effectively be the basis of vicarious emotional instigation and the conditioning of this response in the observer.

Specifically, the question to be investigated is whether providing the observer with a more direct access to the model's internal state will be more or less effective in producing vicarious emotional instigation. Schachter and Singer (1962) and Valins (1966) conclude from their studies that internal events can be important sources of information for the individual, as he interprets his own feelings and behavior. Perhaps then cognitive interpretation of one's own physiological responses can be the basis for evaluation of these responses in others.

In light of this research, the sound of a heart was chosen as a minimal cue, signalling the model's unconditioned emotional response, in order to serve two purposes. The first was to investigate changes in heard heart rate as a minimal cue for the occurrence of conditioned vicarious autonomic responses in the observer. Secondly, it is assumed that exposure to changes in model's heart rate, unlike to arm movement, has established meaning for observers. Therefore, use of heart rate provides a test of Berger's paradigm, i.e., are we able to distinguish between observer response to the unconditioned response and the unconditioned emotional response of the model when a meaningful response is exhibited by the model.

Cardiac Response as a Measure of Vicarious Conditioning

Given the importance of physiological aspects of observational learning, an emphasis should also be placed on the use of a variety of measures of autonomic change. One physiological response which has been shown to be an indicator of central processes and a significant mediator of man's interaction with his environment is heart rate. There is a large body of empirical research which indicates that heart rate change varies consistently with certain emotional and cognitive states of an individual.

Therefore, reliable inferences may be drawn from observation of certain consistent heart rate patterns.

Lacey, Kagan, Lacey, and Moss (1963) found that heart rate decelerations occurred when the experiment demanded that the subjects attend to visual and auditory inputs. However, heart rate accelerated when subjects were required to solve mental arithmetic problems or when they received a painful stimulus. They interpret these results to mean that cardiac deceleration accompanies and perhaps facilitates ease of "environmental intake," whereas cardiac acceleration is related to "rejection of the environment." That is, when subjects needed to receive inputs without demands for cognitive elaboration, storage, and/or retrieval, cardiac deceleration occurred. However, manipulation of symbols and retrieval of stored information led to cardiac acceleration. They found that if the experimental task consisted of both receiving input and cognitive elaboration, heart rate lay between that which occurred with rejection and that which occurred with intake. Also, if input was required but was aversive, there would be a balanced intermediate effect. Therefore, their studies established that the pattern of the heart rate response can be shown to be dependent on stimuli or tasks of the situation, with acceleration of heart rate decreasing the effectiveness of external stimuli and deceleration of heart rate facilitating sensory receptivity.

Lacey's hypothesis is supported by Porges and Raskin (1969) who found that attention to mild external stimuli was associated with decelerated heart rate whereas attention to internal stimuli was associated with acceleration of the cardiac response.

A large number of studies have investigated cardiac response to anxiety. Most have found that heart rate acceleration is associated with general anticipation of the noxious stimulus; however, expectation of the

noxious stimulus at a specific time creates a decelerative heart rate response just prior and during the expected time of the aversive stimulation (Deane, 1961, 1965, 1969; Elliott, 1966; Hodges and Spielberger, 1966; Obrist, Wood, and Perez-Reyes, 1965; Lacey, 1967; Wilson, 1964). Heart rate deceleration has been found in anticipation of both aversive and non-aversive stimuli (DeLeon, 1964; Hastings and Obrist, 1967; Wood and Obrist, 1964, 1968).

Wilson (1969) performed an extensive analysis of the cardiac response during classical conditioning. He concludes that the responses obtained during training and extinction are a combination of the spontaneous response to the CS and the UCS plus the conditioned response which is gradually established by pairing of the CS and UCS. The extent of the decelerative response during training depends on the original direction of the response to the UCS. For a shock UCS, the initial response is accelerative and therefore repeated trials for habituation and predictability are necessary to overcome the acceleration and produce the decelerative response. Then, since the response to shock is directionally opposed to that response being established through training, the curve on any given trial is a function of both the declining potency of the shock and the increased predictability of the shock occurrence. On the other hand, when predictability is established for an UCS that itself produces a decelerative response, i.e., noise, the two combine to cause a sharp deceleration.

The importance of cognitive factors in heart rate effects has been discussed by Lazarus, Deese, and Osler (1952), Ax (1964), and Lazarus and Opton (1966). Hodges and Spielberger (1966) conclude that cognitive interpretation of the situation is an important factor since they found that general anxiety level was not related to heart rate response or to threat of

shock but that fear of shock subjects had greater heart rate acceleration than those subjects who reported little or no fear of shock.

Lewis and Wilson (1970) found that cardiac deceleration occurs during the selection process from the stimulus field. However, the heart rate returns to base level if the subject's selection response is labeled as correct by the experimenter; it remains depressed if they are told that the selection response is incorrect. Based on these results, they suggest that three factors are important for cardiac responsivity: (1) the intent of the subject, i.e., taking-in or rejecting, (2) the subject's state; IQ and personality variables, and (3) the objective environmental situation, i.e., difficulty.

Obrist, Webb, and Sutterer (1969) suggest that both heart rate and somatic motor activity have a common central origin in that both are initiated by the same central processes. They gain support for this conclusion from studies of conditioning which demonstrate that cardiac changes can occur with skeletal and respiratory responses controlled (Black, 1965, 1967; Miller and DiCara, 1967). They interpret these results to indicate that cardiac change is related to somatic activity at a central level.

That cardiac response is indicative of central processes and thereby plays an important role in determining the behavioral consequences of a vicarious experience, is suggested by Craig (1968). He compared the effect on arousal of direct, imagined, and vicarious stress experiences and found heart rate changes in different directions for the various conditions. Heart rate taken during the test periods accelerated above the resting level for the imagined and direct stress conditions but decelerated for the vicarious stress condition. This finding is consistent with Lacey, et al., (1963), and suggests that cardiac deceleration reflects in-

creased sensitivity to environmental inputs, which is indicative of the operation of central processes and the important role played by cognitive processes in the vicarious experience.

Finally, Craig and Lowery (1969) investigated heart rate response in a situation much like Berger's. Subjects were told that they would watch another subject who would be presented with a series of pictures, which he was to remember, and that during some of the pictures either (1) the other subject would be shocked, (2) the other subject would be shocked and that later the actual subject would also be shocked, or (3) the other subject would be told to jerk his arm. They found that there was a significant increase in heart rate for the group who believed that they would also receive shock. However, the groups that just saw arm movement or just watched someone else being shocked produced heart rate deceleration.

The above review of heart rate literature suggests the value of the use of heart rate as a reliable measure of change and also the importance of the investigation of heart rate change as a cue in vicarious learning. Therefore, this study will investigate the use of heart rate as a measure within a vicarious conditioning experiment.

In summary then, the major purposes of this study were (1) to determine if information about changes in heart rate of a model, interpreted by the observer as caused by either noxious or non-noxious antecedents, is sufficient for producing vicarious conditioning, and (2) to examine the use of heart rate of the observer as a measure of vicarious conditioning.

Preliminary Investigation

This problem was first investigated by this writer in a pilot study (Kravetz, 1970). In this study, eighteen male subjects participated in a vicarious conditioning experiment based on Berger (1962). The study

utilized Berger's theoretical controls and was a modification of his aversive conditioning situation. As in Berger, subjects were observers to an aversive conditioning experiment; however, they only had auditory access to this information. That is, subjects only heard cues that would be prevalent in an aversive conditioning experiment. Also, instead of arm movement as in Berger's experiment, they were presented with the heart rate of the model, as it ostensibly changed with the model's emotional response to the shock. Therefore, in addition to presentation of a minimal cue of the model's response, there is also minimal information about the entire "observed" situation. In essence, we have an imagined vicarious experience, with minimal direct cues of both the observed situation and the emotional response of the model within that situation.

Three conditions were provided to meet theoretical requirements suggested by Berger. In the experimental condition, ΔHR-Sh, the observers were led to believe that they would be hearing the heart of a subject who was in a heart rate conditioning experiment, with shock as the UCS and a tone as the CS. Two control conditions were used. In one, ΔHR-NoSh, the observers were told that they would be hearing the heart of a subject who was merely doing a series of brief exercises after the presentation of the tones. In both of these conditions, subjects heard a heart with changes in the rate following the UCS. In the second control condition, NoΔHR-Sh, the instructions were identical to those in the experimental group, but the heart these observers heard contained no rate changes following the UCS. Galvanic skin response and heart rate of the observer were taken as measures of vicarious conditioning. A complete description of this study can be found in Appendix A. In general, results suggested that heart rate of a model is a salient cue for the occurrence of vicar-

ious conditioning and that a vicarious response can be instigated by minimal cues of the observed situation.

Method of the Present Study

Although the previous study did demonstrate the basic phenomenon in which we are interested, it is evident that more stringent control groups and a more sensitive measure of heart rate would be valuable. Therefore, a number of modifications are offered in this replication and expansion of the preliminary study.

Two major changes were made in the design of the experiment; one condition was significantly altered and one control condition was added to the design.

In the previous investigation, the condition involving exercises was offered as a control. However, it could be argued that exercises are a meaningful activity for male subjects and therefore would significantly alter both their cognitive and physiological responses to "observation" of that experience. The results of the preliminary study seem to indicate that the exercise condition did actually serve as another experimental treatment rather than as a control condition. However, if this condition is to serve as a control for response to the unconditioned response of the model, in this case heart rate change, it is necessary that the presentation of the stimuli within the experimental situation be neutral; subjects' responses to increases in heart rate would then reflect their own conditioned responses to that cue with minimal interference from the experimental manipulation. To this end, a neutral reason for the increases in heart rate was presented, i.e., that the model was viewing slides of nonsense syllables.

In addition to the theoretical controls used in the previous study,

it was decided that a sensitization control group would be necessary to establish the presence of a true conditioning effect. Since the classical conditioning paradigm has temporal association of the CS and the UCS as one of its essential elements, the lack of associative factors is an important control condition in a test of conditioning. Although previous studies have assumed a conditioning effect (Berger, 1962; Bandura and Rosenthal, 1966), none have used a sensitization control to establish whether generalized arousal or actual conditioning was responsible for their results. Therefore, in this study, one condition was presented wherein the CS and UCS were not paired.

The third major modification of this study was a more precise measure of heart rate change. A beat-by-beat measure was taken for six seconds before and twelve seconds after the CS.These measures allow separate analysis of responses during different periods of the vicarious experience and provide data for analysis of both tonic and phasic heart rate changes. Due to the lack of significant GSR results in the preliminary investigation, this measure was not taken in the present study.

In order to minimize personal contact between the experimenter and subjects, the instructions were presented by tape and were simplified and clarified. Also, a written questionnaire was administered at the end of the experiment rather than the interview method used previously.

Other changes are that this study used a larger sample, paid subjects, a shorter schedule for the conditioning procedure, and two confederates rather than one.

Direct Heart Rate Conditioning Experiment

For the purposes of this study, direct heart rate conditioning under the same laboratory conditions as those used in the vicarious conditioning

experiment was first demonstrated. If vicarious conditioning effects were not obtained, one could then state that the particulars of the vicarious conditioning experiment were responsible for the lack of significant results rather than a general inability to produce heart rate conditioning under our laboratory conditions. A direct heart rate conditioning experiment was carried out with a sample of twelve male subjects.

This experiment consisted of two conditions, an experimental condition and a sensitization control. The experimental condition involved eighteen trials, nine adaptation, in which the tone CS was presented alone, and nine training trials, in which the tone CS was paired with a white noise UCS. A delay procedure was used; the tone CS (75db, 1000-Hz) lasted 5-seconds, and for the paired trials, the UCS (white noise, 99 db) was administered immediately after the CS and lasted 2-seconds. The sensitization procedure consisted of nine adaptation trials, nine CS alone trials, and nine UCS trials presented alone. Each trial for both conditions was initiated by the experimenter at 30-second intervals, with all stimulus events controlled by timers (Wilson, 1969). Heart rate of subjects was recorded by a Beckman Type R Dynograph.

Measures were taken of the linear distance between successive pulses on the EKG record (R-R interval scores) during the interstimulus interval (CS-UCS) for each subject on every trial.

The raw scores for the points of maximum change, which occurred post-CS and pre-UCS, were used for measurement of the cardiac response. The beat of maximum acceleration ($R\text{-}R_A$) which occurred in the first five seconds of a trial and the beat of maximum deceleration ($R\text{-}R_D$) which occurred after the accelerative beat and before UCS onset were recorded for each subject on every trial (Geer, 1964). Analysis of variance performed on

the $(R-R_D)-(R-R_A)$ difference scores across adaptation and training trials, indicated that conditioning of the heart rate response was obtained (see Table I). Simple effects tests indicated significant differences in the difference scores of adaptation and conditioning trials under the experimental condition ($F = 6.75$, $df = 1/170$, $p < .01$), but for the sensitization control condition no significant effects for the same comparison were obtained ($F = 1.26$, $df = 1/170$, ns). These results established that cardiac conditioning could be obtained in the present setting.

TABLE I

ANALYSIS OF VARIANCE FOR DIRECT HEART RATE CONDITIONING EXPERIMENT

Source	df	MS	F	P
Between subjects (A)	1	20.78	1.84	ns
Error between	10	11.31		
Within subjects (B)	17	6.18	1.73	<.05
Adaptation × Training (B_1)	1	3.90	1.09	ns
Trials within blocks (B_2)	8	6.43	1.80	ns
$B_1 \times B_2$	8	6.23	1.75	ns
A × B	17	7.52	2.11	<.01
$A \times B_1$	1	24.67	6.91	<.01
$A \times B_2$	8	5.93	1.66	ns
$A \times B_1 \times B_2$	8	6.95	1.95	ns
Error within	170	3.57		

Vicarious Heart Rate Conditioning Experiment

Subjects

The subjects were forty-eight males, ages 17-21, drawn from the paid subject pool at The University of Michigan. Each subject received $1.50 for his participation in this experiment.

Materials

Audio tapes were used to present instructions and the various conditions to subjects. Presentation of stimuli was based on the heart rate conditioning experiment of Wood and Obrist (1964), modified for purposes of a vicarious instigation experiment, and consisted of all auditory cues that would be present in an aversive conditioning experiment. The tapes consisted of a series of 1-sec. tones, 1000-Hz, which were presented as the CS, and a burst of white noise, which was presented to subjects as either the sound of a shock machine or as the sound of a slide projector. As subjects were also listening ostensibly to the heart rate of the subject in the direct conditioning experiment, a simulated heart rate, amplified from an electronic metronome, was presented at approximately 72 bpm.

Four stereo tapes were used to present the conditions used in this experiment. Three conditions corresponded to those in the preliminary investigation (ΔHR-Sh, NoΔHR-Sh, ΔHR-NoSh) and one was a sensitization control (Sen.). Instructions identified the various auditory cues for the subjects.

In ΔHR-Sh, NoΔHR-Sh, and ΔHR-NoSh, ten consecutive adaptation trials were followed by ten training trials, seven conditioning (trials 11, 13, 14, 16, 17, 18, 19) and three test (trials 12, 15, 20). During adaptation and test trials, the tone was presented and followed by continuation

of the heart rate at 72 bpm. For conditions ΔHR-Sh and ΔHR-NoSh, during conditioning trials, the tone was followed by a 6-sec. presentation of the sound of a shock machine or slide projector, after which the simulated heart rate was noticeably increased for 10-sec. For condition NoΔHR-Sh, the 6-sec. presentation of the sound of the shock machine was never followed by a noticeable increase in heart rate. The interstimulus interval (CS-UCS) was 6-sec. and the intertrial interval during adaptation and training trials averaged 40-sec. for these three conditions.

For the sensitization control, ten consecutive adaptation trials were followed by fourteen training trials: seven presentations of the CS alone (trials 12, 14, 16, 19, 20, 22, 23) and seven presentations of the UCS (shock and heart rate change) alone (trials 11, 13, 15, 17, 18, 21, 24). For the ten adaptation trials and the seven CS alone trials, the tone was presented and followed by continuation of the heart rate at 72 bpm. For the UCS alone trials, the 6-sec. presentation of the sound of the shock machine was followed by a noticeable 10-sec. change in heart rate. The intertrial interval averaged 30-sec.

A Kodak Carousel Programmer, Model 1, was used as the source for a .5-sec. tone (6.5 kHz), which was recorded on the second channel of the tape at points of CS and UCS onset and used to activate the event marker on the oscillograph.

Procedure

Four separate groups were used to test the hypotheses of this study. The experimental condition, ΔHR-Sh, was essentially the same as that used in the preliminary study. Subjects were led to believe that they would hear the heart rate of another subject who was participating in a heart rate conditioning experiment, with shock as the UCS and a tone as the CS. Three control conditions were used. One control condition was the sensi-

tization group, in which there was the unpaired presentation of the tone and the shock followed by changes in heart rate of the model. The second control condition, NoΔHR-Sh, was identical to the one used in the preliminary investigation. Instructions were the same as those for the experimental group, but the heart rate heard by these subjects did not noticeably change after UCS presentation. In the third control condition, ΔHR-NoSh, subjects were told that they would be hearing the heart rate of another subject who was seeing a series of nonsense syllables presented by slides. Subjects were randomly assigned to one of these four conditions.

As in the previous study, a confederate was used to increase the credibility of the experimental situation. In this study, the experiment was conducted by one female experimenter and two male confederates. Each confederate was limited to being paired with fifty-percent of the subjects in each condition; however, subject and confederate pairs were randomly assigned within this fifty-percent limit.

The male confederate posed as another subject involved in the experiment and briefly spoke with the actual subject as they waited for the experimenter to arrive. During this time, the confederate would informally explain his role in the experiment. In conditions involving shock, the confederate would state that he had participated in the first half of this study the day before, during which he had been administered a series of shocks. He would explain that he knew that his role now would also involve shock. For the nonsense syllable condition, ΔHR-NoSh, the confederate would enter the waiting area and act as any uninformed subject might. He would briefly speak to the actual subject to equalize for the effect of interpersonal contact between the model and the observer across the conditions.

After a short time, the experimenter would enter and ask the actual subject to follow her to the experimental room. She told the confederate subject that her assistant would be with him in a moment. Such an "assistant" was invented to reduce the amount of time necessary between placing the subject in the room and beginning the experiment. No subject seemed to doubt the existence of the assistant.

Two small experimental rooms (8' x 8') were used to complete the simulation. The subject was briefly shown the room where the other subject would ostensibly be placed and was given an opportunity to view the formidable equipment that had been assembled for his benefit.

When the subject entered his own room, the door was closed and he was seated at a table. He was told that his heart rate would be measured throughout the experiment; conventional EKG strap electrodes were attached: two recording electrodes to the right inner wrist and left calf and a ground electrode to the right calf, using Sanborn electrode paste. He was told that both he and the other subject would be given instructions at the same time through earphones, which he was then told to put on and leave on throughout the experiment.

No mention was made of the purpose of the experiment nor was any reference made to the conversation between subjects. If the subject asked, however, if he would be shocked, he was assured that he would not be shocked and told that further detail would be given to both subjects at the same time. The attempt was made to vary as little as possible from the routine described above. All subjects who made specific reference to the purpose of the experiment, or to the conversation with the other subject, seemed satisfied to wait for instructions.

The subject's EKG activity was recorded on a Beckman Type R Dynograph. The paper speed of the oscillograph was 50 mm per sec. and amplifier

sensitivity was 10 millivolts per centimeter. Heart rate was monitored continuously throughout the session.

After leaving the subject, the experimenter activated the tape recorder and instructions were presented to subjects through earphones. The instructions presented all necessary information to the subject, identifying both the experimental situation and the cues that he would hear. In the instructions, the confederate subject was ostensibly told what his role would be, i.e., that he would either receive a series of shocks (ΔHR-Sh, Sen., and NoΔHR-Sh) or would be presented with a series of slides (ΔHR-NoSh). He was also told that he would hear his own heart rate throughout the experiment. This procedure described the situation to the actual subject and also established the presence of the other subject within the experimental situation. The actual subject was then told that he was a control and as such would hear everything that the other subject would hear; the only difference between subjects would be the actual experience with the shock (ΔHR-Sh, Sen., and NoΔHR-Sh) or the slides (ΔHR-NoSh). This was used to assure the actual subject that he would not be shocked, to describe the experiment again so that he would be able to identify the various auditory cues, and to present a plausible reason for his presence. The exact instructions given to subjects can be found in Appendix B.

After the instructions were presented, the experimenter activated the oscillograph. The tape then presented all experimental simuli, as described above. Also, on playback, the Kodak Programmer detected the previously recorded 6.5 kHz signals in the output from the tape recorder. At these points, a relay was closed to cause the event marker on the EKG machine to be activated and mark the points of CS and UCS onset on the subject's record.

At the conclusion of the tape, the experimenter entered the subject's room and removed the electrodes.

The subject was then given a brief form to complete. Any subject who noted on this form or mentioned to the experimenter that he did not believe that there was another subject, or did not believe that he had been listening to the heart rate of another subject, was excluded from the sample. A copy of this form can be found in Appendix C. Its major purpose was to establish whether subjects accepted the cover story, if they believed that they were listening to the heart rate of another subject, and to get some impression of their thoughts about the other subject and about the experiment in general.

CHAPTER III

AN EXPERIMENTAL DEMONSTRATION OF VICARIOUS HEART RATE CONDITIONING: RESULTS AND DISCUSSION

Results

Heart rate was measured during the interval beginning 6-sec. before and terminating 12-sec. after CS onset. Measures were taken of the linear distance between successive pulses on the EKG record (R-R interval scores) during this 18-sec. interval for each subject on every trial; all analyses were performed on the original measures in millimeters (Wilson, 1969).

Scoring of all records was performed by two coders. Previous to the scoring, guidelines for measuring the linear distance between beats were established by the experimenter in an attempt to reduce the amount of individual judgment required by the coders. After all records were scored, two records from each condition that were scored by one of the coders were randomly chosen and assigned to the other coder for independent scoring. A correlation coefficient (r) measured the degree of agreement between the two coders in the scoring of these sixteen records; scoring reliability was 95-99%.

The mean of the distances between all pairs of successive beats occurring wholly within the following three 6-sec. intervals was calculated in millimeters: interval (A), 6-sec. prior to CS onset; interval (B), 6-sec. immediately following CS onset and preceding UCS onset; and interval (C), 6-sec. during which the shock was ostensibly administered or

during which the slides were ostensibly being presented.

Three approaches to the data were taken. First, tonic heart rate was viewed as a measure of differences in overall arousal level of subjects. Data consisted of the mean heart rate during interval (A) and was calculated separately for adaptation, conditioning, and test trials over all four conditions.

Secondly, the occurrence of conditioning was determined in terms of the anticipatory response to the UCS in the interstimulus interval, as it differed between conditions on training trials and also as it differed within conditions from adaptation to conditioning. The data consisted of the differences between subjects' mean heart rate during interval (B) and interval (A); this was calculated separately for adaptation and training trials over all four conditions.

Thirdly, the occurrence of differential responses to the cues signalling the emotional response of the model and to the shock was determined by analysis of data during interval (C). These data consisted of subjects' mean heart rate during interval (C) and were calculated separately for adaptation, conditioning, and test trials for all conditions.

Tonic Heart Rate

The overall experimental results are plotted in Figure 2 for all groups, with the mean heart rate in each of the three measurement intervals calculated for each type of trial. The mean heart rate and variance for the three measurement intervals across adaptation, conditioning, and test trial blocks for the four conditions can be found in Table 2.

Inspection of Figure 2 reveals that the four groups ordered them-

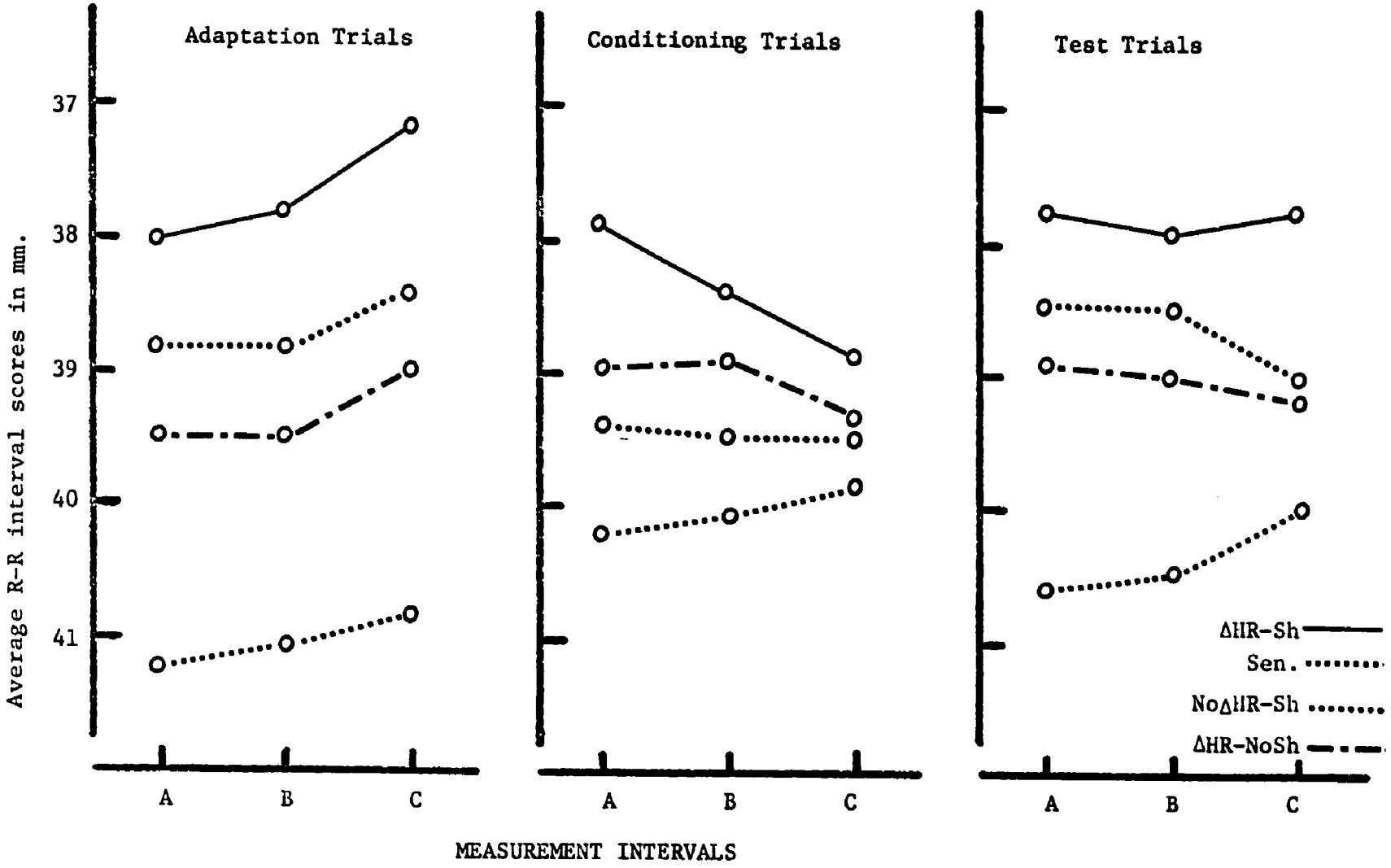


Figure 2. Average R-R interval scores in mm. across adaptation, conditioning, and test trial blocks for the four conditions. Measurement interval A: from 6-sec. pre-CS onset to CS onset; measurement interval B: from CS onset to UCS onset (6-sec.); measurement interval C: from UCS onset to UCS offset (6-sec.)

Table 2

MEAN HEART RATE AND VARIANCE FOR THE A B C MEASUREMENT INTERVALS ACROSS ADAPTATION, CONDITIONING, AND TEST TRIALS FOR THE FOUR CONDITIONS

(Measured in mm.)

	TRIAL BLOCKS								
	Adaptation Trials			Conditioning Trials			Test Trials		
PHASE	A	B	C	A	B	C	A	B	C
CONDITION									
ΔHR-Sh									
Mean	37.9994	37.8195	37.2289	37.9211	38.4849	38.8033	37.7579	37.9440	37.7082
Variance	38.9570	35.8911	36.1455	32.8364	34.1995	33.3677	37.3130	29.3469	26.7739
Sen.									
Mean	41.3282	41.1752	40.8607	40.3638	40.1201	39.8065	40.6931	40.5225	40.0802
Variance	77.1609	75.7749	72.3816	69.5083	65.6863	65.8503	66.3645	68.3508	67.5122
NoΔHR-Sh									
Mean	38.8531	38.8449	38.4788	39.4700	39.5182	39.5739	38.5861	38.5220	39.1408
Variance	37.5278	33.1287	32.8679	25.2046	25.7517	21.0054	23.0930	22.0854	24.0583
ΔHR-NoSh									
Mean	39.4970	39.5013	39.0296	39.0246	38.9288	39.4614	38.9563	39.0692	39.2454
Variance	31.6267	32.8213	28.5569	24.9307	26.1106	27.9905	23.2041	26.5361	28.9680

selves consistently over the three blocks of trials, with the experimental group, ΔHR-Sh, always manifesting the highest heart rate and the sensitization control, Sen., having the lowest heart rate. However, analysis of variance of tonic heart rate levels (measure A) failed to yield any significant differences between the four conditions or between the adaptation, conditioning, and test trial blocks. Also, significant interaction effects were not obtained (Table 3).

Table 3

ANALYSIS OF VARIANCE FOR TONIC HEART RATE FOR THE FOUR CONDITIONS

Source	df	MS	F
Between subjects			
Conditions	3	51.6909	<1.0
Error between	44	129.2843	
Within subjects			
Trials	2	2.1311	1.1454
Trials × Conditions	6	1.4803	<1.0
Error within	88	1.8606	

Anticipatory Heart Rate

Conditioning of the cardiac response was determined by analysis of anticipatory responses occurring during the CS-UCS interval (B-A measure).

Based on previous findings in heart rate conditioning studies, a decelerative response in the interstimulus interval was predicted. Figures 3,4, 5, and 6 depict difference scores (B-A) of mean heart rate from 6-sec. pre-CS (A) to 6-sec. post-CS (B) across adaptation and conditioning trials for the four conditions. Heart rates during adaptation trials for all conditions show large variations in these B-A differences across trials, with cardiac deceleration on some trials and acceleration on other trials. When adaptation trials were analyzed across two trial blocks (trials 1-5 vs 6-10), although there was a significant block effect, due to habituation of cardiac deceleration over the two trial blocks ($F = 5.4086$, $df = 1/44$, $p < .05$), neither significant Conditions nor Conditions X Blocks ($F = 1.1168$, $df = 3/44$, ns) effects were obtained (Table 4).

Table 4

ANALYSIS OF VARIANCE OF B-A SCORES FOR ADAPTATION TRIALS IN TWO BLOCKS OVER THE FOUR CONDITIONS

Source	df	MS	F
Between subjects			
Conditions	3	.2604	<1.0
Error between	44	1.0615	
Within subjects			
Trials	1	4.5416	5.4086*
Trials x Conditions	3	.9378	1.1168
Error within	44	.8397	

*$p < .05$

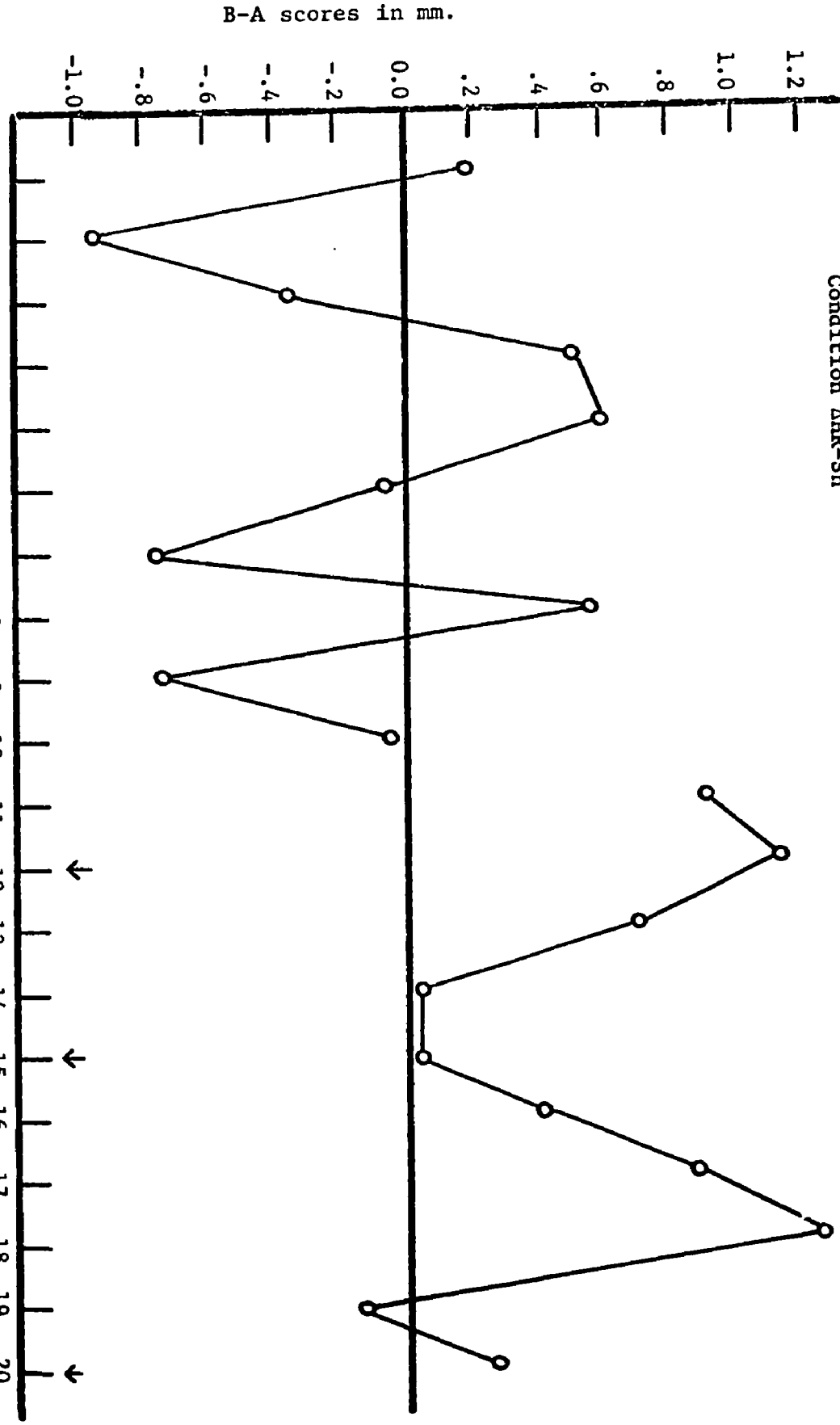


Figure 3. B-A scores in mm. for Condition ΔHR-Sh. Points above 0.0 on the difference score axis (B-A) indicate cardiac deceleration; points below 0.0 indicate cardiac acceleration. The arrows above the training trials identify the test trials.

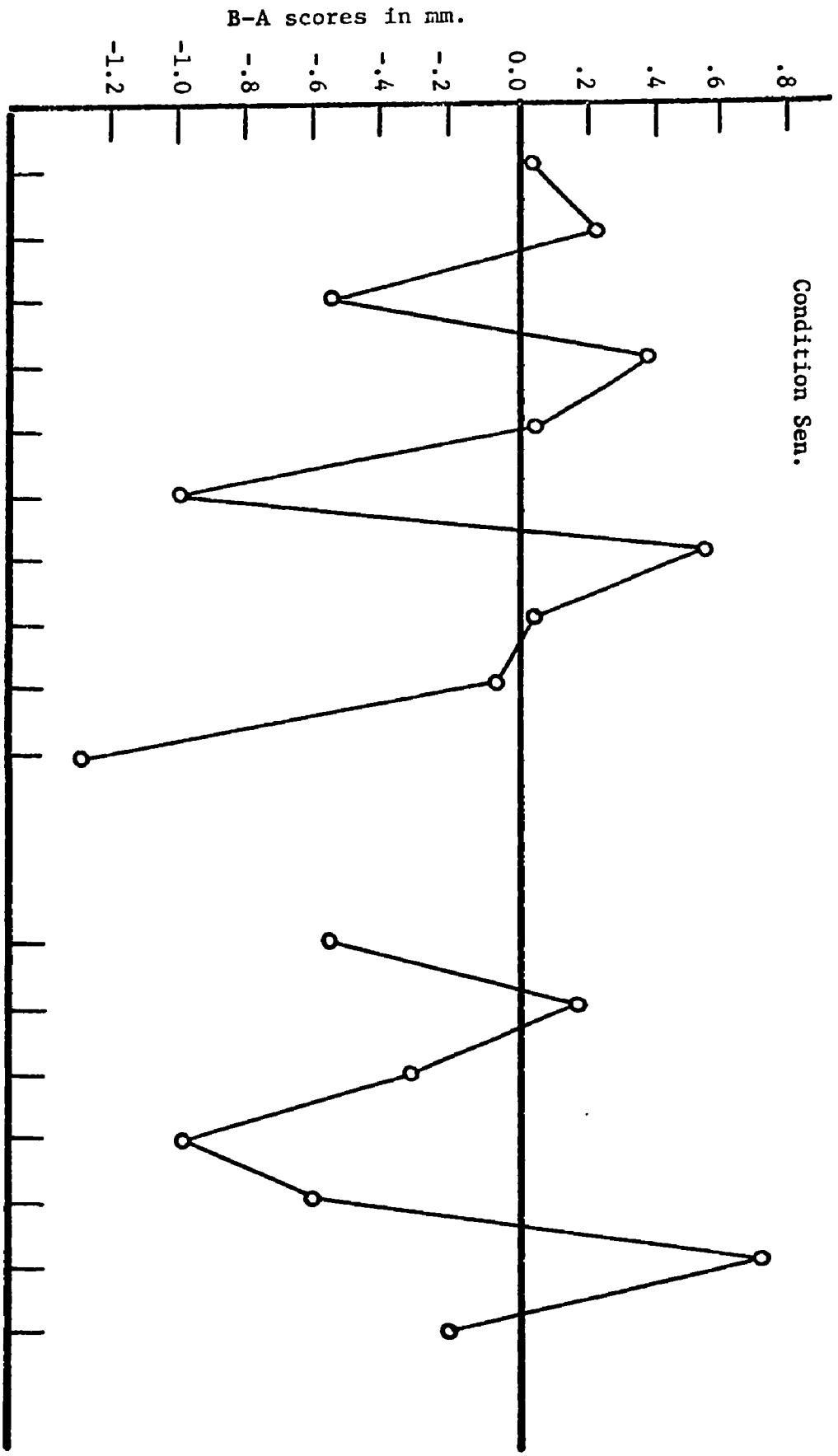


Figure 4. B-A scores in mm. for the sensitization control condition. Points above 0.0 on the different score axis (B-A) indicate cardiac deceleration; points below 0.0 indicate cardiac acceleration.

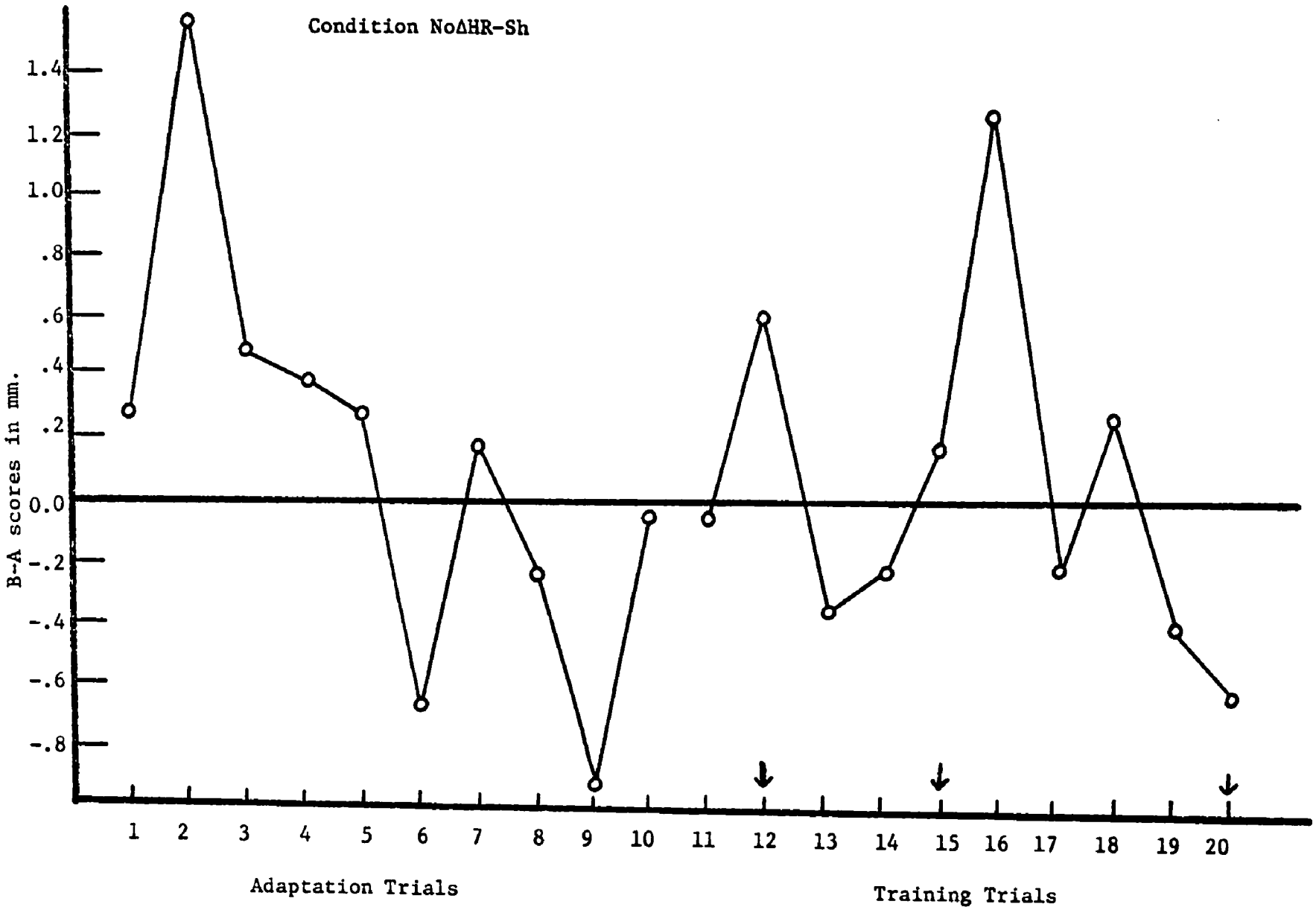


Figure 5. B-A scores in mm. for Condition NoΔHR-Sh. Points above 0.0 on the difference score axis (B-A) indicate cardiac deceleration; points below 0.0 indicate cardiac acceleration. The arrows above the training trials identify the test trials.

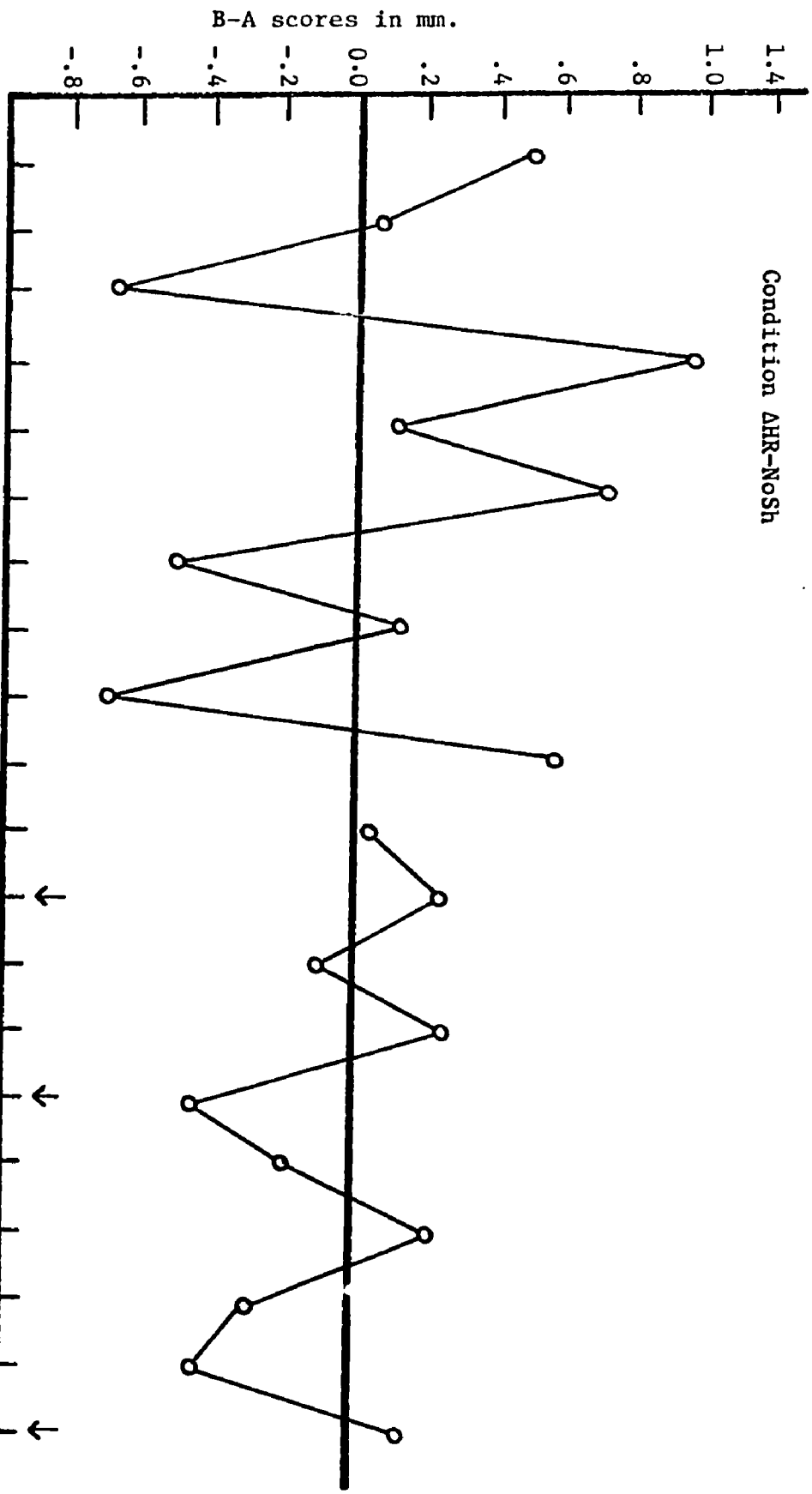


Figure 6. B-A scores in mm. for Condition ΔHR-NoSh. Points above 0.0 on the difference score axis (B-A) indicate cardiac deceleration; points below 0.0 indicate cardiac acceleration. The arrows above the training trials identify the test trials.

Examination of the training portion of Figures 3, 4, 5, and 6, trials 11-20, indicates that the largest decreases in heart rate during the interstimulus interval appear during training trials for conditions in which the tone CS and a "shock" UCS were paired. The decrease associated with the experimental condition, ΔHR-Sh, is substantially greater than that in Condition NoΔHR-Sh. Analysis of variance of B-A scores over the first and second half of training trials for the four conditions (Table 5) indicated only that there were significant differences between groups ($F = 3.3108$, $df = 3/44$, $p < .05$).

Table 5

ANALYSIS OF VARIANCE OF B-A SCORES FOR TRAINING TRIALS IN TWO BLOCKS OVER THE FOUR CONDITIONS

Source	df	MS	F
Between subjects			
Conditions	3	2.5079	3.3108*
Error between	44	.7575	
Within subjects			
Trials	1	.2368	<1.0
Trials × Conditions	3	.4714	<1.0
Error within	44	.9949	

*$p < .05$

An a posteriori analysis of the differences between the experimental condition and each of the control groups over training trials revealed that significant differences appeared only between the experimental and the sensitization control conditions ($F = 8.0733$, $df = 1/22$, $p < .05$) and the experimental condition and NoΔHR-Sh groups ($F = 5.7401$, $df = 1/22$, $p < .05$) (See Tables 6 and 7).

Table 6

ANALYSIS OF VARIANCE OF B-A SCORES FOR TRAINING TRIALS IN TWO BLOCKS FOR CONDITIONS ΔHR-Sh AND SEN.

Source	df	MS	F
Between subjects			
Conditions	1	20.4384	8.0733*
Error between	22	2.5316	
Within subjects			
Trials	4	5.9456	1.4547
Trials × Conditions	4	2.3426	<1.0
Error within	88	4.0873	

* $p < .05$

Table 7

ANALYSIS OF VARIANCE OF B-A SCORES FOR TRAINING TRIALS IN TWO BLOCKS FOR CONDITIONS ΔHR-Sh AND NoΔHR-Sh

Source	df	MS	F
Between subjects			
Conditions	1	5.7011	5.7401*
Error between	22	.9932	
Within subjects			
Trials	4	4.2737	1.3024
Trials × Conditions	4	3.7312	1.1370
Error within	88	3.2815	

* $p < .05$

The differences between the experimental group, ΔHR-Sh, and the slide condition, ΔHR-NoSh, did however approach significance ($F = 4.2310$, $df = 1/22$, $p < .10$) (See Table 8).

Therefore, the anticipatory response to the UCS shows a significant deceleration following CS onset during training trials of the experimental condition only. That the experimental group and the sensitization control group did significantly differ establishes that paired presenta-

tion of the CS and UCS was essential for obtained results. Therefore, these results tend to support the major hypothesis of this study, i.e. that the various conditions would produce differential effects by the classical conditioning process.

Table 8

ANALYSIS OF VARIANCE OF B-A SCORES FOR TRAINING TRIALS IN TWO BLOCKS FOR CONDITIONS ΔHR-Sh and ΔHR-NoSh

Source	df	MS	F
Between subjects			
Conditions	1	7.0180	4.2310*
Error between	22	1.6587	
Within subjects			
Trials	4	3.2311	<1.0
Trials × Conditions	4	2.0576	<1.0
Error within	88	3.3815	

* $p < .10$

Examination of B-A scores for adaptation and training trials clearly indicates that the different treatments produced distinguishable effects.

As noted above, B-A scores over adaptation trials did not differ across conditions but there were significant differences during training. Table 9 lists average B-A differences for the four conditions over adaptation and training trial blocks. Examination of the table indicates a small and accelerative change to CS onset for the sensitization condition, little change in the other two control conditions (ΔHR-NoSh and NoΔHR-Sh), and a definite decelerative change for the experimental condition, ΔHR-Sh, from adaptation to training.

Table 9

AVERAGE B-A DIFFERENCES IN MM. FOR THE FOUR CONDITIONS ACROSS ADAPTATION AND TRAINING TRIALS

	TRIAL BLOCKS	
CONDITIONS		
	Adaptation	Training
ΔHR-Sh	-0.1864	0.4505
Sen.	-0.1529	-0.2228
NoΔHR-Sh	0.0010	0.0146
ΔHR-NoSh	0.0043	-0.0332

As shown in Table 10, analysis of variance of B-A scores across adaptation and training trial blocks over the four conditions did not yield a significant effect. However, there were reliable differences in B-A scores over adaptation and training trial blocks for the different

groups. Separate analyses indicated significant Group X Blocks interactions between the experimental group and conditions Sen., NoΔHR-Sh, and ΔHR-NoSh ($F = 4.9600$, $df = 1/22$, $p < .05$; $F = 5.0164$, $df = 1/22$, $p < .05$; $F = 5.9044$, $df = 1/22$, $p < .05$ respectively). These three analyses can be found in Tables 11, 12, and 13. Simple effects tests on these three analyses indicated that there were only significant differences between adaptation and training in the experimental condition ($F = 8.0549$, $df = 1/22$, $p < .01$; $F = 10.4733$, $df = 1/22$, $p < .01$; $F = 10.5308$, $df = 1/22$, $p < .01$ respectively). These results can be taken to indicate that conditioning was accomplished only for the subjects in the ΔHR-Sh group; no differences between adaptation and training were found for subjects in the three control conditions. Therefore, in terms of a conditioned anticipatory response to the UCS, the experimental condition produced the only response which significantly differed from that which occurred during adaptation and which significantly differed in degree and direction from response patterns shown in other conditions during training.

These results support the hypothesis that heart rate ostensibly associated with the model's unconditioned emotional response is a salient cue which can serve as the basis for vicarious classical conditioning. This minimal cue of the model's response and a minimal presentation of the "observed" situation were effective in obtaining vicarious conditioning effects. Several other conclusions can be drawn on the basis of these results as well. One is that heart rate is a useful measure of observer response, as it served to differentiate between the various treatment effects. A trace conditioning paradigm producing direct conditioning of heart rate with a shock UCS (Wood and Obrist, 1964) was also effective in obtaining conditioning with a vicariously elicited UCR. Also, the changes

support the conclusion that differentiation can be made between subject response to the unconditioned response of the model, i.e. changes in the model's heart rate alone, and an inferred unconditioned emotional response of the model, i.e. these heart rate changes accompanied by the knowledge of their appropriate antecedents. Therefore, in an experimental setting with proper controls, we are able to distinguish between subject responses to the various components of the entire situation.

Table 10

ANALYSIS OF VARIANCE OF B-A SCORES ACROSS ADAPTATION AND TRAINING TRIAL BLOCKS FOR THE FOUR CONDITIONS

Source	df	MS	F
Between subjects			
Conditions	3	.4162	<1.0
Error between	44	.5840	
Within subjects			
Trials	1	.4424	1.4080
Trials × Conditions	3	.6768	2.1540
Error within	44	.3142	

Table 11

ANALYSIS OF VARIANCE OF B-A SCORES ACROSS ADAPTATION AND TRAINING TRIAL BLOCKS FOR CONDITIONS ΔHR-Sh AND Sen.

Source	df	MS	F
Between subjects			
Conditions	1	1.2280	2.1499
Error between	22	.5712	
Within subjects			
Trials	1	.9645	3.1916
Trials × Conditions	1	1.4989	4.9600*
Error within	22	.3022	

* $p < .05$

Table 12

ANALYSIS OF VARIANCE OF B-A SCORES ACROSS ADAPTATION AND TRAINING TRIAL BLOCKS FOR CONDITIONS ΔHR-Sh AND NoΔHR-Sh

Source	df	MS	F
Between subjects			
Conditions	1	.1852	<1.0
Error between	22	.5004	
Within subjects			
Trials	1	1.2695	5.4626*
Trials × Conditions	1	1.1658	5.0164*
Error within	22	.2324	

* $p < .05$

Table 13

ANALYSIS OF VARIANCE OF B-A SCORES ACROSS ADAPTATION AND TRAINING TRIAL BLOCKS FOR CONDITIONS ΔHR-Sh AND ΔHR-NoSh

Source	df	MS	F
Between subjects			
Conditions	1	.2573	<1.0
Error between	22	.6023	
Within subjects			
Trials	1	1.0780	4.6646*
Trials × Conditions	1	1.3645	5.9044*
Error within	22	.2311	

* $p < .05$

The above results support the conclusion that experimental manipulations, which established the observed situation as either aversive or non-aversive and which presented heart rate cues as consistent or inconsistent with the description of the experiment given during instructions, had a significant effect on physiological processes. As in the preliminary investigation of this problem (Kravetz, 1970), it is suggested that of the two cues presented, knowledge of model's heart rate and of his being shocked, heart rate was the more important and had more pronounced effects. Again, when heart rate was consistent with information presented by the experimenter, heart rate conditioning occurred. However, when heart rate did not increase with shock presentation, effects on heart

rate were minimal. Also, when the heart rate change was associated with an irrelevant task, effects on heart rate of the observer were minimal and conditioning did not occur.

UCS Elicited Heart Rate

Inspection of the changes in mean heart rate as a function of trial blocks, Figure 2, suggests that the various treatments did produce differential effects on measure C as compared with pre measures A and B. A 3 X 4 X 3 analysis of variance of the A, B, and C measures over all four conditions for adaptation, conditioning, and test trial blocks (Table 14) failed to support the hypothesis that these heart rate changes were a function of the differences between conditions. However, separate analyses of adaptation, conditioning, and test trials did reveal significant differences.

Analysis of variance on adaptation trials indicated that there were significant effects associated with trial blocks and with phases, i.e. changes between measurement intervals per trial ($F = 7.0478$, $df = 4/176$, $p < .05$; $F = 15.2617$, $df = 2/88$, $p < .05$ respectively). The first effect was primarily due to attenuation of the cardiac deceleration response over the early adaptation trials and its subsequent replacement with a small amount of cardiac acceleration. The significant phase effect was primarily due to a slight but consistent increase in cardiac rate over interval C. There was no conditions effect nor significant interaction effects (Table 15).

Based on these results and those cited earlier, we may conclude that during adaptation the four conditions did not yield significant differences over any of the three measurement intervals. Results based

Table 14

ANALYSIS OF VARIANCE FOR THE A B C MEASURES ACROSS ADAPTATION, CONDITIONING, AND TEST TRIAL BLOCKS FOR THE FOUR CONDITIONS

Source	df	MS	F
Between subjects			
Conditions (C)	3	122.0751	<1.0
Error between	44	378.0256	
Within subjects			
Trials (T)	2	2.8376	<1.0
Conditions × Trials (C×T)	6	6.7857	1.5731
Error (S×T×C)	88	4.3136	
Phase (P)	2	.3559	<1.0
Conditions × Phase (C×P)	6	1.0006	2.0052
Error (S×P×C)	88	.4990	
Trials × Phase (T×P)	4	1.9978	3.9678*
Conditions × Trials × Phase (C×T×P)	12	.6784	1.3474
Error (S×C×T×P)	176	.5035	

* $p < .05$

Table 15

ANALYSIS OF VARIANCE FOR THE A B C MEASURES FOR ADAPTATION TRIALS IN FIVE BLOCKS FOR THE FOUR CONDITIONS

Source	df	MS	F
Between Subjects			
Conditions (C)	3	314.9224	<1.0
Error between	44	688.2644	
Within Subjects			
Trials (T)	4	27.5187	7.0478*
Conditions × Trials (C×T)	12	4.3466	1.1132
Error (S×T×C)	176	3.9046	
Phase (P)	2	18.4590	15.2617*
Conditions × Phase (C×P)	6	.6229	<1.0
Error (S×P×C)	88	1.2095	
Trials × Phase (T×P)	8	1.1685	1.2420
Conditions × Trials × Phase (C×T×P)	24	.6263	<1.0
Error (S×C×T×P)	352	.9408	

* $p < .05$

on analyses of measure (A), which was used to make inferences about tonic heart rate; measure (B), the anticipatory response; and analysis of responses during the third measurement interval (C), all support the conclusion that differences between conditions did not occur during the adaptation phase of this experiment. Therefore, neither did differential instructions nor other experimenter-confederate effects significantly influence inter-group differences prior to presentation of the UCS, the unconditioned stimulus of the model and heart rate changes, during the training trials.

However, in the course of conditioning, a pronounced decelerative effect during UCS presentation for the experimental condition, ΔHR-Sh, is present. It appears also that there is a decelerative effect for Condition ΔHR-NoSh. An analysis of variance for conditioning trials (Table 16) revealed a significant Conditions X Phase interaction ($F = 2.6191$, $df = 6/88$, $p < .05$); however, a Newman-Keuls test showed that heart rate during the UCS presentation was significantly lower than pre-CS heart rate only in the experimental condition. There were no significant effects during test trials (Table 17). Therefore, it appears that only subjects in the experimental condition had a significant response to presentation of the UCS, and that no subjects had a differential response to its absence during test trials.

These results from interval (C) also support conclusions stated above, that differences in instructions and cue presentation significantly affected the responses of subjects to the taped heart rate. Only when shock was paired with a significant change in taped heart rate was there a pronounced decelerative heart rate response in the subjects' own heart

Table 16

ANALYSIS OF VARIANCE FOR THE A B C MEASURES FOR CONDITIONING TRIALS IN FIVE BLOCKS FOR THE FOUR CONDITIONS

Source	df	MS	F
Between Subjects			
Conditions (C)	3	99.2666	<1.0
Error between	44	611.0779	
Within Subjects			
Trials (T)	4	5.2413	<1.0
Conditions × Trials (C×T)	12	3.3324	<1.0
Error (S×T×C)	176	6.2487	
Phase (P)	2	2.1735	1.0942
Conditions × Phase (C×P)	6	5.2025	2.6191*
Error (S×P×C)	88	1.9864	
Trials × Phase (T×P)	8	3.9357	1.7504
Conditions × Trials × Phase (C×T×P)	24	3.2127	1.4289
Error (S×C×T×P)	352	2.2484	

* $p < .05$

Table 17

ANALYSIS OF VARIANCE FOR THE A B C MEASURES FOR TEST TRIALS IN TWO BLOCKS FOR THE FOUR CONDITIONS

Source	df	MS	F
Between Subjects			
Conditions (C)	3	84.0123	<1.0
Error between	44	244.1180	<1.0
Within Subjects			
Trials (T)	1	3.4773	<1.0
Conditions × Trials (C×T)	3	1.2073	<1.0
Error (S×T×C)	44	6.6537	
Phase (P)	2	.1784	<1.0
Conditions × Phase (C×P)	6	1.8436	1.1051
Error (S×P×C)	88	1.6682	
Trials × Phase (T×P)	2	1.3869	<1.0
Conditions × Trials × Phase (C×T×P)	6	.5563	<1.0
Error (S×C×T×P)	88	1.9135	

rate to presentation of these cues. Lack of a significant heart rate change or of a salient situation for the model produced little change in heart rate responses of subjects to UCS presentation. Also, presentation of the CS alone in the sensitization condition did not produce a decelerative response during the third measurement interval. Therefore, it may be concluded that the experimental condition was able to differentially affect subject heart rate response, as evidenced by subjects in this condition (ΔHR-Sh) having the only pronounced response to actual cue presentation and the only conditioned response in anticipation of these cues.

Inspection of the distribution of responses to the post-experimental questionnaire (Table 18) reveals that there are differences in response patterns between conditions. For Question 1, subjects in Condition ΔHR-NoSh were evidently the least interested and the most bored. This seems to suggest that mention of shock was an important differentiating factor. Responses to Question 2 also differentiate between conditions involving shock (ΔHR-Sh, Sen., and NoΔHR-Sh) and the condition that does not involve shock (ΔHR-NoSh), with subjects in the slide condition perceiving the model as less anxious than those subjects in the shock conditions. It is interesting that in this question subjects ordered themselves in terms of the absence of shock, consistency of cues, and then in terms of the predictability of the occurrence of shock; subjects in the slide condition (ΔHR-NoSh) thought that the model was not anxious and subjects who could not predict the occurrence of shock, in the sensitization control, thought that the situation was most anxiety-provoking for the model. Also, the only question which all subjects did not complete was Question 2; subjects often stated that they did not know what the

Table 18

SUBJECT RESPONSES TO THE POST-EXPERIMENTAL QUESTIONNAIRE

	Condition			
	ΔHR-Sh	Sen.	NoΔHR-Sh	ΔHR-NoSh
This experiment was for me:				
interesting	7	8	6	4
anxiety-provoking	2	1	3	1
boring	3	3	2	7
other	0	0	1	0
This experiment was for him:				
interesting	3	1	3	4
anxiety-provoking	6	7	4	2
boring	0	0	1	3
enjoyable	0	0	0	0
painful	0	1	1	0
I thought about the other subject:				
always	3	2	4	0
sometimes	7	10	5	8
rarely	2	0	3	2
never	0	0	0	2
My feelings throughout were:				
bored	4	5	2	8
happy	0	0	0	0
anxious	3	0	4	0
concerned	5	5	3	0
curious	0	2	3	4

other subject felt. Interpretation of this observation is difficult, but it may be that these subjects were most anxious about the model's experience and therefore were most evasive in their thoughts.

The distribution of responses on Question 3 indicates that subjects in the slide condition (ΔHR-NoSh) show the least thought for the model; these were also the subjects who most frequently reported being bored. Subjects in Condition ΔHR-Sh and the sensitization control were more frequently concerned about the model than those in NoΔHR-Sh. One could suggest that lack of corroborative evidence of the painfulness of the shock, i.e. lack of increases in heart rate of the model, lessened the concern of these subjects in Condition NoΔHR-Sh for the model.

In general, we may conclude that the aversive and nonaversive nature of the situation and cues presented affected both the physiological and cognitive processes during the experiment. Cognitively, subjects did react differentially to the model being shocked and not being shocked, so that it appears that this was an important factor. Also, subjects were able to state that the experience was different for the model than for themselves. This suggests that attention was paid to the experience of the model, and that interpretations and reactions of the subjects did differ in terms of the experimental manipulations utilized. That attention was paid to the experience of the model tends to support a conclusion that some form of empathic response did occur and that the degree and nature of this response differed in terms of the situation presented.

Discussion

Although the results tend to support the major hypothesis of this study, they should be interpreted in light of their lack of general power. It is apparent that a large within-subject variance influenced the results. Overall analyses of variance consistently failed to reveal significant differences between treatments. However, comparison of the experimental condition with each of the control conditions showed that the various treatments did produce differential effects on mean heart rate changes over blocks of trials. Also, separate analyses within types of trial indicated significant differences between conditions. A larger sample and perhaps additional trials, notably test trials, would increase the power of obtained results. It must be noted however that we are dealing here with an extremely subtle phenomenon; direct heart rate conditioning usually is accomplished by direct application of potent, aversive stimuli. Hence, even a weak demonstration of vicarious heart rate conditioning deserves attention.

As mentioned earlier, this was essentially an imagined vicarious experience, with minimal cue presentation. It is probable that direct observation of the model would be more effective in increasing the level of instigation and the occurrence of conditioned responses; both would be enhanced by presentation of visual as well as auditory cues of the experimental situation and of the model's emotional response within that situation.

Berger notes that his observers' GSRs tended to occur less frequently during the last half of the conditioning period. It should be noted that his procedure involved approximately a ten-minute exposure to the model, a significantly shorter period of time than used in this study.

Berger suggests that observers became habituated to the situation and that they were less attentive to stimuli as the experiment progressed. It could be predicted that such a habituation process would be more likely to occur when visual cues were not present. Also, it should be easier for subjects to filter out repetitious auditory cues whose meaning they must continually and actively remember if they are to continue to respond.

Berger also suggests that vicarious instigation may be transitory and that the effect may lessen with repeated exposures to the model "as the observer begins to exercise some control over his emotional responses"(1962, p. 463). Also, the observer becomes more able to anticipate CS presentation and the model's response. It seems likely that these processes could account for the lack of powerful results in this present study; that consistent results were obtained in spite of such processes is indicative of the presence of the predicted phenomenon and gives support to conclusions drawn.

It is clear from Berger's description of his experimental situation that the model was able to view the observer throughout the experiment; it is not as apparent that the experimenter was also present, but it is suggested, i.e. "the experimenter appeared to be taking readings from both the performer and observer" (p. 456). This suggests the presence of some social pressure on the observer to attend to the model's behavior and to appear interested and/or concerned. There was no observation of the observer by the experimenter or the model in this present study. Observer interpretation of a norm or expectation which stated "you should care" could be ignored.

Bandura and Rosenthal (1966) suggest that subjects are able to

utilize self-imposed competing cognitive responses to counter the effects of anxiety-provoking stimuli and that such responses modify physiological responses. It appears that if subjects in this present study were anxious, use of competing responses was facilitated by both minimal cue presentation and the lack of social surveillance.

Such considerations would suggest the use of more salient cues, i.e. visual, and variation of the model's response, perhaps to varying degrees of shock, to reinstigate observers' responses and interfere with the habituation process. The meaningfulness of the situation could also be enhanced by either threatening the observer with shock or by using subjects who had actually participated in an experiment which used electric shock. This is an important factor, for if shock is not an established conditioned stimulus for the observer, then effects of a "vicarious" experience which involved shock to the model and where evidence of the model's response was minimal could also be expected to be minimal. This factor was not controlled nor manipulated in this study.

DiLollo and Berger (1965) note the importance of corroborative evidence of the model's unconditioned emotional response and suggest that lack of arm movement in their study did not achieve significant effects because there was no corroborative evidence of the response as would be expected in that situation. They suggest that this reasoning also applies to Berger's control condition involving lack of arm movement in response to shock presentation. This could also account for results obtained in this experiment for Condition NoΔHR-Sh. Here, it is likely that lack of heart rate changes of the model suggested to the observer that the shock actually was not too painful. This does not detract from the value of this condition as a control for the UCS. It does, however,

support the conclusion that the heart rate response of the model was a meaningful cue for subjects, and that cognitive interpretation of internal events does generalize to interpretation of these responses in others.

These conclusions are given additional support by responses to the post-experimental questionnaire, which were described above. There is a suggested correspondence between the extent of heart rate change by subjects and their cognitive processes. It is evident that a more reliable and quantifiable measure of cognitive processes would further contribute to understanding of the relationship beteen cognitive and physiological processes. However, the information available from the questionnaire does provide an impression of observer cognitions that is consistent with interpretations of physiological data.

It is notable that tonic heart rate did not differ over trial blocks nor between conditions. This finding is consistent with that of Craig and Lowery (1969) who found that only threat of shock produced a higher tonic level of heart rate than other vicarious conditions. Those conditions of theirs which corresponded to the conditions used in the present experiment did not differ significantly. Therefore, it appears that the vicarious nature of the situation was the most salient factor for tonic heart rate patterns. If all situations are similar on this dimension, differences between treatments are reflected only in examination of phasic changes.

That the phasic pattern was decelerative is consistent with heart rate conditioning studies reviewed earlier. The pronounced decelerative effect occurred only for the experimental condition in anticipation of and with presentation of the UCS. If cardiac deceleration occurs with increased sensitivity to environmental input, then this response is

suggestive of the central processes which occur predominantly in Condition ΔHR-Sh and are reflected in questionnaire responses.

The heart rate conditioning literature offers an additional interpretation of obtained results. As noted earlier, the direction and extent of the conditioned heart rate response is dependent on the initial response to the UCS. The predicted decelerative response in heart rate conditioning can therefore be defined as either a pronounced deceleration or as decreased acceleration as training progresses (Wilson, 1969). If empathy entails greater involvement, the vicarious nature of the task would require "environmental input" without cognitive elaboration; on this basis, we would predict a decelerative response. However, the nature of the situation might be defined as anxiety-provoking, in which case there would be an accelerative heart rate response. If in fact both processes are present, we would predict intermediate effects, which would be less decelerative than those obtained in a vicarious situation without anxiety. This appears to be a probable explanation for the obtained results. If the greatest amount of anxiety and the greatest degree of attending could be predicted for the experimental condition, then only an intermediate conditioned heart rate response could be expected; this would tend to minimize differences found among the various treatments.

If the decelerative heart rate response is an indicator of increased attention, we can infer that attending to the emotional response of the model is indicative of a process we may call empathy. Such a conclusion is supported by several observations. That this decelerative response is particularly evident in the experimental condition tends to discount explanations which are equally likely for all conditions, i.e. boredom, daydreaming, wondering, etc. Also, the fact that we are measuring a post-CS

response indicates that the subject responses observed are varying in a consistent pattern and are controlled by experimental manipulations, i.e. are specific to stimulus presentation. Although an accelerative effect was obtained in conditions Sen. and ΔHR-NoSh, which could be indicative of boredom, anxiety, or imagination (Craig and Weinstein, 1965), this response does not differ over blocks of trials nor among conditions. Therefore, it may be concluded that there was no significant accelerative changes that were controlled by the particulars of the experiment.

The deceleration of the subjects' heart rate obtained in the experimental condition of this experiment may be indicative of attention to presented stimuli; that this degree of attending is evident only in the experimental condition suggests the presence of vicarious instigation. Such an interpretation is consistent with impressions derived from the post-experimental questionnaire.

In summary, we may conclude that it is possible to obtain conditioning with minimal cues signalling the model's unconditioned emotional response as the basis for the conditioning process. Also, this study supports Berger's conceptualization of vicarious emotional instigation and indicates that it is possible to control for pseudo-vicarious effects in a simple experimental situation. It appears that heart rate of the model is a salient cue about his emotional response and as such can be the basis for vicarious classical conditioning.

Implications for Future Research on Vicarious Learning

The finding that the heart rate of the model is a salient cue about his emotional response suggests that this cue may be equally applicable to many varying situations used in vicarious conditioning experiments.

It would be relatively simple to superimpose various situations and model characteristics on this basic design, as the only variations would be in instructions and the description of the experiment. Such a paradigm would allow systematic variation of the components of the fundamental phenomenon. That is, many of the components of the observed situation, i.e. task of model, model characteristics, the unconditioned emotional response of the model, and the length of exposure of the observer to the situation, could be easily manipulated through instructions and cue presentation.

Such a design could also be used to demonstrate learning, i.e. the association of responses to previously neutral stimuli, and to investigate the transfer of this learning to other situations in which these cues are present. It would also provide a procedure for measuring conditioning as a function of antecedent consequences to both the model and observer. Both subjects could be exposed to the same situation and then could be placed in this experimental situation, each subject believing that he was hearing the heart rate of the other.

It would also be valuable to compare phasic heart rate response during direct and vicarious conditioning. The use of a cardiotachometer would facilitate evaluation of the topography of the conditioned heart rate response in vicarious conditioning and provide a basis for direct comparison with the form of the curve during direct conditioning.

If we have in fact investigated the effects of a minimal cue of the model's unconditioned emotional response, this experiment could be used as the basis of a design which would investigate the relative effects of additional visual cues, i.e. facial expressions, posture, and verbal expressions by the model.

It would also be valuable to use a more sophisticated measure of cognitive processes for interpretation and correlation with physiological data, and to use several physiological measures to get a total view of the physiological responses of observers. The use of more sophisticated measures would contribute to the understanding and prediction of empathic responses versus oppositional responses in observers. Such findings could then be applied to modeling experiments to predict the occurrence and extent of modeling, choice of models, and the responses of the observer during the modeling procedure.

Implications for Social Work Research and Practice

An excellent review of therapeutic implications of modeling is presented by Bandura (1969a). His descriptions of studies concerned with the establishment of new response patterns through modeling are quite thorough and include psychotherapeutic changes achieved through modeling techniques (pp. 151-167). Role playing, psychodrama, and vicarious reinforcement effects have been increasingly recognized as important intervention techniques in practice settings (Bertcher, Gordon, Hayes, and Mial, 1970; Corsini, 1966).

In the above-mentioned practice applications of modeling techniques, the behavioral components of the defined problem are the major targets of change; the emotional aspects are expected to change as a function of behavioral change. For example, in role playing or behavioral rehearsal, emphasis is placed on the client assuming behavioral characteristics of the "other." In the process of assuming this role, the client may imagine the emotional components of the imitated behaviors but emphasis is placed on replication of the behavioral manifestations of those emotions.

Therapeutic application of research concerning vicarious learning of affective responses is not as well defined nor researched as applications of modeling effects. That autonomic responses are less accessible by present intervention techniques partially accounts for the emphasis on behavioral change and the application of modeling procedures. Therefore, the paradigm which this present study offers for the learning of affective responses is not readily transferable to development of new methods which could be easily and directly applied to social work practice. However, one major therapeutic technique which directly involves autonomic responses and uses vicarious processes to facilitate the change process has been developed: vicarious extinction.

The therapeutic value of "social imitation" in eliminating fear responses in observers was suggested as early as 1924 (Jones). Since that time, a large number of empirical studies of vicarious extinction, which are reviewed in detail in Chapter I, have convincingly demonstrated the utility of this procedure.

The implications of this present study for social work practice are most evident in relation to desensitization and vicarious extinction techniques. In addition to the use of relaxation in desensitization, it may be that instrumental conditioning could be used to train a person to slow down his heart rate. He could then be taught to apply this learning in the presence of anxiety-provoking stimuli. Research could determine whether this would be more or less effective than the present use of relaxation. Also, if heart rate is a meaningful cue of a person's emotional response, as suggested by this present study, it may be that presentation of the model's heart rate in conjunction with the modeled approach behaviors would facilitate the vicarious extinction process. Since anxiety is a prominent factor in many

problems commonly handled by social workers in a large number of different settings, i.e., family service agencies, mental hospitals, schools, private clinics, employment agencies, etc., and since desensitization has been shown to be a powerful change technique, it appears that the research suggested above would have potential value for a broadly applicable intervention technique.

It would also be valuable to research the utility of heart rate and other physiological measures for the diagnostic process. Research suggests that emotions may develop as verbal labels are attached to internal events. It may be that varying emotional reactions are based on identical physiological responses. Differences in emotionality may be derived from different levels of awareness of internal changes and different cognitive interpretations of the meaning of these events. Research directed toward this problem could lead to development of new intervention techniques if, in fact, this was found to be a salient factor. As social workers are often confronted with problems based on dysfunctional emotional reactions of clients, any research that developed a means of cognitively manipulating client interpretation of physiological changes would be a significant contribution.

Diagnostic techniques at present rely on verbal report and observation of overt behaviors. However, monitoring of physiological processes may facilitate identification of problem areas, account for inconsistencies between verbal report and behavior, and offer a baseline measure from which the effectiveness of therapeutic procedures could be determined. Again, this is most obviously applicable in the case of an anxious client who is unable or unwilling to identify anxiety-provoking situations and behaviors. In these cases, a therapist often makes inferences concerning the internal state of a client, with no behavioral confirmation. Use of heart rate in

conjunction with other physiological measures would provide the therapist with additional data, which could be used both for his own understanding of his client and for direct use in the therapy session.

In addition to confirming areas in which anxiety is present, the therapist could also use physiological measures to evaluate his own effectiveness in the therapy session. His own hypotheses concerning his client's anxiety level, willingness to continue on certain topics, attention level, etc., could be confirmed or challenged by physiological data. Research is needed to determine to what extent we can now rely on heart rate and other measures. It may be that several physiological measures, e.g., heart rate and GSR, may be needed for a reliable analysis of a client's anxiety level or determination of when the client is no longer paying attention to what is happening within the interview or group session. We would also need to investigate whether this data could be obtained in a form that could readily be interpreted by the worker.

Finally, it seems likely that therapy generally promotes a vicarious extinction effect. Observing the social worker talking about or performing anxiety-provoking behaviors without adverse consequences could serve a vicarious extinction function for the client. This may also apply to the effectiveness of the presentation of expert or high prestige models to client groups. These models, in addition to being experts and prestigious, are able to talk about and demonstrate anxiety-provoking behaviors, i.e., leaving the hospital, applying for a job, meeting new people, etc., without becoming overtly anxious. Therefore, an observer-client who attends to the model due to the fact that the model is similar or salient also is likely to participate in a process of vicarious extinction.

The above suggests the utility of desensitization within a group setting, the use of a group to provide multiple models for others in that group, and the use of multiple therapists; all these would increase opportunities for clients to undergo this vicarious extinction process. If research discovers that this is a major factor in group settings, it would suggest that situations be structured to take specific advantage of this factor and offer models for specific situations and behaviors that are problematic, i.e., anxiety-provoking, for specific client groups. The success of the use of films to promote the vicarious extinction effect suggests that social workers develop films for specific client problems, i.e., fear of applying for a job, fear of crowds, fear of new people, etc., with the goal of using these films for the alleviation of specified anxieties associated with specific situations and behaviors.

In summary, it is well established that modeling is a potent change technique. The above discussion suggests several areas for research suggested by this present study which would extend the benefits of observational learning for social work practice.

APPENDIX A -- A PRELIMINARY STUDY

Heart rate as a minimal cue for the occurrence of conditioned vicarious autonomic responses[1]

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Three groups of Ss participated in a vicarious conditioning experiment. Ss heard the heart beats of a model who ostensibly was either being shocked following a tone or who was exercising. Among those hearing a model being shocked, half heard a change in heart rate after each shock; for the remaining half, no change in heart rate occurred. Heart rate and GSR of the actual Ss were collected as measures of vicarious conditioning. GSR data showed no significant effects. However, heart-rate changes showed that conditioning occurred in the experimental condition and in one of the control conditions. The results of this study suggest that heart rate of a model is a salient cue for the occurrence of vicarious classical conditioning.

Research concerned with vicarious emotional instigation suggests (1) that emotional responses of a model elicit emotional responses in Os (Lazarus et al, 1962), and (2) that an O's vicariously aroused emotional responses may become associated with formerly neutral stimuli (Berger, 1962; Bandura & Rosenthal, 1966; Craig & Lowery, 1969). In vicarious instigation, the unconditioned emotional response of the model serves as the unconditioned stimulus for the O's own emotional response. The meaning of the given unconditioned emotional response is inferred by the O from the context and from the related behaviors of the model.

In research on vicarious emotional instigation, it has usually been the overt behavior of the model that provided the O with principal information concerning the internal state of the former. The question can be raised whether providing the O with more direct access to the model's internal state, associated with a given emotion, would be more or less efficient in producing similar emotional reactions in the O. Schachter & Singer (1962) and Valins (1966) conclude from their studies that internal events can be important sources of information for an individual when he interprets his *own* feelings and behavior. These studies suggest that cognitive interpretation of one's own physiological responses may be the basis for evaluation of these responses in others. In light of the above research, the present experiment sought to determine if information about changes in heart rate of a model, interpreted by the O as caused by either noxious or nonnoxious antecedents, are sufficient for producing vicarious classical conditioning.

PROCEDURE

Eighteen male undergraduates from introductory psychology classes at The University of Michigan were assigned randomly to one of three conditions. A BioLink Telemetry System was used to monitor Os' heart rates throughout the experiment, and a Nesco recorder and calibrator were used to record GSR.

In the experimental condition (ΔHR-Sh), the Os were led to believe that they would be hearing the heart rate of a S who was in a heart-rate conditioning experiment with shock as the UCS and a tone as the CS. Two control conditions were used. In one (ΔHR-NoSh), the Os were told that they would be hearing the heart rate of a S who was merely doing a series of brief exercises after the presentation of tones. In the second control condition (NoΔHR-Sh), the instructions were identical to those in the experimental group but the heart rate these Os heard contained no changes following the UCS.

A male confederate posed as the S involved in the experiment and spoke with the O while they waited for E to arrive. During this time, he briefly and informally explained his role, i.e., to be shocked or to do a series of exercises. O was then placed in a small room by the E, and the remainder of the experiment was presented via earphones.

Audio tapes were used to present instructions and stimuli. Each O was told that the purpose of the experiment was to measure the effects on the S of hearing his own heart rate either while he was being shocked or while doing exercises. The O was told that he was a control and would therefore be presented with the auditory stimuli that existed for the S, i.e., tones, sound of shock machine, heart rate. After instructions were completed, the O heard the simulated heart beat of the S and the cues that were relevant for that particular condition.

The audio tapes that Os heard were based on a heart-rate conditioning experiment by Wood & Obrist (1964). They consisted of a series of 1-sec, 1,000-Hz tones (CS) and the sound of a heart beat simulated at approximately 72 bpm. In the ΔHR-Sh condition and the

Table 1
Mean Changes in Heart Rate During Adaptation, Conditioning, Test Trials*

Condition	Adaptation	Conditioning	Test	F(df = 2/30)	p
ΔHR-Sh	1.466^{a}	2.097^{b}	2.428_{b}	7.20	<.05
ΔHR-NoSh	0.733_{a}	1.514_{b}	1.868_{b}	10.17	<.05
NoΔHR-Sh	1.533_{a}	1.375_{a}	1.559_{a}	.30	NS

** Means within each row having subscripts in common are not significantly different from each other.*

NoΔHR-Sh condition, the tape also included a burst of white noise presented to Os as the sound of a shock machine (UCS). Five consecutive adaptation trials were followed by 12 conditioning trials, and interspersed among these 12 were 14 test trials, their order determined randomly.

The tape for the experimental condition (ΔHR-Sh) contained all cues of a heart-rate conditioning experiment. During adaptation and test trials, a tone was presented and followed by continuation of the heart rate at 72 bpm. However, for conditioning trials, the tone was followed by a 6-sec presentation of the sound of a shock machine, after which the heart rate was noticeably increased for 10 sec.

The timing of the two control tapes was exactly the same as that of the experimental condition tape; only the number of cues available to the O was varied. To control for the UCS (ΔHR-NoSh), the tape consisted only of an increased heart rate; the sound of the shock machine was omitted. As noted above, the Os were told that they were hearing the heart rate of a S doing exercises after presentation of a tone. To control for the UCR (NoΔHR-Sh), the sound of the shock machine was never followed by a noticeable increase in heart rate. Os were told that they were listening to the heart rate of a S who was in a heart-rate conditioning experiment, the same instructions given to the experimental group. Os' own heart rates and GSR were collected as measures.

All Os were briefly interviewed after the experiment. Any O who had not accepted the cover story or did not believe that he had been listening to the heart rate of a S was excluded from the sample.

RESULTS

Heart rate was measured for 15 sec preceding and for 15 sec following CS onset. The data consisted of the differences between the Os' mean pre-CS heart rate and the mean post-CS heart rate, calculated separately for adaptation, conditioning, and test trials. GSRs were defined as decreases in skin resistance of 1,000 ohms or greater. This movement had to occur within 4 sec following the termination of the CS.

A two-way analysis of variance for changes in skin resistance failed to support the hypothesis that GSR was a function of the differences between conditions ($F = 0.952$, $df = 2/15$, n.s. However, a similar analysis of heart-rate changes showed significant differences between conditions ($F = 21.61$, $df = 2/15$, $p < .05$) and between trials ($F = 11.45$, $df = 2/30$, $p < .05$). Also significant was the interaction between condition and trials ($F = 3.105$, $df = 4/30$, $p < .05$). Table 1 shows mean heart-rate changes observed during adaptation, conditioning, and test trials in the three conditions. Simple effects tests show that there were significant differences between trials in the experimental condition (ΔHR-Sh) and in one of the control conditions (ΔHR-NoSh). In both of these conditions, Newman-Keuls tests reveal that the conditioning trials did not differ from the test trials, while both were significantly different from adaptation trials. These results can be taken to indicate that conditioning was accomplished for the experimental Os (ΔHR-Sh) and for Os who heard changes in the heart rate of an individual ostensibly engaged in exercises (ΔHR-NoSh). No differences between adaptation, conditioning, and test trials were found for Os who heard a person being shocked but whose heart rate remained constant (NoΔHR-Sh).

DISCUSSION

In general, the results suggest that changes in another person's heart rate can be salient cues of his emotional reaction and, as such, be a basis for the occurrence of vicarious emotional instigation and the conditioning of the O's own heart rate. However, on the basis of the present results, it appears that heart rate was not sufficient to produce vicarious conditioning of the galvanic skin response.

No systematic attempt was made to analyze cognitive processes of Os. However, one interesting observation can be made from postexperimental interviews. Os in conditions involving shock often stated that they quickly forgot about the "S" and were not concerned about him. However, those in Condition ΔHR-NoSh reported that they actively thought about the "S" throughout the experiment, picturing and imagining what exercises he was doing.

Since no shock is mentioned in Condition ΔHR-NoSh, it is notable that Os in this condition were successfully conditioned, while those in Condition NoΔHR-Sh were not. On early trials, Os in Condition NoΔHR-Sh showed greater responsiveness to the CS than Os in Condition ΔHR-NoSh: however, these early responses emitted on adaptation trials were not significantly different from their responses to the CS following training. On the other hand, during adaptation trials, Os in Condition ΔHR-NoSh showed little reaction to the CS, but after presentation of the CS-UCS pairings, their responses became as strong as those in Condition ΔHR-Sh.

It appears that a form of socially mediated heart-rate conditioning was achieved in the present experiment. The manipulation that established the situation as either aversive or nonaversive had a significant effect on both physiological and cognitive processes. It affected the sensitivity of Os during adaptation trials and their cognitive work throughout the experiment. It is also evident that of the two cues presented, heart rate and shock, heart rate was the more important and had more pronounced effects. When heart rate was consistent with the information presented by the E, heart-rate conditioning occurred. However, discrepancy between heart-rate cues and instructional set apparently prevented conditioning.

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NOTE

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APPENDIX B

INSTRUCTIONS FOR CONDITIONS ΔHR-Sh, Sen., NoΔHR-Sh

Subject #1 and subject #2 - you should both be able to hear me now.

Subject #1 - You have agreed to be in an experiment in which you will receive a series of electric shocks. As you know, yesterday we established the highest level of shock you could tolerate. This level of shock will be used in today's session. During today's session, you will be presented with three types of stimuli. You will hear a series of tones and you will receive a series of electric shocks. Also, you will be able to hear your own heart beat throughout the experiment. We are interested in the effects of your hearing your own heart rate as you respond to the shock. As we are also using heart rate as a measure of the results of this experiment, please do not move more than necessary.

Subject #2 - You are the control subject. You will not be shocked at any time. As the control subject, you will be presented with all the stimuli that are being presented to Subject #1, except the shock. You will therefore hear everything that occurs in Subject #1's room. You will hear the tones when he hears them, you will hear the buzz of the shock machine when he is being shocked, and you will hear his heart beat, just as he hears it. Since you will hear all the sounds Subject #1 hears, - the tones, the buzz of the shock machine, and his heart beat -- any differences between your heart rate and his can be attributed to his being shocked, since everything else is exactly the same for both of you. Please remain as still as possible so that your heart rate can be clearly measured.

Subjects #1 and #2 - The experiment will now begin. First, you will both begin to hear Subject #1's heart beat. Then you will hear the first

of the tones. The shock will begin after a short time.

INSTRUCTIONS FOR CONDITION ΔHR-NoSh

Subject #1 and subject #2 - You should both be able to hear me now.

Subject #1 - During today's session, you will be presented with three types of stimuli. You will hear a series of tones, and you will be presented with a series of nonsense syllables, for example, wub, gix, wuh. These will be presented on the small screen in front of you. Also, you will be able to hear your own heart beat throughout the experiment. We are interested in the effects of your hearing your own heart rate as you view the nonsense syllables. As we are also using heart rate as a measure of the results of this experiment, please remain as still as possible.

Subject #2 - You are the control subject. As the control, you will hear all the stimuli that are being presented to Subject #1. You will hear the tones when he hears them, you will hear the static sound which occurs when the slides are being presented, and you will hear his heart beat, just as he hears it. Since you will hear all the sounds Subject #1 hears -- the tones, the presentation of the slides, and his heart beat -- any differences between your heart rate and his can be attributed to his seeing the nonsense syllables, since everything is the same for both of you, except that you do not see the syllables. Please remain as still as possible so that your heart rate can be clearly measured.

Subjects #1 and #2 - The experiment will now begin. First, you will both begin to hear Subject #1's heart beat. Then you will hear the first of the tones. The slides will begin after a short time.

APPENDIX C

POST-EXPERIMENTAL QUESTIONNAIRE

Name

This experiment is also concerned with your feelings and thoughts about the other subject. Please complete the following by checking the most appropriate answer.

I was:

Subject #1 ____ Subject #2 ____

This experiment was:

	for me	for the other subject
interesting	_____	_____
anxiety-provoking	_____	_____
boring	_____	_____
enjoyable	_____	_____
other (please explain)	_____	_____

I thought about the other subject:

always ____ sometimes ____ rarely ____ never ____

My feelings throughout were generally:

bored	_____
happy	_____
anxious	_____
concerned	_____
other (please explain)	_____

My thoughts and/or feelings about the other subject were generally: (please describe briefly)

Additional comments:

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