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WEIN, KENNETH STUART

THE EFFECTS OF DIRECT AND IMAGINAL  
STIMULATION ON PHYSIOLOGICAL AND SELF-REPORT  
MEASURES: A TEST OF THE CONTINUITY  
ASSUMPTION.

THE UNIVERSITY OF NORTH CAROLINA AT  
GREENSBORO, PH.D., 1978

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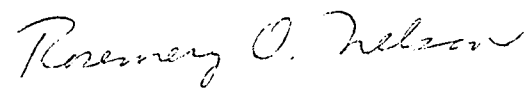
THE EFFECTS OF DIRECT AND IMAGINAL STIMULATION ON  
PHYSIOLOGICAL AND SELF-REPORT MEASURES:  
A TEST OF THE CONTINUITY ASSUMPTION

by  
Kenneth S. Wein

A Dissertation Submitted to  
the Faculty of the Graduate School at  
the University of North Carolina at Greensboro  
in Partial Fulfillment  
of the Requirements for the Degree  
Doctor of Philosophy

Greensboro  
1978

Approved by:

  
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APPROVAL PAGE

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WEIN, KENNETH STUART. The Effects of Direct and Imaginal Stimulation on Physiological and Self-Report Measures. (1978)  
Directed by: Dr. Rosemary O. Nelson. Pp. 126

One of the primary assumptions underlying the "cognitive trend" in behavior therapy and the covert conditioning model of behavior is that imaginal stimuli elicit reactions comparable to those observed with external stimulation. The present study was designed to test the assumption of continuity between external and imaginal stimuli, and to address several procedural questions related to the covert conditioning behavior therapy techniques. Twelve female college undergraduates were exposed to subjectively determined positive, negative, and neutral stimuli in both their real-life (overt) and imaginal (covert) forms. Exposure to each of the stimuli lasted for 90 seconds. Measures of heart rate, skin conductance, and self-reported affective intensity were used to evaluate autonomic and subjective reactivity to each stimulus. Subjects were exposed to the six experimental stimuli in counterbalanced orders to avoid confounds associated with a standardized sequence of stimulus presentations. Additionally, the saliency of the six stimuli was determined to be roughly equivalent by means of image clarity ratings for covert stimulus presentations, and attentional focus ratings for overt stimulus presentations. Results indicated that reactions to real-life and imaginal stimuli were indistinguishable both across and within the three stimulus valence categories on cardiovascular and verbal response measures, and on a measure of absolute change in electrodermal activity. When changes in electrodermal activity were viewed as percent changes from pre-trial baseline levels, real-life stimuli were found to

elicit proportionately larger increases than imaginal stimuli. The superior arousal producing capability of real-life stimuli on this measure was evident across the three stimulus valence categories and within each category. Thus, the assumption of continuity between overt and covert stimulus properties was found to be valid for some, but not all response dimensions. Several theoretical and practical implications of the findings for behavioral assessment and therapy were discussed. First, differential patterns of cardiac and electrodermal reactivity to the experimental stimuli indicated that peripheral measures of autonomic nervous system activity do not respond in a synchronous manner, and that a comprehensive approach to assessment must include a multi-dimensional analysis of clinically relevant physiological behavior. Second, the observation of autonomic reactivity to affectively loaded imaginal stimuli provides theoretical support to those cognitively oriented clinicians who have extended the "overt" behavioral treatment techniques into the area of cognition. Third, the temporal patterns of cardiovascular and electrodermal reactivity to imaginal inputs helped to specify timing and exposure variables in Cautela's covert sensitization (1967) and covert positive reinforcement (1970a) techniques.

## ACKNOWLEDGEMENTS

The author wishes to offer his gratitude to Dr. Rosemary O. Nelson for her dedicated guidance throughout the preparation of this work and throughout the author's graduate studies. Her expertise in the field of clinical behavior therapy, her respect for data, and her commitment to graduate education have provided the author with an invaluable model of professional conduct.

Appreciation is extended to Dr. Robert G. Eason for his help in psychophysiological measurement, and in the statistical analysis and interpretation of the data. Most importantly, the author gratefully recognizes Dr. Eason's contribution to the establishment of one of the country's finest graduate psychology institutions.

Special thanks are also offered to Drs. Jacqueline Gaebelien and P. Scott Lawrence for their constructive suggestions during all phases of the study, and for their major roles in the development of the author's cognitive abilities. Gratitude is also extended to Dr. Sandra Powers for her informative feedback during the planning and preparation of this work.

The author offers thanks to Mr. Ken Gruber for his help with the computerized statistical analyses, to Ms. Roberta Sadler for providing lessons in polygraph technology, and to Ms. Sabina Grillo and Ms. Luda Holsgrove for typing several drafts of this lengthy manuscript on short notice.

Finally, and most importantly, the author acknowledges the patience, the unqualified selflessness, and the emotional and material support of his dear wife, Shelley. Without her contribution, the author could not have achieved his career objectives.



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## CHAPTER I

### INTRODUCTION

#### Historical Background of Cognitive Behavior Therapy Research

Behavior therapists have been repeatedly criticized for ignoring or deemphasizing covert phenomena in their analysis of behavior disorders (Breger & McGaugh, 1965; Murray & Jacobson, 1971). Although this criticism may have been accurate several years ago, it is no longer justifiable. An examination of the applied behavioral literature written during the last decade reveals an accelerating number of articles focusing on private events in behavioral assessment and therapy. This "cognitive trend" (Mahoney, 1974) in behavior modification is the result of contemporary behavioral researchers' willingness to include covert phenomena within their theoretical framework.

Consideration of cognitive processes in behavior therapy, however, has only recently been tolerated. Early behavior therapists avoided controlled research of private phenomena on the grounds that covert events were "mentalistic" and unobservable, and thus "soft" and unscientific areas of inquiry (Mahoney, 1974). Their exclusion of cognitive and symbolic processes from basic and applied behavioral research is primarily attributable to the profound influence of James B. Watson, the "father of American behaviorism." His writings reveal an explicit denial of the existence of "mental states" and an

insistence that covert events do not have a legitimate place in the science of psychology (Watson, 1913). B. F. Skinner, too, has contributed to the behaviorists' aversion to the consideration of cognitive behavior. Although his theoretical accounts of behavior are replete with speculation on covert phenomena (Skinner, 1953, 1963, 1969), his early cautions regarding the empirical investigation of private events have had the effect of limiting controlled behavioral research in the area of cognition.

The consequence of the early behavior therapists' avoidance of covert phenomena was an approach to treatment that had limited clinical relevance. Behavioral assessment and modification focused almost exclusively on the overt motor response system; cognitive events were either ignored or deemphasized. Breger and McGaugh's (1965) popular critique of behavior therapy was in many respects accurate when it was written. The behaviorists' failure to focus on covert phenomena in both research and clinical practice undoubtedly limited the comprehensiveness of that treatment approach.

Several developments in the late 1960's functioned to eliminate the non-cognitive bias of behavior therapy. The first applied behavior analyst to address the issue of private events was Lloyd Homme. In an article that is now considered to be a classic in the annals of behavior modification, Homme ignored the traditional ban on covert phenomena, and suggested a technology for the control of "coverants," the "operants of the mind" (Homme, 1965). Expressing the conviction that it is time that operant conditioners come to grips with private events, Homme reiterated the view of Skinner (1953): "We need not



suppose that events which take place within an organism's skin have special properties for that reason." Thoughts, images, reflections, and so on, were conceptualized not as "states" of the organism, but as covert components in a response chain. Arguing that each individual can reliably discriminate the occurrence or nonoccurrence of his own covert responses, Homme suggested the application of Premack's Differential Probability Hypothesis (1965) to control the frequency of these occurrences.

In addition to making a large contribution to the behavioral self-control literature, Homme was the first to invite applied behavioral researchers to consider private responses within the realm of scientific inquiry. As Mahoney (1970) points out, though, Homme's paper was not received well by his contemporaries. Behavior therapy, in 1965, was in its early stages of development and was struggling to provide applied psychologists with an alternative to the intrapsychic models upon which many of the traditional psychotherapies were based. Behavior therapists feared that acceptance of Homme's invitation to consider covert phenomena would lead applied behavior analysis back to the earlier days of mentalism and introspection.

For the next four years, Homme remained the only behavior modifier willing to transgress the ban on private events. Then in 1969, Bandura devoted an entire chapter of his behavior modification text (1969) to the role of cognitive and symbolic variables in complex human behavior. The "cognitive trend" in behavior modification had begun. A term for a new area in applied behavioral research, "cog-

nitive behavior modification," was soon coined, and articles focusing on the role of cognition in the production and modification of behavior disorders began to appear at an accelerating rate. Researchers had finally become aware that many of the popular behavioral techniques failed to modify covert activity. As a result, an increasing number of procedures designed to produce changes in the verbal-cognitive response system began to appear in the behavior therapy journals. Wolpe developed a procedure, known as thought stopping (1969), to eliminate undesirable covert response sequences. Cautela developed covert positive reinforcement (1970a), covert extinction (1971), and covert negative reinforcement (1970b) to manipulate the frequency of particular cognitions, and covert sensitization (1967) to modify the emotional valence of inappropriately attractive stimuli. Ellis' Rational Emotive Therapy (1962), which had been developed independently of behavior therapy, was translated into the terminology of the behavioral framework (Russell & Brandsma, 1974), and was eventually labelled by Ellis himself as a behaviorally oriented treatment procedure (Ellis, 1973). Lazarus (1971) and D'Zurilla, Wilson and Nelson (1973) developed Cognitive Restructuring procedures to eliminate emotional reactions produced by seemingly irrational cognitions. Meichenbaum (1973) developed a procedure to modify the internally generated speech, or self-statements, of individuals displaying a wide range of behavior disorders. Systematic desensitization, behavior therapy's most popular and most thoroughly researched treatment technique, has been conceptualized as a cognitive proce-

ture by a number of authors (Bandura, 1969; Jacobs & Wolpin, 1971; Wilkins, 1971). The technique, as it is outlined by Wolpe (1958), involves the symbolic presentation of anxiety-producing stimuli, and may therefore be viewed as a form of cognitive counterconditioning.

This list of cognitive behavior modification procedures is by no means an exhaustive one. It is presented merely to illustrate the "cognitive trend" in behavior therapy, the clinical scientists' newly acquired interest in covert phenomena. Also illustrative of the cognitive trend is the growing interest of experimentally minded investigators in the outcome of the cognitive behavior therapy procedures (cf: Mahoney, 1974; Meichenbaum, 1973, 1975a,b; Thoreson & Mahoney, 1974), and the recent development of two cognitive behavior modification journals (Cognitive Therapy and Research, Biofeedback and Self-Regulation).

The basic assumption underlying all of the cognitive behavior modification procedures is that covert and overt behaviors obey the same psychological laws and are thus open to similar manipulations (Bandura, 1969; Homme, 1965). The validity of this premise is the primary focus of the present investigation.

#### The Continuity Assumption and the Covert Conditioning Model

Cognitive processes have been viewed by behavioral scientists in a number of different ways. One may choose to view cognitions as self-statements (Luria, 1961; Meichenbau, 1973), as thinking styles (Beck, 1970) or belief systems (Ellis, 1962), as problem solving abilities

(D'Zurilla & Goldfried, 1971; Goldfried & Goldfried, 1975), as coping skills (Meichenbaum & Cameron, 1973), or as imaginal representations (Bandura, 1969; Moore, 1977). Each of these descriptions of covert events implies that they are, in fact, human activities. Meichenbaum (1975a,b), in a summary of the variety of conceptualizations of private events, has concluded that the relative merits of each approach has yet to be determined. An analysis of each of these conceptualizations, however, suggests that they may all be subsumed under a common theoretical framework. The many discussions of covert events in the clinical and experimental literature imply that cognitions are private responses. As such, it is justifiable to assume that covert and overt events are not fundamentally different, in the sense that both are human behaviors.

The notion that cognitive activity is, in fact, a kind of behavior has led behaviorists to conceptualize covert events within a learning theory framework. The argument advanced for this conceptualization of cognition is based on the reasoning that (1) covert activities, like overt activities, are behaviors; (2) behaviors are manipulable via the laws of learning; (3) therefore, cognitions are open to manipulation via learning principles. The view that cognitions are events subject to the same laws of learning as overt phenomena has been termed the continuity assumption (Mahoney, 1974; Meichenbaum, 1975), although occasionally other labels, e.g., the homogeneity assumption (Mahoney, Thorsen, & Danaher, 1972), or the identity assumption (Mahoney, 1974), have been applied. This premise is central to both the covert conditioning/continuity mediational model of behavior (Bandura, 1969), and

to the theoretical rationales advanced by the authors of many cognitive behavior therapy procedures (e.g., Cautela, 1970a,b, 1971,1972; Homme, 1965; Wolpe, 1969). Mahoney offers a succinct summary of the covert conditioning/continuity perspective:

...as the name implies, the covert conditioning (continuity) model imposes the theory and language of conditioning on private experience. Thoughts, images, memories, and sensations are described as covert stimuli, covert responses, or covert consequences. The...conventional principles of reinforcement, punishment, and extinction are said to describe the function and patterning of private experience. (1974, p.61)

Numerous behavioral theorists have voiced support for the continuity assumption (e.g., Bandura, 1969; Jacobs & Sachs, 1971; Mahoney, 1970, 1974; Skinner, 1953, 1963; Smith, 1974; Staats, 1970, 1975; Ullmann, 1970). They have asserted that the distinction between public and private events is not tantamount to a distinction between physical and mental (non-behavioral) phenomena. Unlike some of the early behavior modifiers, they conceptualize cognitions as covert stimuli and covert responses. They insist that private events differ from external stimuli and motor responses only in their inaccessibility to public observation. The behavioral principles and terminology which they use to characterize covert activities are "continuous" with those that are used in their descriptions of overt activities.

Meichenbaum (1974) has cited Dollard and Miller (1950) and Skinner (1953) as the major contributors to the covert conditioning/continuity perspective. Dollard and Miller's references to "higher mental processes" and "cue producing responses" presuppose the existence of covert mediating stimuli. Like the contemporary cognitive behavior

therapists, they suggest that cognitions are behaviors which are modifiable via the application of learning principles, and which may serve as discriminative stimuli for succeeding responsiveness.

Skinner's contribution to the covert conditioning/continuity perspective cannot be overstated. His writings reveal his strong support for the continuity assumption:

An adequate account of human behavior must consider events taking place within the skin of the organism, not as physiological mediators of behavior, but as part of behavior itself. (1963, p. 953)

We need not suppose that events which take place within an organism's skin have special properties for that reason. A private event may be distinguished by its limited accessibility but not, so far as we know, by any special structure or nature. (1953, p. 257)

Some of the objects of introspection are private (covert) responses. The stimuli they generate are weak, but nevertheless of the same kind generated by overt responses. It would be a mistake to refuse to consider them as data just because a second observer cannot feel or see them...(1969, p. 242)

In this book, Science and Human Behavior, Skinner (1953) presents rather extensive discussions of private events and self-control. References to covert stimuli, responses, and consequences are scattered throughout the text. Such internal activities as decision making, recall, and self-instructional speech are conceptualized as operant events which are controlled by the variables of which all behavior is a function.

Other notable contributions to the continuity assumption and the covert conditioning model of behavior come from Homme (1965), Bandura (1969), Smith (1974) and Staats (1970, 1975). Homme devised the con-

cept of the covert (covert operant), thereby suggesting the continuity between private and non-private behavioral phenomena. Bandura, in his analysis of the role of cognitive processes in human behavior, examined the evidence bearing on Homme's proposition. His review of the findings from both applied and basic research helped to support the notion that covert events may function as significant controlling stimuli, as conditionable responses, and as powerful reinforcers. Theories of motivation and cognitive learning advanced by Smith and by Staats also treat cognition within a learning theory framework. Each of their accounts rests heavily on the assumption that covert events may be described in terms of the same processes and principles used to describe overt behavioral phenomena. Smith's introductory remarks offer illustration:

The underlying assumption...is that cognitive activity is in fact a kind of behavior. Cognitive events arise as responses to other cognitive events or to external stimulation. They serve in turn as stimuli to still further cognitive events or to frankly motoric responses. Functionally speaking they are embedded in the ongoing stream of behavior and are an intrinsic part of it...It is thus to be expected that cognitive events will be subject to the same laws as are other forms of behavior. (p. 161)

As mentioned earlier, the continuity assumption and the covert conditioning model of cognition categorize private events in terms of their function: stimulus, response, or consequence. Acceptance of the notion that there is correspondence between the function of overt and covert events must await empirical validation. Preliminary evidence, however, suggests that covert phenomena can be described in terms of lawful relationships and systematic processes, and that these processes,

parallel those observed in overt phenomena (Mahoney, 1974). Numerous authors (e.g., Bandura, 1969; Cautela, 1973; Jacobs & Sachs, 1971) have reviewed the literature bearing on the continuity between covert and overt stimuli, responses, and consequences. Although many of the studies cited failed to meet the requirements of controlled experimental design, the converging data suggest that the processes and principles governing public and private events are continuous.

Laboratory demonstrations of the correspondence between the properties of public and private stimuli are supportive of the continuity assumption. Evidence that covert events can serve as powerful controlling stimuli in human behavior lends credence to the view, expressed by advocates of the continuity/covert conditioning model, that cognitions constitute elements in the "behavioral stream," functioning as antecedent stimuli in the flow of human activity. Behavioral theories of cognition advanced by Homme (1965), Bandura (1969), Smith (1974), and Staats (1970, 1975) are strengthened by evidence suggesting that private stimuli have arousal properties and discriminative functions identical to their real-life counterparts.

#### The Continuity of Overt and Covert Stimuli

Several prominent behaviorists have argued that imaginal stimuli exert a powerful controlling influence on human behavior. Skinner (1953) has stated, "One may generate an emotional response by recounting an emotional event" (p. 275). Mahoney (1974), in his discussion of cognitive influences of behavior points out that "there is long



acknowledged evidence that...imaginal stimuli play a very significant role in human performance" (p. 39), and that "self-generated stimuli and covert stimuli elicit reactions comparable to those observed with external stimulation" (p. 40). Bandura (1969) concurs: "...symbolized aversive events possess emotion-arousing properties analogous to their real-life counterparts" (p. 473).

Most of the research purporting to demonstrate responsiveness to cognitive events utilize procedural operations whereby subjects are instructed to "think about" or "imagine" various experiences. Measures of physiological activity, e.g., heart rate, respiration rate, galvanic skin response, are interpreted by cognitive researchers as evidence of the arousal producing properties of symbolic stimulation. Nonmediational behaviorists might argue that the instructions verbalized by the experimenters function as external stimuli which reliably predict measurable autonomic arousal. Though this nonmediational position eliminates the need for inference, it should be emphasized that the nature of the procedural operations employed in this research strongly implicates the operation of inferred (covert) mediating factors. It is extremely doubtful that instructions to "imagine" or "think about" various events would elicit significant increases in arousal unless subjects perform cognitive work. Bandura (1969), in his discussion of the role of symbolic processes in systematic desensitization, insists that covert activities mediate emotional responsiveness to various instructional influences:

It is true that the therapist exercises some degree of control over the timing and duration (and nature) of

the client's implicit activities, but no conditioning effects are likely to ensue unless clients engage in appropriate cognitive representations of the suggested sequence of events. (1969, p. 584)

Cognitions are, by definition, publicly unobservable. Their existence may be justifiably inferred, however, on the basis of repeated demonstrations of physiological activity in response to experimenter-induced (and self-reported) covert stimulation.

Most of the research purporting to demonstrate the arousal properties of imaginal stimuli involves comparisons of the physiological reactions elicited by negative imagery with reactions elicited by positive and/or neutral imagery. In a study conducted by Grossberg and Wilson (1968), subjects first listened to descriptions of fearful and neutral scenes, and were then told to imagine each of the scenes four times. Measures of heart rate, skin conductance, and muscle action potentials were recorded during each of the listening and imagining phases. The results indicated that fearful and neutral scenes produced equal levels of arousal during the four listening phases, but that fearful scenes generated significantly higher levels of heart rate and skin conductance than neutral scenes during the four imagining phases. These findings suggest that subjects' autonomic arousal was produced by the visualization of aversive imagery, rather than by the externally presented stimulation of the experimenter's verbalizations.

May and Johnson (1973) utilized a "time-locked" technique to investigate the effects of symbolic stimuli on autonomic activity. Subjects in each of two groups were instructed to memorize, in correct order, a list of numbers, neutral words, and either stressful words

(murdered, mutilated, massacred; group 1) or relaxing words (peaceful, tranquil, restful; group 2). They were then presented with a sequence of tones, each of which served as a signal to cue a particular thought (word or number). Each subject was told, during the instruction phase of the study, that thoughts of words were to be associated with corresponding imaginal representations. The word "tranquil," for example, was to generate images of an empty beach, a calm spring morning, or any other tranquil scene selected by the subjects. The word "massacred" might generate a covert picture of a deadly war battle or some similar imagined scene. Since the subjects memorized a predetermined sequence of numbers and words, the experimenters were able to determine the relationship between each tone, the thought (i.e., the particular word-image or number) it cued, and the elicited autonomic response. The results indicated that internally produced images produced marked physiological changes, and that the direction of the changes was a function of the affective nature of the cognition. Heart rate and respiration rate were shown to be the most sensitive measures. Within groups, differences were obtained between stressful or relaxing versus neutral images; between groups, stressful and relaxing images produced markedly different autonomic responses. This study powerfully demonstrates the impact of cognitive self-arousal.

An investigation conducted by Haney and Euse (1976) provides further evidence supporting the notion that covert stimuli possess arousal properties. Subjects in this study had their heart rate and skin conductance responses monitored while engaging in neutral, positive,

and negative visual imagery. The findings indicated that both positive and negative imagery generated and sustained high levels of skin conductance over a 60-second exposure interval; peak arousal under both conditions occurred approximately 27 seconds after initial exposure. The results for heart rate measure revealed that exposure to negative covert scenes produced greater increases than exposure to neutral scenes. Although the study's use of experimental controls to check for image clarity and basal arousal level is commendable, the data must be interpreted with caution due to the author's failure to control for order effects associated with a standardized sequence of stimulus presentations. Haney and Euse's investigation does, however, suggest that covert imaginal stimuli are capable of producing large increases in autonomic responsiveness.

A recent study conducted by May (1977a) further illustrates the impact of internal thoughts on physiological activity. Autonomic nervous system responding (heart rate, respiration rate and amplitude, skin conductance, and GSR frequency) to thoughts of phobic and neutral content were compared in populations of phobic and nonphobic subjects. The results showed that phobic imaginal stimuli produced greater arousal (increased heart rate and respiration amplitude) than neutral imaginal stimuli, and that phobic subjects reacted to these stimuli more than nonphobic subjects.

Several areas of clinical research corroborate the findings of the foregoing studies. A number of investigations of the process and outcome of imaginal systematic desensitization have shown that covert

imagery possesses significant arousal properties (Clark, 1963; Folskins, Lawson, Opton, & Lazarus, 1968; Lang, Melamed, and Hart, 1970). Lang et al., for example, continuously recorded subjects' autonomic responses as they imagined a series of increasingly anxiety-provoking scenes taken from a fear hierarchy. A systematic relationship was observed; progression through the hierarchy was accompanied by corresponding increases in measured autonomic arousal. Similar findings have been generated by research on sexual behavior. Simply by cueing thoughts of sexual activity, high levels of arousal, as measured by penile volume and blood flow, can be produced (see Bandura, 1969).

Although the foregoing studies document the arousal-producing properties of covert visual imagery, they do not provide controlled tests of the assumption of continuity between external and private stimulation. Bandura's contention that "symbolized...events possess emotion-arousing properties analogous to their real-life counterparts" (1969, p. 473) must be tested by comparing the autonomic responses produced by a variety of private and public stimuli, matched with respect to critical qualitative and quantitative variables.

Two investigations which come close to meeting this criterion have been performed by Barber and Hahn (1964) and by Craig (1968). Subjects in the Barber and Hahn study were initially asked to immerse their hands into a pail of extremely cold water (2°C.). They were then divided into four experimental groups. Group A subjects (pain stimulation group) repeated the identical procedure. Subjects in group B (innocuous stimulation group) were also requested to immerse their

hands in water a second time, but this time the water was at room temperature. Group C subjects (waking imaginal pain group) immersed their hands in room temperature water, but were instructed to "imagine vividly and to think continuously that it is as cold as ice and as uncomfortable and painful as the previous water." Group H subjects (hypnotic imagined pain group) were hypnotized before receiving instructions to imagine the painful stimulation. Throughout both phases of the study, measures of heart rate, skin resistance, and muscle action potentials were recorded. The results indicated that instructions to imagine the painful stimulus (in both the awake and hypnotic states) produced physiological response (increased heart rate and muscle tension and a tendency toward reduced skin resistance) nearly identical to the responses produced by actual pain stimulation.

Craig (1968) corroborated these findings. Using the "cold pressor," once again, as the unpleasant stimulus, he exposed subjects to three experiences in balanced orders: direct aversive stimulation, vicarious aversive stimulation and imaginal aversive stimulation. Measures of heart rate recorded during the anticipatory and test phases of the three conditions indicated that direct and imagined stresses produced nearly equal and marked increases.

The Barber and Hahn (1964) and Craig (1968) investigations provide only tentative support for the assumption of stimulus continuity. The failure of the former study to control for order effects associated with overt and covert stimulus presentations in one factor limit the generalizability of the findings. Another problem in-

volves the failure of both studies to utilize an array of public and private stimuli representing the full range of the affective dimension. The Barber and Hahn and the Craig investigations compared imaginal and direct aversive stimuli; they did not eliminate the possibility that neutral and/or affective pleasant covert stimuli fail to arouse responses comparable to their overt counterparts. Recent findings from investigations of the outcome of covert reinforcement therapy (Ladouceur, 1974; Marshall, Boutiller, & Minnes, 1974) suggest that positive imaginal stimuli do not possess reinforcement properties. These findings may be the result of the inability of positive covert stimuli to generate sufficiently high levels of autonomic activity.

Yet another problem with the Barber and Hahn (1964) and Craig (1968) studies involves their selection of a common aversive stimulus for their entire subject populations. No doubt, few would deny the highly unpleasant nature of the "cold pressor" task. Variability in subjects' pain thresholds and in their perceptions of the aversiveness of the task, however, may have confounded the data. Intersubject differences require that affective negative stimuli be tailored to the individual subject. Furthermore, the use of the "cold pressor" task, rather than a wider range of aversive stimulus presentations limits the generalizability of the findings of the continuity between imaginal and direct aversive stimulation. It is plausible that aversive stimuli which are more representative of those used in clinical practice (e.g., nausea) are not comparable to their overt and covert forms.

Five conclusions are justified from a review of the research on imaginal self-stimulation: (1) imaginal stimuli are capable of generating and sustaining significant increases in autonomic responsiveness; (2) positive, negative, and neutral covert stimuli produce autonomic responses which differ with respect to both character and magnitude; (3) the results of preliminary and uncontrolled investigations suggest that aversive public and private stimuli possess similar arousal properties, but more methodologically sound research is needed; (4) no studies have utilized positive and neutral stimuli to examine the notion of overt and covert stimulus continuity; and (5) previous studies designed to assess the correspondence between overt and covert stimulus properties have failed to employ stimuli which are subjectively determined and tailored to the individual subject.

#### Therapeutic Implications of Research on Covert and Overt Stimulation

Investigations designed to examine the arousal properties of direct and imaginal stimuli have implications not only for the theoretical issue surrounding the continuity assumption and the covert conditioning model; they have significant practical implications for behavior therapy as well. If it can be shown that overt and covert stimuli possess similar arousal properties, then the classical conditioning techniques originally designed for use with real-life CSs and UCSs can be modified for use with symbolic stimulus presentations. Cautela's covert sensitization (1967) and Wolpe's imaginal systematic desensitization (1958) are two examples of cognitive behavior therapy



techniques whose theoretical underpinnings rely on the assumption of continuity between overt and covert stimuli. Covert sensitization differs from the aversive counterconditioning procedures described by Rachman and Teasdale (1969) only in that it employs private rather than externally observable stimuli. Imaginal systematic desensitization is merely the cognitive form of the in vivo desensitization procedure formulated three decades earlier by Mary Cover Jones (1924). The demonstration of continuity between public and private events has implications for the operant based behavior modification techniques as well. If cognitive representations of events arouse responses similar in magnitude and character to those evoked by the real-life occurrences, then covert and overt contingency arrangements should be equally effective in manipulating the frequencies of specified target behaviors. Cautela's covert positive reinforcement (1970a), covert negative reinforcement (1970b), covert extinction (1971), and covert punishment (1973) are based on this proposition. The extension of a wide range of behavioral techniques into the cognitive arena is justifiable if the assumption of stimulus continuity is validated.

Other therapeutic implications of research focusing on the autonomic correlates of imaginal stimuli involve Cautela's covert conditioning behavior therapy techniques, specifically covert positive reinforcement (1970a) and covert sensitization (1967). Covert positive reinforcement was originally formulated as an operant based procedure in which clients generate imaginal representations of positively valenced stimuli following the visualization of adaptive

behavior patterns. If it can be shown that positive visual imagery possesses arousal properties, then it can be argued that covert positive reinforcement operates via a classical, in addition to, or instead of, an operant process. Such a finding would have major procedural implications for the practice of covert reinforcement therapy. For example, a classical conditioning interpretation would suggest that superior treatment outcomes would accrue when target stimuli are introduced during some range of high autonomic reactivity to previously presented positive visual images. Such a temporal relationship between the presentation of imaginal CSs and UCSs is based on the assumption that maximal conditioning occurs at peak levels of physiological arousal. An operant interpretation of the process of covert reinforcement would predict maximal therapeutic gains when target stimuli are visualized prior to, rather than during, the presentation of positive imaginal UCSs.

Two studies have evaluated the autonomic correlates of positive visual imagery (Folkins et al., 1968; Haney & Euse, 1976). Whereas Folkins et al. obtained negative findings, Haney and Euse found that covert positive stimuli generated and sustained significant increases in autonomic reactivity. The resolution of these conflicting data may indicate that positive affective states can be conditioned to target stimuli. The rationale advanced by Lazarus and Abramovitz (1962) for the emotive imagery techniques is based on this proposition. Similarly, Wolpe's systematic desensitization (1958), viewed as a counter-conditioning procedure (Davison, 1968), conditions positive

affective states generated by relaxation and positive visual imagery to phobic stimuli. The issue of whether or not classical conditioning phenomena are involved in the process of covert positive reinforcement has not yet been resolved.

Empirical evaluations of the arousal-producing properties of covert stimuli also have important implications for procedural parameters in Cautela's covert conditioning techniques. The temporal patterns of subjects' autonomic reactivity to the onset of prolongation of positive and negative visual imagery provides valuable information regarding the image duration required to reach maximum arousal. These data can be useful in formulating the temporal parameters in covert reinforcement and sensitization which allow for a precise pairing of peak arousal and target stimuli. If, in fact, maximal conditioning occurs at peak arousal levels, then the presentation of target stimuli within some range of high autonomic reactivity should result in stronger conditioned responses and superior treatment outcomes. Only one study (Haney & Euse, 1976) has examined the autonomic correlates of prolonged visual imagery. The findings indicated that peak arousal occurred approximately 27 seconds after the onset of positive and negative imagery. Because of procedural confounds, however, the study's reported implications for the temporal parameters in Cautela's techniques are limited.

Conspicuously absent in previous research designed to assess the effects of direct and imaginal stimulation are: (1) the use of stimuli of positive and neutral valence to evaluate the continuity

assumption; (2) the use of emotionally-loaded stimuli which are subjectively determined and tailored to the individual subject; (3) the presentation of affective stimuli which are heterogeneous across subjects; (4) the counterbalancing of stimulus presentations in order to eliminate procedural confounds associated with stimulus order effects; (5) the use of prolonged stimulus exposures (greater than 60 seconds) in order to assess habituation and baseline recovery durations; and (6) the use of self-report measures in order to assess differences in subjective reactivity to overt and covert stimulus presentations. The proposed study adds to the previous research by incorporating each of the above procedural elements in its experimental design, thereby providing controls absent or confounded in earlier studies. As a result, the findings of the present investigation have greater external validity, and they represent the result of a more powerful test of the continuity assumption.

It was hypothesized that the findings of the present investigation would generally support the assumption of continuity between overt and covert stimuli. The results of preliminary research evaluating the continuity of affectively negative public and private events (Barber & Hahn, 1964; Craig, 1968), together with the documentation of the arousal-producing properties of aversive covert stimuli (Bandura, 1969; Mahoney, 1974), suggested that the results of present study would confirm the notion of stimulus continuity for negatively valenced inputs. This finding was expected for both the two physiological measures and for the self-report measure of affective inten-

sity. More caution was exercised, however, in predicting stimulus continuity for affectively neutral and positive stimuli. The absence of research assessing the continuity of stimuli of neutral and positive valence, and conflicting data from studies evaluating the autonomic correlates of positive imagery, made predictions difficult. On a theoretical level, however, there was reason to assume that the continuity assumption would be validated across all three stimulus valence categories and across all dependent variables. As Skinner (1953, 1969) has argued, there is no evidence that private events have special properties, nor is there evidence that private events may be distinguished from public ones by any special structure or nature.

It was also hypothesized that differences in autonomic and self-reported reactivity to positive, negative, and neutral stimulus presentations would accrue. Previous research comparing physiological responsiveness to imagined stimuli varying in affective content (Grossberg and Wilson, 1968; Haney and Euse, 1976; May, 1977a; May and Johnson, 1973) justified the prediction that affectively loaded stimulus inputs would generate higher levels of autonomic arousal than neutral inputs.

## CHAPTER II

### METHOD

#### Experimental Design

Twelve undergraduate college students were administered a pre-experimental questionnaire designed to determine their subjective rating of affective intensity for each of 12 stimuli. Three items, one each of positive, negative, and neutral valence were then presented to each subject in both their direct and symbolic (imaginal) forms; the order of the six stimulus presentations was counterbalanced. Measures of heart rate, skin conductance, and self-reported affective intensity were used to evaluate autonomic and subjective reactivity to each stimulus. The study follows a 2(direct vs. symbolic) x 3(positive vs. negative vs. neutral valence) repeated measures experimental design.

#### Subjects

Twelve female students randomly selected from a human subjects pool and enrolled in introductory psychology courses at the University of North Carolina at Greensboro served as subjects. Participation in this study fulfilled a course requirement to participate as subjects in psychological research. Subject selection is further described in section entitled "Experimental Stimuli."

### Experimenter

The study's author, a male doctoral psychology student, served as the experimenter. He conducted all phases of the investigation.

### Experimental Stimuli

Each of 34 potential subjects completed a "Stimulus Rating Questionnaire" (Appendix A) before entering the experimental laboratory. The subjects indicated on an 11-point scale (-5 = extremely unpleasant, 0 = neutral, +5 = extremely pleasant) their affective intensity rating for each of 12 stimuli. The items included on the questionnaire were selected by the experimenter to reflect an array of affectively loaded stimuli commonly found in the counterconditioning behavior therapy literature. Four items expected to elicit a negative affective state (spider, snake, cockroach, cat feces), four expected to generate positive reactions (flower, perfume, nude male magazine centerfold, chocolate) and four expected to produce a neutral effect (plant, rock, twig, water) were listed on the questionnaire. For each subject, one item falling in the -4 to -5 range, one falling in the +4 to +5 range, and one item rated 0 were selected as the negative, positive, and neutral stimuli, respectively. Twenty-two subjects whose stimulus ratings failed to include items in each of the above ranges were eliminated from the study. Of the 12 subjects who were selected for the study, five rated two or more stimuli within the same range of affective intensity. For each of these subjects, the stimulus selected least

frequently by prior experimental subjects was chosen. Thus, an attempt was made to generate categories of positive, negative, and neutral stimuli which were as heterogeneous as possible across subjects. Table 1 presents a list of the three stimuli used for each of the 12 subjects. (Table 1, and all subsequent tables, may be found in Appendix B.)

Each of the three stimuli selected for each subject was presented in both its direct and imaginal forms. During direct exposure, the physical stimulus was presented and the subject was requested to focus her attention on stimulus characteristics representing all relevant sensory modalities. The subject was instructed to signal the experimenter by raising her right index finger when her attention was completely focused on the physical stimulus properties. A 90-second exposure interval began immediately following the subject's signal. During imaginal exposure, each subject was told to close her eyes, to listen, and to direct her attention to a running description of the appropriate stimulus, verbalized by the experimenter. The description, which was standardized for each stimulus (Appendix C), encouraged the subject to generate a vivid covert image of the stimulus, including all of its sensory attributes. The subject was instructed to signal the experimenter by raising her right index finger when a vivid covert scene was successfully imagined. She was then instructed to maintain the image with maximal clarity and intensity during a 90-second exposure interval.

Though the subjects chosen for the investigation were selected on the basis of their extreme verbal reactivity to the items listed



on the "Stimulus Rating Questionnaire," there is no reason to assume that the subject selection process engendered any form of systematic error into the study. The subjects' verbal lability to the experimental stimuli in no way insured high levels of physiological reactivity to the stimuli. According to Lang's (1968) "triple response mode" hypothesis, behavior sampled from each of the three primary response dimensions (verbal, motoric, physiological) correlate poorly. Thus, individuals who are verbally labile in a particular stimulus situation need not be physiologically labile in that situation. Additional evidence that the particular subjects chosen for the study were not more physiological labile than the general population comes from the finding that the present results were consistent with previous research designed to evaluate autonomic reactivity to affectively loaded inputs.

#### Apparatus

Before exposure to the six experimental stimuli, subjects were required to scrub their hands with soap and water in order to ensure accurate physiological recordings. Each subject was then escorted into the experimental room, where she was seated in a reclining chair, locked in a position midway between the upright and fully reclining positions. A 3-foot table located approximately 1-1/2 feet in front of the subject was used to place stimuli during the direct exposure periods.

Additional apparatus used in the study included a Grass Model 79 polygraph, equipped with a Grass Tachograph Pre-Amplifier Model

7P4A and a Grass Low Level DC Pre-Amplifier Model 7PlA. This equipment continuously and simultaneously recorded heart rate and skin conductance. A manual event recorder was attached to the polygraph in order to delineate critical time intervals. To obtain heart rate recordings, a Photoelectric Transducer Model PTTI-6 was attached to the subject's left index finger. To record skin conductance responses, silver chloride electrodes were attached to the first and third fingers of the subject's right hand. The polygraph was located behind the subject and was monitored by the experimenter, who was also out of the subject's view.

### Procedure

Before electrode attachment, the subject was given general information regarding the purpose of the experiment (Appendix D). The nature of psychophysiology was explained, and a description of the response measures was given. The subject was then told that she would be exposed to each of three objects selected from the items on the "Stimulus Rating Questionnaire," and that each of the objects would be presented in both its real-life and imaginal forms. Each subject was informed that some of the stimulus presentations may be unpleasant, and permission was obtained to expose her to the objects for brief time periods.

Recording sensors were then attached, and the subject was asked to sit comfortably in the reclining chair. A 10-minute adaptation period followed in order to establish a stable basal pattern. After

7 minutes, the experimenter announced to the subject, "Three more minutes," so that the sensitivity of the skin conductance preamplifier could be adjusted to the individual subject's reactivity level.

Each subject's particular negative, positive, and neutral stimuli were then presented in both their direct and imaginal forms. The sequence of the six stimulus presentations was counterbalanced across subjects such that each of the six stimuli appeared an equal number of times in each ordered location. (See Appendix E for a list of the stimulus sequences.)

For the three direct stimulus exposures, the subject was presented with the actual stimulus and was instructed to signal the experimenter when she believed that her full attention was focused on sensory impressions from all sensory modalities. Following the signal, the subject was exposed to the stimulus for 90 seconds. The stimulus was then removed, and a three minute rest period followed.

For the three imaginal stimulus exposures, the subject was given a standardized vivid description of the stimulus (Appendix B), including suggestions to image all relevant sensory impressions, and was instructed to signal the experimenter when a clear covert image was obtained. The experimenter then terminated his verbal suggestions and instructed the subject to maintain the image. A 90 second exposure period followed after which the subject was given the command to stop imagining. A three minute rest period followed before the beginning of the next trial.

Immediately after the 90 second presentation of each of the six experimental stimuli, each subject was asked to verbally express clarity ratings (5 = realistically vivid, 1 = little or no picture) for the three imaginal stimulus exposures, and concentration ratings (5 = highly focused attention, 1 = poorly focused attention) for the three direct stimulus exposures. Each subject was also asked to verbally rate the affective intensity (-5 = extremely unpleasant, 0 = neutral, +5 = extremely pleasant) for each of the six experimental stimuli. These data permitted an analysis of self-reported reactivity to the six stimulus categories.

During the three minute rest periods following the direct and imaginal exposures, each subject was given brief relaxation exercises, including suggestions of warmth, heaviness, and calmness. Haney and Euse (1976) report that relaxation procedures are successful in minimizing initial value effects and producing stable skin conductance levels.

To summarize, the following procedural sequence was conducted: (a) negative, positive, and neutral stimuli were determined; (b) an ordered sequence of the six stimulus presentations was already selected for the subject; (c) the rationale and procedure of the study were explained; (d) recording sensors were attached; (e) an adjusted basal skin conductance level was obtained; (f) the first experimental stimulus was presented for 90 seconds; (g) an affective intensity rating and an image clarity or concentration rating were obtained; (h) a three minute rest period followed during which brief relaxation exercises

were given; (i) sequence (f) through (h) was repeated for the remaining five experimental stimuli. Figure 1 illustrates the procedural sequence for the direct and imaginal stimulus exposure trials.

(Figure 1 and all subsequent figures may be found in Appendix F.)

### CHAPTER III

#### RESULTS

##### Summary of Data Treatment

A check was conducted on the independent variables in order to ensure that differences in reactivity to the six stimulus presentations were not the result of differential levels of image clarity and attentional focus. When it was determined that the saliency of the six stimulus categories was roughly equivalent, the dependent variables were computed and submitted to a series of statistical analyses.

There were two kinds of dependent variables: physiological and verbal. The physiological measures are described first.

Average heart rate (HR), expressed in terms of beats per minute (bpm), and skin conductance (SC), expressed in mhos (reciprocal of ohms), were sampled during the 90 second stimulus exposure interval and during three separate 15 second pre-stimulus intervals. Each of the three pre-stimulus intervals was used as a separate baseline for statistical treatment. They included (a) baseline 1, the 15 seconds of the previous rest period, (b) baseline 2, the final 15 seconds of the instructions period, during which the experimenter informed the subject of the nature of the upcoming stimulus presentation, and (c) baseline 3, the 15 seconds immediately prior to the subject's signal that the stimulus was being vividly perceived. Figure 1 shows the

time intervals during the trial sequence that were sampled for the statistical analysis of physiological data.

Average HR and SC for each sampled time interval were determined by inspecting the deflection of the polygraph pen during the interval and using a clear ruler to draw a line estimating mean HR and SC for the interval. This procedure was utilized to specify mean HR and SC levels for the three baselines, for the 90 second stimulus exposure interval, and for each of six 15 second intervals comprising the 90 second exposure interval.

The first set of statistical analyses conducted on physiological data focuses on differences among the three baselines on measures of mean HR and mean SC. These analyses were carried out in order to gain a detailed view of the pattern of autonomic activity preceding exposure to the experimental stimuli. Since baseline levels of HR and SC were sampled prior to the experimenter's instructions (baseline 1), during the final 15 seconds of his instructions (baseline 2), and during the imagery description or attention focusing segment (baseline 3), comparisons among the three baselines reflect the effects of the pre-exposure manipulations. Physiological data recorded during the second baseline were influenced by the subject's knowledge and anticipation of the upcoming stimulus presentation, while data recorded during the third baseline were influenced by the subject's exposure to imaginal suggestions during imaginal exposure trials, and to the actual physical stimulus during direct exposure trials. Baseline 1, which was sampled before the beginning of each trial, is the only baseline that

is free of major procedural manipulations. Therefore, a finding of statistically significant differences among the three baselines would indicate that the pre-exposure manipulations affect physiological reactivity. Such a finding would also indicate that HR and SC changes resulting from exposure to the experimental stimuli should be computed on the basis of comparisons with the first pre-trial baseline interval.

Following the analysis of differences among the three baselines on the physiological variables, HR change scores and SC change scores were calculated for each of the six experimental stimuli. Since the baseline analyses revealed that the experimental manipulations did, in fact, influence subjects' autonomic arousal, HR and SC change scores were based on comparisons with pre-trial baseline 1. Specifically, HR change scores were determined for each of the six experimental stimuli by subtracting the mean HR level during baseline 1 from the mean HR level of the corresponding 90 second stimulus exposure interval. SC change scores were determined in the same manner.

Because the degree of HR and SC change following exposure to stimuli depends, in part, upon initial baseline levels, percent change scores were calculated for both physiological measures. For each of the six experimental stimuli, percent HR change and SC change were computed by dividing the change score for that exposure interval by the pre-trial baseline level of the corresponding interval. The HR and SC percent change variables supplement the HR and SC change variables by providing measures of autonomic reactivity that take



into account initial levels of arousal.

In addition to the four physiological dependent measures (HR change, SC change, HR percent change, SC percent change) a verbal measure was used to evaluate differential reactivity to the six stimulus categories. Self-reported affective reactions to the six stimuli were assessed by means of subjects' affective intensity ratings. After each stimulus exposure, subjects rated the stimulus on a scale ranging from +5 (extremely pleasant) to -5 (extremely unpleasant). These data constituted the fifth and final dependent measure used in the investigation.

Each of the study's five dependent variables was used to assess differences between modes of stimulus presentations (direct vs. indirect) and among stimulus valences (positive vs. negative vs. neutral). Two separate multivariate analyses of variance (MANOVAs) were conducted on HR change, SC change, and affective intensity ratings, and on HR percent change, SC percent change, and affective intensity ratings. The two MANOVAs were carried out in order to avoid confounds associated with the use of a single MANOVA on correlated dependent measures. The two separate MANOVAs also permitted a comparison of the composite discriminant functions obtained with physiological change measures and the verbal measure on the one hand, and physiological percent change measures and the verbal measure on the other hand.

For ease of data presentation, the results of the MANOVAs are described in two separate subsections. Comparisons between direct and

imaginal modes of stimulus presentation are discussed under one heading, and comparisons among the three stimulus valence categories are presented under another heading. The finding of non-significant mode x valence interactions for all analyses eliminated the necessity for a separate subsection devoted to interaction effects.

Following the analysis of differences between modes of stimulus presentation and among stimulus valence categories, the temporal patterns of autonomic arousal for imaginal positive, negative, and neutral stimulus presentations were analyzed descriptively. Average HR and SC levels were determined for the six successive 15 second segments of each 90 second stimulus exposure interval. These data were transformed to a measure of percent HR and SC change and then plotted. The adaptation curves resulting from continuous exposure to imaginal positive, negative, and neutral stimuli were assessed descriptively due to limitations in computer capability.

Thus, the data were analyzed as follows: first, a check was conducted on the independent variables to ensure that differential levels of reactivity to the six experimental stimuli could not be attributed to differences in image clarity and attentional focus. Second, differences among the three baselines on measures of mean HR and mean SC were assessed in order to determine whether the instructional manipulations prior to exposure influenced autonomic reactivity. Third, the study's five dependent variables were submitted to a series of MANOVAs to evaluate differences between direct and indirect modes of stimulus presentation, and among positive, negative, and neutral

stimulus valence categories. Finally, the temporal patterns of HR and SC reactivity in response to imaginal stimulus presentations were plotted and analyzed descriptively.

#### Image Clarity and Attentional Focus Ratings

To ensure that differences in reactivity to the six stimulus presentations were not due to differential levels of image clarity and attentional focus, a check was conducted on the independent variables. Subjects' ratings of image clarity (5 point rating scale) for the imaginal stimulus exposures and their ratings of attentional focus (5 point rating scale) for the direct stimulus exposures were submitted to a 2(modes of stimulus presentation) x 3(stimulus valences) analysis of variance (ANOVA). The results of the analysis, summarized on Table 2, indicate that the main effects of mode and valence and the mode x valence interaction effect did not reach statistical significance. Mean ratings of image clarity and attentional focus were 3.97 and 3.81 for direct and imaginal modes of stimulus presentation, respectively, and 3.96, 4.17, and 3.84 for positive, negative, and neutral stimulus valence categories, respectively. It was thus determined that the saliency of the stimulus categories was roughly equivalent.

#### Differences Among Baselines

Three different baselines were included in the study's design in order to provide a more detailed view of the pattern of autonomic

activity preceding exposure to the experimental stimuli. Because baseline levels of HR and SC were sampled prior to the experimenter's instructions (baseline 1), during the final 15 seconds of his instructions (baseline 2), and during the imagery description or attention focusing segment (baseline 3) (see Figure 1), differences among the three baselines reflect the effects of pre-exposure instructional manipulations. Table 3 presents mean HR and SC scores for the first, second, and third baselines of each stimulus exposure trial.

Multivariate Analysis of Variance. Average HR and SC scores sampled during the baseline periods were submitted to a multivariate analysis of variance (MANOVA) with repeated measures on three factors. The components of the analysis were modes of stimulus presentation (direct vs. indirect), stimulus valences (positive vs. negative vs. neutral), and baselines (1-3). The results of the analysis are provided on Table 4. The main effects of mode and valence failed to reach statistical significance, as did all interactions. A significant main effect of baselines,  $F(2,22) = 8.51$ ,  $p < .01$ , however, indicates a differential effect among the three pre-stimulus periods on the HR and SC composite function. Roy's Maximum Root Criterion (1957), which maximally distinguishes among the three baselines by finding a unique composite of the HR and SC measures, generated a  $\lambda$  maximum of 99.66%, indicating that the established composite variable (first canonical variable) accounts for almost all of the variability in baseline scores. The MANOVA, viewed in terms of a univariate analysis of discriminant function scores, yielded an  $\eta^2$  of

.594 [ $F(2,22) = 8.51$ ], indicating that the three baselines differ at the  $p < .01$  level. Correlation coefficients between the first canonical variable and the separate HR and SC variables were +.90 and +.21, respectively. Thus, the significance of the MANOVA can be attributed more to the contribution of HR scores than SC scores.

A Neuman-Keuls post-hoc analysis of the discriminant function means indicated that the composite HR and SC variable distinguished between all baseline pairs at the  $p < .01$  level. Thus, subjects' autonomic arousal increased significantly throughout each of the three pre-stimulus segments of the trial sequence.

Heart Rate. Separate ANOVAs were conducted on HR and SC scores. The HR ANOVA (Table 4) yielded a significant main effect of baseline,  $F(2,22) = 12.09$ ,  $p < .001$ . The main effects of stimulus valence and mode of stimulus presentation indicated that scores could not be distinguished on these factors. A Neuman-Keuls post-hoc analysis of differences between pairs of baseline means indicated that HR levels sampled during the second and third baseline periods were significantly higher than the HR level sampled during baseline 1 ( $p < .01$  for both comparisons). The second and third baselines, however, could not be distinguished on the HR measure. Thus, the experimenter's verbal instructions had the effect of elevating subjects' HR, and preliminary exposure to the experimental stimuli during the imagery description and attention focusing periods sustained these increases.

In addition to the baseline main effect, the valence x baseline interaction,  $F(4,44) = 2.67$ ,  $p < .05$ , reached statistical significance.

Neuman-Keuls comparisons indicated that for both positively and negatively valenced stimulus inputs, HR levels sampled during the second and third baseline periods were greater than those sampled during the first baseline period ( $p < .01$  for all comparisons), but differences between the second and third baselines failed to reach significance. Thus, for the affectively loaded stimuli, the experimenter's instructions regarding the nature of the upcoming stimulus presentation produced HR increases, and these elevated HR levels were sustained during the imagery description and attention focusing phase of the trial. The patterns of HR reactivity for neutral trials indicated that HR sampled during the third baseline period was at a significantly higher level than HR sampled during the first baseline period ( $p < .05$ ). All other comparisons were non-significant. Thus, the experimenter's instructions regarding the nature of the upcoming neutral stimulus failed to produce significant increases, but preliminary exposure to the neutral stimuli (imagery description and attention focusing phase) had the effect of accelerating the HR response beyond the level obtained during the pre-trial baseline segment.

All Neuman-Keuls post-hoc comparisons between pairs of stimulus valence means at each of the three baseline levels failed to reach significance on the HR measure. Thus, HR levels obtained during baselines 1, 2 and 3 did not differentiate positive, negative, and neutral trials.

Skin Conductance. The ANOVA conducted on SC scores (Table 6) produced a significant main effect of baselines,  $F(2,22) = 4.53$ ,  $p < .05$ . All other main effects and interactions were nonsignificant.

A Neuman-Keuls post-hoc analysis of differences among pairs of baseline means indicated that the third baseline interval produced higher levels of SC arousal than the first ( $p < .05$ ) and second ( $p < .05$ ) baseline intervals, and that the first and second intervals did not differ. These findings indicated that the experimenter's instructions regarding the nature of the upcoming stimulus presentation failed to arouse subjects' SC reactivity beyond the pre-instructional rest period, but that preliminary exposure to the experimental stimuli (during imagery description and attention focusing) increased SC beyond the levels obtained for the resting and instructional periods.

Summary of Baseline Analyses. A 2(modes of stimulus presentation) x 3(stimulus valences) x 3(baselines) repeated measures MANOVA was carried out on HR and SC scores sampled during each of three pre-exposure baseline intervals. The analysis of discriminant function scores indicated that subjects' autonomic arousal increased significantly throughout each of the pre-exposure segments of the trial sequence; the instructional (second) segment was associated with higher levels of reactivity than the pre-trial (first) segment, and the preliminary stimulus exposure segment (third, imagery description and attention focusing) was associated with even higher levels of reactivity than the instructional (second) segment.

Although the ANOVAs conducted on HR and SC scores both produced significant baseline main effects, posteriori comparisons among baseline means for the two measures revealed different patterns of autonomic arousal across the trial sequence. HR was found to

accelerate between the resting baseline and instructional baseline intervals, and it remained relatively stable between instructional baseline and preliminary exposure baseline intervals. SC, on the other hand, did not increase substantially between the resting and instructional baseline periods, but it did display a marked increase between the instructional and preliminary exposure periods.

Thus, three conclusions are justified: (1) The experimental manipulations had a significant effect upon autonomic reactivity; (2) Arousal, viewed as the composite discriminant function of HR and SC scores, increased markedly across the three sampled segments of the trial sequence; and (3) HR increased as a result of instructional influences, while SC increased as a result of preliminary exposure to the experimental stimuli.

Because the second and third baselines were sampled after the beginning of the trial sequence, they reflect the influence of experimental manipulations. Physiological data recorded during baseline 2 was influenced by the subjects' knowledge and anticipation of the upcoming stimulus presentation, while data recording during baseline 3 was influenced by the subjects' exposure to imaginal suggestions during imaginal exposure trials and to the actual physical stimulus during direct exposure trials. Baseline 1, which was sampled during the rest period immediately before the beginning of each trial, is the only baseline that is free of the effects of major procedural manipulations. The remaining analyses, therefore, focus on comparisons with baseline 1.



### Direct vs. Imaginal Stimulus Presentations

Table 7 presents mean HR and SC change scores, mean HR and SC percent change scores, and mean affective intensity ratings for each of the six experimental stimuli. Note that the change and percent change physiological variables were computed on the basis of comparisons with data recorded during the first baseline interval.

Two separate repeated measures MANOVAs were conducted on HR change, SC change, and affective intensity ratings, and on HR percent change, SC percent change, and affective intensity ratings. The two MANOVAs were carried out in order to avoid confounds associated with the use of a single MANOVA on correlated dependent measures. They also permitted a comparison of the discriminant functions obtained when physiological change scores were viewed relative to baseline levels of autonomic arousal, and when they were viewed without taking into account baseline arousal levels.

Both repeated measures MANOVAs were carried out on two factors. The components of the analysis were modes of stimulus presentations (direct and indirect) and stimulus valence (positive, negative, and neutral). For ease of data presentation, this section will review the results obtained for the main effect of mode and for the mode x valence interaction. The next section discusses the results obtained for the main effect of stimulus valence.

Multivariate Analysis of Variance. Table 8 summarizes the results of the 2(direct vs. imaginal modes of stimulus presentation) x 3(posi-

tive vs. negative, vs. neutral stimulus valences) repeated measures MANOVA conducted on HR change scores, SC change scores, and affective intensity ratings. The main effect of modes of stimulus presentation failed to reach significance. Thus, stimuli presented in their direct and imaginal forms generated similar levels of responsiveness on a function representing the composite of the three dependent variables.

The results of the same 2 x 3 MANOVA conducted on HR percent change scores, SC percent change scores, and affective intensity ratings is summarized in Table 9. The findings parallel those of the previous analysis. Direct and imaginal stimulus presentations generated roughly equal levels of reactivity on the composite discriminant function of the three dependent measures.

The MANOVA conducted on the mode x valence interaction failed to reach significance for the analysis using absolute HR and SC change scores and affective intensity ratings. When the analysis was carried out with percent HR and SC change scores and affective intensity ratings, the results were identical; the mode x valence interaction was statistically non-significant. Thus, in the multivariate context, reactivity to direct and imaginal stimulus presentations was similar for positive, negative, and neutral inputs.

Multivariate analyses carried out by Roy's (1957) method determine the unique combination of dependent variables that maximize the differences among experimental groups. The procedure generates a set of discriminant function scores representing a single composite or canonical variable and performs a univariate analysis on this com-

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posite function. Table 10 presents the means of the canonical variable for direct and imaginal presentations of positive, negative, and neutral stimuli. Note that the discriminant function scores are roughly equal for presentations of direct and imaginal stimuli within each valence category, and that this equivalence holds for the analyses using the change and percent change measures.

Heart Rate. A 2(modes) x 3(valences) repeated measure ANOVA was performed on the HR change and HR percent change variables. Table 11 summarizes the results of the analysis for HR change, and Table 12, for HR percent change. The main effects of mode of stimulus presentation failed to reach significance for both analyses, as did the mode x valence interaction effects. Thus the HR variables did not differentiate direct and imaginal presentations across all three stimulus valences and within each stimulus valence category. Mean HR change scores for direct and imaginal modes of stimulus presentation were 1.45 bpm and 1.75 bpm, respectively. Mean HR percent change scores for the two presentation modes were 1.90 for direct inputs and 2.34 for imaginal inputs.

Skin Conductance. Table 13 presents a summary of the 2(modes) x 3(valences) repeated measures ANOVA performed on the SC change variable. The main effect of mode did not reach statistical significance, indicating that the absolute level of SC change in response to direct and imaginal stimulus presentations could not be differentiated. Mean SC changes for scores for direct and imaginal stimulus presentation modes were 0.7 and 0.4 micromhos, respectively. When the

same 2(modes x 3(valences) repeated measures ANOVA was carried out on the SC percent change variable (Table 14), a significant mode effect,  $F(1,11) = 6.58$ ,  $p < .05$  resulted. Thus, when the magnitudes of subjects' SC changes were viewed in proportion to their initial baseline levels of arousal, presentations of real-life stimuli produced SC increases that were significantly greater than those produced by exposure to imaginal stimuli. Mean percent SC change scores for direct and imaginal presentation were 14.55 and 7.33, respectively. Of the five dependent variables of the study, percent SC change was the only measure that differentiated direct and imaginal exposure to the experimental stimuli.

The mode x valence interaction effects were non-significant for both the SC change ANOVA and the SC percent change ANOVA. This finding indicates that within each stimulus valence category, direct and imaginal modes of stimulus presentation produced indistinguishable levels of SC reactivity.

Affective Intensity Ratings. Table 15 presents the results of a 2(modes) x 3(valences) repeated measures ANOVA carried out on affective intensity ratings. The analysis produced a non-significant main effect of mode and a non-significant mode x valence interaction effect. Mean affective intensity ratings for direct and imaginal modes of stimulus presentation were 0.16 and 0.14 respectively. Thus, on the verbal measure, responsiveness to direct and imaginal stimulus presentations could not be differentiated across the three stimulus valences and within each stimulus valence category.

Summary of Effects Due to Modes of Stimulus Presentation. The results generally support the assumption of continuity between overt and covert stimuli. Separate MANOVAs conducted with change and percent change physiological variables, respectively, and affective intensity ratings revealed that reactivity to direct and imaginal stimuli could not be differentiated. This finding held when the three stimulus valence categories were viewed collectively and when comparisons between direct and imaginal presentations were made within each stimulus valence category.

The results of univariate analyses on the HR change, HR percent change, SC change, and affective intensity variables paralleled those obtained for the MANOVAs. Direct and imaginal modes of stimulus presentation produced indistinguishable levels of reactivity across and within stimulus valence categories.

Of the five dependent variables, only the SC percent change measure distinguished between direct and imaginal modes of stimulus presentation. Relative to their initial SC levels, subjects displayed larger conductance changes in response to real-life stimuli than to imaginal stimuli.

#### Positive vs. Negative vs. Neutral Stimulus Valence Categories

Multivariate Analysis of Variance. The 2(mode) x 3(valence) MANOVA carried out on HR and SC change scores and affective intensity ratings (Table 8) produced a highly significant main effect of stimulus

valence,  $F(2,22) = 134.77$ ,  $p < .001$ . Thus, when the three dependent measures were optimally combined to maximize differences among positive, negative, and neutral stimuli, a univariate analysis performed on the composite function indicated that the three stimulus categories produced markedly different levels of reactivity. The MANOVA, conducted by Roy's (1957) method generated a  $\lambda$  maximum of 98.72%, indicating that the established composite (canonical) variable accounts for almost all of the variability in reactivity to the three stimulus categories. Correlation coefficients between the canonical variable and HR change scores, SC change scores, and affective intensity ratings were +.01, -.06, and +.97, respectively. Thus, the verbal measure of affective intensity contributed much more to the significant multivariate valence effect than the two physiological measures.

Neuman-Keuls post-hoc comparisons of discriminant function means indicated that the canonical variable differentiated all possible pairs of positive, negative, and neutral stimuli at the  $p < .01$  level.

The 2(mode) x 3(valence) MANOVA performed on HR and SC percent change scores and affective intensity ratings (Table 9) also produced a highly significant stimulus valence effect,  $F(2,22) = 144.22$ ,  $p < .001$ . Thus, when changes in physiological reactivity were viewed as percent changes from pre-trial baseline levels, the findings paralleled those of the previous multivariate analysis. The three stimulus valence categories generated markedly different levels of reactivity.

Heart Rate. The 2(mode) x 3(valence) ANOVA on HR change scores (Table 11) produced a significant valence main effect,  $F(2,22) = 4.36$ ,  $p < .05$ . The results of Neuman-Keuls comparisons of valence means (positive = 1.23 bpm, negative = 3.48 bpm, neutral = 0.10 bpm) indicated that negatively valenced inputs generated significantly greater HR increases than neutral inputs ( $p < .05$ ). No other posteriori comparisons reached statistical significance.

The 2(mode) x 3(valence) ANOVA on HR percent change scores (Table 12) also produced a significant main effect of valence,  $F(2,22) = 4.08$ ,  $p < .05$ . Thus, when subjects' HR reactivity was assessed in terms of change relative to initial baseline levels, the three stimulus valences were still found to generate different levels of responsiveness. Neuman-Keuls comparisons revealed that negative stimuli produced more HR acceleration than positive ( $p < .01$ ) and neutral ( $p < .01$ ) stimuli. Mean HR percent change scores for the three valence were 1.71 for positive inputs, 4.36 for negative inputs, and 0.29 for neutral inputs.

Skin Conductance. The ANOVA carried out on SC change scores (Table 13) produced a significant main effect of valence,  $F(2,22) = 4.36$ ,  $p < .05$ . Mean SC change scores were 0.7, 0.6, and 0.3 micromhos for positive, negative, and neutral stimulus valences. Neuman-Keuls comparisons revealed that positive and negative stimuli generated larger SC increases than neutral inputs ( $p < .05$  for both comparisons). All other post-hoc comparisons failed to reach statistical significance.



When the ANOVA was conducted on the SC percent change variable (Table 14), the valence effect approached, but failed to reach statistical significance,  $F(2,22) = 3.05$ ,  $p < .07$ . Thus, when SC changes were viewed as changes relative to baseline levels, the three stimulus valence categories were differentiated to a somewhat lesser degree. Mean percent SC changes for the three valences were 14.91, 12.81, and 5.10 for positive, negative, and neutral valences, respectively.

Affective Intensity Ratings. A highly significant main effect of valence,  $F(2,22) = 169.90$ ,  $p < .001$ , was produced by the ANOVA on self-reported affective intensity data (Table 15). Post-hoc Neuman-Keuls tests indicated that subjective reactivity to all possible pairs of stimulus valences differed at the  $p < .01$  level of statistical significance. Affective intensity means for positive stimuli were 3.88, for negative stimuli, - 3.88, and for neutral stimuli, - 0.46.

Summary of Effects Due to Stimulus Valence. Categories of positive, negative and neutral stimuli were clearly differentiated on separate MANOVAs conducted with change and percent change physiological data and affective intensity ratings. The highly significant multivariate valence effects resulted more from the contribution of the verbal measure to the canonical variable than from the contributions of the HR and SC measures.

The ANOVA conducted on HR change scores indicated that negatively valenced inputs produced significantly greater HR increases than neutral inputs. The measure of percent HR change revealed that negative stimuli produced proportionately larger HR increases than the other two stimulus valence categories.

The ANOVA carried out on the SC change variable indicated that positive and negative stimuli produced more reactivity than neutral Stimuli. When SC changes were viewed as percent changes from baseline, the significance level of the valence effect was somewhat moderated.

Subjects' verbally reported ratings of affective intensity clearly differentiated the three stimulus valences when an ANOVA was performed on this measure. Statistically significant differences in subjective reactivity to all possible pairs of positive, negative, and neutral stimuli were obtained.

#### Temporal Patterns of Autonomic Arousal

The continuous recording of HR and SC during stimulus exposure trials permitted an assessment of the temporal patterns of physiological reactivity associated with each stimulus input. Average HR and SC levels were determined for the six successive 15 second segments of each 90 second stimulus exposure interval. These data were then transformed to a measure of percent HR and SC change from the first pre-trial (resting) baseline. The percent change physiological measures were used to evaluate temporal patterns of autonomic arousal because, unlike absolute change measures, they take into account initial levels of baseline reactivity. Surely, a conductance increase of five micromhos from a baseline level of 10 micromhos is more meaningful than one of five micromhos from a baseline level of 25 micromhos.

Limitations in computer capability precluded the performance of a mode x valence x time segments repeated measures MANOVA. Therefore, percent HR change and percent SC change across the six time segments were plotted for imaginal positive, negative, and neutral stimuli, and descriptive analysis of the adaptation curves were conducted. Analyses of temporal patterns of HR and SC reactivity were limited to imaginal exposure trials because curves of adaptation to imaginal stimulus inputs have clinical relevance to numerous covert conditioning behavior therapy techniques. For example, the temporal patterns of autonomic arousal in reaction to presentations of negatively valenced imaginal stimuli have procedural implications for timing and exposure variables in covert sensitization (Cautela, 1967).

The adaptation curves resulting from exposure to categories of positive, negative, and neutral imaginal stimuli are presented in Figure 2 for the HR percent change variable and in Figure 3 for the SC percent change variable. Although trend analyses could not be conducted due to computer limitations, visual inspection of the plotted HR data revealed that (1) negative images produced proportionately larger HR increases than positive and neutral images throughout the 90 second exposure period; (2) peak HR reactivity occurred during the first 15 second exposure interval (i.e., during the 15 seconds immediately following the subjects' signal that the stimuli were being vividly imaged) for all three stimulus valences; and (3) HR decreased systematically during continuous exposure to both positive and negative images, but baseline levels were recovered only during exposure to positive images.

Examination of the adaptation curves for the SC data revealed a somewhat different temporal pattern of arousal. Figure 3 indicates that (1) negative images produced proportionately larger SC increases than positive and neutral images during the first 15 seconds of exposure; (2) positive and negative images produced proportionately similar SC changes over the remaining 75 seconds of exposure; (3) SC reactivity to negative images peaked during the first 15 second segment and this SC level was sustained during the second 15 second segment; (4) SC reactivity to positive images increased during the first segment, but did not reach its peak until the second segment; and (5) baseline SC levels were recovered during exposure to neutral images, but not to positive and negative images.

#### Overview

Direct and imaginal modes of stimulus presentation produced indistinguishable levels of reactivity when the dependent measures were analyzed in multivariate contexts. This finding held when differences between the two modes of presentation were assessed across and within categories of positive, negative, and neutral stimuli. The results of separate univariate analyses conducted on HR change, HR percent change, SC change, and self-reported affective intensity data also support the assumption of continuity between real-life and covert stimuli. Of the five dependent variables, only the SC percent change measure distinguished between the two modes of stimulus presentation. Real-life stimuli generated proportionately larger SC changes than imaginal stimuli.

The three stimulus valences produced markedly different levels of reactivity when the dependent measures were analyzed collectively with multivariate procedures and individually with univariate procedures. The analysis of HR data revealed that negatively valenced inputs produced the highest levels of reactivity. On the HR change measure, negative stimuli generated larger increases than neutral stimuli, and on the HR percent change measure, negative stimuli generated proportionately larger increases than both neutral and positive stimuli.

The analysis of the SC change data suggested that positive and negative stimuli produced roughly equal conductance increases, and that these increases surpassed those provided by neutral stimuli. Differential levels of reactivity among the three stimulus valences were moderated on the SC percent change measures.

Subjects self-reported reactions to the three stimulus valence categories were clearly distinguishable. The analysis of affective intensity ratings produced highly significant differences in subjective reactivity to all possible pairs of positive, negative, and neutral stimuli.

Visual inspection of the curves of adaptation to imaginal stimulus presentations indicated that peak HR reactivity occurred during the first 15 seconds of exposure to positive and negative inputs. Peak SC reactivity occurred during the first 15 seconds of exposure to positive stimuli. These findings have significant procedural implications for timing and exposure variables in several covert conditioning behavior therapy procedures.

## CHAPTER IV

### Discussion

#### HR and SC Reactions During Baseline Intervals

HR and SC levels were sampled during three different baseline intervals in order to assess the influence of the pre-exposure manipulations on subjects' autonomic reactivity. Baseline 1 was sampled prior to the trial sequence, baseline 2 was sampled during the final 15 seconds of the instructional segment, and baseline 3 was sampled during the final 15 seconds of the imaginal suggestion or attentional focusing period. Therefore, HR and SC levels produced during the second baseline reflect the subjects' knowledge and anticipation of the upcoming stimulus presentation, and HR and SC levels produced during the third baseline reflect subjects' reactivity to imaginal suggestions during imaginal stimulus trials, and to the actual physical stimulus during direct stimulus trials.

The results indicated that the pre-exposure manipulations had a dramatic effect upon autonomic reactivity. Arousal, viewed as the composite discriminant function of HR and SC scores, increased markedly across the three sampled time segments. The experimenter's instructions regarding the nature of the upcoming stimulus presentation increased subjects' arousal beyond the levels obtained during the pre-trial baseline period. Furthermore, preliminary exposure to the experimental stimuli (during imagery description and attention focusing baseline period) increased subjects' arousal beyond the levels

obtained during the instructional segment. .

The patterns of SC reactivity across the three baseline periods revealed that the instructional manipulations failed to produce SC levels that were significantly higher than those sampled during the pre-trial baseline interval. An examination of Table 3, however, reveals that SC increases, resulting from instructional influences, were observed in five of the six stimulus exposure trials. Although these increases did not reach statistically significant levels, the data do show a trend in the direction of elevated SC reactivity during the second baseline segment. Furthermore, when SC was viewed collectively with HR in the multivariate context, the composite discriminant function indicated that instructional manipulations did produce increases in the integrated physiological system (Van Egeren, 1973).

Numerous psychophysical researchers have documented the effects of instructional influences on skin conductance. Woodworth and Schlosberg (1956), for example, point out that subjects in the experimental laboratory display noticeable fluctuations in SC as a result of procedural manipulations:

When O has been harnessed into the recording apparatus and readings are started, his palmer conductance is usually found to be rather high, and it rises slowly while he is waiting to see what E will do to him...(If) a rest period is announced, the (SC) level tends downward only to go up again when announcement is made that the experiment will soon resume...Changes in conductance are related to apprehension, relief, intense mental work, habituation, and perhaps other psychological factors (pp.146-147).

Gormazano (1966) notes that in an experimental situation, care must be exercised in presenting instructions to subjects because of SC

increases resulting from subject-experimenter interactions. In his discussion of GSR conditioning, he points out that subjects will display conductance increases if, before the onset of conditioning trials, subjects are informed that the experiment will soon begin, or that unpleasant stimuli (e.g., shock) will be administered.

A significant elevation in SC level was observed between baselines 2 and 3. Thus, preliminary exposure to the experimental stimuli during the imagery description and attention focus intervals increased subjects' SC beyond the levels obtained during the instructional segment. This finding is consistent with a large body of literature documenting the effects of sensory stimuli on skin conductance. (cf: Gormazano, 1966; Woodworth & Schlosberg, 1956).

The finding that HR increased markedly between the first pretrial baseline and the second instructional baseline is consistent with Lacey's (1967) theory concerning the "directional fractionation" of the cardiac response. According to Lacey's observations, cardiac deceleration represents the normal orienting response to external stimuli to which the subject wishes to attend, whereas cardiac acceleration represents a state of arousal associated with internal concentration or rejection of external stimulation. The finding of HR acceleration between the pre-exposure baseline and instructional baseline periods may indicate that subjects were attending to and concentrating on the experimenter's instructions. It is equally plausible, however, to argue that the accelerative HR response was the result of subjects' apprehension concerning the experimental situation and upcoming trials.



Each of the analyses of differences among baselines generated non-significant effects for the mode of presentation factor. The results indicated that subjects displayed indistinguishable levels of autonomic reactivity when anticipating direct vs. imaginal stimulus presentations during baseline 2, and when receiving preliminary exposure to direct vs. imaginal presentations during baseline 3. For each of the three baselines, physiological responses produced during direct trials could not be differentiated from those produced during imaginal trials. This finding held when the three stimulus valences were viewed collectively and when each valence category was separately assessed. Furthermore, identical results regarding mode of presentation were obtained with the analysis using HR scores, SC scores, and the discriminant function scores representing the composite of both measures. Thus, subjects' anticipation of, and preliminary exposure to, presentations of a real-life stimulus could not be distinguished from their anticipation of, and preliminary exposure to, its covert counterpart. This finding is supportive of the continuity assumption and the covert conditioning model of behavior, and it is consistent with the findings of previous research documenting physiological arousal in anticipation of imagined or direct stress (Craig, 1968).

#### Comparison of Direct vs. Imaginal Stimulus Presentations

Before evaluating physiological reactivity to direct vs. imaginal stimuli, it is necessary to consider the possibility that the particular sequence of stimulus presentations (overt followed by

covert vs. covert followed by overt) influenced the results. Though stimulus presentations were counterbalanced to avoid confounds associated with trial order effects, it is possible that subjects exposed first to overt stimuli were able to generate clearly more vivid images of these stimuli during subsequent imaginal presentation trials, than subjects exposed first to covert stimuli. If, in fact, the presentation of overt stimuli followed by covert stimuli resulted in increased image clarity, then valid comparisons of reactivity to direct vs. imaginal stimuli would be difficult to draw. To determine whether the particular sequence of stimulus presentations affected the subjects' abilities to produce clear images, image clarity ratings for trials beginning with overt presentations were compared with image clarity ratings for trials beginning with covert presentations. Mean clarity ratings for overt-first trials and covert-first trials were 3.72 and 3.88 (5-point scale), respectively. Thus, subjects generated images of roughly equal clarity when covert stimuli were arranged to precede overt presentations of the same stimuli, and when they were arranged to follow overt presentations of the stimuli.

Perhaps the most important comparison in the present study involved the analysis of differential levels of autonomic and subjective reactivity to direct and imaginal stimulus presentations. The findings were generally consistent with the hypothesis that overt stimuli generate responses that cannot be distinguished from those produced by their covert counterparts.

The assumption of continuity between direct and imaginal stimuli was supported by the results of the MANOVA performed on physiological

change scores and subjective ratings, as well as the MANOVA carried out on the physiological percent change variables and the subjective measure. Both analyses revealed that the arousal producing properties of overt and covert stimuli are roughly equivalent, and that this equivalence holds when comparisons are made across and within the three stimulus valence categories. The extent to which covert and overt stimuli generate comparable levels of arousal can be seen by inspecting the discriminant function scores associated with the six experimental stimuli (Table 10). The scores, which are generated by a function representing the "optimal" combination of cardiovascular, electrodermal, and verbal measures, indicate that in the multivariate context, real-life and imaginal stimuli produce strikingly similar levels of reactivity.

The results of univariate analyses performed on HR and SC change scores, HR percent change scores, and affective intensity ratings paralleled those obtained with multivariate procedures; overt and covert stimuli produced indistinguishable levels of reactivity across and within stimulus valence categories.

The analysis of SC percent change data, however, produced a significant main effect of mode of stimulus presentation. Relative to pre-trial baseline levels, subjects displayed larger conductance changes in response to direct presentations of stimuli than they did in response to imaginal stimulus presentations. The fact that the analyses of SC change scores and SC percent change scores produced differing results underscores the need to supplement measures of

absolute change with measures of percentage change from baseline in physiological research. Contrasting findings for the two skin conductance measures were obtained because the percent SC change variable treats a large absolute increase in SC from a high baseline level the same as a somewhat smaller increase from a lower baseline level.

Of the study's five dependent variables, only the percent SC change variable failed to support the notion of overt and covert stimulus continuity. Thus, Mahoney's (1974) contention that "self-generated stimuli and covert stimuli elicit reactions comparable to those observed with external stimulation" (p. 40) was confirmed on measures of cardiovascular and verbal reactivity and rejected on a measure of electrodermal reactivity.

The findings obtained with HR data corroborate previous investigations documenting the assumption of overt and covert stimulus continuity. Barber and Hahn (1964) found that imaginal presentations of painful stimuli produced HR increases nearly identical to the increases produced by actual pain stimulation. Craig (1968) also reported that direct and imaginal aversive stimuli generate nearly equal and marked elevations in heart rate.

The present study adds to earlier research bearing on the continuity assumption by showing that self-reported affective reactions to a physical stimulus paralleled the reactions produced by imaginal presentations of the same stimulus. Subjects rated overt and covert forms of stimuli at nearly the same level of affective intensity. This equivalence held across all three stimulus valence categories.

Thus, the correspondence between the properties of public and private stimuli is not limited to their comparable cardiovascular arousing capabilities; the correspondence is evident on the subjective response channel as well.

That the analysis of SC percent change data failed to support the stimulus continuity hypothesis is not surprising in the light of previous research comparing electrodermal responses to direct and imaginal stimuli. Barber and Hahn (1964), in their investigation of the physiological effects produced by real and imagined stress, found that direct exposure to the "cold pressor" stimulus produced significantly larger decreases in skin resistance (i.e., larger increases in SC) than imaginal exposure to the same stimulus. Craig (1968) replicated these findings on a measure of non-specific GSR frequency. Subjects in this investigation displayed a substantially greater number of nonspecific GSRs under conditions of direct exposure to the cold pressor than under conditions of imaginal exposure. Furthermore, increased SC levels resulting from direct experience with the unpleasant stimulus were sustained for much longer periods of time. May (1977b) reported that SC level and GSR frequency reacted to visual presentations of a phobic stimulus, but not to imaginal presentations of the stimulus. The findings of these studies, together with the result obtained in the present investigation, suggest that the continuity assumption may be valid for particular response channels, and that broad assertions regarding the continuity of public and private events should be replaced with statements that specify the response

dimension on which overt and covert stimuli are believed to produce comparable reactions. Further research comparing the two modes of stimulation on a wider range of physiological dependent variables may indicate that certain autonomic systems are more sensitive to external inputs than to internally generated inputs.

The differing results obtained with the cardiovascular and electrodermal measures suggest some degree of response specificity in the autonomic nervous system. Explanations for the superior arousal capabilities of direct stimuli on the SC measure, but not on the HR measure, must remain speculative. It is possible that SC increases are closely related to externally elicited orienting responses, while HR increases are more representative of concentration and prolonged attention to stimulus inputs, regardless of their mode of presentation. Lacey (1967) and Graham and Clifton (1966) have argued that HR deceleration is associated with orienting responses to external stimuli, while HR acceleration is associated with internal concentration or rejection of external input. The finding that HR accelerated in response to both external and internal stimulation, while SC increased more in response to external stimulation than to internal stimulation, suggests that SC may be more closely related to the orienting reflex than HR. It may be that the direction of the HR response is not as dependent on the mode of presentation factor as Lacey has argued, and that it is more closely related to attentional factors than to externally produced orienting responses.

The finding that the continuity assumption was validated for some, but not all physiological response dimensions has important

implications for behavioral assessment. Since the publication of Lang's now classic article outlining the "triple response mode" hypothesis (1968), behavior therapists have acknowledged the need for a multi-channel assessment of clinically relevant target behaviors. Generally low correlations between verbal, motoric, and somatic behaviors have been documented repeatedly in the assessment literature (cf: Cone & Hawkins, 1977; Hersen & Bellack, 1976). Furthermore, therapeutic changes produced in one response dimension have been shown to be fairly independent of changes in the other dimensions (Rachman & Hodgson, 1974). As a result, behavioral clinicians have formulated treatment strategies designed to have a direct effect on one response dimension and an indirect and subsequent effect on the others. Bio-feedback (Shapiro & Schwartz, 1972) and cognitive restructuring (Lazarus, 1971) are just two examples of techniques that focus predominantly, if not exclusively, on a single response channel. The findings of the present investigation suggest that the triple response mode hypothesis should be further extended to include the notion of response specificity within each of the three behavioral systems. Differential levels of SC and HR sensitivity to overt and covert stimuli indicate that at the peripheral level, the autonomic nervous system does not behave in a synchronous manner. Indeed, the time has come for experimentally oriented clinicians to utilize multiple measures of autonomic activity, and to determine which therapeutic techniques have an effect on which physiological response systems. The need for a multi-dimensional approach to assessment and therapy within each of the three response modalities has recently been expressed by

by Hodgson and Rachman (1974) and Katkin (1975).

The finding that multiple measures of autonomic nervous system (ANS) activity do not react to stimuli in a synchronous manner should not be construed as an indication that the nervous system consists of a group of independently functioning, dissociated subsystems. The observation of increased HR and decreased SC in reaction to a common stimulus presentation can be the result of processing at the level of the central nervous system (CNS). Morgan (1965) emphasizes the need to view discrepant patterns of physiological activity within the context of the aggregate neurophysiological system. Thus, although there appears to be asynchrony in peripheral autonomic function, one must be aware of the fact that the CNS operates as an integrating mechanism that can account for the observed asynchronies.

The finding that a common stimulus is capable of producing changes on one measure of physiological activity, while it exerts little or no effect on another measure, can also be explained with reference to learning phenomena. Numerous studies investigating GSR conditioning (cf: Gormazano, 1966) have shown that through contiguity, stimuli can acquire the capacity to elicit large increases in skin conductance. More recent research focused on operant control of the HR response (Miller and DiCara, 1967) has provided further evidence of the conditioning of autonomic behavior.



### Comparisons Among Positive, Negative, and Neutral Stimulus Valences

Stimuli of positive, negative, and neutral valence were clearly differentiated with multivariate techniques. The meaningfulness of the significant multivariate valence effects is questionable, however, in view of the fact that the verbal measure contributed much more to the discriminant functions than did the physiological measures. Since the subjects selected their own positive, negative, and neutral stimuli, their differential affective intensity ratings are as much a check on the independent variables as they are a reflection of differing levels of subjective reactivity to the three valence categories.

Nevertheless, univariate analyses of HR and SC data produced an interesting set of findings. For both HR measures, negative stimuli were found to generate the largest increases. HR increases resulting from exposure to negative stimuli surpassed those resulting from exposure to neutral stimuli. When HR increases were viewed in terms of percent change from baseline, negative stimuli were observed to produce larger increases than both neutral and positive stimuli.

Others have provided evidence that HR increases accompanying negatively valenced inputs are greater than those accompanying inputs of positive and neutral valence. May and Johnson's (1973) investigation of the effects of symbolic stimuli on autonomic arousal revealed that aversive images produced larger increments in HR than did neutral and relaxing images. Grossberg and Wilson (1968) reported that HR increases resulting from the visualization of fearful scenes surpassed those resulting from the visualization of neutral scenes. Lang,

Melamed, and Hart (1970) found that spider phobic subjects displayed increasingly greater HR reactivity as they progressed through a series of subjectively graded imaginal scenes in an anxiety hierarchy. The results of a more recent study conducted by Haney and Euse (1976) offer further support for the finding of greater HR reactivity to negative imaginal stimuli than to neutral imaginal stimuli.

An investigation conducted by Prigatano and Johnson (1974) compared cardiovascular responses to real-life presentations of a variety of positive and negative stimuli. Spider phobic subjects were exposed to slides of phobic (spider), pleasant (sea-scape), and generally aversive (surgical laboratory) scenes. Results indicated that phobic slides produced the largest HR increases, followed by slides of generally aversive scenes, and finally, pleasant scenes. Thus, findings from numerous laboratory investigations of cardiovascular responsiveness to stimuli of varying affective content corroborate the results of the present study: negatively valenced stimuli produce larger increases in HR than do neutral and positive stimuli.

The differences among the three stimulus valences on HR measures can be readily explained with reference to the observations of Lacey (1967), who pointed out the association between cardiac deceleration and "environmental intake," and between cardiac acceleration and "rejection of the environment." Since the negatively valenced stimuli used in the study were subjectively determined and tailored to each individual, it is certain that they were perceived as being aversive by the subjects. The affective intensity ratings made by subjects

after each stimulus presentation indicated that negative stimuli were, in fact, viewed as being extremely unpleasant. Considering the aversiveness of the relevant stimuli, it is plausible that elevated HR levels accompanying negative stimulus presentations were the result of the subjects' "rejection" of them.

A series of studies conducted by Lewis and his associates (see Wilson, 1969) have shown that there is a strong positive relationship between greater amounts of attention and HR deceleration. The present study's finding of HR acceleration accompanying the presentation of negative stimuli may, therefore, indicate that subjects' rejection of the stimuli was characterized by decreased attentiveness or avoidance. Although subjects' ratings of image clarity and attentional focus indicated that negative stimuli were clearly perceived, other measures of attention, such as duration of eye fixation (for real-life stimuli) would be required in order to validate this hypothesis.

The analyses of differences among the three valence categories on the SC data contrasted with the analyses of the HR data. For the SC change variable, positive and negative inputs were found to produce significantly higher levels of reactivity than neutral inputs. No other comparisons among the valences reached statistical significance. When the magnitude of SC change was adjusted by computing the percent change from baseline measure, the significance of the valence effect was moderated to a small degree.

The findings for the SC variables were consistent with results obtained from several studies comparing electrodermal reactivity to

stimuli varying in affective content. An early investigation conducted by Shock and Coombs (1937) assessed SC levels accompanying presentations of 16 odors rated on a scale running from very pleasant to very unpleasant. Their results revealed that subjects displayed high levels of reactivity to odors at both ends of the scale relative to odors judged to be neutral. Dysinger (1931) presented 150 stimulus words intended to run the range of the affective dimension. Pleasant words (e.g., vacation, darling) and aversive words (e.g., suicide, vomit) were found to produce marked and equal SC increases relative to neutral words (e.g., basket, make). More recent and better controlled investigations corroborate these earlier findings. Grossberg and Wilson (1968) reported that electrodermal activity is more sensitive to symbolic presentations of negative stimuli than neutral stimuli. The findings of a study conducted by Haney and Euse (1976) indicated that stimuli from both extremes of the affective continuum produce higher SC levels than do neutral stimuli.

Thus, the affective nature of the stimuli to which subjects were exposed influenced their physiological responses. Regardless of the mode of stimulus presentation, HR was found to be sensitive to negative inputs, and SC to both positive and negative inputs. The finding that SC increases accompanied presentations of stimuli representing both ends of the affective dimension and HR increases accompanied only negative stimuli can be explained with reference to the view, expressed earlier, that electrodermal activity is more closely associated with the orienting response than is cardiovascular activity. Since orienting reflexes would be expected to follow presentations of

novel stimuli regardless of their emotional valence, the sensitivity of SC to positive as well as negative stimuli is not surprising. On the other hand, the documented association between cardiac acceleration and "rejection of the environment" (Lacey, 1967) can account for the observation that HR increases accompanied only negatively valenced inputs. Thus, contrasting psychological determinants of electrodermal vs. cardiovascular responding appear to be responsible for the finding of autonomic asynchrony across stimulus valences.

#### Temporal Patterns of Autonomic Activity

To obtain information about the temporal patterns of autonomic reactivity to positive, negative, and neutral images, percent HR and SC change scores were plotted at 15 second intervals. (See Figure 2 for HR data and Figure 3 for SC data.) Although computer limitations precluded trend analyses of the resulting adaptation curves, visual inspection of the plotted HR and SC data provided information of relevance to numerous cognitive behavior therapy techniques. The applicability of the findings to the covert conditioning procedures are discussed in the next section.

For negatively valenced images, onset of peak HR and SC arousal occurred during the first 15 second interval. Although neither HR nor SC reactivity returned to their respective pre-trial baseline levels during the 90 second exposure period, a trend toward decreased arousal was observed for both measures.

Inspection of Figure 2 corroborates the previously reported finding that HR was not very sensitive to positive images. The moderate

increases in HR which were produced, however, peaked during the first 15 second interval. The SC percent change measure, which did react significantly to presentations of positive imaginal stimuli, peaked during the second interval. Baseline levels of arousal were recovered for HR, but not for SC, during the exposure period.

The SC adaptation curves obtained in the present study differ in some respects from those reported by Haney and Euse (1976) in their investigation of SC responses to positive, negative, and neutral images. Although the present results replicate Haney and Euse's finding of higher levels of SC reactivity to affectively loaded images than to neutral images, the shape of the adaptation curves obtained in the two studies present markedly different pictures of the temporal pattern of SC arousal. Whereas the present investigation found that onset of peak reactivity to negative images occurred during the first 15 seconds of exposure, Haney and Euse reported that peak arousal to negative images was first reached 27 seconds after the onset of the exposure interval. Contrary results were also obtained for positive imaginal stimulus presentations. The present findings revealed that maximal SC increases occurred during the second 15 second segment and were sustained during the third segment. Haney and Euse found that a wave of SC reactivity occurred 10 seconds after exposure to positive images, with its peak arousal coming approximately 20 seconds later.

The contrary results obtained by the two studies may be the result of differences in methodology and experimental design. First, Haney and Euse's (1976) failure to control for order effects associated with a standardized sequence of stimulus presentations represents a major

design confound. Although the authors allowed sufficient time between trials for reactivity to return to basal levels, at least some of the variability in their data must be attributable to the particular sequence of stimulus presentations. In the present investigation, care was taken to counterbalance stimulus presentations in order to eliminate such procedural confounds.

Another major difference which may account for the conflicting findings involves the absence, in Haney and Euse's (1976) investigation of an imagery description and/or rehearsal time period during the trial sequence. Subjects in their study were given imagery rehearsal exercises several days prior to the experimental procedure, and were instructed to simply "start the image" while physiological data were being recorded. Image clarity ratings collected during the course of the Haney and Euse study indicated that subjects experienced more difficulty producing vivid negative and neutral scenes than positive scenes. (Based on a 10-point scale, mean image clarity ratings in their study were 8.70, 7.42, and 7.35 for positive, negative, and neutral stimuli, respectively.) In the present investigation, each imaginal trial consisted of an image description interval, during which subjects were encouraged to visualize the stimulus and all of its sensory attributes. The 90 second exposure interval began after subjects indicated, by signalling the experimenter, that a vivid image was being perceived. Thus, image clarity ratings collected in the present study indicated that the saliency of the three imaginal stimuli was roughly equivalent. (Based on a 5-point scale, image clarity ratings in the present study were 3.96, 4.17, and 3.99 for positive,

negative, and neutral stimuli, respectively.) The physiological data obtained in the present study reflect the autonomic effects of continuous exposure to clearly visualized images. Data recorded in the Haney and Euse study more likely reflect subjects' attempts to generate images following the command to do so. The longer latency to peak SC reactivity to negative images, reported by these authors, may have been the result of lower levels of image clarity for these images. The short latency wave of SC reactivity observed to accompany positive images is consistent with Haney and Euse's finding that subjects generated clear positive images without difficulty.

Yet another explanation for the contrasting latency data obtained in the two studies involves differences in the timing of the onset of the imaginal exposure interval. Haney and Euse's (1976) exposure period began immediately after their subjects were given the command to "start the image." In the present study, the exposure interval commenced after subjects signalled that a vivid image was being perceived. The longer latency to peak SC reported by Haney and Euse was likely to result of subjects' attempts to produce a clear image during the early portion of the exposure period. In the present investigation, subjects had performed the necessary cognitive work prior to the onset of the exposure interval.

It is interesting to note that despite the prolonged exposure period used in the present investigation (90 seconds), baseline levels of SC and HR were not recovered for negatively valenced images. The continuous recording of SC data also indicated that reactivity to positive images was sustained at relatively high levels throughout



the interval. The failure of autonomic reactivity to return to pre-trial resting baseline levels has important procedural implication for the covert conditioning techniques, as do the data involving duration to peak arousal.

### Relevance to Cognitive Behavior Therapy

The results obtained in this investigation have major theoretical and practical implications for cognitive behavior therapy. As elaborated below, the theoretical issues partially resolved by the data involve the validity of the continuity assumption and the covert conditioning behavioral model, as well as the process responsible for therapeutic behavior change with covert positive reinforcement (Cautela, 1970a). On the practical level, the data help to specify timing and exposure parameters for several popular covert conditioning techniques, such as covert sensitization (Cautela, 1967) and covert positive reinforcement (1970a).

The Continuity Assumption. Whether covert events have a legitimate place in the science of behavior is, surprisingly, still an issue among behaviorists. As mentioned earlier, references to covert mediating stimuli in accounts of human behavior have only recently been tolerated by applied behavior analysts. Yet, there is a preponderance of research documenting physiological and overt behavioral responsiveness to covert events, and the present study corroborates the earlier reports.

The results generally supported the notion that overt and covert stimuli possess similar arousal properties. Analyses conducted on four of the five dependent measures, and on discriminant functions representing composites of the dependent measures, validated the view, expressed by numerous behavioral theorists (e.g., Bandura, 1969; Mahoney, 1974; Smith 1974; Staats, 1970, 1975), that covert stimuli elicit reactions comparable to those observed with external stimulation. Only the SC percent change measure differentiated reactivity to direct and imaginal stimulus presentations. Thus, the assumption of public and private stimulus continuity was documented on measures of cardiovascular and verbal reactivity and on the measure of absolute change in electrodermal activity. It was rejected, however, when changes in electrodermal activity were viewed relative to initial baseline levels.

It is important to note that although direct stimuli aroused larger percent SC increases than their imaginal counterparts, imaginal stimulus presentations still produced respectable levels of electrodermal activity. An examination of Figure 3 clearly indicates that prolonged exposure to affectively loaded covert stimuli generated and sustained fairly large conductance increases. Therefore, the rejection of the continuity assumption on the SC percent change measure should not be viewed as an indication that imaginal events are incapable of producing electrodermal reactivity. The data merely indicate that direct exposure to a stimulus generates even larger percent SC increases than the respectable increases generated by imaginal exposure to the same stimulus.

The observation that direct and imaginal stimuli produce comparable levels of cardiovascular and verbal reactivity, together with the observation that imaginal stimuli generated increases in electrodermal activity, justify the extension of numerous "overt" behavioral techniques into the cognitive arena. The documentation of the arousal producing properties of covert events lends support to those applied behaviorists who have modified the "overt" classical conditioning procedures so that they can be used with symbolic stimulus presentations. The theoretical underpinnings of Cautela's covert sensitization (1967) and Wolpe's imaginal systematic desensitization (1958) techniques rely on the assumption that conditioning procedures involving real-life CSs and UCs can be altered for use with covert stimuli. Covert sensitization differs from aversive counterconditioning (Rachman & Teasdale, 1969) only in that it employs private rather than public stimuli. Imaginal systematic desensitization and in vivo desensitization (Jones, 1924) operate under nearly identical procedural guidelines. They differ only in the mode of stimulation employed. The finding that covert stimuli possess arousal properties similar to their overt counterparts provides theoretical support to Cautela, Wolpe, and others who have expanded the scope of the classical conditioning therapies.

The documentation of autonomic reactivity to imaginal stimuli also justifies the expansion of the operant based behavior modification procedures into the realm of cognitive events. The finding that covert and overt events arouse similar responses lends support to the

notion that covert and overt contingency arrangements are functionally isomorphic. The theoretical underpinnings of Cautela's covert positive reinforcement (1970a), covert negative reinforcement (1970b), covert extinction (1971), and covert punishment (1973) rely on the assumption that real-life and imaginal contingencies are equally capable of producing changes in the frequency of specified target behaviors.

Although there is an enormous body of data indicating that the covert conditioning techniques are effective in producing therapeutic change (cf. Bandura, 1969; Cautela, 1972; Kazdin, 1977; Mahoney, 1974), only a few controlled investigations have tested the relative capacities of the direct and imaginal procedures to modify behavior (Callahan & Leitenberg, 1973; Cautela, Flannery & Hanley, 1974; Rosenthal, Rosenthal & Chang, 1977). Yet, such research is badly needed in order to justify the extrapolation of learning principles developed in the laboratory to cognitive phenomena. In the most recent and best controlled comparison of the overt and covert conditioning techniques, (Rosenthal et al., 1977) subjects were exposed to either direct, modeled, or imaginal shocks in order to suppress their undesirable nail-biting habits. All three aversion techniques were found to produce significant behavior change on self-report and objective measures. No outcome differences among the treatments were obtained. This investigation provides indirect support to those who embrace the notion that the processes and principles governing overt and covert behavior are identical. Furthermore it justifies the

cognitive behavior therapists' tendency to draw upon the extensive research on overt behavior in order to generate therapeutic change in the covert analogue. Indeed, the results of the present investigation are consistent with the findings of Rosenthal et al. Since direct and imagined aversive stimuli produced comparable increases in autonomic arousal, it is not surprising that direct and imaginal pain are equally effective in their capacity to suppress undesirable acts.

The Process of Covert Positive Reinforcement. Another theoretical issue relevant to the present findings involves the learning principles believed to operate in Cautela's covert positive reinforcement technique (1970a). The procedure was originally formulated as an extrapolation from operant principles derived from research on overt behavior. In covert positive reinforcement, clients are required to generate imaginal representations of positively valenced stimuli following the visualization of desirable behavior patterns. The assumption is that the functional relationship between overt behavior and overt reinforcement also applies in the covert analogue. Results obtained in the present investigation, however, suggest that classical conditioning may also be involved in the process of covert positive reinforcement.

Presentations of positive imaginal stimuli were observed to produce increases in electrodermal activity, as Figure 3 clearly indicates. Though these increases were significantly smaller than those generated by their direct counterparts, positive images were still observed to accompany sizeable SC changes. In fact, conductance increases resulting from positive images were significantly greater than

those produced by neutral images. Though HR was not very sensitive to positive images, an examination of the HR data plotted in Figure 2 indicates that a slight degree of HR acceleration did accompany exposure to positive imaginal stimuli. The finding that positively valenced images possess arousal properties suggests that positive affective states can be conditioned to target stimuli. Indirect support for this view comes from outcome research on emotive imagery (Lazarus & Abramovitz, 1962) and systematic desensitization (Wolpe, 1958), two techniques that have been conceptualized as attempts to condition positive affective states to phobic stimuli. The abundance of literature documenting the effectiveness of Wolpe's procedure (cf. Bandura, 1969) lends credence to the notion that classical conditioning effects can be produced with affectively positive imaginal UCSs.

The documentation of the arousal producing capabilities of positive imagery suggests that therapeutic gains from covert positive reinforcement (Cautela, 1970a) may involve classical as well as operant conditioning. Numerous clinical researchers (Barrett, 1968; Davison & Wilson, 1973; Mahoney, 1974) have reported that the imagery based procedures are difficult to implement because clients experience difficulty controlling the onset and termination of critical imaginal scenes. Kazdin (1977), in his discussion of research issues in covert conditioning, points out that clients frequently initiate an ongoing-movie-like series of overlapping images. It is plausible, then, that therapeutic improvement following covert positive reinforcement is the

result of inadvertent pairings of covert target stimuli and pleasant imagery. If subjects are unable to alter imagery content at will, residual arousal associated with overlapping covert scenes is likely to produce conditioning effects.

Research has indicated that covert positive reinforcement is as effective when the reinforcing scene is presented after the target response as it is when the reinforcing scene is presented before the response (Hurley, 1976; Ladouceur, 1974; Marshall, Boutilier & Minnes, 1974). These findings are consistent with the classical conditioning interpretation of the process underlying Cautela's (1970a) technique. Overlapping sequences of reinforcing images and covert target responses would be expected to produce conditioning effects regardless of the contingency arrangements.

It should be emphasized that a classical conditioning interpretation of the process of covert positive reinforcement does not rule out the contribution of operant factors to the technique's effectiveness. As Staats (1975) points out in his discussion of the emotional - motivational - discriminative (A-R-D) personality system, stimuli may possess attitudinal as well as reinforcing qualities. Thus, presentations of affectively pleasant scenes during covert positive reinforcement may strengthen preceding target images and, at the same time, alter their emotional valence.

Temporal Parameters of the Covert Conditioning Techniques. The temporal patterns of subjects' HR and SC reactivity to positive and negative visual imagery have important practical implications for the

specification of timing and exposure variables in Cautela's covert conditioning techniques. Two assumptions are required in order to speculate on the procedural parameters of these techniques. First, it must be assumed that the procedures produce therapeutic gains as a result of the contiguous pairing of images varying in affective content. The foregoing discussion underscores the need to consider classical as well as operant factors in the process of Cautela's procedures. Second, it must be assumed that maximal conditioning occurs at peak UCS arousal. Though a large body of research deriving from the Yerkes-Dodson law has suggested that learning is facilitated at moderate levels of physiological reactivity (Eysenck, Arnold, and Meili, 1972), numerous researchers have suggested that maximal conditioning effects are produced when target stimuli are timed to occur during some range of high autonomic arousal (Hall, 1976; Haney & Euse, 1976). Pavlov (1927) was well aware of the importance of timing of CS-UCS presentations in classical conditioning, writing, "We thus see that the first set of conditions required for the formation of a new conditioned reflex encompasses the time relation between the presentation of the unconditioned stimulus and the presentation of that agent which has to acquire the properties of a conditioned stimulus" (p.28). If it can be assumed that maximal conditioning occurs at peak arousal levels, then the presentation of target stimuli at or near the onset of peak autonomic reactivity should produce stronger conditioned responses, and superior treatment outcomes in the covert conditioning techniques. The results of the present study indicated that the onset



of peak HR and SC reactivity to negative imaginal stimuli occurred during the first 15 second exposure interval. Thus, in covert sensitization (Cautela, 1967) and covert punishment (Cautela, 1973), subjects should be instructed to display cognitive representations of target stimuli shortly after the onset of clearly perceived aversive imagery. Although more precise methods of data reduction are required in order to pinpoint the exact image duration recommended for CS-UCS pairings, the present findings suggest that aversive imaginal conditioning would produce superior treatment outcomes if subjects would visualize target images (e.g., inappropriately attractive sexual objects, high calorie foods) within 15 seconds of the onset of clearly perceived aversive imagery (e.g. nausea). Such an arrangement would result in the contiguous association of the CS with a wave of high autonomic reactivity to the UCS.

Although HR was found to be fairly insensitive to imaginal presentations of positive stimuli, the onset of peak SC reactivity to positive images was observed to occur during the second 15 second interval, and this high level of arousal was sustained during the third interval. These data suggest that the timing of critical scenes in covert positive reinforcement (Cautela, 1970a) should be arranged such that target images (e.g., low calorie foods) are visualized at least 15 seconds after subjects signal clear cognitive representations of reinforcing events (e.g., picturing oneself as slim, athletic, attractive). This temporal arrangement would allow maximal autonomic reactivity to the UCS to be contiguously associated with the target CS.

The adaptation curves resulting from continuous exposure to positive and negative images also have implications for the spacing of trials in Cautela's covert conditioning techniques. Throughout the 90 second exposure interval, baseline levels of HR and SC were not recovered for presentations of negatively valenced imaginal stimuli. In order to capitalize on the fairly high levels of residual arousal accompanying negative images, covert sensitization should be conducted with as short an intertrial duration as possible. In this manner, the sustained levels of reactivity to preceding negative images would be carried forward to subsequent trials. If, however, the clinician wishes to condition positive affective states to adaptive behavior patterns, and negative affective states to undesirable responses within the context of the same covert sensitization package, as Cautela (1967) suggests, then sufficient time must be permitted for arousal to return to baseline levels. Short intertrial durations might result in the accidental pairing of residual arousal from the preceding negative image with the subsequent positive image. Yet, the requirement that baseline arousal levels must be recovered before proceeding to subsequent trials might prove to be uneconomical. Clinicians who wait for reactivity to negative images to return to baseline levels, before proceeding to positive trials, would likely be faced with the problem of excessively long intertrial durations. The observation that high levels of reactivity to negative images were maintained throughout the 90 second exposure interval suggests that an interchanging sequence of affectively pleasant and aversive conditioning trials would be unreasonable.

The temporal patterns of arousal resulting from exposure to imaginal stimuli also have implications for the spacing of trials in covert positive reinforcement (Cautela, 1970a). Although HR was not very sensitive to imaginal presentations of positive stimuli, SC increases were observed to be rather large. Moreover, SC baseline levels were not recovered during the 90 second exposure interval. To gain maximum benefits from the residual arousal accompanying presentations of pleasurable scenes in covert positive reinforcement, trials should be spaced as closely as possible. An examination of Figure 3 indicates a systematic decrease in SC level following the third 15 second interval of exposure to positive imaginal stimuli. By keeping intertrial durations at a minimum, residual arousal can be carried forward to subsequent covert reinforcement trials. The relatively rapid diminution of SC reactivity to positive images underscores the need for very brief time intervals between trials in covert positive reinforcement.

Though the learning literature addressing the issue of spaced vs. massed practice would suggest that short intertrial durations might hamper conditioning effects, Haney & Euse (1976) suggest that the effectiveness of Cautela's covert procedures would be maximized when trials are spaced closely. Their position is based on three assumptions: 1) Cautela's techniques involve the process of classical conditioning, 1) maximal conditioning occurs when subjects are maximally activated, and 3) short intertrial durations capitalize on residual arousal accompanying the presentation of preceding stimuli. Although

the findings of the present study are consistent with Haney and Euse's assumptions, future research comparing the effects of varying CS-UCS intervals and varying intertrial durations is needed in order to specify the optimal temporal parameters in Cautela's techniques.

### Summary

Responsiveness to real-life and imaginal stimuli was found to be indistinguishable on cardiovascular and verbal response measures, and on a measure of absolute change in electrodermal activity. When changes in electrodermal activity were expressed in terms of percent of change from pre-trial baseline levels, real-life stimuli were found to elicit larger increases than their covert counterparts. Thus, the assumption of overt and covert stimulus continuity was found to be valid for some, but not all response dimensions. Several theoretical implications of these findings were discussed.

Firstly, the results indicated that at the peripheral level, the autonomic nervous system does not respond in an synchronous manner. The superior arousal producing properties of direct stimuli on the SC measure, but not on the HR measure, suggest that skin conductance may be more closely associated with externally elicited orienting responses, and HR may be related to concentration and prolonged attention to stimulus inputs, regardless of their mode of presentation.

The second implication of the findings involves Lang's "triple response mode" hypothesis (1968). Differential levels of SC and HR sensitivity to overt stimuli and to covert stimuli underscore the need

for behavioral clinicians to conduct a multi-dimensional assessment of target behaviors within each response modality.

The third, and perhaps the most important issue raised by the findings involves the observation that imaginal stimuli were capable of arousing and maintaining significant increases in autonomic arousal. The documentation of the arousal producing properties of covert stimuli justifies the extension of numerous "overt" behavioral treatment procedures into the area of cognition. Thus, the theoretical underpinnings of Cautela's covert conditioning procedures (1972) are supported by the findings of the present study.

Comparisons of electrodermal and cardiovascular reactivity to stimuli varying in affective content indicated that both positive and negative inputs produced SC increases, but that only negative inputs were capable of producing HR increases. These findings were consistent with the view that increases in SC and HR are associated with different psychological functions, the former reflecting the orienting response, and the latter reflecting rejection of aversive environmental input.

Besides the theoretical implications of the present findings, the data also have practical implications for two popular covert conditioning techniques. The temporal patterns of SC and HR reactivity to positive and negative visual imagery helped to specify timing and exposure variables in covert sensitization (Cautela, 1967) and covert positive reinforcement (Cautela, 1970a). To maximize the strength of conditioned responses obtained with covert sensitization, it was

recommended that CS-UCS pairings occur within the first 15 seconds of the onset of clear negative visual imagery, and that intertrial durations be kept at a minimum. For covert positive reinforcement, the data revealed that CS-UCS pairings should occur between 15 and 30 seconds after the onset of vivid positive imagery, and that intertrial time intervals should similarly be kept as short as possible.

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## Appendix A

Stimulus Rating Questionnaire

Name: \_\_\_\_\_ Instructor: \_\_\_\_\_ Sec: \_\_\_\_\_

Directions: This questionnaire is designed to determine how you feel about a number of objects, or stimuli. You may find that some of the stimuli are extremely pleasant, that others are extremely unpleasant, and that some are neutral. Rate each of the following items on the scales of pleasantness to the right of each item. Note the following labels for the various points on the scales:

- 5 = extremely unpleasant
- 4 = quite unpleasant
- 3 = moderately unpleasant
- 2 = somewhat unpleasant
- 1 = a little unpleasant
- 0 = neutral
- +1 = a little pleasant
- +2 = somewhat pleasant
- +3 = moderately pleasant
- +4 = quite pleasant
- +5 = extremely pleasant

Please circle your answers.

- |                         |  |
|-------------------------|--|
| 1. chocolate            | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 2. glass of water       | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 3. small snake          | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 4. plant                | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 5. large spiders        | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 6. twig                 | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 7. fresh flower         | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 8. cat feces            | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 9. "Playboy" centerfold | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 10. cologne/perfume     | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 11. large cockroaches   | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |
| 12. rock                | <u>-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5</u> |

## Appendix B

### Tables

Table 1

Positive, Negative, and Neutral Stimuli Selected for Exposure

<u>Subject</u>	<u>Stimulus Categories</u>		
	<u>Positive</u>	<u>Negative</u>	<u>Neutral</u>
1	perfume	snake	water
2	chocolate	spider	twig
3	flower	snake	rock
4	perfume	cockroach	water
5	flower	cat feces	plant
6	nude	snake	rock
7	flower	cat feces	twig
8	perfume	cockroach	twig
9	flower	snake	plant
10	nude	spider	water
11	chocolate	cockroach	plant
12	nude	spider	rock



Table 2

Analysis of Variance on Image Clarity  
and Attentional Focus Ratings

Source	df	MS	F
Subjects	11	1.9798	
Mode	1	.5000	1.32
Mode x Subjects	11	.3788	
Valence	2	2.4306	2.58
Valence x Subjects	22	1.0215	
Mode x Valence	2	.4916	2.33
Mode x Valence x Subjects	22	.2110	

Table 3

Average Heart Rate and Skin Conductance Levels Recorded During  
Baseline Intervals of Stimulus Exposure Trials

Stimulus Presentations*	Heart Rate (in beats per minute)			Skin Conductance (in micromhos)		
	Baseline 1	Baseline 2	Baseline 3	Baseline 1	Baseline 2	Baseline 3
D (+)	87.25	90.33	91.58	4.9	5.1	5.2
D (-)	87.00	93.83	94.08	4.5	4.8	5.2
D (N)	87.83	89.25	90.75	4.7	5.0	5.4
I (+)	88.16	91.67	91.25	5.2	5.1	5.5
I (-)	87.25	89.92	92.25	5.0	5.1	5.6
I (N)	88.17	89.33	90.58	4.8	4.9	4.9

\*abbreviations: D = direct stimulus presentations;  
I = imaginal stimulus presentations;  
(+) = positive stimuli;  
(-) = negative stimuli;  
(N) = neutral stimuli

Table 4

Multivariate Analysis of Variance on HR and SC Data  
Recorded During Baseline Intervals

Source	df	MS	F (upper bound)
Subjects	11	4.215	
Mode	1	.067	0.49
Mode x Subjects	11	.136	
Valence	2	.083	0.66
Valence x Subjects	22	.125	
Baseline	2	.732	8.51**
Baseline x Subjects	22	.086	
Mode x Valence	2	.121	0.86
Mode x Valence x Subjects	22	.141	
Mode x Baseline	2	.027	1.59
Mode x Baseline x Subjects	22	.017	
Valence x Baseline	4	.064	2.13
Valence x Baseline x Subjects	44	.030	
Mode x Valence x Baseline	4	.027	1.16
Mode x Valence x Baseline x Subjects	44	.023	

\*\*  $p < .01$

Table 5

Analysis of Variance on HR Data Recorded During Baseline  
Intervals

Source	df	MS	F
Subjects	11	1557.23	
Mode	1	15.15	0.32
Mode x Subjects	11	47.22	
Valence	2	37.07	0.79
Valence x Subjects	22	47.14	
Baseline	2	346.68	12.98**
Baseline x Subjects	22	26.71	
Mode x Valence	2	22.54	0.39
Mode x Valence x Subjects	22	57.63	
Mode x Baseline	2	15.50	2.18
Mode x Baseline x Subjects	22	7.10	
Valence x Baseline	4	28.59	2.67*
Valence x Baseline x Subjects	44	10.70	
Mode x Valence x Baseline	4	6.60	0.50
Mode x Valence x Baseline x Subjects	44	13.21	

\*  $p < .05$

\*\*  $p < .01$

Table 6

Analysis of Variance on SC Data Recorded During  
Baseline Intervals

Source	df	MS	
Subjects	11	249.81x10 <sup>-6</sup>	
Mode	1	.39x10 <sup>-6</sup>	0.10
Mode x Subjects	11	3.63x10 <sup>-6</sup>	
Valence	2	1.67x10 <sup>-6</sup>	1.02
Valence x Subjects	22	1.64x10 <sup>-6</sup>	
Baseline	2	3.49x10 <sup>-6</sup>	4.53*
Baseline x Subjects	22	.77x10 <sup>-6</sup>	
Mode x Valence	2	1.23x10 <sup>-6</sup>	0.91
Mode x Valence x Subjects	22	1.35x10 <sup>-6</sup>	
Mode x Baseline	2	.74x10 <sup>-6</sup>	2.47
Mode x Baseline x Subjects	22	.30x10 <sup>-6</sup>	
Valence x Baseline	4	.34x10 <sup>-6</sup>	1.03
Valence x Baseline x Subjects	44	.33x10 <sup>-6</sup>	
Mode x Valence x Baseline	4	.54x10 <sup>-6</sup>	0.23
Mode x Valence x Baseline x Subjects	44	2.34x10 <sup>-6</sup>	

\*p<.05

Table 7

Mean Scores of the Dependent Measures  
for the Six Experimental Stimuli

Measures	Stimulus Presentations*					
	D(+)	D(-)	D(N)	I(+)	I(-)	I(N)
HR change (beats per minute)	1.08	3.36	-0.08	1.38	3.59	0.28
HR percent change	1.58	4.09	0.04	1.83	4.64	0.54
SC change (micromhos)	0.9	0.7	0.5	0.6	0.6	0.0
SC percent change	18.33	15.07	10.27	11.49	10.55	-0.07
Affective Intensity Rating	4.08	-4.08	0.50	3.67	-3.67	0.42

\*abbreviations: D = direct stimulus presentations;

I = imaginal stimulus presentations;

(+) - positive stimuli;

(-) = negative stimuli;

(N) = neutral stimuli.

Table 8

Multivariate Analysis of Variance on SC Change Scores,  
HR Change Scores, and Affective Intensity Ratings

Source	df	MS	F (upper bound)
Subjects	11	.310	
Mode	1	.381	3.40
Mode x Subject	11	.112	
Valence	2	50.404	134.77**
Valence x Subjects	22	.374	
Mode x Valence	2	.175	3.85
Mode x Valence x Subjects	22	.045	

\*\*p<.01

Table 9

Multivariate Analysis of Variance on SC Percent Change Scores,  
HR Percent Change Scores, and Affective Intensity Ratings

Source	df	MS	F (upper bound)
Subjects	11	.295	
Mode	1	.498	3.66
Mode x Subjects	11	.136	
Valence	2	49.092	144.22**
Valence x Subjects	22	.346	
Mode x Valence	2	.158	3.47
Mode x Valence x Subjects	22	.046	

\*\*p < .01



Table 10

Means of the Canonical Variables for MANOVA on HR Change Scores, SC Change Scores, and Affective Intensity Ratings (MANOVA 1), and for MANOVA on HR Percent Change Scores, SC Percent Change Scores, and Affective Intensity Ratings (MANOVA 2)

Stimulus Presentations*	MANOVA 1	MANOVA 2
D(+)	1.665	1.599
D(-)	-1.253	-1.320
D(N)	0.275	0.225
I(+)	1.464	1.425
I(-)	-1.127	-1.174
I(N)	0.153	0.164

\*abbreviations: D = direct stimulus presentations;  
 I = imaginal stimulus presentations;  
 (+) = positive stimuli;  
 (-) = negative stimuli;  
 (N) = neutral stimuli.

Table 11

## Analysis of Variance on HR Change Scores

Source	df	MS	F
Subjects	11	23.659	
Mode	1	1.620	0.15
Mode x Subjects	11	10.719	
Valence	2	70.988	4.15*
Valence x Subjects	22	17.119	
Mode x Valence	2	0.024	1.00
Mode x Valence x Subjects	22	0.024	

\* $p < .05$

Table 12

## Analysis of Variance on HR Percent Change Scores

Source	df	MS	F
Subjects	11	.00449	
Mode	1	.00034	0.22
Mode x Subjects	11	.00155	
Valence	2	.01024	4.08*
Valence x Subjects	22	.00251	
Mode x Valence	2	.00002	0.02
Mode x Valence x Subjects	22	.00100	

\* $p < .05$

Table 13

## Analysis of Variance on SC Change Scores

Source	df	MS	F
Subjects	11	$1.61 \times 10^{-6}$	4
Mode	1	$2.24 \times 10^{-6}$	4.57
Mode x Subjects	11	$.49 \times 10^{-6}$	
Valence	2	$1.57 \times 10^{-6}$	4.36*
Valence x Subjects	22	$.36 \times 10^{-6}$	
Mode x Valence	2	$.24 \times 10^{-6}$	0.86
Mode x Valence x Subjects	22	$.28 \times 10^{-6}$	

\* $p < .05$

Table 14

## Analysis of Variance on SC Percent Change Scores

Source	df	MS	F
Subjects	11	.050	
Mode	1	.094	6.58*
Mode x Subjects	11	.014	
Valence	2	.064	3.05
Valence x Subjects	22	.021	
Mode x Valence	2	.005	0.59
Mode x Valence x Subjects	22	.008	

\* $p < .05$

Table 15

## Analysis of Variance on Affective Intensity Ratings

Source	df	MS	F
Subjects	11	.984	
Mode	1	.014	0.04
Mode x Subjects	11	.347	
Valence	2	362.056	169.90***
Valence x Subjects	22	2.131	
Mode x Valence	2	1.056	3.07
Mode x Valence x Subject	22	.344	

\*\*\*p&lt;.001

## Appendix C

Imaginal Stimulus Presentations

1. chocolate. You are sitting at a table. Directly in front of you, on the table, is an unwrapped chocolate bar. Focus your full attention on the creamy milk chocolate. Notice its luxuriously rich appearance. Imagine, now, reaching for the chocolate, and slowly bringing it toward your mouth. Imagine the anticipation of the first exciting bite. Sense the chocolate aroma. Picture yourself, now, placing the chocolate in your mouth. Experience its heavenly rich taste, its creamy smooth texture. Concentrate on its luscious, delectable rich taste. (Repeat until subject signals.)
2. glass of water. You are sitting at a table. In front of you, on the table, is a glass of water. Focus all of your attention on the glass. Notice its cylindrical shape. The water fills nearly the entire glass. Visualize the water level within the glass. The droplets are there because the water is cold. Now imagine that you're reaching over to smell the water. You sniff once, twice, a third time, but the water is odorless. (Repeat suggestions until the subject indicates that she visualizes a clear covert picture.)

3. small snake. You're sitting at a table. In front of you, in an enclosed cage, is a small snake, approximately 18 inches in length. Focus your full attention on the snake. Notice its diamond shaped head, its cloudy eyes, its black and yellow coloring. Now watch its long slick forked tongue, as it slips in and out of its powerfully jawed mouth. Run your eyes slowly down the full length of its body. Notice how its body thickens in the center. See its shiny scales, its symmetrical pattern, its moist, almost slimy appearance. Its tail comes to a point. Now imagine reaching into the cage to touch it. Feel the pulsating sensations as it begins to move in an effort to free itself from your grip.

(Repeat until the subject signals.)

4. plant. You're sitting at a table. In front of you, by itself on the table, is a large coleus plant. Focus your full attention on the plant. Notice its deep red, crimson leaves, outlined on their edges by a rich shade of green. The plant has leaves of all sizes. Those that are large and overgrown have a deep maroon color; the smaller leaves are brighter and more readily reflect a shimmering sunlight. Now focus on the stems. At their base, near the soil, they have a rough, bark-like appearance. As your eye follows the stem to the upper leaves, the stem's color is brighter--almost green, and its texture is much more smooth. (Repeat until the subject signals.)

5. spiders. You're sitting at a table. Before you, on the table, is a jar of two large spiders. Focus your full attention on the



insects. Notice, first, the large central body mass. Its shape is spherical. Close up you can see very small projecting hair-like growths. They cover the insect's body and give it a fuzzy appearance. Two antennae sprout from the body. Now look at the bent, knotted legs, all eight of them. Together, they hold up the insect's body as if struggling against the force of gravity. The legs move harmoniously together in a continuous flow of motion. Their color is a deep brown--almost black. The insects together begin to crawl up the side of the jar. The sixteen feet of the two spiders appear as one mass of fine tangled string. Now imagine that you open the jar to get a close look at the insects. (Repeat until subject signals.)

6. twig. You're sitting at a table. Before you is an ordinary twig from a maple tree. Focus your full attention on the twig. Clearly visualize its coloring--varying shades of tan and brown. Picture its shape--irregular, bent, knotted. Its texture appears to be coarse, dry, very rough. Now reach out and grasp it. Feel the sensation on your fingers, the rough feeling of its brittle bark its knotted areas. Grasp it now with both hands and snap it in two. Listen to the sharp crackling sound. (Repeat until the subject signals.)
7. fresh flower. You are sitting at a table. Directly in front of you, on the table is a yellow rose. Focus your full attention on the flower. Concentrate on its physical appearance. Notice first its stem as it rests in the vase. Focus on its deep green shade,

then on its thorns. Now see its beautiful petals; they're soft, delicate, reaching upward for light. Concentrate for a while on the beauty of the flower. Now take a deep breath and catch the fresh scent. It reminds you of a clear spring morning. The fragrance is incomparable. You begin to contemplate the beauty of nature, its wonders, its gifts. Take another deep breath and focus your full attention on the rose's pleasant scent. Now notice, once again, the color of the petals, the varying shades of yellow. Reach over and look closely at the flower; see its quiet, delicate petals. (Repeat until the subject signals.)

8. cat feces. You are sitting at a table. Directly before you, to your distress, is a piece of feces, from a neighborhood cat, resting on a paper towel. How revolting! Look at it. Focus your full attention on it. Notice its color, its vile brown appearance. And on a table, no less! A lump of brown moist feces. Take a deep breath. Concentrate on the sickening odor as it permeates your nostrils. The smell won't leave. You're wondering how long you can take the smell before you become sick. Look again at the cat droppings on your table, the lumps of dark brown disgust. You begin to wonder how much longer you're going to sit there and see this vile thing (Repeat until the subject signals.)
9. "Playgirl" centerfold. You're sitting at a table. On the table is a "Playgirl" magazine opened to its centerfold. Look at the picture. Focus your full attention on his appearance. First his

face, his hair. Note his handsome, rugged appearance. Search into his eyes. Observe his capturing desirous stare. Slowly run your eyes down the full length of his perfectly shaped body. Feel yourself squirming with excitement and desire for this man. (Repeat until the subject signals.)

10. perfume. You're sitting at a table. In front of you, on the table, is a bottle of fine perfume. Look at the bottle. Reach out and open it slowly. Now bring the bottle to your nose. Concentrate on the exquisite fragrance, its elegant scent. Focus your full attention on the beautiful, subtle smell. Now take another deep breath and capture the full fragrance of the perfume. (Repeat until subject signals.)
11. cockroaches. You're sitting at a table. Directly in front of you, on the table, is a jar containing four huge dark, dark brown cockroaches. You've never seen such huge and grotesque cockroaches. How absolutely revolting. Fix your eyes on the back surface of their shiny filthy bodies. Run your eyes slowly toward their long, protruding, alarming antennae. Watch as they struggle frantically to escape from the jar. Observe their attempts to escape. Watch them crawl, one upon another, to reach the top of the jar. Your beginning to feel discomfort in the pit of your stomach as you focus your eyes on these grotesque insects. (Repeat until subject signals.)

12. rock. You are sitting at a table. Directly before you on the table is a plain old rock. Focus your full attention on its physical appearance. Notice its texture--rough, coarse; its shape--an irregular oval; its color--brown and black. Try to see the speckles of dirt and soil that lie on its surface. Now imagine that you reach out to pick it up. It's not too heavy, as it's only two inches in length. Try to see the rock clearly. Observe it as it rests on the table. (Repeat until subject signals.)

## Appendix D

### Experimental Instructions

This project is designed to investigate how different kinds of stimuli are related to bodily reactions. Specifically, we want to find out if there are differences in bodily reactions when stimuli are presented in their real-life forms and when they are presented in imagination. On the questionnaire that you completed last week, you were asked to indicate how you felt about 12 different kinds of stimuli. I've selected three stimuli from among your answers. You will be exposed to each of the three stimuli in both its actual (or real-life) and its imaginal (or word-picture) forms. During each of these real and imaginal exposures, you will be seated in a comfortable reclining chair and your heart rate and skin conductance will be recorded. Both heart rate and skin conductance are physiological responses which are very subtle and require sensitive instruments for detection and magnification. Each is a measurement of arousal in response to some event. The heart rate measure will determine the average number of times your heart beats in one minute when you are exposed to each of the different stimuli. The skin conductance measure evaluates the electrical reactivity of your sweat glands to each of the stimuli.

Some of the stimuli to which you will be exposed are not very pleasant. All that I will ask you to do, however, is to focus your

attention on the stimulus for about 90 seconds during the real life exposures, and to imagine it for 90 seconds during the imagined exposure. Is this all right with you?

Three tiny pickups will be taped to your fingers, and you'll be asked to remain in the reclining chair while your responses are recorded. You will not be given any electrical shocks or subjected to any dangerous electricity at all. I'm only interested in recording on the polygraph your physiological reactions during real-life and imaginal exposure to the different stimuli.

When a stimulus is presented in its real-life form, it is important that you concentrate on the actual stimulus and focus your full attention on its characteristics. After I present it to you, you may find that it takes several seconds to fully concentrate and focus on the object. As soon as you reach a high level of concentration and attention, signal me by slightly raising your right index finger, and then continue to concentrate on the stimulus until I say "stop."

Similarly, when a stimulus is presented in its imaginal (or word-picture) form, it is important that you generate a clear, vivid image of the object. Try to produce an imaginal picture that is so vivid that it almost appears to be physically present. To do this, you may find it helpful to imagine all of the senses involving the stimulus, including sight, touch, smell, sound, and taste. Of course, your eyes will be closed during the imaginal representations, and I will describe the stimulus in order to help you produce a vivid image. As soon as you manage to produce a realistically clear and vivid image

of the stimulus, signal me by raising your index finger. I will stop describing the stimulus, and you will be asked to maintain the image until I instruct you to stop imagining. Are there any questions?

## Appendix E

Stimulus Sequences

<u>Subject No.</u>	<u>1st</u>	<u>2nd</u>	<u>3rd</u>	<u>4th</u>	<u>5th</u>	<u>6th</u>
1 and 9	4	5	1	6	3	2
2 and 12	6	3	4	2	1	5
3 and 7	3	1	5	4	2	6
4 and 11	5	6	2	1	4	3
5 and 10	1	2	6	3	5	4
6 and 8	2	4	3	5	6	1

1 = direct positive stimulus

2 = direct negative stimulus

3 = direct neutral stimulus

4 = imaginal positive stimulus

5 = imaginal negative stimulus

6 = imaginal neutral stimulus



## Appendix F

### Figures

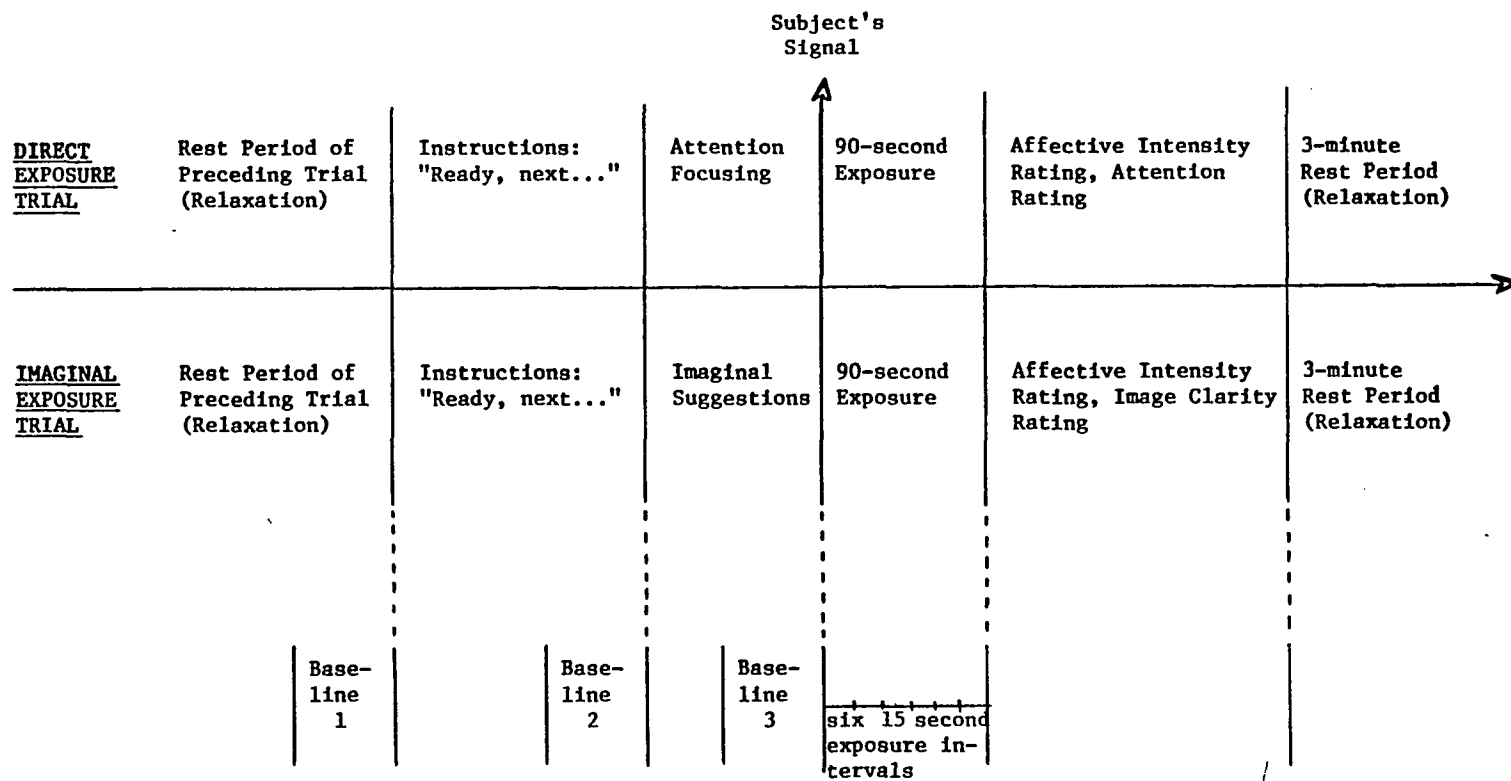


FIGURE 1 - Procedural sequence for direct and imaginal stimulus exposure trials.

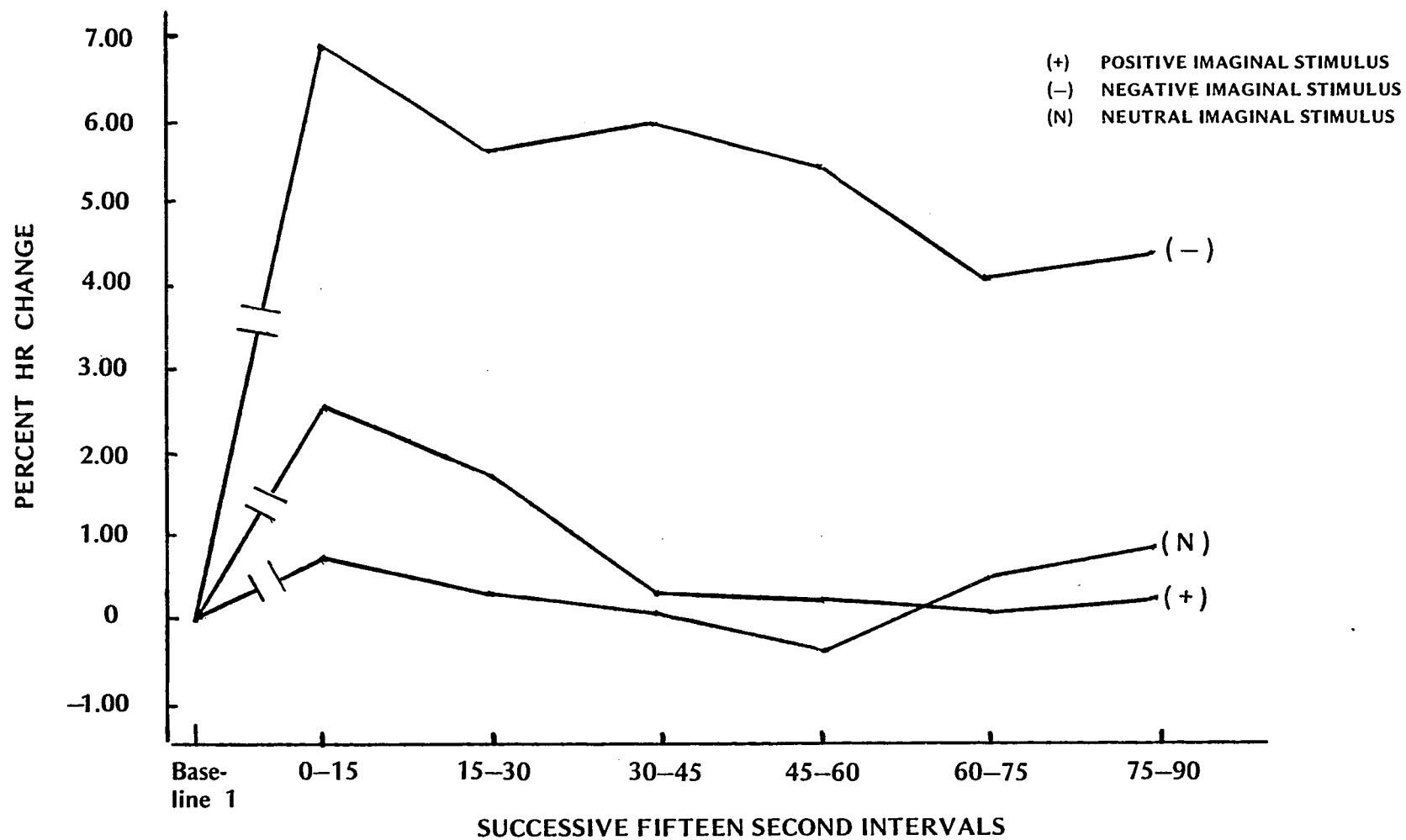


FIGURE 2 — Percent HR change from baseline 1 in reaction to continuous exposure to positive, negative, and neutral imaginal stimuli.

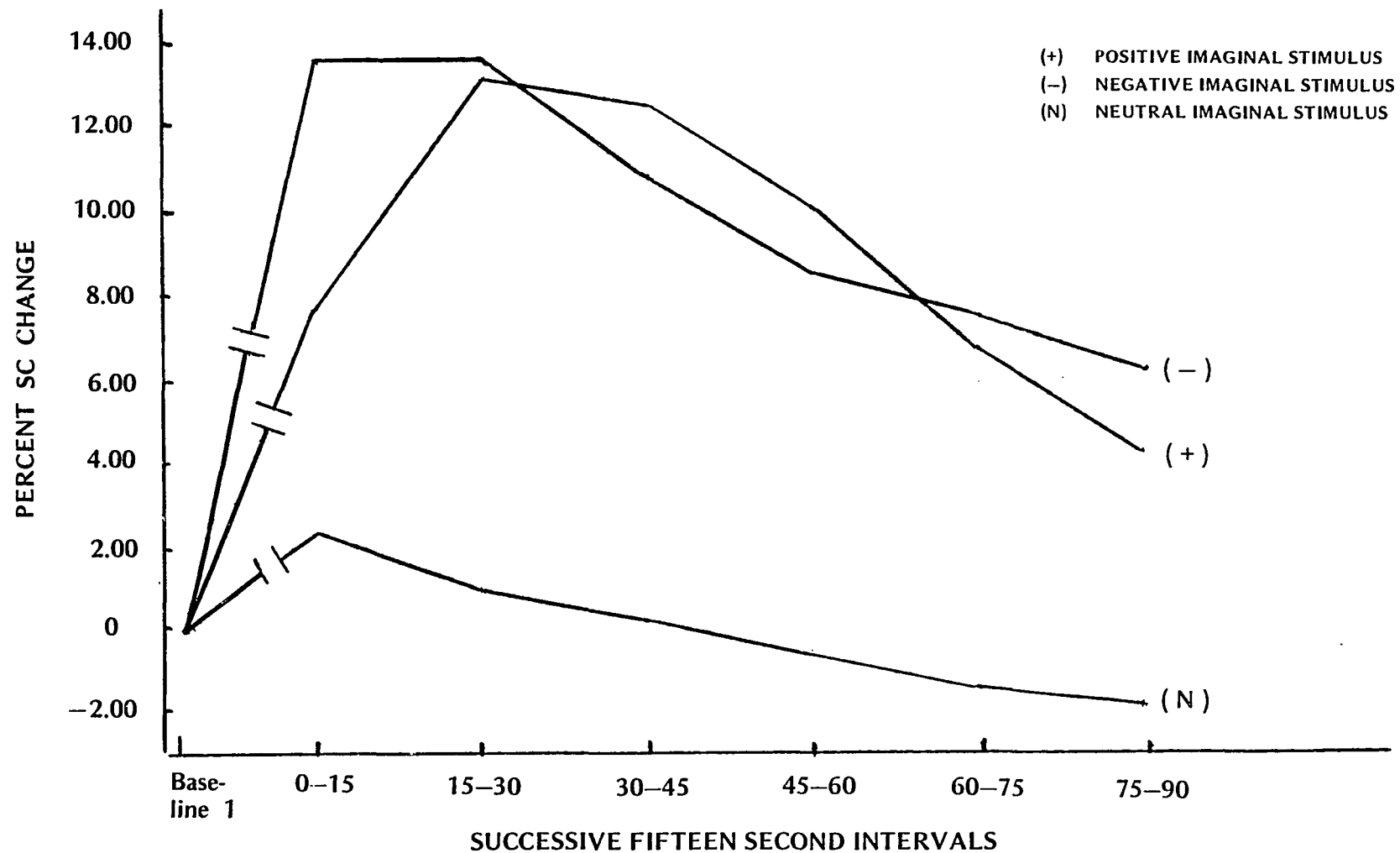


FIGURE 3 — Percent SC change from baseline 1 in reaction to continuous exposure to positive, negative, and neutral imaginal stimuli.

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