PUPILLARY RESPONSES TO VISUALIZATION OF STRESSFUL SCENES

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PREFACE

This study is concerned with the analysis of pupillary responses to visualization of stressful images. The primary objective is determining the ability of the pupil reflex response to discriminate between visualized scenes that differ in the amount of stressfulness in a manner highly analogous to the differential stressfulness of scenes used in Desensitization Therapy. Snake phobic and nonphobic subjects were used to determine the ability of the pupillary response to differentiate these subjects.

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CHAPTER I

INTRODUCTION

Systematic desensitization therapy (SDT) as developed by Wolpe (1958) is an example of the clinical appoication of experimentally derived models of acquisition and changing of behavior as well as illustrating the necessity of a very active role by the individual in the treatment process. The SDT model requires the individual to learn a modified form of Jacobson's (1938) relaxation procedures. Passive listening about relaxation does not teach patients to relax; relaxation must be practiced systematically and frequently before the therapy proceeds. The theoretical basis is that muscular relaxation is a response pattern that is incompatable with the response pattern of anxiety thus fulfillig the basic requirements of Sherrington's (1906) reciprocal inhibition. A common sense observation would be that a person simply couldn't be anxious and relaxed at the same time.

The next step in SDT is explicit delineation of those situations in which the individual's behavior is not adaptive or adjustive. Wolpe emphasizes those situations in which the individual experiences anxiety. According to Wolpe (1958), the fear situations must be described in discrete units and furthermore, they must be arranged in order of the amount of fear they generate. That is, the scenes must be graded from low fear situations to high fear situations by the patient.

The fear situations are imaginal scenes that contain some degree of reference to the feared objects or situations. The degree of reference may vary on a distance continuum -- the feared stimulus could be very far away to very close. It may also vary on a similarity basis -- the scene barely resembles the feared situation to the scene being exactly the same as the feared situation. The degree may vary on a numerical basis -- just one feared object to very many of the objects. The degree could also vary on an active-passive continuum -- the feared object could be very passive to very active. In fact, the ways in which degree of reference may be varied is limited only by the ingenuity of the therapist.

The fear situations or scenes are thus arranged in a hierarchy along a fear or anxiety evoking continuum. The patient is required to introspect and to reveal the content and intensity of his negative emotional states in response to these hierarchical scenes. The assumption is that internal emotional states in response to these visualized scenes parallel the hierarchy; that is, the evoked anxiety ranges from low to high in a graded response to the graded stimuli. The greater the difference between the verbally reported fear and the actual arousal, the less likely theraputic changes will be made.

The third step of SDT is the visualization of the anxiety evoking situations or scenes while in a deeply relaxed state which is presumed to be incompatible with an anxious or negative emotional state, The patient visualizes the lowest anxiety scene in the hierarchy. If no anxiety is felt during the scene, then the next higher scene is visualized and so on. If anxiety is felt during the visualization of a scene, then the individual returns to the last successfully visualized scene (no felt anxiety). The process of visualization of stressful scenes while relaxed thus continues until the patient is able to successfully visualize the highest or most anxiety producing scene with no felt anxiety. The individual should then be able to encounter the feared object in real life situations with no feelings of anxiety.

Wolp's theoretical formulation of the SDT process as "reciprocal inhibition" is based on Sherrington's (1906) concept of reciprocal inhibition whereby the evocation of one reflex suppresses the evocation of other reflexes. The conditions specified by Wolpe for reciprocal inhibition to occur are:

> If a response antagonistic to anxiety can be made to occur in the presence of anxiety-evoking stimuli so that it is accompanied by a complete or partial suppression of the anxiety responses, the bond between these stimuli and the anxiety responses will be weakened (1958, p. 71).

SDT is thus based on at least the following crucial elements: (a) exposure to aversive stimuli (b) gradations in this exposure from least to most anxiety provoking and (c) pairing of anxiety-competing responses with graded exposure to aversive stimuli.

Many publications by numerious authors (e.g., Wolpe, 1952 & 1958; Lazarus, 1963; Wolpe & Lazarus, 1966; and Rachman, 1959) have claimed a high degree of success in relatively short periods of time using this technique with diverse forms of anxiety disorders. For example, Wolpe (1958) reports 89.5 percent of his patients as either apparently cured or much improved in a mean of about thirty sessions. In a group on eighteen phobic children, Lazarus (1960) found that 78 percent of all his private practice clients had derived marked benefit from systematic desensitization techniques.

The Role of Anxiety

The use of the concept of anxiety in association with abnormal behavior is a surprisingly recent phenomena. Sarbin (1964) has attributed the use of "anxiety" to Freud's writings in the 1930s about "angst". However, as all psychology students are well aware, "anxiety" has become the topic of many texts as well as a crucial determinant in the diagnosis of many forms of deviant behaviors. According to the Diagnostic and Statistical Manual (APA, 1968), anxiety is the chief characteristic of neurosis and may be "felt and expressed directly, or it may be controlled unconsciously and automatically by conversion, displacement and various other psychological mechanisms (p. 39)".

Cattell and Schier (1961) found that the basic operational definitions for some 120 different precedures for assessing anxiety seem to arise from psychological behavior, overt behavior, and self-reports. Maher (1966) in a summary of a great deal of work found no strong evidence to warrant an empirical distinction between anxiety and any more general conception of increased drive or arousal.

Ullmann and Krasner (1969) in summarizing many additional studies of "anxiety" concluded that the empirical intercorrelations between different definitions of anxiety are of a very low order. In another summary of anxiety research, Bandura (1969) rejects the notion of autonomic mediation of behavior (e.g., we run because we feel fear in favor of a central mediation concept that leads to the view that autonomic (i.e., anxiety) and avoidance responses are co-effcets of the central mediation process rather than causally linked events — we run and feel afraid simultaneously because we saw a bear.

Wolpe, however, has speculated (1958) that anxiety is a major causal determinant of inappropriate avoidance behavior and that reciprocally inhibitory processes occurring in the autonomic nervous system result in more appropriate behaviors because the anxiety has diminished in strength. Wolpe's emphasis on the role of anxiety as a major factor in behavior is clearly not supported by the summaries reviewed above. The predominant theme appears to view what Wolpe calls "anxiety" as increased drive or arousal.

Goals of Behavior Therapy

The contrast between traditional comfort-supportive or "talking" therapy and behavior or "action" therapy is perhaps most vivid when examining the goals of the therapy. In comfort-supportive therapy, the goals tend to be global or molar changes in the total individual. Examples might be the Freudian attainment of "real insight", Rogerian "self-actualization", or an Adlerian change of "life style". As a consequence of the global nature of the goals, the criteria for goal attainment tend toward the global as well, with resultant difficulties in measurable validity and reliability.

Behavior therapy typically has molecular changes as the goal of therapy with the possible coalescing of many molecular changes over the course of therapy into apparent molar changes. An example would be the token economies in mental hospitals that reinforce small units of behavior of schizophrenic patients until chains of molecular behaviors (e.g., eye contact, listening to others, dressing appropriately, etc.) are built up into molar changes in social functioning. Consequently, the criteria for goal attainment in behavior therapy tend to be the specific occurence or non-occurrence of specifiable molecular behaviors.

The goal of behavior therapy is generally a change in the frequency of some behavior or response. The goal may be a reduction of approach responses (e.g., drinking alcohol), a reduction of avoidance responses (e.g., fear of flying) or may be the emitting of some desitable specific behavior. Behavioral responses are thus viewed in terms of rate or frequency of response. Behavior and goals do not have moral or value systems attached as closely to them as in more dynamic systems which attach "meanings" to each behavior that has a special meaning to the therapist (e.g., the habitual practice of parsimoniousness viewed as being anal retentive). The behavior therapist consequently indulges in less speculation about the symbolism of individual responses.

Since behavior therapy is focused on small discrete changes, the ability to assess these small changes appears necessary in the evaluation of different techniques or precedures used in therapy. More traditional measures of change have focused on the large changes that were the goals of therapy and thus aren't suited for the finer changes that are part of behavior therapies.

Variables in Counterconditioning

Counterconditioning is basically the procedure of conditioning a second and conflicting response to a conditioned stimulus. At this definitional level, counterconditioning is a seemingly straightforward task, but at the complex human level, involves intricate arrangements of variables simultaneously impinging on the organism. Simple experimental extinction of complex emotional behavior, that is, nonreinforcement of the stimulus (CS) until the conditioned response (CR) is no longer elicited by the CS, is difficult to demonstrate in humans. This is perhaps due to the emotional response being operantly reinforced by the cessation of the anxious state. The chain of responses initiated by the aversive stimulus is maintained by negative reinforcement (termination of an aversive state).

The total number of variables operating in the counterconditioning of emotional responses of humans is probably limited only by the ingenuity of researchers to tease out more or less relevent aspects of the total stimulus field. Many of these individual variables could most likely be placed in one of three general catagories of variables that appear to be present in at least therapeutic counterconditioning. These are type of incompatible behavior, type of stimulus presentation and their temporal relationship to each other.

Types of incompatible behavior includes those behaviors presumed to be antagonistic or incompatible with emotional arousal. The classical antagonistic behavior is eating, first demonstrated by Jones'(1924) treatment of an animal phobia. Folkins, Lawson, Opton, & Lazarus (1968) included cognitive rehearsal (thinking about some situation) as an antagonistic response while most researchers have accepted relaxation as a sufficient antagonistic response, There are few reported variations in incompatible responses with the list including cognitive rehearsal, muscular relaxation, hypnotic relaxation, suggestion of relaxation, chemical or drug induced relaxation or various combinations of these responses.

Type of stimulus presentation typically ranges from the real physical stimulus event to the symbolic representation of events thet are threatening to that individual. The stimulus presentations may have gradations within the chosen class of presentation to regulate the amount of threat involved; these dimensions include physical proximity, length of presentation, a symbolic-reality dimension, and the number of threatening elements within a total stimulus complex.

The temporal relationship of anxiety-antagonistic behavior with anxiety-evoking stimuli has not been as widely researched as the two elements themselves but it appears that, in general, the two should be repeatedly paired with the antagonistic behavior maintained as continuously as possible with brief and irregular presentations of the threatening stimulus cues. This may be contrasted with the optimal temporal relationship of classical conditioning where the CS (analogous to the anxiety-eliciting stimuli) preceeds the UCS (the function of the anxiety-antagonistic behavior) by a very brief interval. This conceptual incompatibility possibly results from relatively long lasting hormonal effects of emotional arousal. Most investigations of temporal relationships in classical conditioning use relatively discreet short latency and duration reflex responses such as eye blink, knee jerk, and other brief muscular responses while emotional arousal is a complex neural, humoral, and muscular response that is of a relatively more enduring nature when compared with an eye blink.

Thus, the cognitive representation of stimuli and the diffuse enduring nature of emotional arousal make it difficult to determine whether the theraputic changes result from classical or operant procedures. Additionally, the measures used in studies of the theoretical nature of theraputic counterconditioning may not have been sensitive to finely graded short latency responses that might clarify the temporal relationships of CS and UCS to anxiety responses. The next section therefore examines measures used in assessment of physiological changes

Physiological Measures

The traditional clinical measure of physiological arousal, or anxiety, has been the galvanic skin response (GSR); this appears to be based on the assumption that an increase in arousal leads to a corresponding increase in skin conductance. Paul (1969), however, suggests that caution must be used in interpreting the GSR as a direct function of anxiety, for a number of factors such as the water load of the cornial layer of the skin have been shown to lead to paradoxical skin conductance effects.

Research using heart rate as an indicater of arousal have shown, at times, equivocal results also.Folkins et al. (1968) reported confusing patterns of heart rate as a response to film induced stress after undergoing various therapeutic procedures. A possible explanation of the difficulty is Lacey's notion (1956) of stimulus specificity; this is the idea that properties of the stimulus influence differential responding of the autonomic nervous system. Painful or threatening stimuli lead to defensive responses which include increases in heart rate while novel or nonthreatening stimuli may lead to an orienting or approach response which frequently includes a brief heart rate decrease.

An additional measure is respiration rate that is typically included to estimate or control for the interaction of respiration and heart rate. This interaction or sinus arrhythmia is the increase in heart rate at the peak of inspiration and the decrease in heart rate toward the end of exhalation. This appears to be the prototypical interaction of physiological cycles.

A potentially fruitful physiological response that may be sensitive to arousal changes is the pupil reflex. Due to the relative scarcity of published research utilizing pupillograpyic techniques, the background of this measure is greatly expanded below.

Pupillography

Loewenfeld (1958), in a major review of the literature on pupillary reflexes, focused on the study of the anatomical and physiological mechanisms of reflex constriction and dilation. A second review by Loewenfeld (1966) covered the effects of scotopic versus photopic receptor systems and near vision on pupillary diameter. Another important review, by Hess (1968), dealt with psychological and psychiatric factors in relationship to pupillary diameter changes. Hess, in reporting that the idea of the pupil as a sensitive index of emotional, sensory, and mental activity is relatively old, cited Schiff (1874), Heinrich (1869) and Roubinovitch (1900) as studying pupillary dilation as a function of mental activities.

Hess (1965) renewed interest in the pupillary reflex as a function of psychogenic activity after this topic had been dormant since the initial investigations cited ablve. Three factors appear to have influenced this renewed interest; first, technological advancements made it possible to obtain accurate records of change in pupillary diameter; second, investigators became concerned with "direct" real-time measures of response rather than relying only on retrospective reports by subjects; third, advanced knowledge about anatomical, neurological, and physiological mechanisms of pupillary control indicated an intimate relationship between pupil size and the state of the central nervous system, especially the autonomic branch.

The average pupil diameter in the normal adult human under daylight conditions ranges from 3 to 4 mm with small changes of 0.1 to 0.2 mm in diameter occurring continously and spontaneously (Adler, 1959). The muscles controlling pupillary diameter are the unstriated sphincter pupillae and dilator pupiliae. The sphincter pupillae lie in the posterior iris stroma just in front of the pigmented epithlium next to the edge of the pupil. The range of dilation of the pupil is typically from a diameter of 1.5 mm when maximally contracted to a diameter of 8 mm when maximally dilated.

The dilator pupillae appears to be composed of two parts, Bruch's membrane and radial reinforcement bundles. The cells of Bruch's membrane entwine with the fibers of the sphincter at the internal edge of the iris and extend on to the posterior side of the iris to the ciliary iris margin. The reinforcement bundles, which are anterior to Bruch's membrane and posterior to the iris stroma, form radial strands that extend toward the iris margin.

The innervation of the pupillary musculature appears to be seperate with the sphinctor pupillae innervated solely by cholinergec, parasympathetic fibers while the dilator pupillae are innervated by adrenergic, sympathetic fibers. The afferent nerves of the light reflex arise in the retinal ganglion cells and branch in the lateral geniculates, leading then to the pretectal nuclei synapsing there with fibers leading to the Edinger-Wesphal nuclei of the Oculomotor nucleus. From the Edinger-Wesphal nuclei parasympathetic, efferent fibers preceed to the ciliary ganglion in the third cranial nerve. The direct light reflex (constriction of the pupil when the eye is light stimulated) appear the same in innervation (Adler,1959; Lowenstein & Loewenfeld, 1962).

Indirect evidence leads Lowenstein and Loewenfeld (1962) to conclude that "cortico-thalamo-hypothalamic" tracts are involved in the efferent sympathetic innervation of the dilator pupillae. In addition, fibers leaving the spinal cord between cervical VIII and thoracic IV are known to be involved with pupillary activity. These sympathetic nerves enter the peripheral sympathetic chain and synapse in the superior cervical ganglion with fibers that join with the fifth cranial nerve near the peripheral end of the Gasserian ganglion (Loewenfeld, 1958).

Pupillary Reflex Mechanisms

Lowenstein and Loewenfeld (1962) list several pupillary reactions: the light reflex, the reaction to near vision, pupillary reflex dilation, the darkness reflex, the lid-closure reflex, and pupillary unrest. The pupillary reflex dilation, of interest to the present work, has been defined by Lowenstein and Loewenfeld as "Pupillary dilation elicited by sensory or emotional stimuli, or by spontaneous thoughts or emotions (p. 236).

Pupillary reflex dilation appears to be due to two neural factors and two humoral factors (Lowenstein & Loewenfeld,1962). The neural factors are active sympathetic discharge causing the dilator pupillae to contract and inhibitory sympathetic impulses which suppress activity in the Edinger-Wesphal nucleus which in turn causes the sphincter pupillae to relax. The humoral factors are the release of adrenal epinephrine by a severely stressed organism and the release of nor-epinephrine by sympathetic nerve endings in the heart and arteries in moderately aroused organisms.

These four factors may be distinguished on the basis of latency of dilation, rate of dilation and duration of peak dilation. The adrenal epinephrine response has the longest latency with prolonged duration of peak dilation. The nor-epinephrine response has a shorter latency and shorter duration of peak dilation. Both of these humoral factors produce extensive dilations in man. The active sympathetic discharge to the dilator pupillae results in short latencies renging from 0.3 to 0.5 seconds in man with large dilation of short duration usually followed by immediate recontraction. The sympathetic inhibition of the Edinger-Wesphal nucleus is characterized by short latency (0.3 seconds), slow rate of dilation, and the smallest increase in dialtion of the four mechanisms. In normal individuals, the pupillary reflex dilation is a result of the interaction of these mechanisms with the humoral mechanisms being important only in cases involving at least moderately strong forms of stimulation resulting in rapid and long-lasting, massive dilations.

Proposed Investigation

The proposed investigation will examine a crucial and pivotal assumption of the SDT process that has only recently been even briefly questioned (Lang et al., 1970). Wolpe clearly makes the assumption that a finely graded stimulus hierarchy leads to an equally finely graded set of physiological responses without any supporting evidence other than the subject introspecting and reporting the current state of his arousal.

Grossberg and Wilson (1968) report physiological responses that discriminate between visualizing aversive and neutral scenes but nonphobic subjects have the same pattern of responses. Lang et al.(1970) report brief evidence supporting the assumption that more aversive stimulation leads to larger physiological change. Paul (1969a & b) found that imagining aversive scenes led to more arousal than neutral scenes and that systematic relaxation reduced the arousal responses. Although these studies show arousal to aversive stimuli, they do not support the notion of a finely graded response system to finely graded stimuli. As pointed out above, the traditional measures such as HR, SC, and RR may not be sensitive to the fine changes in arousal implied in Wolpe's formulations.

Therfore, this study will look at the relationship between the verbal report of the subjects' introspecting and the physiological response as measured by the pupillary reflex response during the visualization of various scenes that approximate the scenes used clinically in SDT. The pupillary reflex response appears well adapted to the measurement of fine differences in arousal in response to internal events such as visualization. The pupil reflex response has short latency, easily measured discrete changes, and, unlike the circulatory and respiratory systems, the pupil is not involved in crucial vegetative functions which makes it somewhat easier to evaluate and control the timing sequence of stimulation and response. Interpretation and scoring are more straightforward than in the case of heart rate, skin conductance or respiratory rate.

The proposed investigation will include rather unique controls for the processing load or mental effort necessary in the task of visualization. Many studies of cognitive processing (discussed below in Chapter II) have demonstrated that the pupil reflex response is a valid measure of the processing time and amount of processing load in simple and complex short and long term memory tasks, paired associate learning tasks and in instructed forgetting. The unique control is the construction of paired aversive and non-aversive stimulus scenes that are as identical as possible except for the one or two crucial words referring to the feared stimulus. It is the reference to the feared stimulus that must control the anxiety response or otherwise it would make no sense to vary the reference to the feared object. Therefore, a pair of scenes that are identical except that one contains, for example, the word "boat" and the other contains the word "snake" should control for the amount of mental effort to visualize either scene, as well as the cognitive difficulty involved in the grammatical and semantic structure of the scene. Any differences in the pupil dialtion in response to either scene should be attributable to the arousal or anxiety elecited by the anxiety related qualities of the reference to the feared stimulus.

CHAPTER II

A PARTIAL REVIEW OF THE LITERATURE

The main thrust of the literature has been toward assessing the efficacy of SDT as a clinical technique for the modification of abnormal or deviant behavior. Most studies show that SDT is effective and efficient when applied to even diverse forms of anxiety disorders (Wolpe, 1952 & 1958; Lazarus, 1963; Wolpe & Lazarus, 1966; and Rachman, 1959). Wolpe, for example, reports 89.5 percent of his patients as either apparently cured or much improved in a mean of about 30 sessions. In a group of eighteen phobic children, Lazarus reported (1963) that 78 percent of all his private practice clients had derived marked benefit from systematic desensitization techniques.

More rigorously controlled experimental studies have shown that SDT works as well in the laboratory as it does in the clinic. Paul (1968) in a two year follow-up on systematic desensitization of social-evaluative anxiety in college males found no evidence of relapse or symptom substitution. Paul had earlier (1967) compared SDT with traditional insight therapy and found that SDT resulted in 85 percent improvement of maladaptive anxiety while insight and placebo-attention therapy resulted in 50 percent improvement. Paul concluded that the changes were reliable, predictable and show further generalization. Again, no evidence of relapse or symptom substitution were found in a two year follow-up.

In comparing SDT with no treatment controls, Lang & Lazovik (1963) found that SDT subjects showed a greater reduction in phobic behavior, as measured by avoidance behavior, than did nonparticipating controls. The SDT subjects tended to hold or increase the gains made in therapy when tested at a six month follow-up and gave no evidence of symptom substitution.

Desensitization of specific fears generalized positively to other fears and for their subjects, Lang, Lazovik, and Reynolds (1965) found that the degree of fear change could be predicted form measurable aspects of the therapy process. All measures of fear change yielded high positive correlations with the number of hierarchy items successfully completed except that subjects who completed less than 15 items of the 20 item hierarchy were no different in terms of fear change than pseudotherapy or untreated subjects. Lang _et al_. suggest that "the therapeutic task must be well advanced before effects clearly greater than those achieved by control subjects are observed (1965, p. 401)."

Moving to studies that examine the components or the essential parts of SDT, Davison (1968) argued that the SDT process is counterconditioning rather than reciprocal inhibition or drive reduction, and to the extent that desensitization involves counterconditioning, the contiguous association of graded anxiety-provoking stimuli and incompatible response would constitute a necessary condition for fear reduction. Davison found disruption of the pairing between graded aversive stimuli and relaxation rendered the technique ineffective in modifying the avoidance behavior of snake phobics to snakes. Davison also found that only subjects that had completed the highest item of a 26 item hierarchy were able to successfully complete a Behavioral Avoidance Test. The subjects of Davison that were able to perform the terminal behavior experienced high anciety while performing tne previously unattained behavior.

In comparing the effectiveness of a laboratory analogue of SDT with the separate effects of cognitive rehearsal (i.e., "thinking about" something) and relaxation, Folkins _et al._ (1968) demonstrated that cognitive rehearsal appeared to the most effective treatment in reducing the response to a stressful film. Davison (1969), in a critique of the Folkins _et al._study, argued that their SDT group became sensitized to the aversive scenes because of the pairing of imagined scenes with emotional upset rather than with emotional calm because the subjects were not allowed to terminate the visualized aversive scenes as soon as they experienced but were required to continue visualization of the scenes.

The studies above have essentially manipulated the exposure to aversive stimuli and the pairing of anxiety-competing responses with graded exposure to aversive stimuli. The third essential element of SDT is gradations in exposure from least to mont anxiety provoking. Differential ordering of stimulus presentation in SDT was studied by Krapfl & Nawas (1970) who used a standard order, a reverse order, that is, from high to low anxiety scenes, and a random order presentation of hierarchy scenes to snake phobic subjects. The subjects in the desensitization groups showed significantly greater improvement than did subjects in control groups. While there was no difference between standard order and reverse order groups, the random order group tended to improve less than the other two SDT groups.

Thus, while Wolpe has not been supported in the necessity of presenting aversive scenes from low to high, SDT as a whole has been demonstrated to be a very effective technique in changing behaviors.

Implosive Therapy

Although Implosive Therapy (IT) as developed by Stampfl (1967) is based on different theoretical assumptions than SDT, it may be argued that IT is essentially the presentation of the highest or most anxiety provoking scene of the hierarchy repeatedly without the contigous pairing of any sort of incompatible or competing responses such as deep relaxation. Stampfl (1967) bases his approach on the classical conditioning paradigm in which emotional responses to neutral stimuli are acquired through the pairing of neutral and noxious stimuli. These emotional states which may be labeled fear or anxiety function as motivators of avoidance behavior and the reduction or elimination of the fear state serves as a reinforcer of that behavior. Stampfl states "The imagery, thoughts, or other stimuli correlated with the past experience of pain will be avoided, and whatever action or mechanism which prevents them from reoccurring will be learned and maintained on the basis of anxiety reduction (p. 497)." Stampfl's basic premise is that repeated evocation of anxiety responses to imaginal cues in the absence of primary reinforcement will lead to extinction of those responses. Stampfl reported that therapy time was reduced to one to fifteen hours to effect behavioral change in phobic subjects.

The knowledge gained from laboratory research that a conditioned stimulus followed by non-reinforcement leads to extinction of the emotional response to that conditioned stimulus leads directly to Stampfl's procedure of implosion. The patient, or client, is presumed to be avoiding those stimulus cues that have anxiety-eliciting potential. It is the therapist's role to deduce those cues and to attempt to extinguish their anxiety-eliciting propertied by verbally describing in detail to the patient the sequence in which the cues occur. In a sense, the therapist forces the patient to be exposed to the anxiety-eliciting cues that he has been avoiding. With the avoidance response circumvented, greater exposure to the cues will occur and anxiety extinction will occur.

Hogan & Kirchner (1967) found that one hour of IT was effective in reducing the anxiety responses of phobic subjects. Using only subjects who were unable to pick up a rat from a cage, Hogan & Kirchner successfully employed one implosive therapy session to extinguish their fear of rats. Of 21 experimental subjects, 14 were able to pick up the rat, while of 22 control subjects, only two were able to pick up the rat in the post-treatment test and seven controls refused to even enter the room. The experimental subjects exhibited more approach responses after implosion while, conversely, the avoidance responses of the controls were intensified as all of them had been able to enter the experimental room on the pre-test.

SDT and IT were compared for effectiveness and efficiency in reducing snake phobic behavior by Barrett (1969) who found no significant differences between these groups in terms of increased approach responses. IT was found to be more efficient in that therapy was completed in 45 percent of the time required for SDT but SDT was more consistent across subjects and across tome whereas IT was more variable.

In direct contrast to the above findings, Mealiea & Nawas (1970) found that for their subjects SDT was a much more effective treatment than IT for increasing approach responses of phobic subjects. Perhaps an important differenct is that Mealiea & Nawas used a standard set of scenes with all subjects. It is possible that <u>S</u>s in the IT cindition simply were not maintained in a high anxiety state by the standard scenes. Barrett

(1969) and Hogan & Kirchner (1967) used individualized IT scenes that changed within a session to maintain the high states of anxiety. The subjects were not allowed to make avoidance responses that could serve to conserve the anxiety to the phobic stimulus.

While IT has been demostrated effective in serveral studies, an explanation of the divergent results when compared to SDT might be that IT is simply more difficult to practice. The constant evocation of anxiety requires more effort and ingenuity from the therapist than does the avoidance of anxiety in SDT. The maintenance of high anxiety states in IT could fruitfully be studied to see how the anxiety states change from moment to moment during the presentation of the stressful scenes.

Physiological Measurement

Insofar as various elements of SDT are related to Wolpe's reciprocal inhibition theory of maladaptive response elimination, it is essential to demonstrate that appropriate physiological changes accompany the various elements of SDT. Paul (1969 a) found that in general, both relaxation training and hypnotic suggestion produced significantly reduced subjective tension and distress and physiological arousal (HR and SC decreased) when compared to no treatment controls. Relaxation training was found significantly more effective than hypnotic suggestion especially for response systems not under direct voluntary control. In a concurrent study reported separately (Paul, 1969 b), imagination of stressful stimuli produced significantly less physiological arousal during a relaxed state than during a non-relaxed state thus demonstrating that during relaxation subjects are able to visualize previously stressful stimuli without physiological arousal. Evidence for the sensitization of subjects was found when visualization of stressful stimuli was not paired with relaxation of either type. Paul's self-relaxed control group had significantly more arousal during the second session of visualization of stressful stimuli than to the first imagination session.

The assumption of physiological arousal to imagining fearful or stressful scenes was studied in greater detail by Grossberg & Wilson (1968) who found that imagining fearful scenes produced significantly more arousal responses (HR and SC both increased) in phobic subjects than did imagining neutral scenes. In addition, a significant decline in arousal responses to repeated presentations of frarful scenes was found suggesting a rapid extinction or habituation process. Non-phobic control subjects, however, demonstrated the same significant arousal responses to imagining the same fearful scenes as compared to imagining the neutral scenes. The authors suggest that a confounding of extraneous factors such as differential scene content, experimenter bias or manner of instructions could account for the paradoxical arousal of nonphobic subjects to fearful scenes. The conclusion was that visualization or imagining is a specifiable operation which has measurable effects on subjects.

In a brief study dealing with the assumption that graded fearful scenes or a hierarchical ordering of scenes leads to a corresponding graded or hierarchical ordering of physiological arousal, Lang, Melamed, & Hart (1970) presented 11 scenes in a random balanced order to 20 subjects. The scenes were selected from hierarchies constructed during three sessions with each S and the individual hierarchies were from 12 to 20 scenes in length. A near monotonic relationship between self-reported anxiety response and the rated hierarchy position was found. Heart rate response curves closely approximated those of self-reports of anxiety with a highly significant linear trend. Large skin conductance responses were associated with higher hierarchy items but only one phobic group had a significant linear trend between hierarchy rank and skin conductance response. No relationship was found between respiration rate and hierarchy level or ranking. Lang et al. concluded that an increase in the hierarchy rank of a visualized scene is associated with an increase in sympathetic arousal as measured by heart rate and skin conductance.

Thus, little support of the assumption of finely graded physiological responses associated with finely graded imaginal scenes has been reported in the literature. The lack of evidence may be due to the nature of the responses used. For example, HR and SC are involved with crucial vegetative processes of the body and simply may not be able to reflect fine changes associated with imaginal stimuli. The next section therefore examines studies utilizing the pupillary reflex response which does reflect rather fine changes in stimulation.

Pupillographic Studies

The work of Hess and his associates has generated recent interest by psychological researchers in the pupil reflex response. Hess & Polt (1960) measured pupillary changes to pictorial stimuli presented after a control slide. The authors found increases in pupil size to slides having positive affective value. Then, in 1965, Hess, Seltzer , & Shlier, reported that pupillary responses discriminated between homosexual and heterosexual males. Four of five homosexuals dilated more to slides of male nudes than to slides of nude females while all the heterosexual males dilated more to slides of nude females than to slides than to slides of nude males. Hess has interpreted pupil dilation as an index of "interest", "emotion", and "motivation" and has employed it as a dependent variable in taste (Hess, 1965; Hess & Polt, 1965) and musical preference (Hess, 1965).

More controversial is Hess's contention that stimuli with negative affect, or distasteful stimuli, lead to a negative pupil response or constriction. Examples of negative stimuli would be pictures of cross-eyed or crippled children, dead soldiers on a battlefield or the body of a murdered gangster. Highly aversive stimuli (e.g., picture of stacks of corpses in a concentration camp) cause an initial dialtion but repeated exposures then evoke constrictions. This notion of constriction responses to aversive stimuli is counter to the prevailing concept that emotional reactions tend to elicit sympathetic activity (which includes pupil dilation).

Many attempts to replicate Hess's constriction findings have had rather poor success. Woodmansee (1965) found only dilation of pupil size in response to recial content photographs by subjects at the extremes of racial tolerance. Peavler & McLaughlin (1967) found pupil dilation to affective stimuli (i.e., a female nude) but found no difference between words varying on good-bad or neutral-aversive dimensions. Polt & Hess (1968) found dilation and constriction responses divided equally among their subjects in response to visually presented words such as "flay", "nude", "squirm", and "hostile". Nunnally, Knott, Duchnowski, & Parker (1967) found significantly larger pupil dilation to slides rated very pleasant on a pleasantness dimension but dilations to neutral and very unpleasant slides did not differ from each other. Guinan (1966) found emotional word slides to be associated with significantly larger pupil size than neutral word slides. The three emotional words Guinan used, "vomit", "sex", and "kiss", did not differ among each other.

On the other hand, Barlow (1969) found patterns of dilation and constriction that tend to support some of Hess's predictions. Pictures of Lyndon Johnson, George Wallace, Martin Luther King, and an unknown white were presented to liberals or conservatives. Liberals dilated to Johnson and King and constricted to Wallace while conservatives had just the oppsite pattern.

The resolution of the unpleasant stimuli-pupil constriction problem may be bound up in the hopeless confounding of the physical characteristics with the psychological characteristics. The primary function of a mobile pupil is to regulate the amount of light entering the eye and to make adjustments that enhance visual acuity. Hess reports himself (1965) that constiction responses were found only with visual stimuli. Unpleasant tasting liquids and disliked music consistently evoked dilation.

Much less controversial are studies that show changes in pupil size as a function of mental activity. Again, Hess was the modern pioneer of this area (Hess & Polt, 1964). In studying varied difficulty of multiplication problems, Hess found the mean extent of pupil dilation was directly related to the degree of problem difficulty.

Repeatedly, studies have shown that pupil size reflects mental activity and differentiates between levels of task difficulty. Kahneman and his associates have focused carefully on the pupil response as as index of "processing load" in a series of carefully designed studies. Kahneman describes the characteristic response pattern of the pupil as dilation as the material is presented to the subject for processing and then constriction as the report of solution signals completion of the task. This pattern of response held for short and long term memory tasks (Beatty & Kahneman, 1966; Kahneman & Beatty, 1967) and for digit transformation tasks (Kahneman & Beatty, 1966).

Kahneman & Beatty (1967) measured pupil size during a pitch discrimination task in which subjects had to discriminate between a standard tone of constant frequency and a comparison tone which varied in frequency. Pupillary dilations were greater in response to the comparison tone. The standard tone required less attention by the subject and therefore elicited small pupil dilations. The principle factor was thus argued to be the processing load which is self imposed (mental effort) as opposed to the arousal generated directly by the stimulus itself.

Investigation of the effect of creating images to abstract and concrete words (Simpson & Paivio, 1966) found that the imagery task reliably led to pupillary dilations, but differences between abstract and concrete words were found only when the subjects had to make some overt response, such as a key press, to signal task completion. Simpson & Hale (1969) suggested this motor response enhancement of pupil dilations might be due to the demand it imposes on the subject to make a decision.

In contrast Kahneman & Peavler (1969) reported that pupillary dilation on a paired-associate test were equal whether or not the subject responded verbally. Perhaps it is the response effort rather than the response per se that causes the difference. Simpson & Paivio's subjects possibly did not perform the task as conscientiously when they did not have to report task completion.

Relationship of the Literature to the Present Study

Wolpe makes the assumption that imaginal scenes that differ in stressfulness lead to differential levels of anxiety that correspond to the levels of stressfulness. It is further contended that the imaginal scenes must be presented in a hierarchial fashion from low to high stressfulness while the patient is in a relaxed state. SDT as a whole has been demonstrated effective while the components (i.e., relaxation, hierarchial arrangement and cognitive rehersal) lead to equivocal results when examined.

Studies of the physiological responses to imaginal stimulation have shown increased arousal to stressful scenes when compared with neutral scenes but finely graded anxiety responses simply have not been reported. It seems possible that the response measures used have not been sensitive enough to discriminate differential arousal responses. It seems equally possible the pupillary reflex response is sensitive to fine differentials in arousal. Therefore, the following hypotheses will be examined in this study.

Hypothesis I. Imagination of scenes that differ in stressfulness will lead to anxiety responses that correspond to the level of stressfulness of each scene.

Hypothesis II. Subjects reporting high fear (phobic _S_s) will respond with higher anxiety responses than will subjects reporting low fear (non-phobic _S_s).

CHAPTER III

METHODOLOGY

Subjects

Twenty-four female subjects ranging in age from 17 to 20 participated in three basic phases of this study. During the first phase or pretesting, prospective subjects were administered the Wolpe Degree of Discomfort (Wolpe & Lazarus, 1966), the Experimental Discomfort Index, which was the experimental imagery scenes restated in the form of the Wolpe Discomfort Index and rated in exactly the same manner (Appendix A), and a list of the exact aversive protocol items later used as imaginal scenes during pupil measurement. The exact protocol items were ranked by subjects in an analogous manner to the construction of a desensitization stimulus hierarchy.

The possible range of scores on the Experimental Discomfort Index is 0 to 36 with nine aversive items that may be rated from zero to four in terms of discomfort caused by that item. If a subject rated all the aversive as causing absolutely no discomfort, then the score for that subject would be zero times nine or zero. If a subject reated all aversive items as causing discomfort "practically always", then the score for that subject would be four times nine or 36.

Subjects were assigned to groups for the remaining experimental phases on the basis of their responses to the Experimental Index with subjects on the two extreme ends of scores comprising the low fear and high fear groups and subjects scoring at or around the median making up the medium fear group. A total of 57 potential subjects were given the items of the pre-testing phase. Twenty-seven subjects were then selected on the basis of the pre-test and willingness to participate. All subjects received credit in an Introductory Psychology class for participating in this study. Of the 27 subjects selected, three were dropped from the results because of technical difficulties resulting in unscorable pupillary data. A total of 24 subjects, three groups of eight each, comprise the experimental sample.

The low fear group had a mean score of 10.5 for the nine aversive items. The medium fear group had a mean score of 16.88 and the high fear group had a mean score of 27.88 for the nine aversive items.

Apparatus

The basic design of the equipment used to obtain the pupillometric data is essentially similar to that used by virtually all of the current investigators involved in pupillometric research (see Hess, 1965).

The pupillometer used in this study consists of a ½ inch plywood rectangular viewing box with inside dimensions of 22½" x 22½" x 48½". The front, or S's end of the box, was enclosed except for an opening in the center to provide for viewing the rear of the box and to allow for photographing of Ss' eyes. This opening was provided with a stationary eyepiece that incorporated a red lighting system to provide a red light source for the infra-red film and an adjustable chin rest. The opening extended far emough downward to allow Ss to speak unimpeded. The rear end of the box was open and fitted with a tight fitting screen (a thin polyethylene sheet) with a fixation cross (3/4" high with 1/2" arms) positioned in the center. All interior surfaces were painted flat black to minimize reflectance.

A Beaulieu R16 movie camera was positioned on the side of the box to the S's right. The camera was mounted on a fully adjustable support which provided for precise adjustments of camera position and focus. The lens of the camera extended approximately 1/8" into the interior of the box through a tight fitting aperture in a system of sliding panels designed to allow adjustment in camera position.

A half-silvered mirror was postioned adjacent to the S's end of the pupillometer which extended from top to bottom and from side to side thus completely subtending the field of view within the box. The mirror was positioned at a 45 degree angle to both the S's forward line of vision and the central axis of the camera lens. This positioning of the mirror allowed S a clear view of the fixation cross on the rear screen and also allowed a reflected image of the right eye to strike the camera lens system.

The camera used was a Beaulieu R16ES equipped with a Vemar 135 mm f/2.8 telephoto lens, a Vemar "C" mount adapter and a 30 mm extension tube to provide for precise focusing at a lens to subject distance of 24 inches. Camera speed was set and calibrated to 2 frames/second (exposure duration of .2 seconds per frame) driven by a regulated power supply to prevent speed fluctuations (Raytheon VR6114). Kodak High Speed Infrared Type 2481 film was used and developed in Kodak Microdol-X developer for the times recommended by the film maker.

The rear projection screen was illuminated by a 200 watt incandescent bulb in a flexible desk lamp positioned behind the fixation cross. The eyepiece contained five miniature 12 volt bulbs powered by a variable transformer set to provide illumination at S's eye of approximately 16-18 ft-c.

All trials were run in a large room in which the windows were covered with aluminum foil to eliminate variation in incident illumination due to changes in external light levels. The room was uniformly illuminated by fluorescent ceiling fixtures which remained on throught all experimental sessions. The ambient light level at S's eye level while seated was 100 ft-c.

All instructions and stimulus items were presented over a tape recorder (Uher Royal de Luxe) equipped with headphones for the S. One channel of the tape recorder controlled camera operation; a cue was placed on the control channel which activated a sound-operated relay within the tape recorder which was connected by cable to the camera thus allowing the camera to start and stop by automatic control.

Connected to the audio output of the tape recorder was an external sound-operated relay (Grason-Stadler, Model E7300A-1) which controlled a frame marker. The onset of a stimulus activated a pinhole light source mounted inside the eyepiece and out of S's line of sight. It served to identify the sequence of stimulus events on the developed film.

Visualization Scenes

The scenes visualized by the Ss were divided into two basic types: neutral and aversive. The neutral and aversive scenes were paired as precisely as possible with the only difference between a given neutral-aversive pair being some degree of stressfulness (i.e., reference to a snake). The scenes were designed to represent three general levels of stressfulness arranged along a hierarchy from low to high. Three scenes were constructed for each level and each type of stimulus for a total of eighteen scenes (see Appendix B). The scenes average 13.8 words each and the average duration was five seconds. The nine aversive items were ranked or ordered into a hierarchy by each S during the pre-test phase and in the post-experimental phase to establish the perceived relative stressfulness of these visualization scenes.

Procedure

Subjects were scheduled for testing in a random fashion. Ss were given a list of alternative times and were allowed to choose the exact time for their own experimental session. Three high fear group Ss were tested sequentially and two medium fear group Ss were tested sequentially. Additionally, 90 percent of Ss kept their scheduled appointments.

Subjects were tested individually, Upon arrival in the experimental session, each S completed a short biographical questionnaire. At the beginning of the experimental phase each S was seated comfortably at the pupillometer and the chin rest adjusted so her right eye was positioned in the center of the camera's viewfinder. During the adjustment of camera focus, the S had the opportunity to visually explore the interior of the pupillometer and become accustomed to the experimental situation.

After each S was comfortably seated and the apparatus adjusted, the tape recorder was turned on and the experimental sequence began. First, each S heard a set of instructions designed to prepare S for the experimental procedure and to minimize anxiety about the situation (see Appendix C). The instructions lasted approximately four minutes and 25 seconds. Each S then heard the following four practice scenes. The practice scenes are identical in form and time sequence to the experimental scenes but differ in content and were not photographed.

1. Imagine standing in front of the library looking at the water fountain.
2. Imagine looking at the morning headlines in the campus newspaper.
3. Imagine holding and petting a small kitten.
4. Imagine standing in front of a large class and giving a speech.

During the practice trials and after their completion, there were opportunities for S to ask questions and for E to clarify instructions, if this was necessary. All Ss demonstrated they had a clear understanding of the experimental task by the end of the practice trials.

The 18 experimental scenes then began at the rate of one scene per minute. Alternating Ss heard mirror image randomized sequences of the 18 experimental scenes. That is, there were two sequences or orders of scene presentation that were mirror images of each other in terms of neutral/aversive type of stimuli. The scenes were coded by stimuli type (1 being neutral and 2 being aversive) and by level (1, 2, and 3 from low to high level). A randomized sequence of presentation was constructed. Order 1 was: 21, 11, 23, 22, 12, 22, 12, 21, 11, 12, 13, 23, 13, 22, 23, 11, 13, and 21. The mirror image of order 1 was: 11, 21, 13, 12, 22, 12, 22, 11, 21, 22, 23, 13, 23, 12, 13, 21, 23, and 11. These two orders were alternated to control for the effects of orders of scene presentation.

The timing sequence was identical for each scene regardless of the type of level of that scene. First, the signal "ready" was presented to S and the camera simultaneously began filming. Four seconds later the visualization scene was begun and this reading of the scene (conversly, listening by S) lasted an average of five seconds (the range was 4 to 6 seconds). Ten seconds after the "ready" signal, the instruction "visualize" was given. Then, fifteen seconds after the "ready" signal, the instruction "report" was given. The camera then stopped filming. Next, twenty-five seconds after the "ready" signal, the instruction "rest" was given. Thirty-five seconds of rest was followed by another "ready" signal and the sequence was repeated eighteen times for a total experimental time of eighteen minutes. The camera filmed continuously from each "ready" signal to each "report" instruction for a total filming time of fifteen seconds for each scene. The camera was operated at the rate of 2 frames per second resulting in thirty frames of film for each experimental scene or 540 frames per subject.

When the instruction "report" was given, each S reported two digits that signified how that scene was visualized and the amount of subjective discomfort, anxiety or fear experienced while visualizing that particular scene. E recorded the verbal reports given immediately after completion of visualization of each scene.

Immediatly following completion of the eighteenth experimental scene, each S was given a list of the nine aversive scenes to rank order into a hierarchy of discomfort or anxiety producing stimuli ranging from 1 to 9 in rank.

The Behavioral Avoidance Test (BAT) followed completion of the experimental tasks. The purpose of this test was to determine how close each S would approach a 4½ foot long bull snake in a 12" x 18" x 24" glass cage with a ½" wire mesh top. The harmless snake was in a cage upon a table in an adjacent room to the experimental room. The cage was 10 feet from the door. The BAT room was completely bare except for the table, cage, and snake. The single window in the room was covered by aluminum foil to block out external and irrelevent stimuli intrusions.

The instructions given to all Ss for the BAT were: In the next room is a harmless snake in a cage. I would like for you to look at it. Please open the door and go in.

Each S was allowed to approach the snake with no instuctions. After S stopped approaching the snake, she was asked to put on a leather glove, open a trap door in the wire-mesh top, reach in and touch the snake. Immediately after completion or refusal of all these steps, each S was asked to rate her subjective discomfort, anxiety or fear while she was still in the BAT room and looking at the snake. The immediate decision of each S was accepted with an appropriate pause to allow S to change her mind. When E was asked if he really wanted S to touch the snake, the standard reply was "I would like for you to."

The BAT was scored in a nine step checklist fashion. Step 1 was entering the BAT room; 2 through 4 were one yard approaches defined by the number of tiles on the floor the S moved toward the snake. Step 5 was looking through the glass side of the cage; step 6 was looking down into the cage through the wire top. Step 7 was opening the trap door, step 8 was inserting gloved hand and 9 was touching the snake. After step 9, each S rated her anxiety on a 1 to 7 scale with 7 representing the highest level of discomfort. Each S was pledged to keep the experimental procedure confidential and to not discuss any aspect of it, especially the BAT.

Film Development and Scoring

Each exposed roll of Kodak High Speed Infrared film was processed individually in a Superior Color Reel 16mm bulk film developing tank. The film was processed with Microdol-X developer. Kodak Rapid Fix and Kodak Photo-Flo solutions. The developing times recommended by Kodak (Kodak KP

623536 12-71) were followed as precisely as possible. One roll of film was inadvertently processed for too long a period of time causing some degree of overdevelopment. This overdevelopment produced the highest quality of film images, indicating that more effort should be expended in optimizing exposure-development techniques with infrared film.

The processed film was scored by displaying the pupil image in a microfilm reader (Xerox Microforms Reader Model 2240) which produced an image magnification of forty times the film size. The combination of lens on the 16mm camera and the magnification of the microfilm reader produced an image ten times the actual size of the pupil. Pupil diameter was measured directly from the screen of the microfilm reader with a transparent ruler frame by frame to the nearest millimeter which would correspond to the nearest tenth millimeter of actual pupil diameter change. Some frames were not scorable due to eye blinks or other movements. These nonscorable frames accounted for five percent of the total of 12960 frames scored. The majority of unscorable frames occurred during the "ready" or prestimulus period (the baseline period). The film judged unscorable for three Ss appeared to be misfocused either due to S's moving after the lens was focused or perhaps poor technique in focusing.

CHAPTER IV

RESULTS

The pupillary data was prepared for statistical analysis by the baseline conversion method (see Headley, 1973). The eight frames preceding the onset of a stimulus constituted the baseline period for that particular stimulus or scene. The average of the eight baseline frames was subtracted from each of the 22 post-baseline frames resulting in deviation from baseline scores. Thus, eighteen baseline averages and eighteen sets of deviations from each baseline were calculated for each S. All trials within a given condition for each S were then averaged on a second-by-second basis; the three trials in the high level aversive condition were averaged, the three trials in the high level neutral condition were averaged, the three trials in the medium level aversive condition were averaged and so on. The twenty-two experimental task frames were collapsed to eleven pairs of frames to compensate for missing data in some cells due to blinks or head movements. These type-level second-by-second averages of deviation scores were the units for the analyses of varience and other statistical tests discussed below.

The first pair of frames in the listening period were dropped (frames 9 and 10 from onset of filming) to give an equal number of data points in the listening and visualization time periods. The experimental listening period was six seconds in duration. Dropping the first two frames (0.5 seconds each) from this period equated the listening period with the visualization period (each equals 5 seconds).

In all the statistical analyses, the .05 level was adopted as the minimum for an effect to be considered significant. All tests on within-subjects effects were tested using the conservative procedure of reducing the degrees of freedom to one and twenty-one to compensate for possible violations of the symmetrical matrix assumption underlying the statistical model (Geisser & Greenhouse, 1958).

Overall Analysis

The overall analysis of variance is shown in Table 1. The factors are: frames, five levels; period, two levels; group, three levels; type, two levels; and levels, three levels. As seen in Table 1 only two main effects, frames and period are significant. The frame by period interaction and the period by level interaction are also significant effects.

Contrary to the hypotheses of the study, neither stimulus type or level appear to have any reliable effect on pupil dilation. Also, group assignment, i.e., low fear, medium fear and high fear, does not lead to any reliable differences in pupil dilation while either listening to or visualizing scenes pertaining to the phobic area.

Table II shows the analysis of variance for the listening period. This analysis was performed to investigate the significant frame by period and period by level interactions. Only the frames effect is significant for this time period, while the effect of levels approaches significance (p .10).

The analysis of variance for the visualization period is shown in Table III. Only the frames effect (p .05) is significant. No other effects produce reliable differences during this time period.

TABLE I

OVERALL ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
G	2	6.571	3.285	1.899
SwG	21	36.316	1.729	
F	4	2.114	.529	15.349**
GF	8	.281	.035	1.021
FSwG	84	2.892	.034	
P	1	.902	.902	5.093*
GP	2	.343	.172	.969
PSwG	21	3.718	.177	
T	1	.004	.004	.04
GT	2	.341	.171	1.532
TSwG	21	2.339	.111	
L	2	.993	.497	1.17
GL	4	.630	.158	.371
LSwG	42	17.822	.424	
FP	4	6.554	1.639	75.92**
GFP	8	.133	.017	.772
PFSwG	84	1.813	.022	
FL	8	.094	.012	.914
GFL	16	.155	.009	.755
LFSwG	168	2.152	.013	
PL	2	.363	.182	5.317*
GPL	4	.120	.03	.88
PLSwG	42	1.434	.034	
FT	4	.026	.006	.418
GFT	8	.187	.023	1.503
TSFwG	84	1.303	.016	
PT	1	.002	.002	.053
GPT	2	.087	.043	1.188
TPSwG	21	.766	.036	
LT	2	.719	.359	1.282
GLT	4	.213	.053	.190
TLSwG	42	11.769	.280	

TABLE I (Continued)

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
FPL	8	.298	.037	2.385
GFPL	16	.276	.017	1.084
LSPFwG	168	2.676	.016	
FPT	4	.035	.0089	.686
GFPT	8	.204	.025	1.971
TPFSwG	84	1.085	.013	
FLT	8	.042	.005	.496
GFLT	16	.163	.010	.955
TLFSwG	168	1.788	.011	
PLT	2	.003	.0015	.032
GPLT	4	.183	.046	.929
TLPSwG	42	2.065	.049	
FPLT	8	.119	.015	1.069
GFPLT	16	.056	.004	.251
TLPFSwG	168	2.341	.014	

* = significant at .05 level, corrected df (see text)
** = significant at .01 level, corrected df (see text)

TABLE II

PERIOD ONE ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
G	2	2.441	1.221	1.995
SwG	21	12.848	.612	
F	4	8.025	2.006	59.45**
FG	8	.1781	.022	.661
FSwG	84	2.834	.034	
L	2	1.173	.587	3.389
LG	4	.275	.069	.397
LSwG	42	7.271	.173	
T	1	.0003	.0003	.004
TG	2	.239	.119	1.758
TSwG	21	1.425	.068	
FL	8	.296	.037	2.55
FLG	16	.245	.015	1.057
LFSwG	168	2.438	.014	
FT	4	.046	.012	.951
FTG	8	.232	.029	2.378
TFSwG	84	1.026	.012	
LT	2	.331	.166	1.357
LTG	4	.241	.060	.493
TLSwG	42	5.132	.122	
FLT	8	.078	.009	.671
FLTG	16	.123	.008	.529
TLFSwG	168	2.437	.015	

** = significant at the .01 level, corrected df (see text)

TABLE III

PERIOD TWO ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Sum of Squares	Mean Square	F
G	2	4.473	2.236	1.727
SwG	21	27.186	1.295	
F	4	.644	.161	7.226*
FG	8	.236	.029	1.325
FSwG	84	1.871	.022	
L	2	.183	.091	.32
LG	4	.475	.119	.416
LSwG	42	11.984	.285	
T	1	.006	.006	.076
TG	2	.189	.095	1.182
TFSwG	21	1.679	.079	
FL	8	.095	.012	.84
FLG	16	.186	.012	.84
LFSwG	168	2.391	.014	
FT	4	.015	.004	.23
FTG	8	.602	.019	1.217
TFSwG	84	1.362	.016	
LT	2	.390	.195	.94
LTG	4	.155	.039	.187
TLSwG	42	8.702	.207	
FLT	8	.084	.010	1.039
FLTG	16	.096	.006	.594
TLFSwG	168	1.692	.010	

* = significant at the .05 level, corrected df (see text)

The frames by period interaction can clearly be seen by examining Figure 1. During period one, or listening, pupil dilation increases rapidly over frames to a peak average increase of .36 mm. Then, in period two, or visualization, the pupil dilation decreases slowly over frames from .34 mm to .26 mm.

The level by period interaction reflects a differential ordering of mean pupil dilations for each level of stimuli in the two time periods. During listening the high level of stimulus has a mean dilation of .31, the low level of stimulation has a mean dilation of .23, and the medium level of stimulation has a mean dilation of .22. During the visualization period, the order changes. High level of stimulation again leads to the largest mean increase in pupil size with a mean of .314. The medium level produced a mean dilation of .262 and the low level has the smallest mean dilation, .257. Thus, the ordering of the means was high, low, medium during listening and high, medium, low during visualization.

The baseline means were calculated for the three groups. Group three, high fear, had the largest baseline of 5.23 mm mean pupil size, group two, medium fear, had a mean baseline pupil size of 4.67 mm, while group one, low fear, had the smallest mean baseline pupil size of 4.45 mm. Table IV presents the analysis of variance for these baseline means and indicates that the differences among the groups are not reliable.

TABLE IV

BASELINE ANALYSIS OF VARIANCE

Source	Degrees of Freedom	SS	MS	F
G	2	2.903	1.452	1.699
SwG	21	17.948	.855	

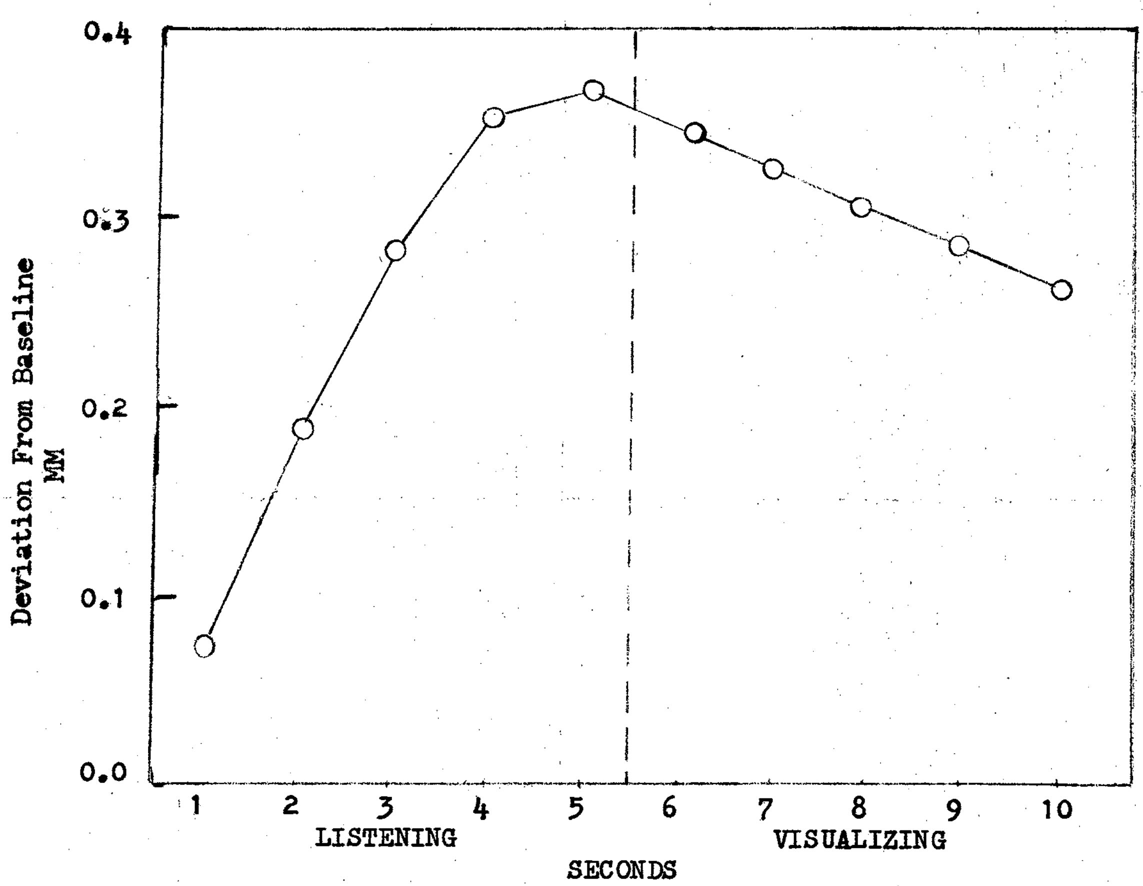

Figure 1. Average Pupil Response to "Listen" and "Visualize" Over All Conditions and Subjects

A Check of the Law of Initial Values

The Law of Initial Values (LIV) deals with changes from baseline as the response measure. Wilder (1950) states that the true algebraic change has a negative correlation with the true value of X ; the true response of a variable to a stimulus decreases as the true pre-stimulus level increases, i.e., change has a negative correlation with the initial level. Lacey (1956) proposed that autonomic responses that conform to the LIV should be scored in a way to account for physiological principles such as homeostasis. Lacey devised the Autonomic Lability Score (ALS) to rid the change score of dependence upon the pre-stimulus level. Lubin, Hord, & Johnson (1964) showed that if Wilder's LIV holds, the ALS will always have higher validity than the simple algebraic difference score.

The average baseline pupil size for each S/condition (types and levels) was paired with the average peak score for that condition. The peak score was chosen because it indicates the maximum change before opposing of homeostatic mechanisms come into play and attempt to counteract the change. The average peak dilations ranged from -.09mm to 1.12mm and the average baselines ranged from 3.17mm to 6.94mm.

The pearson product moment correlation of coefficients between baseline means and peak dilations are: group one, $r_{xy} = .14$; group two, $r_{xy} = -.009$; and group three, $r_{xy} = .11$. The correlations are not significant and show that initial or baseline pupil size is not related to the amount of change following that baseline period. A further conclusion is that using the simple difference score for the present set of pupillary data is justified.

Verbal Reports

The verbal reports of the Ss represent five different aspects of the Ss' responses to the stimulus materials. The pre-testing data included both the Experimental Discomfort Index (EDI) and a hierarchical ranking of the nine aversive stimulus scenes. Immediately following each visualization, the Ss reported both the intensity and the anxiety of that visualization. The fifth type of report data was the hierarchical ranking of the aversive stimuli again following the pupillometric tasks and preceeding the BAT.

These verbal reports were analysed in the following manner. First, the agreement between tne pre-test hierarchy ranking and the post-test hierarchy ranking was investigated by calculating Spearman's rho for each S. Table V shows the Spearman rank order correlations between the rank ordering of the nine aversive stimulus items for the two different rankings. The correlations for all the Ss ranged from .40 to 1.00 with median correlations of .92 to .94. Only one S had a non-significant correlation between her two rank orderings of the aversive stimuli. The pre- and post-hierarchy rankings were separated by a period of four months.

The second step in the analysis of the verbal report data was examining the relationship between the responses given of the EDI and the responses given immediately after visualization. The EDI items were slightly grammatically modified versions of the scenes used in the experimental visualization. The EDI asks the S to rate how a hypothetical situation would make him feel while the post-visualization anxiety report was a rating of how the S actually felt while visualizing the very same situations. Table VI shows the Spearman rank order correlations between the EDI ratings and the verbal ratings of anxiety for the same item pairs

TABLE V

SPEARMAN RANK ORDER CORRELATIONS BETWEEN
PRE AND POST HIERARCHY RANKINGS

	Subjects							
	1	2	3	4	5	6	7	8
Group 1	1.00**	.93**	1.00**	.68	.40	.95**	.82*	.82*
Group 2	.88*	.95**	.92**	.82*	.93**	.90**	.97**	.96**
Group 3	1.00**	.90**	.98**	.97**	.80*	.95**	.95**	1.00**

* = significant at the .05 level
** = significant at the .01 level

TABLE VI

SPEARMAN RANK ORDER CORRELATIONS BETWEEN EDI
RATINGS AND VISUALIZATION ANXIETY RATINGS

	Subjects							
	1	2	3	4	5	6	7	8
Group 1	.87*	.92**	.56	.76*	.03	.95**	.95**	.91**
Group 2	.58	.91**	.44	.86*	.73*	.98**	.82*	.73*
Group 3	.86*	.72*	.44	.39	-.35	.86*	.90**	.51

* = significant at the .05 level
** = significant at the .01 level

for each S. Sixteen of the 24 Ss had significant correlations between the two ratings which were separated by four months.

The third step was to investigate the relationship between the Intensity ratings and the Anxiety ratings that were reported after visualizing a given stimulus scene. A high correlation sould indicate that visualizations that were high in intensity were also high in anxiety or that low intensity scenes had low anxiety. A negative correlation would indicate that high intensity scenes were low in anxiety and so on. Table VII shows that sixteen of the twenty-four Ss had non-significant correlations between Intensity and Anxiety ratings. Five Ss had significant positive correlations between Intensity and Anxiety ratings.

In the fourth step in investigating the verbal reports of Ss, the relationship between the post-experimental hierarchy rankings and the post-visualization anxiety ratings was examined by calculating Spearman rank order correlations. Table VIII shows that twenty Ss has significant correlations ranging from .80 to .98.

With groups ranging from low fear to high fear in reported fear of snakes, the verbal reports might be expected to be very different in the Ss' affective response to imagining scenes dealing with their particular fear areas. Additionally, the intensity or clarity of visualization might be expected to differ among the fear groups. A Kruskal-Wallis Analysis of Variance by ranks was performed to see if the three groups differed from each other in Intensity of Anxiety ratings following each visualization. The calculated Kruskal-Wallis H for the Intensity ratings is 5.04 (n. s.) with group one, low fear, having the lowest intensity. The calculated Kruskal-Wallis H for the Anxiety ratings of .86 indicates no differences between groups in response to either stressful or non-stressful scenes.

TABLE VII

SPEARMAN RANK ORDER CORRELATIONS BETWEEN ANXIETY AND INTENSITY RATINGS OF VISUALIZATION

	Subjects							
	1	2	3	4	5	6	7	8
Group 1	.55	.07	-.07	-.89*	0.00	.86*	-.05	0.00
Group 2	.58	.24	.85*	.44	.64	.08	.33	.01
Group 3	.07	.97**	0.00	.77*	.82*	.51	-.73*	-.98**

* = significant at the .05 level
** = significant at the .01 level

TABLE VIII

SPEARMAN RANK ORDER CORRELATIONS BETWEEN VISUALIZATION ANXIETY RATINGS AND POSTTEST HIERARCHY RANKINGS

	Subjects							
	1	2	3	4	5	6	7	8
Group 1	.95**	.87*	.51	.88*	.55	.89*	.86*	.91**
Group 2	.89*	.84*	.70	.96**	.95**	.96**	.86*	.98**
Group 3	.86*	.92**	.81*	.62	-.07	.92**	.98**	.84*

* = significant at the .05 level
** = significant at the .01 level

Analysis of the Intensity and Anxiety ratings for each group was performed to see if the conditions differed from each other. A Friedman two-way analysis of variance by ranks (Siegel, 1956, pp. 166-173) was calculated for each group for both Intensity and Anxiety reports with subjects being rows and conditions being columns. No differences in the Intensity ratings were found. Low level neutral items were seen as vividly as high level aversive items in all groups.

The analysis of Anxiety ratings by Friedman two-way analysis of variance by ranks produced a significant χ_r^2 of 19.25 ($p<.01$) for Group one, χ_r^2 of 22.43 ($p<.001$) for Group two, and a χ_r^2 of 27.21 ($p<.001$) for Group three. Examination of the column totals shows for each group high level aversive items were consistently rated the highest in anxiety, medium level aversive items were rated medium levels of anxiety, and low level aversive items were rated lowest in anxiety of the aversive items while all three levels of neutral items were rated lower than the low level aversive items but not different from each other.

The BAT

The results of the BAT show that in Group one, low fear, six Ss complete all steps including touching the snake. Two Ss in the low fear group did not touch the snake; one of these looked down into the cage and the other opened the trap door. In Group two, medium fear, three Ss touched the snake while five did not. Of the five not touching the snake, one approached within six feet, another stood next to the cage and looked through the side, and two looked down into the cage. No Ss in Group three, high fear, touched the snake. Two Ss approached to six feet from the cage, three Ss looked through the side of the cage and three Ss looked down into the cage. A chi-square analysis indicates significantly more Group one, low fear, Ss touched the snake than did the Ss in any of the other groups. The $\chi^2 = 6.00$.

The verbal report of anxiety on a one to seven scale was the final phase of the BAT. The range of reported anxiety was from one to seven. A Kruskal-Wallis analysis of variance by ranks indicates no difference among groups in reported anxiety with a calculated H of 2.885, a nonsignificant value.

CHAPTER V

DISCUSSION

"Common sense" or even thoughtful reflection on "what happens" when a person imagines or visualizes different events leads to the conclusion that stressful or fearful images somehow arouses the individual or makes him anxious. People report feeling anxious or uncomfortable while visualizing stressful scenes. These common sense observations have been combined with clinical observations regarding anxious people to produce clinical theories regarding the acquisition and modification of maladjusted behavior (see Wolpe, 1958).

These trends were outlined above in Chapter II along with reports of studies indicating different aspects of an individual's response to diverse forms of stimulation. The major trend of the previous published studies has been to report increased arousal to stressful stimulation.

The major hypothesis of this study, that visualization of differentially stressful scenes will lead to differential arousal that corresponds to the degree of the stressfulness, was not supported. No differences in pupillary dilations were found between levels of stressfulness. That is, imagining a low stress scene or a neutral scene led to the same degree of pupil dilation as imagining a high stress scene. To emphasize this finding, an examination of the scenes used shows that visualizing "writing the word 'snake'" or visualizing "holding a large snake and touching it to your cheek " or visualizing "seeing a rubber boat in a variety store" all lead to the same degree of pupil dilation.

Verbal reports following visualization do indicate significant differential degrees of anxiety or discomfort that correspond to the differential levels of stressfulness. Visualizing about writing the word "snake" led to less discomfort or anxiety than did visualizing about holding or touching snakes. In addition, aversive items were rated higher in anxiety than were non-aversive items which also supports the notion of a hierarchical ordering of anxiety or feelings of discomfort felt by an individual.

The second hypothesis under examination was that snake phobic Ss would respond with larger pupil dilations when visualizing about phobic relevant stimuli than would nonphobic Ss when visualizing the same stimuli. This hypothesis was not supported. There is no demonstrable difference in the pupil dilation of phobic Ss compared to nonphobic Ss under any of the stimulus conditions used in this study.

Perhaps more surprising is the lack of difference in the verbal reports of phobic versus nonphobic Ss. Nonphobic Ss reported as much subjective discomfort as did phobic Ss while imagining aversive (phobic relevant) stimuli. Furthermore, there were no differences between the groups in intensity of the visualizations.

The Behavioral Avoidance Test (BAT) demonstrated that the Ss in the study were behaviorally different in their responses to a snake. All high fear group Ss refused to make physical contact with the snake or to even open the snake cage thus demonstrating at least some degree of phobia toward snakes. The medium fear group split into three Ss who touched the snake and five who refused to touch the snake. The low fear group had two Ss who refused to touch the snake while the other six touched it. These two Ss, who were assigned to the low fear group on the basis of their self-report about discomfort regarding snakes were, in fact, behaviorally somewhat phobic toward snakes. This may have confounded the group comparisons, but examination of the individual pupil response curves suggests they are no different from the rest of the low fear group in terms of pupil dilation in response to visualization.

Less clear cut is the report of anxiety while completing the BAT. Three of the nine Ss touching the snake reported very high anxiety while touching the snake. Four of the nine touching the snake reported no or very little anxiety while touching the snake. All other Ss reported medium to high levels of anxiety while in the room with the snake regardless of group classification.

Grossberg & Wilson (1968) reported that neutral or nonphobic Ss responded, in terms of heart rate (HR) and skin conductance (SC), to visualizing fearful scenes just as phobic Ss had, and they also reported significant differences (HR and SC) between imagining fearful and neutral scenes for both phobic and nonphobic Ss. Grossberg & Wilson speculated that the nonphobic Ss responses were confounded with extraneous factors such as bias in E's presentation, content of the scene or the manner of scene presentation. However, the present results support the finding that nonphobic subjects respond physiologically to visualization in the same way that phobic Ss do. The finding of no difference between responses to aversive and nonaversive stimuli is not in agreement with the major findings of Grossberg & Wilson who reported differences in HR and SC to fearful and control scenes.

Heart rate and skin conductance were reported to increase in association with the hierarchy rank of visualized scenes by Lang, Melamed, &

Hart (1970). Also Lang *et al.* reported significantly more vivid visualization to aversive items than to neutral items but close examination of the method of scene construction shows that three sessions were used by the *Ss* to construct and practice the aversive scenes while the *Ss* in the current study had only minimal contact with the visualization scenes prior to the experimental task. Familiar and practiced scenes might be expected to be more vivid than novel scenes.

Hare (1973) reported HR differences and SC differences for all his *Ss* (both spider phobic and nonphobic *Ss*) when comparing neutral scenes with spider-aversive scenes and he found the differences between groups to be suggestive of orienting responses (OR) for nonphobic *Ss* and defensive responses (DR) for phobic *Ss*. That is, HR decelerated for nonphobic *Ss* but accelerated for phobic *Ss*. This finding is accepted by current practice as part of the differences between OR and DR (Graham & Clifton, 1966).

A recent study (Libby, Lacey, & Lacey, 1973) found pupil dilations greatest to visual stimuli that were midway on a Pleasantness-Evaluation dimension. Dilations were larger to unpleasant than to pleasant stimuli. Heart rate slowing was also found to be linearly related to pleasantness with unpleasant stimuli provoking the greatest slowing. The authors argued this finding supported an attention to the environment pattern response (an OR). Tonic levels changed significantly during the course of the experiment with HR increasing and pupil diameter decreasing.

Other studies (such as Paul, 1969a & b) may be cited showing differences in physiological responses to aversive or stressful stimulation compared to neutral stimulation. The results of the present study seem to be contradictory to the majority of studies reported in the literature but one must not lose sight of the important fact that Ss had substantial pupil dilations to both listening to and visualizing scenes presented to them aurally. These increases in pupil size to nonaversive as well as aversive visualizations possibly provide the key to understanding the seemingly contradictory results.

Close examination of the scenes used in Grossberg & Wilson (1968), Lang et al. (1970), Hare (1973), Paul (1969a & b), and Libby et al. (1973) indicates that the general method is to construct neutral scenes from items checked as causing no discomfort on a Fear Survey Schedule and aversive scenes are constructed from items checked as causing high fear. Libby et al. (1973) used a gray card with five digits as a control scene. The neutral scense used in the present study are not separate scenes but are identical to the aversive scenes except for the word or words referring to "snake." For example, the neutral scene paired with imagining a snake in a cage at the zoo is not some pleasant, neutral scene such as walking of a beach or some irrelevant scene but the identical scene except that a rabbit is in the cage instead of a snake.

This parallel construction of aversive and nonaversive scenes produces pupil dilation curves similar to those found in pupillary studies of cognitive processing. Headley (1973), in a study of searching of long term memory, found pupil dilations almost identical in shape and magnitude to the present study. Clark (1970) and Johnson (1969) reported pupil response curves very similar to the present ones in response to short-term memory tasks with no affective component involved in stimulus presentation.

Pupillary studies of long and short term memory, imagery, and paired associate learning have shown that the amount of mental effort or the processing load determines the amount of pupil dilation in a given task. Kahneman, Tursky, Shapiro, & Crider (1969) in a tightly designed paced mental task with three levels of difficulty and time-locked recordings of pupil dilation, heart rate and skin conductance have alse shown that these measures have similar patterns of sympathetic-like increase during information intake (attention to external stimuli) and processing (attention to internal stimuli) followed by a decrease during the report phase. The peak response for each measure was directly related to the processing load for rach task.

The present experimental task was designed to keep the processing loads as uniform as possible across conditions so the scenes were very similar in number of words, grammatical construction, length of time, and manner of presentation. The Ss were seated looking into an empty box while wearing earphones so that extraneous visual and auditory stimulation were kept to an absolute minimum. The scenes were presented over the the earphones. These factors all point to the high involvement of the Ss in the task. There was also was a requirement to report after each scene which should have enhanced the involvement in the task. The processing loads seem to be fairly high with the average intensity rating of 5.42 on a one to seven rating scale indicating the Ss felt the visualizations were fairly vivid or intense.

The processing load was intended to be identical between aversive and nonaversive pairs. The amount of processing load differences between the words "state" and "snake" (e.g.,"write the word ______ on the blackboard") when imbedded in a relevant and identical context must be of a small order, yer Ss reliably report very large differences in their subjective responses to imagining these almost identical scenes. Ss also report their subjective response to visualization in an almost one to one fashion with their response to same aversive items while not visualizing them or not reporting their current internal state in response to that item at that moment.

While processing loads within a level (e.g., high aversive matched with high neutral) were purposefully matched, it appears that the processing loads across levels were also equated. The items, regardless of level, resemble each other very closely in grammatical construction, number of words, and type of words. It appears that this matching of processing loads both within and across conditions may have led to the finding of no significant group, type or level effects.

This study was designed to maximize differences in pupillary responses to affective type stimulation. Behaviorally extreme (i.e., phobic, moderately phobic, and nonphobic) Ss were used. Stimulus items were chosen to represent extremes of phobic-relevent stressfulness (while maintaining a resemblance to SDT type scenes). Yet, the careful control for possible differences in processing loads seems to have effectively eliminated any pupil dilation differences.

In light of these findings, and especially considering the Kahneman et al. (1969) findings that HR and SC responses are similar to the pupil response when processing loads are controlled, a tentive conclusion is that perhaps previous studies had stressful scenes that differed from control in information processing demands. Visual stimulus studies have typically equated control sliges with affective content slides only in terms of brightness and/or contrast with no attempt made to control information processing loads.

Libby et al.(1973), for example, used a gray slide with five digits as the control slide for scenes of nudes, deformed infants, mutilated bodies and so on. The current results suggest that the increase in pupil dilation found by Libby et al.(1973) may simply reflect the greater information processing load imposed by viewing an attractive nude female compared to a gray card with five digits. In a similar fashion, the results of previous studies finding increased HR and SC to visualizing stressful scenes may be reflecting differences in processing load rather than some difference in anxiety produced by the stimulus scenes.

The other possibility is that the pupil dilation response reflects some different aspect of autonomic activity than does HR or SC. The pupil may be exquisitely sensitive to processing loads. Thus, the rather small sympathetic-like arousal responses found for HR and SC to visualization of stressful scenes may simply be overwhelmed in the pupil by the pupil's response to the processing loads rather than to the affective components of the situation.

The arguemant might be made that all the Ss in this study were very aroused so that very little pupil dilation is "left" to respond to imaginal stimulation. This may be refuted by three lines of evidence. First, the baselines were consistent with the light levels (i.e., 3-4mm) . Secondly, the pupil response reflected systematic and large changes in response to listening and visualizing. The third line of evidence is that the Law of Initial Values did not apply in this study; that is, the size of the pupil during the baseline period was not related to the amount of change produced by listening and visualizing. These factors all point to the conclusion that the Ss were not highly aroused during the experimental task.

The results do not support Wolpe's contention that imaginal stimulation leads to anxiety responses that correspond to the stressfulness of the stimulation. Anxiety of a debilitating nature would likely involve humoral changes (e.g., increase in ephenephrine levels) which would lead to massive, long lasting pupil dilations. There is no evidence the pupil dilations in this study resulted form such humoral changes. The baseline pupil sizes were consistent with the light levels, the baseline values did not significantly change over the course of trials, and the Ss did not report anxiety while visualizing nonstressful scenes. Thus, the dilations found are a result of the direct innervation of the eye that reflects the processing load or "mental effort" the S is excerting.

It is possible that Hess's findings of homosexual dilations to pictures of nude males compared to pictures of nude females may be reflecting the greater processing load involved when an S is viewing something he is greatly interested in or that the Ss "stopped thinking" when viewing the unappealing nude females.

The experimental question is now how to seperate affect from processing loads. This seems an extremely difficult task as response to affective stimulation appears related to the subjects attitudes and interest in that particular affective domain so that "blocking out" might reduce the processing load involved as less of the stimulus is attended to or, conversly, that processing load might go up as Ss are aware of subtle nuances in the stimulus that less involved Ss might miss completely. It might be fruitful, however, to carefully vary processing loads while maintaining several constant affective values so that if high level processing loads in low level affect conditions led to larger dilations than low level processing loads in high affect conditions, the greater responsitivity of the pupil to processing loads rather than to affective stimulation would be demonstrated. If HR and SC measures were included, the effect of processing load during affective stimulation would be clearer as the differences between orienting and defensive responses could be sorted out using HR data.

CHAPTER VI

SUMMARY

The purpose of this study was to examine the pupillary response to visualization of stressful scenes. Three levels of stressfulness, low, medium and high were carefully matched to three levels of psuedo-stressfulness. Each stressful and nonstressful pair of scenes were identical except for one or two words that referred to the stressful object (snake). Twenty-four subjects were each auditorally presented each scene to visualize while a filmed record of the pupil was being made. Immediately after each visualization, each S rated how intense or vivid that scene was. Each also rated how anxious they felt while visualizing that scene. Post-experimental ranking of the stressful scenes was done to indicate the Ss evaluation of stressfulness of the stressful scenes. All Ss participated in a Behavioral Avoidance Test in which their approach to a live harmless snake was assessed and their anxiety responses to the snake were recorded.

The major findings were that pupil size reliably increases during the intake of information and slowly decreases during the visualization period. No differences between groups were found or between type (stressful or nonstressful) of scene. In addition, no differences between levels of stressfulness were found when analysing the pupillometric data. The verbal responses of the Ss reliably discriminated between levels of stressfulness in terms of the subjective anxiety felt by the Ss while visualizing the scenes. Verbal reports of the intensity of the visualization did not discriminate between groups of subjects of type of scene or level of stressfulness. The groups were different in terms of number of Ss willing to touch a live harmless snake with the low fear group exhibiting more approach responses than the medium or high fear groups.

The technique of pupillometry offered a second-by-second monitoring of the visualization task and the findings fit within framework of processing load theory.

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APPENDIX A

EXPERIMENTAL DISCOMFORT INDEX

The subjects were assigned to groups on the basis of their responses to this discomfort index.

	0	1	2	3	4
77. Sitting in a car and seeing a snake cross the road.					
78. Seeing a realistic rubber boat in a variety store.					
79. Cuddling up a teddy bear on your stomach.					
80. Seeing a large monkey at a pet show.					
81. Seeing a large snake in a glass cage at the zoo.					
82. Seeing a large rabbit in a glass cage at the zoo.					
83. Seeing a large snake at a pet show.					
84. Writing the word "state" on a blackboard.					
85. Stepping on a large snake in the woods.					
86. Holding a large snake close to your face and touching it to your cheek.					
87. Stepping on a large stick in the woods.					
88. Cuddling up a large snake on your stomach.					
89. Seeing a kitten in a wire cage in a pet store.					
90. Writing the word "snake" on a blackboard.					
91. Sitting in a car and seeing a dog cross the road.					
92. Seeing a realistic rubber snake in a variety store.					
93. Holding a rubber ball close to your face and touching it to your cheek.					
94. Seeing a snake in a wire cage in a pet store.					

APPENDIX B

EXPERIMENTAL VISUALIZATION SCENES

Low level aversive scenes.

1. Imagine standing by a blackboard and writing the word "snake."
2. Imagine you're in a variety store and you see a realistic rubber snake on the shelf.
3. Imagine sitting in a car and you see a snake go across the road.

Low level neutral scenes.

1. Imagine standing by a blackboard and writing the word "state."
2. Imagine you're in a variety store and you see a realistic rubber boat on the shelf.
3. Imagine sitting in a car and you see a dog go across the road.

Medium level aversive scenes.

1. Imagine you're in a pet store and you see a snake in a wire cage.
2. Imagine you're at a pet show and you see a large snake on display.
3. Imagine you're at the zoo and you see a large snake in a glass cage.

Medium level neutral scenes.

1. Imagine you're in a pet store and you see a kitten in a wire cage.
2. Imagine you're at a pet show and you see a large monkey on display.
3. Imagine you're at the zoo and you see a large rabbit in a glass cage.

High level aversive scenes.

1. Imagine walking in the woods and stepping on a large snake.
2. Imagine lying on a divan with a large snake curled up on your stomach.
3. Imagine holding a large snake close to your face and touching it to your cheek.

High level neutral scenes.

1. Imagine walking in the woods and stepping on a large stick.
2. Imagine lying on a divan with a teddy bear cuddled up on your stomach.
3. Imagine holding a large rubber ball close to your face and touching it to your cheek.

APPENDIX C

EXPERIMENTAL INSTRUCTIONS

The following instructions were tape recorded and heard by all _S_s.

In this experiment we will be photographing your eyes while you do some simple visualization tasks. Later, when you look into the apparatus you will see a small black cross in the center of an illuminated field. Since we are interested in the exact center of your eye, it is imperative that you maintain a steady gaze at the center of the screen. The small black cross will be your fixation point.

Now let me tell you about the visualization tasks you will be doing. First, you will hear the word "ready." This is a signal to fixate on the small black cross. Then, you will be read a scene description. Listen carefully and when the instruction "visualize" is given, you are to visulize that scene as vividly as possible. After a short period of visualization, you will hear the instruction "report." Your task then is to report out loud two things. First, you are to rate the clarity or intensity or how real the scene seemed on a one to seven scale. A one or two rating would mean that you were unable to obtain or had difficulty in obtaining a visual image of that scene while a six or seven rating would mean that scene was very real or very intense in clarity for you. Intermediate intensities would receive ratings between one and seven. Your second task is to rate how much tension or anxiety you felt during visualization of scene on a one to seven scale. If the scene aroused no anxiety or tension at all, or very little, then that anxiety rating would be one or two. If the scene aroused considerable anxiety, then you would report a rating of six or seven. After making these two reports, you will have a short rest period during which you may shut your eyes if you wish. You will then hear the signal "ready" again and the sequence will be repeated again with a different scene.

It is possible that your ratings of the clarity of the scene and of the anxiety that accompanies the visualization may be very different. You may "see" the scene very vividly with a rating of six or seven with almost no accompaning anxiety for a rating of one or two. Of course, the opposite may also be true. A scene may be very unclear or hard to "see" for an intensity rating of one or two while the anxiety aroused by that scene may be considerable for an anxiety rating of six or seven. Just remember to give the intensity rating first and the anxiety rating second.

Now we will have some warm-up scenes to help you sharpen up your visualization skills. When you hear the signal "ready" focus on the small black cross, listen to the scene description and on the signal "visualize" imagine that scene as clearly as you can. Put yourself into that scene and try to make real you participation in that scene.

VITA

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