THE UNIVERSITY OF MANITOBA

STIMULUS INTENSITY MODULATION AND SUCCESS AT BIOFEEDBACK-MEDIATED RELAXATION TRAINING

by

Alvin D. Croll

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE DEGREE OF

MASTER OF ARTS

Department of Psychology
Winnipeg, Manitoba

November, 1980

STIMULUS INTENSITY MODULATION AND SUCCESS AT BIOFEEDBACK-MEDIATED RELAXATION TRAINING

BY

ALVIN DAVID CROLL

A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF ARTS

ACKNOWLEDGEMENTS

First, I would like to thank my committee members, Gord Barnes, Al Pressey and Barney Sneideman and especially my advisor David Koulack for their support and guidance in getting this thesis done. Your timely and constructive criticism, not to mention your collective expertise in the not-so-gentle art of butt-kicking,helped me break through some of the more difficult spots along the way.

Many thanks are also due to Drs. John Schallow and Ted Gupton for making available to me the biofeedback equipment, without which I could not have done this research.

To my parents and Reuben and Fran and all my other relatives in Montreal: thanks for your love and encouragement during the years it took to finish this degree and for your unwavering belief that I would some day finish it. I was not always so sure.

Finally, and most importantly, thanks to Kati, Duncan and Judy for putting up with me and even managing to love me through everything. It really helped.

ABSTRACT

There is a central nervous system process involved in selective attention which filters out environmental stimuli and enables us to focus on what is most important at any given moment. Because of individual differences in the amount of input which is filtered out, the amount of stimulation necessary to maintain a comfortable level of arousal in a given situation varies among individuals. Perceptual augmenters, who filter out too little stimulation, are over-aroused and seek to limit further input. Perceptual reducers, on the other hand, filter out too much stimulation and are under-aroused, leading them to be stimulation seekers.

The present research examined the possibility that in biofeedback-assisted relaxation training, augmenters would welcome the opportunity to lower their level of arousal while reducers would resist efforts to lessen input from the environment and their bodies. Specifically, it was hypothesized: 1) that augmenters would show higher baseline frontalis EMG levels than reducers or moderates, 2) that augmenters would achieve the lowest EMG levels during biofeedback training, and 3) that in self-report measures after biofeedback training, augmenters would report the greatest decrease in subjective discomfort and anxiety.

From an initial sample of 300 undergraduate students who filled out the Vando R-A scale, 20 augmenters, 20 moderates and 20 reducers were selected, with males and females

equally represented in each group. Prior to relaxation training subjects completed the Spielberger State-Trait Anxiety Index (STAI) and the Nowlis Mood Adjective Check List (MACL). The EMG electrodes were then attached and after a four-minute adaptation/baseline period, subjects attempted to relax while listening to a ten-minute tape of autogenic exercises and observing the EMG meter. Following this training phase, the subjects underwent a ten-minute test phase in which they attempted to relax as deeply as possible using the EMG machine and the autogenic exercises they had just learned.

Finally, the subjects completed the STAI state anxiety scale, the MACL, and answered four questions concerning their feelings about the experiment.

Analysis of variance showed no significant differences between any of the three groups on baseline EMG, STAI or MACL measures, although significant sex differences were observed on all the measures. Biofeedback trial blocks were analyzed using analysis of variance with baseline EMG as a covariate followed by post-hoc Scheffe multiple comparisons. On the biofeedback trial blocks, significant main effects were found for groups, with augmenters maintaining a lower mean EMG level than reducers during the experiment. Most importantly, the significant interaction between trial blocks and groups confirmed the hypothesis that augmenters would be more successful than reducers in lowering their tension level over trial blocks. Not only did the augmenters lower their tension more, but the reducers actually showed increasing tension levels from the baseline as the experiment progressed. No significant differences for groups or sex were observed on the post-test STAI or MACL scales, although all results were in the predicted direction. In addition, reducers reported less enjoyment and more boredom from the experiment and less success at producing warmth and heaviness in their limbs. A significantly larger proportion of the reducers preferred the training phase over the test phase.

These results are discussed in light of other studies on perceptual reactance and implications for biofeedback research and treatment are put forward.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

STIMULUS INTENSITY MODULATION AND SUCCESS AT BIOFEEDBACK-MEDIATED RELAXATION TRAINING

During the last 20 years, electromyographic (EMG) biofeedback has gradually established itself as an effective tool in the behavioural treatment of chronic anxiety and tension headache (Budzynski, 1977; Budzynski, Stoyva & Adler, 1970; Green, Green & Walters, 1970). Along with relaxation procedures such as Jacobson's (1938) progressive relaxation and Schultz and Luthe's (1958) autogenic training it is possible to teach cognitive and physical strategies which lower muscle tension and reduce overall levels of autonomic arousal (Brenner, 1977; Budzynski and Stoyva, 1969; Green et al, 1970; Wallace, 1969).

The discomfort experienced by the chronically anxious patient is a state of hyperarousal which is due to maladaptive responding to the contingencies of a perceived threat (Mischel, 1979). Relaxation techniques such as biofeedback, meditation, progressive relaxation and autogenic training are seen as methods of inducing lower levels of physical and mental activity. These feelings of relaxation are then paired with some conscious thought such as a word or image, which, like a conditioned stimulus, can then be used to "turn on" feelings of relaxation when the person feels too tense.

Conceptually, biofeedback is based on three basic principles. (Pelletier, 1977):

1. If a person is given accurate enough information about

a neurophysiological or biological function through electronic or other means, then the person can learn to regulate that function to some extent by cognitive processes.

2. For every change in the physiological state there is a consequent change in the mental emotional state, and conversely, every change in the mental emotional state, conscious or unconscious, is followed by an appropriate change in the physiological state.

3. Bringing certain physiological functions under greater cognitive control can have a positive effect in combatting the effects of stress and anxiety.

In treating chronic anxiety with biofeedback-mediated relaxation procedures these principles are coupled with the patient's desire to change, and new more adaptive methods of coping with stress are learned.

Typically, in treatment, a patient is seen for six to twelve sessions in which he or she is taught to recognize the physical and mental correlates of anxiety and how they are interrelated. Electrodes are attached to a convenient muscle such as the frontalis (forehead) and the person watches a meter or listens to a tone which provides information on whether the muscle is becoming more relaxed or more tense. The patient then uses physical exercises and cognitive strategies which are useful in learning to control muscular activity.

With regular practice, patients become increasingly proficient at producing what Hess (1976) calls the "relaxation response", to the point where they no longer require biofeedback equipment and can produce the relaxation at will during the day when they recognize high tension levels.

Generalization of relaxation. Several experimenters have demonstrated that frontalis activity in response to stress is a common factor across most individuals and that of all the muscles in the body it is the best indicator of overall muscular tension level (Budzynski & Stoyva, 1969; Stoyva and Budzynski, 1974).

Exploring the relationship between frontalis tension and anxiety, Smith (1973) tested resting EMG levels in 20 subjects from a non-psychiatric population and found a positive correlation with trait anxiety ($r = .529$, $p < .02$) and covert/overt anxiety ($r = .497$, $p < .05$) as measured by the Cattell IPAT (1961). This was confirmed in studies by Haynes, Moseley & McGowan (1975) and Coursey (1975). It would therefore, appear that anxious subjects manifest higher frontalis tension levels, but an important question for treatment then arises: "Does a reduction in frontalis tension necessarily mean a reduction in anxiety?"

While there is some disconfirming evidence (Alexander, 1975; Alexander, White and Wallace, 1977), the majority of studies have found that decreases in muscular tension or autonomic measures such as heart rate, blood pressure and galvanic skin response are associated with subjective reports of lessened anxiety and lowered scores on measures of state anxiety, (Coursey, 1975; Lader and Matthews, 1971; Townsend, House and Addario, 1975; Wallace and Benson, 1972).

One explanation for the inconsistencies shown in research on the physiological correlates of stress is that individuals respond to stress with different muscular and autonomic patterns, (Malmo and Shagass, 1949a, 1949b; Malmo, Shagass & Davis, 1950) and that some individuals consistently respond to stressors with the same pattern, while others fluctuate in their response pattern (Sternbach, 1966). What this means is that some individuals respond to stress primarily with elevated blood pressure and decreased skin resistance, for example, while others primarily demonstrate increased tension in the back muscles and respiratory changes, and some others do not respond with one consistent pattern.

These differences in responding to stress support Lazarus and Averill's (1972) theory of anxiety as being not a specific response but a syndrome of component reactions such as verbal reports, physiological changes, overt expressive reactions and instrumental (coping) reactions. This does not mean that frontalis tension cannot be used as an indicator of arousal because of individual responses to stress. Rather, it would seem to caution us that while we can use frontalis tension as a measure of an individual's performance at a relaxation exercise, we must be careful in comparing tension levels across subjects as they may be showing greater increases or decreases of tension in other muscles or organs.

Individual Differences in Biofeedback Performance. While biofeedback and relaxation training have been shown to be effective in treating chronic anxiety-related illnesses, several researchers have noted that some individuals learn the task better than others.

In training subjects to reduce muscular tension using EMG feedback, Alexander (1975) noted that while the experimental group in his study, as a whole, significantly reduced frontalis tension, only seven of the nineteen individuals could confidently be assessed as having met a strong criterion of learning the task. In addition, three subjects in the experiment actually showed an increase in frontalis tension over five training sessions.

Roberts et al (1976) found large individual differences in performance among subjects who used hypnosis to produce differences between the finger temperatures of two hands. Neither degree of hypnotic susceptibility nor any of the 14 Minnesota Multiphasic Personality Inventory (MMPI) scales correlated with task performance. The only variable which did predict success at the task was the subjects' confidence or belief in the procedure or in their own ability.

In the course of several experiments involving muscle relaxation training using EMG, Basmajian (1972) found that most subjects can learn to condition the firing of single motor units within a short time, but that certain individuals experience great difficulty in relaxing.

To date, very few studies have been done to discover what the causes of these differences in performance are. The following are some personality measures which have been shown to correlate with biofeedback performance:

Locus of Control. Because the idea of self-control is a key issue in biofeedback, several experimenters have explored the relationship between biofeedback learning and Rotter's (1954, 1966) Internal-External (I/E) scale, which attempts to measure the degree to which a person feels he is in control of his life or is controlled by external forces and chance. One would expect that people who are more internally motivated should do better at learning to control physiological processes.

Fotopoulos (1970) found that, as expected, internals showed greater control of heart-rate increase than externals in the experimental setting under conditions of conscious effort and oscilloscope feedback. However, externals performed as well as internals at the task when given experimenter-controlled feedback via a buzzer for heart rate increases.

In an experiment which correlated I/E scores with success at relaxation training (Jordan, 1975) found that internals were significantly more effective than externals at reducing their EMG levels using progressive relaxation exercises and biofeedback. The internals also reported a greater reduction in subjective tension level following the training session and retained more of the training in a subsequent retest than the externals.

In training 13 tension headache patients to control trapezius muscle tension over 10 one-hour sessions, Otis and Turner (1975) found that scores on the I/E scale successfully predicted dropouts from an experiment on EMG relaxation, the externals dropping out with much greater frequency than internals. Presumably the externals felt they had little control over the EMG machine and became frustrated by their attempts.

Field Dependence-Independence. A measure of perceptual style which is related to locus of control is field dependence (Witkin and Oltman, 1967). This scale measures the degree to which a person has internalized perceptual strategies or is dependent on external cues in the perceptual environment to interpret visual data.

Field independent individuals are not as reliant on cues in the environment as field dependent individuals in differentiating figure and ground as measured by the rod-and-frame test and the embedded figures test.

Dale and Anderson (1975) found that field independent individuals were better at speeding, slowing and maintaining average heart rate than people who were field dependent.

Perceptual style, then would seem to play a role in how a person integrates cues from the environment in learning to control physiological processes. Presumably those who are less reliant on external information for making decisions can exert control more quickly and effectively.

Autonomic Perception Questionnaire (APQ) (Mandler, Mandler and Uviller, 1958). This scale measures a person's awareness of autonomic functions such as heart-rate, gastrointenstinal processes and sweat gland production, which change under stress. It has also been shown to correlate positively with the Taylor Manifest Anxiety Scale (TMAS). The APQ was used by Bergman and Johnson (1971) who found that normal subjects who scored in the middle range on the test were best at bi-directional control of heart rate. High scorers on the APQ overestimated their autonomic activity while low scorers underestimated it, and this apparently hindered performance. This is consistent with the view that what is learned in biofeedback is greater attention to, and greater use of proprioceptive cues from the viscera and musculature of the body. Individuals who are already more in tune with their internal state should learn control of those functions more quickly.

Ego Strength. High scores on the MMPI Ego Strength (Es) scale have been found to correlate with ability to increase and decrease alpha wave production in electroencephalographic (EEG) biofeedback (Hardt, 1977) and ability to increase heart rate (Stephens, Harris, Brady & Shaffer, 1975).

As with locus of control and field dependence, individuals who perceive less threat from, and greater control over their physical and social environments are better equipped for self-control procedures such as biofeedback.

Anxiety. An important factor affecting performance at learning tasks such as biofeedback is anxiety level.

Epstein (1972) has described anxiety in terms of the need for an organism to maintain arousal level within certain homeostatic limits in order to survive. When arousal level is increased beyond the upper limit by strong stimuli or emotions the state is experienced as unpleasant and/or threatening by the individual. When there is no course of action open to the individual to remove the source of arousal, because the source is unknown or because the opportunity to remove it is at a specified time in the future (e.g. a final examination), or if the person lacks the requisite skills in his repertoire, then that state will be experienced as anxiety. At the other extreme, when arousal falls below the homeostatic limit, discomfort or boredom occurs.

The relationship between arousal and performance has been examined by several authors (Freeman, 1940; Hebb, 1955; Malmo, 1959). They predict that for any task, there is one optimum level of arousal which produces maximum efficiency in each individual. If individuals are too highly aroused or bored they will not perform as well.

According to this theory, performance is related to arousal in a curvilinear fashion such that performance improves as arousal increases until the peak of the curve is reached, and then performance begins to deteriorate as the arousal level continues to increase.

To test the effects of anxiety on performance MacFarland and Coombs (1974) selected 33 subjects on the basis of their Taylor Manifest Anxiety scores and had three groups (high, medium and low) try to maintain their heart-rate at its resting level. They found evidence in support of the inverted-U theory of arousal. Moderately anxious subjects performed best and the performance of the high anxiety group was hindered to a significant degree by their anxiety level.

Stephens et al (1975), however, found that ability to raise heart rate was negatively correlated with anxiety as measured by Welsh's factor A scale and positively correlated with Barron's ego strength, which is not consistent with the inverted-U theory of performance.

Further contradictory evidence from an experiment using progressive relaxation showed that membership in the treatment benefit group, as measured by reduced state anxiety scores on the Spielberger State-Trait Anxiety Index (STAI) was best predicted by high scores on pretest state anxiety (Scopp, 1975). While the two previously mentioned studies do not support the inverted-U theory prediction it should be noted that Scopp and Stephens et al (1975) used samples of college and high school students and may not have had as many highly anxious subjects in their experimental groups as in studies using samples from clinical populations.

Stimulus Intensity Modulation. As mentioned previously, individuals attempt to maintain their level of arousal within certain homeostatic limits. (Epstein, 1972) Constantly confronted with a barrage of sensory and cognitive information, a person must select the most meaningful cues and filter out the rest to keep arousal at or near an optimum level. However, there appear to be differences between individuals in the extent to which this filtering takes place, and consequently in the range of those homeostatic limits. Some individuals behave as though too much stimulation is filtered out and they are stimulation-seekers, while others who do not seem to filter out enough stimulation are stimulation-avoiders.

One area which deals with these individual differences in perceptual style is stimulus intensity modulation, or how the sensory mechanisms of the brain and nervous system handle incoming stimulation.

Before attempting to hypothesize how stimulus intensity modulation might affect biofeedback performance it would be wise to explain the term more fully.

Three areas of research in stimulus intensity modulation are of particular interest. Each uses different terminology and different measurement techniques, but the areas overlap to a considerable degree in the factors they are attempting to measure. The areas are:

1. Pavlov's Strength of the Nervous System concept,
2. Eysenck's Introversion-Extraversion Scale, and

3. Petrie's Augmenter-Reducer dimension.

Theories of Stimulus Intensity Modulation

Strength of the Nervous System

Pavlov (as reported in Strelau, 1975) found that in the course of his work on conditioned responses in dogs, there were differences in performance which he attributed to central nervous system processes. He proposed two categories; the weak nervous system and the strong nervous system. He found that the strong nervous system types could endure longer periods of strong and repetitive stimuli and were more resistant to disease. Other Soviet authors have used this concept of strength of the nervous system to investigate individual differences. Individuals are classified as strong or weak nervous system types by questionnaires and physiological measures such as visual or auditory reaction times and visual or auditory threshholds. Weak nervous system types, who are at a higher level of arousal than the strong types, react more quickly and have lower sensory threshholds.

To demonstrate that Pavlov's theories also apply to humans, Pushkin (1972), in an experiment analagous to production line work, tested vigilance as a function of reaction time to visual stimuli over extended periods of time and found that weak nervous system types responded more quickly at first but their performance deteriorated rapidly and the strong types were more consistently ready over time and made fewer mistakes.

The evidence from this study and others (Mangan & Farmer, 1967; Teplov, 1972) that individuals differ on the speed and endurance of responding to stimulation because of the sensitivity of their central nervous system. These individual differences then affect personality by influencing how people arrange their lives to provide themselves with the kinds and levels of stimulation with which they feel most comfortable.

Examining differences in work styles among taxi drivers and foundrymen and relating these differences to the nervous system type as determined by questionnaires and visual reaction time tests, Strelau (1975) found that the weak nervous system types spent more time doing auxiliary activities in order to simplify their jobs (preparing equipment, maintenance, arranging tools). They also took more rest breaks, presumably because they start at a higher level of arousal and fatigue more quickly.

A further study demonstrated the relationship between nervous system strength and preference for the amount of stimulation in the work situation as reflected in the choice of profession, Strelau (1975), found that on the basis of a questionnaire which separated reactive (weak nervous system) from non-reactive (strong nervous system) subjects, in a group of 33 lawyers, 14 were non-reactives while only 5 were reactives ($p < .05$). This evidence supports the theory that non-reactives would seek occupations which provide more intense social interaction. Conversely, in a group of 46 librarians, 15 were at the most reactive end of the scale while only 8 were at the non-reactive end.

Sales, Guydosh and Iacono (1974) tested the relationship between need for stimulation and strength of the nervous system as determined by auditory threshold. Subjects were placed in a quiet, featureless room for 20 minutes and offered a button which, when pressed, would provide them with 2 seconds of auditory and visual stimulation. In the simple condition the stimulation consisted of a single 7½ watt light bulb and a 2-second 60db, 1Khz tone while in the complex condition there were 24 lights of 5 different colours, randomly arranged, which flashed in random 2-second sequences and a 2-second series of 60db, 1Khz tones which were presented when the response button was pushed. As expected, the strong nervous system subjects with the highest thresholds, who were presumably higher in the need for stimulation, showed a significant increase in responding from the simple to the complex situation. Weak nervous system subjects showed little preference for either situation.

In a second experiment, subjects were asked to place figures, which represented people, in models of rooms which represented social situations so that the rooms were filled with as many people as possible without being too crowded. The strong nervous system subjects, as predicted, placed significantly more people in the situations, reflecting greater need for social stimulation.

Introversion-Extraversion

Another measure of individual differences which has been shown to correlate with Strength of the Nervous System measures (Mangan and Farmer, 1967) is Eysenck's introversion-extraversion scale (Eysenck and Eysenck, 1964). Eysenck proposed that as in Pavlov's theory, there are differences in the strength and lability of central nervous system processes which make the introvert more sensitive to stimulation and allow conditioning to occur more rapidly.

On an interpersonal level, Eysenck (1964) proposes that conscience, (which he sees as a cluster of classically conditioned fear responses) is much stronger in the introvert, who is more cautious in interactions with other people and situations which are potentially threatening in terms of negative reinforcement. Analyzing data from several independent studies Eysenck (1967) found that introverts, who are more sensitive to social reinforcement, are prone to develop psychopathology in the neurotic and dysthymic categories, while extraverts are more prone to criminal and psychopathic behaviours. Eysenck explains these behaviours, or at least contributing factors to such behaviours, as being due to inter-individual differences in the ascending reticular activating system (ARAS) and other structures in the brain responsible for arousal level and selective attention. These differences affect the amount of sensory input allowed to pass through the filtering mechanism in the process of attention and consequently determine the amount of stimulation necessary to maintain a comfortable level of arousal.

Petrie (1952) demonstrated that while introverts are more sensitive to pain under normal circumstances, introverted patients in a hospital, who had brain tissue removed for the relief of chronic pain became more extraverted after the operation. This study and evidence from the work of Gray (1970) on animals supports the idea that these differences in response to stimuli are innate rather than learned, although social and cultural influences may play a large role in their expression.

Petrie's Augmenting-Reducing Dimension

One very productive area in individual differences, in terms of showing how differences in perceptual style affect a wide variety of behaviours has been the concept of perceptual augmentation and reduction.

In her 1967 book entitled "Individuality in Pain and Suffering", Petrie, using the Kinesthetic Figural After-effects test (KFA), found that in estimating the width of a wooden block they had held between their fingers while blindfolded, after they had had their fingers stimulated by another block, some subjects consistently overestimated the size of the block while others consistently under-estimated it. The former she called augmenters while the latter were called reducers. People who neither augmented nor reduced were called moderates. Petrie and other researchers, went on to investigate this phenomenon and found that these perceptual styles were related to personality in a number of ways.

Sensory deprivation. Studies by Petrie, Collins and Solomon (1960) and Sales (1971) found that reducers could not tolerate sensory deprivation for as long as augmenters. The restricted movement and lack of auditory and visual stimulation in these experiments was much harder on the reducers who rated the experience as being physically and mentally painful, showing that the lack of stimulation can be as distressing to the reducer as too much stimulation is to the augmenter.

Sales (1971) offered 30 subjects photographs of Scottish tartans that differed in complexity of design and found that the reducers, (determined by the KFA test), preferred the more complex design while augmenters preferred the simpler pattern. He related this difference to a greater need for stimulation on the part of the reducers. In another study, Sales found that when subjects were left alone in a room the activity level of the reducers was much higher.

Human beings, then, experience a lack of stimulation as uncomfortable and avoid situations which are too boring or take steps to provide themselves with more stimulation at these times. Conversely, when the stimulation level increases beyond the range of comfort, people have found ways to decrease sensory input.

Alcoholism. Alcohol has been used for centuries as a way to reduce anxiety before and after stressful events, e.g. the actor who has a few drinks before going on stage or the executive who unwinds with a few martinis after arriving home at night. In the laboratory, alcohol has been shown to have a reducing effect on sensory input in the auditory, visual and somatosensory modalities.

In a sample of 12 alcoholics, Petrie found that half were augmenters and half were moderates; no subjects were reducers. All the moderates scored on the augmenting side of the scale. Barnes (1977) also found alcoholics to be augmenters, using the Vando R-A Scale (1969), a self-report questionnaire which demonstrated high validity in measuring many of the same factors as the KFA (Barnes, 1979). Although Barnes found a significant relationship between augmenting and alcoholism, the relationship was reduced to a non-significant level when age was removed as a factor by an analysis of covariance.

Pain. Augmenters could not tolerate as much pain as reducers in a test using radiant heat focused on the skin (Petrie, Collins and Solomon, 1958). Research by Poser (1960) using pressure as a stimulus confirmed this finding. Studies by Ryan and Kovacic, (1966), and Ryan and Foster (1966), obtained results which agreed with Petrie's conclusions and found as well that there was a significant correlation between perceptual reduction and participation in contact sports. Reducers participated more in contact sports than moderates, who participated more than augmenters.

Petrie hypothesized that reducers feel less pain than augmenters and are therefore more tolerant of pain and fear it less. Since pain can be a warning sign of illness, she reasoned that augmenters would be more preoccupied with their health and physical symptoms. A study by Solon (1967) confirmed the hypothesis using 60 normal females as subjects. Augmenters scored significantly higher on the hypochondriasis scale of the Minnesota Multiphasic Personality Inventory.

Need for stimulation. Petrie saw pain as just one form of sensory bombardment which differentially affected augmenters and reducers. Augmenters shun excessive stimulation of any sort because they have filtering mechanisms which let in too much stimulation, while reducers are uncomfortable because of a lack of adequate stimulation.

Augmenters are seen as over-aroused individuals who avoid strong stimulation as they are already near their optimum level of arousal while reducers are under-aroused and seek to increase stimulation to attain a more comfortable level of arousal.

It is this basic difference in need for stimulation which is seen as contributing to alcoholism in the augmenter, as previously mentioned, and such behaviours as delinquency and criminal acts in the reducer. In a sample of 30 juvenile delinquents, 20 were pronounced reducers and only 6 were pronounced augmenters. The deviant behaviour and thrillseeking which had landed these children in trouble with the law was seen as a result of a need for stimulation expressed as restlessness and boredom by the children (Petrie, McCulloch and Kazdin, 1962).

This finding was confirmed by Farley and Sewell (1976) who used a scale of sensation-seeking (Zuckerman et al, 1964) to test 32 delinquent black adolescents and 32 non-delinquent controls. They found a significant correlation between high sensation-seeking scores and delinquency as measured by frequency and seriousness of the childrens' dealings with police and the court.

Factors affecting stimulus intensity modulation

Given that there are basic differences in perceptual reactance in the nervous system, what other factors affect the way people perceive stimuli?

Drugs. The effects of drugs are well known both in folklore and scientific investigation for their ability to alter the way in which people cope with the world around them.

As mentioned previously several researchers have found alcoholics to be at the augmenting end of the scale and it appears they use alcohol, which causes perceptual reduction to lessen the amount of sensory input in order to achieve a more comfortable state.

A pilot study in which aspirin was found to cause perceptual reduction showed the amount of reduction was much greater in the augmenters, who performed as reducers on the KFA task after taking 2 aspirin tablets (Petrie, 1967).

The opposite effect has been demonstrated for caffeine, which has been shown to have an augmenting effect on perceptual reactance (Haslam, 1967; Vando, 1969), and there is some evidence that nicotine also produces the same effect (Vando, 1969; Hall, 1973).

Gupta (1974) found that phenobarbitol had a significant reducing effect and dexadrine a significant augmenting effect relative to control measurements on the same subjects. To further investigate how individuals use drugs to counteract their sensory deficit or surplus due to perceptual reactance, Deaux (1976) tested 48 drug users with the KFA. He found that individuals whose main drug was a barbiturate were moderates and those who preferred amphetamines were at the reducing end of the scale.

Sex Differences. Petrie (1967) and Baker et al (1978) found perceptual fluctuations which occur regularly with the menstrual cycle. The women sampled tended towards reduction at both ends of the menstrual cycle.

With regard to sex differences on tests of perceptual reactance, both Petrie and Barnes (1979) report the most extreme cases of perceptual reduction occurring in males on the KFA and Vando tests respectively.

Environmental Influences. The context in which the augmenting or reducing takes place is also important. In the strength of the nervous system literature it has been consistently found that the weak nervous system types are more sensitive at lower levels of stimulation but that the strong types can perform tasks better than the weak types at high stimulation levels (Strelau, 1975) (Teplov, 1972). The differences between augmenters and reducers in sensory deprivation have already been mentioned as an example of functioning under extremely low stimulation levels.

Time of Day Influences. Colquhoun (1960) found differences in performance at a vigilance task between introverts and extraverts, with introverts scoring higher in the morning and extraverts scoring higher in the afternoon. Colquhoun and Corcoran (1964) found that introverts performed a letter cancellation task faster than extraverts in the morning and Patkai (1969) found that reaction times of introverts were faster in the morning and extraverts were faster in the afternoon.

There has been quite a lot of criticism of the KFA procedure with regard to test-retest reliability (Baker *et al*, 1978; Barnes, 1976). With so many possible influences on perceptual reactance this does not seem surprising. Perhaps, as Barnes (1976) suggests, we should look at stimulus intensity modulation in terms of state and trait responding with tests of physical reactions such as the KFA, reaction times and sensory thresholds being indicators of a person's level of augmenting or reducing at the time of testing. Questionnaires such as the Vando R-A scale which are not as susceptible to day-to-day fluctuations yield results which are indicative of more stable trait-like behaviour.

Stimulus Intensity Modulation and Biofeedback

Deaux (1976), studied drug choice in subjects who rated high on a drug use questionnaire and identified two groups: one that used amphetamines frequently and one that used barbiturates. He related this drug preference to the KFA used by Petrie (1967) to measure stimulus intensity modulation.

He found that amphetamine users were perceptual reducers who are high in need for stimulation, while the barbiturate users were in the moderate range of the scale which demonstrates a lower need for stimulation. He then asked an interesting question: In the treatment of drug users such as the two groups in his study, would they respond differentially to treatments such as biofeedback or relaxation training? An individual who craves stimulation might inadvertently be driven to increase his or her drug use by a treatment which seeks to reduce the intensity of stimulation from the environment, whereas the overstimulated individual might greatly improve by finding a relaxed and quiet state without the use of drugs.

Three studies have attempted to relate extraversion-introversion to success at learning biofeedback tasks.

Lees (1976) used the Myers-Briggs Type Indicator to distinguish extraverts and introverts, mild extraverts, mild introverts and introverts. Each group attempted to increase alpha wave amplitude during three fifteen-minute daily trials. He found that the introverts, as predicted, performed significantly better than the extraverts.

A study on extraversion-introversion and intelligence as predictors of success at biofeedback by Maphet (1978) found that introverts maintained lower tension levels than the extraverts during the training sessions. Intelligence was not a significant factor in determining successful performance.

A third study by Carlton (1974), did not confirm the findings of the two previous experiments. Thirty-six female subjects selected on the basis of their scores on the Eysenck Personality Inventory, attempted to raise the temperature of their left forefinger during twenty training trials. The hypothesis that introverts, who are more conditionable than extraverts, would show a greater training effect, was not supported.

Summary and Hypotheses

There is a central nervous system process involved in selective attention which filters out environmental stimuli and enables us to focus on what is important at any given moment. Because of individual differences in the amount of input which is filtered out, the amount of stimulation necessary to maintain a comfortable level of arousal in a given situation varies among individuals, and augmenters avoid higher stimulation levels while reducers seek them to maintain a comfortable state.

Biofeedback has been used widely to treat chronic anxiety without regard to whether this discomfort is caused by overstimulation or understimulation. It was the purpose of the present experiment to determine whether augmenters and reducers experience more anxiety and subjective discomfort than moderates and to determine if augmenters, who seek to reduce their level of arousal, perform better at biofeedback-mediated relaxation than reducers, who should resist any attempt to further limit their input from the environment and from their own bodies.

The experiment also attempted to control or account for variables which other experiments on perceptual reactance may have overlooked, namely: sex, time of day as it affects arousal level differentially in augmenters and reducers, and the effects of drugs such as cigarettes, coffee and alcohol which some people may use to raise or lower their arousal level.

The experiment also compared perceptual reactance as measured by the Vando R-A scale, and Strength of the Nervous System, determined by reaction time to see if either measure had greater validity in predicting which subjects would do best at the task.

The reaction time test, which is easily influenced by factors such as drugs, time of day or menstrual cycle which affect perception, is more unreliable as a measure of perceptual reactance while the Vando R-A test measures the more stable trait aspects of reducing/augmenting.

Given that there are basic inter-individual differences in perceptual reactance, the following hypotheses were put forward to predict how perceptual augmenters and reducers might differ in their responses to biofeedback-mediated relaxation training.

Hypothesis I: Baseline EMG. Augmenters will show higher baseline levels of frontalis tension than reducers and moderates.

Hypothesis II: Muscular Relaxation. Reducers will not lower their arousal level to as low a level as augmenters will during relaxation, as measured by frontalis tension.

Hypothesis III: Subjective Relaxation. In self-report measures after relaxation, augmenters will report a greater decrease in subjective discomfort and anxiety.

Hypothesis IV: Reaction Time and R-A Scores. There will be a positive correlation between reaction times and Vando R-A scores.

METHOD

Subjects. Subjects were volunteers from the introductory psychology classes who were fulfilling a course requirement by taking part in the experiment and were paid a fee of three dollars for their participation. The subjects were screened to make certain that they had had no prior experience with biofeedback or relaxation training.

Initially 300 subjects were screened with the Vando R-A test. Based on their scores on this test, 60 subjects were chosen to take part in the experiment; 20 augmenters, 20 moderates and 20 reducers. Males and females were equally represented in each group.

Instruments. The Vando R-A test was administered as a measure of stimulus intensity modulation. It is a 54-item, forced-choice test in which high scores are indicative of perceptual reducers and low scores indicative of perceptual augmenters. A review by Barnes (1979) of studies which have correlated the Vando-test with other personality measures found reliability coefficients of between .69 and .91. Janisse and Dumoff (reported in Barnes, 1979) found a correlation of -.38 between R-A scores and perceived pain in a cold pressor test. Sales (1971) prediction that reducers are higher in internal and external sensation seeking has been confirmed in a number of studies using the Vando scale. Both these findings support Petrie's (1967) theory that reducers can tolerate more pain and that they seek more stimulation to maintain a comfortable level of arousal. This would recommend the use of the R-A scale over the lengthy and cumbersome KFA procedure which has the added drawback of poor test-retest reliability.

Spielberger's State-Trait Anxiety Inventory (STAI) (1972) was used to assess anxiety level pre- and post-test. The STAI consists of two 20-item scales which assess transient anxiety states (A-state) and anxiety which is more stable over time and across situations (A-trait).

The A-state scale has been shown to be sensitive to decreases in anxiety after progressive relaxation and correlates well with physiological measures of anxiety. The STAI is also recommended in experiments requiring a short test of anxiety which will be administered a number of times.

A modified version of the Mood Adjective Check List (MACL) (Nowlis, 1965) was administered pre-and post-test to detect change in subjective affect.

A modified version of Schulz and Luthe's (1958) autogenic training procedure was used to instruct the subjects in muscular relaxation. Many studies have shown these exercises to be of benefit in helping subjects achieve an awareness of what the muscles should feel like when they are relaxed and also relieves some muscular discomfort in tense individuals which better enables them to remain still during the biofeedback trials.

Haynes, Mosely and McGowan (1975) found these passive relaxation exercises to be more effective than progressive relaxation exercises which involve actively tensing and relaxing the muscles prior to biofeedback trials.

In order to further investigate how individuals responded to the biofeedback training, subjects answered verbally four questions rating their enjoyment of the experiment, their degree of boredom during the experiment, which phase of the experiment they enjoyed most and the degree to which they were successful at producing feelings of warmth and heaviness in their limbs as per the taped instructions.

Apparatus

Reaction Time. Subjects performed a visual reaction time test which consisted of a light, a timer and a key which, when pressed, shut off the timer once it had been activated.

Electromyographic Biofeedback (EMG). A BFT Model 401 myograph was used to take continuous muscle potential readings from electrodes placed on the frontalis muscle. This muscle has been shown to best reflect overall tension level and is less affected by posture and gravity than other muscles (Coursey 1976). Before each session the subject's forehead was cleaned with Brasivol, a skin cleanser, to remove dead skin and oils which might, otherwise, affect the accuracy of the recording. Electrodes were cleaned regularly and checked with an ohm meter to maintain less than 10,000 ohms resistance.

Feedback was given to the subjects by having them

FIG. I

EXPERIMENTAL DESIGN

Augmenters N=20	Males	Reaction Time Test STAI Trait and State Anxiety Measures MACL	Adaptation Period	BASELINE PERIOD	Training Phase	Relaxation Phase	STAI State Anxiety Measure
	Females						
Moderates N=20	Males						
	Females						
Reducers N=20	Males						
	Females						
		PRETEST MEASURES	$3\frac{1}{2}$ min.	30 sec.	10 min.	10 min.	POST-TEST MEASURES

watch the myograph meter, having been instructed to keep it as low as possible when attempting to reduce muscular tension. An Autogen 5100 digital integrator monitored the output of the myograph and computed an average EMG reading every 30 seconds.

Procedure

Subjects were administered the visual reaction time test and then the STAI state and trait anxiety scales and the MACL.

They were asked to refrain from smoking cigarettes or drinking coffee, tea or alcohol or taking any non-prescription drugs such as aspirin for at least 3 hours prior to testing as it has been shown in a number of studies that these drugs cause alterations in stimulus intensity modulation. Caffeine and nicotine have been shown to produce perceptual augmentation while alcohol and aspirin cause perceptual reduction (Petrie 1967).

All testing was done between 10 a.m. and 2 p.m. to control for time-of-day effects.

In the reaction time test the subjects sat at a table with a light directly in front of them. The light flashed 10 times at semi-random intervals of 3 to 10 seconds and the subjects responded to the light by pressing a key which stopped a timer and gave their reaction time to the nearest hundredth of a second. The reaction time score for each subject was the mean of the 10 trials.

Subjects sat in a comfortable padded chair and the

EMG electrodes were attached to the frontalis muscle. Reassurance was given to the subjects that there was no danger of electrical shock and that the equipment is only a recording device.

The subjects were then told to sit as still and quiet as possible while equipment was checked and adjusted and a 4-minute adaptation period began. The average EMG reading during the last 30 seconds of this 4-minute period was used as the baseline measure for the recording session.

The subjects were then given a 10-minute relaxation training session by listening to a taped version of the autogenic exercises.

Following the relaxation training the subject was instructed to maintain that relaxed state for 10 minutes by keeping his/her mind as free of thoughts as possible and by keeping the muscles, especially those of the face and neck, relaxed by watching the recording needle and trying to keep it as still as possible.

Average EMG muscle potential readings were taken for every 30-second period as a measure of relaxation.

Following the biofeedback trial the subjects completed the STAI state anxiety scale, the MACL and the verbal interview questions.

Following the session the subjects were given a short debriefing in which the purpose of the experiment was explained to them and they were paid and thanked for their participation.

RESULTS

Sample Characteristics. In the original sample of 300 students who completed the Vando R-A scale the mean score was 30.3 and the standard deviation was 6.54. The sample of 60 subjects drawn from this group for the present experiment had a mean score of 30.22 and a standard deviation of 7.30 which accurately reflected the characteristics of the larger group.

The mean Vando score of the experimental subjects was slightly higher than those of similar groups in other studies which have used this scale, as reviewed by Barnes (1979). However, another finding that the males scored approximately 4 points higher than the females is consistent with results of other studies which have used this scale (Barnes, 1979) (see Table I).

Pretest Measures. An analysis of variance on the pretest dependent measures showed no significant differences between augmenters, moderates and reducers on baseline EMG levels, state anxiety or trait anxiety. Hypothesis I, that augmenters would show higher baseline EMG levels was rejected.

Significant sex differences appeared, however, on all three measures with females exhibiting higher levels of baseline EMG ($F = 6.92$, $p < .01$), state anxiety ($F = 8.62$, $p < .01$) and trait anxiety ($F = 4.99$, $p < .03$). None of the interaction effects was significant (see Table II).

TABLE I

VANDO SCALE MEANS AND STANDARD DEVIATIONS OF EXPERIMENTAL GROUPS.

	Males		Females				
	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Augmenters	24.1	3.95	19.8	3.29	21.9	4.17	
Moderates	31.9	1.59	28.6	0.84	30.2	2.09	
Reducers	40.5	2.46	36.4	2.36	38.4	3.15	
	32.2	7.34	28.3	7.27	30.2	7.30	Marginals

TABLE II

BASELINE EMG AND ANXIETY SCALE MEANS AND STANDARD DEVIATIONS OF GROUPS AND SEXES.

	Augmenters		Moderates		Reducers		
	Mean	S. D.	Mean	S. D.	Mean	S. D.	F value[a]
Baseline EMG (in microvolts)	8.01	3.51	7.99	2.03	7.95	4.06	0.002
STAI Trait Anxiety	36.15	5.76	36.90	7.08	35.35	6.66	0.30
STAI State Anxiety Pretest	36.65	7.61	38.85	9.96	34.90	7.38	1.22
STAI State Anxiety Post-test	29.05	6.29	31.25	7.41	30.20	6.87	0.48

	Males		Females		
	Mean	S. D.	Mean	S. D.	F value[a]
Baseline EMG (in microvolts)	6.90	2.33	9.07	3.70	6.91**
STAI Trait Anxiety	34.33	6.05	37.93	6.42	4.99*
STAI State Anxiety Pretest	33.76	6.76	39.83	8.91	8.62**
STAI State Anxiety Post-test	28.60	6.07	31.73	7.24	0.22

* $p < .05$

** $p < .01$

[a] F values for between-group and sex differences on the post-test anxiety measure are adjusted for pretest anxiety using analysis of covariance. The other F values are from ANOVA for unadjusted means.

TABLE III

PRE- AND POST-TEST GROUP MEANS AND STANDARD DEVIATIONS ON MOOD ADJECTIVE CHECKLIST SCORES.

		Augmenters		Moderates		Reducers		
		Mean	S.D.	Mean	S.D.	Mean	S.D.	F value[a]
Aggression	Pre	0.30	0.65	0.50	0.76	0.75	1.83	0.72
	Post	0.15	0.48	0.35	0.74	0.45	1.35	0.09
Anxiety	Pre	2.40	1.93	2.45	2.52	1.50	1.53	1.82
	Post	0.55	1.05	0.70	2.10	0.55	1.27	0.10
Surgency	Pre	4.20	2.11	4.05	1.98	4.00	2.36	0.05
	Post	4.60	1.90	4.00	1.86	4.15	2.47	0.44
Social Affection	Pre	5.20	2.26	5.15	1.75	5.90	1.44	1.07
	Post	5.70	2.59	5.75	1.99	5.95	1.66	0.33
Depression	Pre	1.00	1.80	0.90	1.37	0.65	1.59	0.27
	Post	0.25	0.91	0.65	1.59	0.45	1.09	0.70
Distrust	Pre	2.50	2.30	3.45	2.16	2.85	1.95	1.03
	Post	1.15	1.46	1.05	1.31	1.65	1.75	1.78
Quiet	Pre	5.40	1.56	4.90	1.91	4.95	1.60	0.56
	Post	7.05	1.31	6.90	1.99	5.85	2.30	2.09
Detached	Pre	2.20	2.39	2.30	2.08	3.00	2.38	0.71
	Post	3.80	2.68	3.25	2.82	4.05	2.74	0.33

[a] F values are for between-group differences from ANOVA tables. Pretest F values are for unadjusted means while post-test F values are adjusted for pretest scores using analysis of covariance.

TABLE III (cont'd)

PRE- AND POST-TEST MEANS AND STANDARD DEVIATIONS ON MOOD ADJECTIVE CHECKLIST SCORES FOR MALES AND FEMALES.

		Males		Females		
		Mean	S.D.	Mean	S.D.	F value[a]
Aggression	Pre	0.30	0.65	0.73	1.55	2.00
	Post	0.10	0.40	0.53	1.22	1.28
Anxiety	Pre	1.13	1.33	3.10	2.18	18.52***
	Post	0.20	0.76	1.00	1.94	0.63
Surgency	Pre	4.73	2.27	3.43	1.77	5.91*
	Post	4.63	1.97	3.86	2.14	0.007
Social Affection	Pre	5.26	1.79	5.56	1.92	0.41
	Post	5.60	2.01	6.00	2.18	0.15
Depression	Pre	0.30	0.74	1.40	1.97	7.65**
	Post	0.16	0.74	0.73	1.52	1.01
Distrust	Pre	2.36	1.95	3.50	2.20	4.32*
	Post	1.20	1.47	1.36	1.58	0.42
Quiet	Pre	5.40	1.79	4.76	1.54	2.22
	Post	6.63	1.84	6.56	2.09	0.13
Detached	Pre	2.20	2.28	2.80	2.28	1.02
	Post	4.16	2.81	3.23	2.59	2.31

* $p < .05$
** $p < .01$
*** $p < .001$

[a] Pretest F values are based on unadjusted means while post-test F values are based on the post-test scores adjusted for the pretest scores using analysis of covariance.

Due to mechanical problems with the reaction time apparatus, scores were found to be too inaccurate and reaction time was dropped as a measure in the experiment.

Pretest Mood Adjective Checklist Scores showed no significant differences due to perceptual reactance on any of the factors, while sex differences were found showing females to be higher on the factors Anxiety ($F = 18.53$, $p < .001$), Depression ($F = 7.65$, $p < .01$), and Distrust ($F = 4.32$, $p < .05$), and males were higher on the Surgency factor ($F = 5.91$, $p < .05$). There were no significant sex by R-A interaction effects (see Table III).

Biofeedback Trials. In order to make more meaningful between-group comparisons on the EMG data, six trial blocks, each comprising the average of six consecutive EMG readings, were formed. The first three blocks were designated Beginning, Middle and End of the Training Phase in which subjects listened to the tape-recorded instructions on Autogenic exercises. The last three trial blocks were designated Beginning, Middle and End of the Test Phase in which the subjects attempted to relax using the technique learned in the previous phase.

An analysis of covariance for repeated measures (see Table IV) was performed using the trial blocks as the dependent variables, sex and groups (augmenters, moderates, reducers) as the independent variables and baseline EMG as the covariate (see Table V).

Significant main effects were found for groups, with

TABLE IV

REPEATED MEASURES ANALYSIS OF VARIANCE OF TRIAL BLOCK EMG SCORES WITH BASELINE EMG LEVEL AS A COVARIATE.

Source	Df	Sum Squares	Mean Squares	F
Groups	2	189.175	94.587	4.87**
Sex	1	31.695	31.695	1.63
Groups X Sex	2	45.545	22.772	1.17
Error	53	1029.882	19.431	
Trials	5	3.567	0.713	0.52
Trials X Sex	5	8.785	1.757	1.28
Trials X Groups	10	33.891	3.389	2.46*
T X S X G	10	25.619	2.561	1.86
Error	270	371.244	1.374	

**p<.01
*p<.05

FIG. II

GROUP EMG LEVELS OVER TRIAL BLOCKS

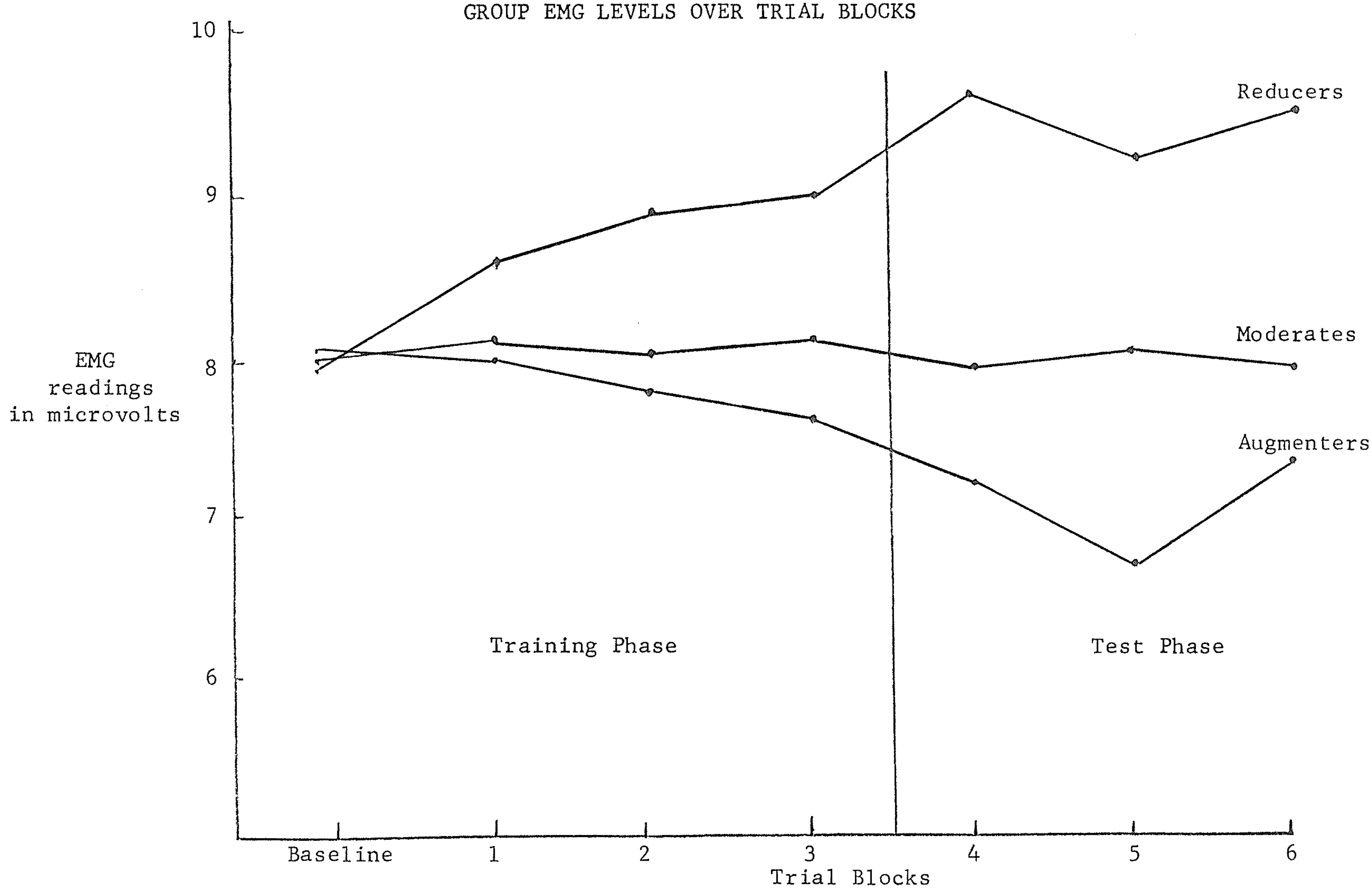


TABLE V

GROUP EMG LEVELS (in microvolts) OVER TRIAL BLOCKS

	Baseline		Trial Block 1		Trial Block 2		Trial Block 3		Trial Block 4		Trial Block 5		Trial Block 6	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Augmenters	8.01	3.39	8.00	3.27	7.82	3.21	7.60	2.67	7.20	2.23	6.66	2.18	7.34	3.04
Moderates	7.99	1.90	8.08	1.98	8.00	1.71	8.12	2.13	7.99	1.74	8.04	2.80	7.92	2.89
Reducers	7.96	3.56	8.58	4.00	8.91	4.40	9.04	4.59	9.57	4.86	9.19	4.32	9.54	4.43

augmenters having a lower mean EMG level over blocks than reducers. Most importantly, the significant interaction between blocks and groups ($F = 2.46$, $p < .05$) confirmed Hypothesis II that augmenters would be more successful than reducers in lowering their tension level. Post-hoc Scheffe multiple comparisons ($\alpha = .05$) of the mean EMG levels within blocks revealed no significant differences in the Training Phase, but augmenters had significantly lower EMG levels than reducers in all three blocks of the Test Phase.

Not only did the augmenters lower their tension level more, but the reducers actually increased in tension, as illustrated in FIG. II, although no group differences from baseline were significant by themselves. In all six blocks of the experiment augmenters, as a group, had EMG levels which were below baseline, while reducers had average scores above baseline and moderates remained quite close to the baseline level. Pearson product-moment correlations between mean EMG deviation scores and Vando scale scores indicated a significant positive relationship in the Training Phase ($r = .25$, $p < .02$) and in the Test Phase ($r = .36$, $p < .002$).

Post-Test Self-Report Measures. To test Hypothesis III, that augmenters would show a greater decrease in subjective discomfort after relaxation, an analysis of covariance was performed on the post-test measures using the pretest scores as covariates to account for initial differences.

Although all results were in the predicted direction, with reducers exhibiting higher levels of discomfort, no significant differences were found for groups or sex on the state of anxiety or any of the eight MACL scales.

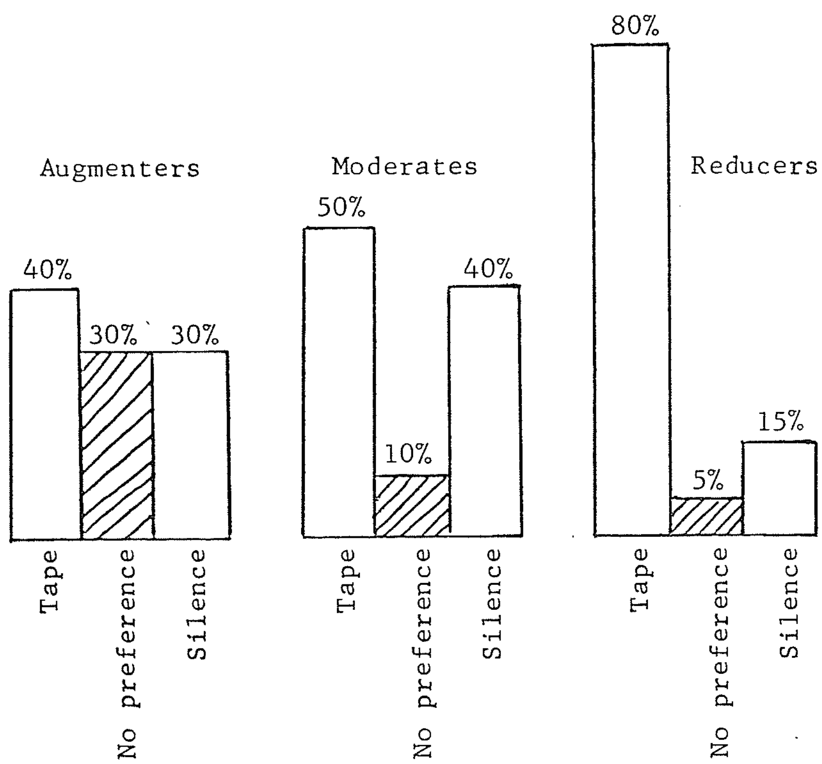
On the post-test verbal interview data, however, significant results were found on all four questions. Analysis of variance, followed by Scheffe multiple comparisons ($\alpha = .05$) showed that augmenters enjoyed the experiment more, were less bored during relaxation, and were more successful at producing feelings of warmth and heaviness in their limbs than were reducers. Females reported significantly more boredom and less enjoyment from the experiment than males ($F = 6.70$, $p < .01$; $F = 5.02$, $p < .03$, respectively).

Eighty percent of the reducers preferred the Training phase with the tape recorded instructions, 15% preferred the Test Phase, in which there was silence, and 5% had no preference, while in the augmenter group only 35% preferred the tape, 30% preferred the silence and 35% expressed no preference (see Fig. III).

FIG. III

PREFERENCE OF SUBJECTS IN EXPERIMENTAL GROUPS

FOR PHASE 1(tape) OR PHASE 2(silence).



DISCUSSION

The findings of this study strongly supported the hypothesis that augmenters would be more successful at biofeedback training than reducers. As well, the augmenters were also more successful at Autogenic Training, enjoyed the experiment more and were less bored during the Test Phase.

While there have been no other studies which have directly tested the relationship between augmenting-reducing and success at biofeedback, if one equates augmenters with introverts (Eysenck, 1955; Petrie, 1967; Vando, 1969) then the present research supports the findings of Maphet (1978) and Lees (1972) who found that introverts were more successful at lowering EMG levels and increasing alpha wave production, respectively.

Perhaps the most plausible explanation for these findings is that the biofeedback-assisted relaxation training session bears a close resemblance to another experimental paradigm, that of sensory deprivation. During a biofeedback session, subjects recline in a heavily padded chair for twenty minutes, in a dimly lit, featureless, soundproof room, having been instructed to keep as calm and motionless as possible. This experimental procedure is very similar to that used by Petrie et al. (1960) who studied sensory deprivation by placing subjects in an "iron lung" type respirator with their arms and legs padded to further reduce sensory input. She found that the reducers were significantly less tolerant of sensory deprivation than the augmenters.

In a study by Sales (1971), subjects were left alone in a quiet, featureless room while waiting for an experiment to begin and their activity level was rated by an observer who sat behind a one-way mirror. It was found that the reducers exhibited significantly more activity (e.g. looking through their purses, reading magazines, walking around the room) than the augmenters during this time, presumably in order to make up for the lack of stimulation in the environment.

So great is the need for reducers to avoid the discomfort of a lack of sensory input, as Petrie (1967) suggests, that they should prefer physical pain to the boredom of sensory deprivation. While the augmenters in Petrie's (1960) deprivation study complained of the physical pain involved in remaining inactive for so long, one subject, a reducer stated that he would never undergo such an experience again for any amount of money because the ordeal of being confined had been worse than the most agonizing pain he could ever imagine.

Similarly, in another study by Petrie et al. (1962) of juvenile delinquents, who were found to be at the reducing end of the scale, almost all the children said they would prefer physical punishment to being put in solitary confinement if they were given a choice.

The present study found evidence, in physiological and self-report data, that augmenters are not only more tolerant than reducers of the level of sensory deprivation associated with biofeedback training, but that they actually enjoy it and find it relaxing. As reported earlier, starting from baseline EMG levels which were virtually identical, the three experimental groups exhibited quite remarkably different responses to the treatment. Reducers increased in tension over the course of the experiment, augmenters lowered their EMG levels steadily and moderates remained close to baseline level.

While the difference in tension level between augmenters and reducers was apparent from the first trial block onwards, it did not reach significance until trial block 4, the first trial block of the Test Phase. During blocks 1, 2 and 3 the tape-recorded instructions and EMG meter provided novel auditory and visual stimulation which, according to Sales (1972), would be more interesting to the reducers and decrease their boredom. Proof of this was seen in the fact that 80% of the reducers preferred the Training phase (when the tape was playing), while only 20% said they preferred the Test phase or had no preference. In the augmenters, however, only 35% preferred the Training Phase, while 65% preferred the silence or had no preference.

As further evidence of how differently augmenters and reducers responded to biofeedback; when the pre-experiment instructions were given one subject in the reducer sample replied, with obvious distate, "You mean I have to just sit here and do nothing!" Another, who found the whole experiment boring said that she preferred the first phase of the experiment (with the tape) because "At least there was something to do in that part."

Conversely, in the augmenter sample one subject reported enjoying the experiment a lot because "It's just the way I like to relax; doing nothing", while another, one of the most extreme augmenters in the male sample, when asked if he had been at all bored during the experiment, replied, "Not at all, I enjoy being bored".

Another factor influencing biofeedback performance may have been the length of the experiment. Ryan and Foster (1967) found that reducers judged time as passing more slowly in two time-estimation tasks. In the previously mentioned research by Sales (1971), the subjects' estimates of how long they had waited for the experiment to begin were in the same direction as in the Ryan and Foster study but failed to reach significance, probably, as Sales points out, because the subjects in his study were free to move around the room and could relieve their boredom somewhat, while in the Ryan and Foster study the subjects had to sit in one place. It is likely that reducers derive a greater portion of their total stimulation intake from internal sensations like muscle movements and are more affected by the restrictions on movement imposed on them by the biofeedback setting.

In the present experiment subjects were restricted in movement for 20 minutes, the length of an average clinical biofeedback session. In the post-experimental verbal reports the reducers reported a significantly higher amount of boredom and significantly less enjoyment of the experiment than the augmenters. The post-test state anxiety and eight MACL factors also indicated that reducers were more uncomfortable at the end of the experiment although none of these measures reached significance. It was felt that the failure to reach significance is probably due to two factors: 1. The MACL and state anxiety adjectives are rated by subjects on a four-point scale which is probably not sensitive enough to detect changes in affect and anxiety after only one session of biofeedback training when six to twelve sessions are usually needed to fully train a subject to relax. Perhaps a ten or hundred point scale would have been more sensitive for the purposes of this experiment; 2. Since the subjects knew they were only to undergo one session of biofeedback the reducers were not as uncomfortable as they might have been if they had known they were to continue with many more sessions as in a real course of biofeedback treatment. Even greater differences between augmenters and reducers might appear after six sessions and the most uncomfortable subjects might begin to drop out of the experiment as in the previously mentioned study by Otis and Turner (1975).

The failure to find higher baseline EMG levels in augmenters as predicted by Hypothesis I was most likely due to the fact that EMG levels were not measured as soon as the subjects entered the laboratory but after they had filled out the pretest questionnaires, heard the pretest instructions from the experimenter and sat quietly in the reclining chair with the EMG electrodes attached for 3½ minutes. By this time the augmenters would have begun to relax and the reducers would be starting to feel restless in the quiet surroundings of the test chamber. Had the measurements been taken as soon as the subjects arrived, the differences between baseline and final EMG measurements might have been even greater than those observed.

The most puzzling results in this study were the significantly elevated pretest levels of baseline EMG, state and trait anxiety and MACL factors Anxious, Depressed, and Distrust in the female sample. Since no other studies on biofeedback or relaxation training have reported such sample differences, these results, taken as a whole, indicate that the females found the experiment more threatening in some way. Perhaps the biofeedback equipment and recording devices, or the presence of the male experimenter in the isolation laboratory were factors in provoking more anxiety in the females.

In summary, the data showed that augmenters reduced muscle tension to a significantly greater degree and subjectively reported feeling more comfortable at the end of the experiment. Since this study simulated only one biofeedback training session, further research is necessary to determine if any different results would occur over several more sessions.

However, if perceptual reactance is a valid predictor of success at biofeedback then there are several implications for sample selection and methodology used in biofeedback training.

First, the question of the appropriateness of clinical biofeedback training for all persons is raised. Perhaps people who are moderate to extreme perceptual reducers should learn more active forms of stress management such as yoga, swimming, jogging, etc. rather than biofeedback or meditation in which they become too restless. Alternatively, biofeedback training could be made less boring for these individuals by having shorter training sessions than those given to augmenters and also providing more complex auditory and visual feedback to maintain their interest.

In laboratory studies of biofeedback training, the experimenter should take the perceptual reactance of the subjects into account when selecting groups or accounting for individual error in the results. Studies where random assignment of subjects to groups is used without regard to perceptual reactance, the efficacy of various treatments administered these groups could be confounded by the proportions of augmenters and reducers in each group. Augmenters would respond more favourably to low stimulation treatments while reducers would respond better to high stimulation treatments.

Studies in the past which have used certain groups such as physical education majors, student nurses or alcoholics for example, were most likely biased towards one end of the reducing-augmenting spectrum, which could easily have affected the outcome.

REFERENCE NOTES

Baker, A.H., Mishara, B.L., Kostin, I.W., & Parker, L. Menstrual Cycle Affects Kinesthetic Aftereffect - An Index of Personality and Perceptual Style. Unpublished manuscript, 1978.

Barnes, G.E. Stimulus Intensity Modulation, Drug Use and Sensation Seeking. Paper presented at International Conference on "Temperament Need for Stimulation Activity". Warsaw, Poland, Sept. 1979.

Jordan, C.J. The effect of locus of control on electromyographic feedback and abbreviated progressive relaxation. Unpublished master's thesis, University of Manitoba, 1975.

REFERENCES

Alexander, A.B. An experimental test of assumptions relating to the use of biofeedback as a general relaxation training technique. Psychophysiology, 1975, 12 (6), 656-662.

Alexander, A.B., White, P.D., & Wallace, H.M. Training and transfer of training effects in EMG assisted muscular relaxation training. Psychophysiology, 1977, 14 (6), 551-559.

Barnes, G.E. The Clinical Alcoholic Personality. Doctoral dissertation. York University, Toronto, 1977.

Barnes, G.E. Individual Differences in Perceptual Reactance: A review of the Stimulus Intensity Modulation Individual Difference Dimension. Canadian Psychological Review, 1976, 17(1), 29-52.

Basmajian, J.V. Electromyography comes of age. Science, 1972, 176, 603-609.

Bergman, J.S., & Johnson, H.I. Sources of information which affect training and raising of heart-rate. Psychophysiology, 1972, 9, 30-39.

Brenner, J. Sensory and Perceptual Determinants of Voluntary Visceral Control. In Schwartz, G.E., & Beatty, J. (Eds.), Biofeedback; Theory and Research. New York: Academic Press, 1977, 29-66.

Budzynski, T.H. Clinical Implications of Electromyographic Training. In Schwartz, G.E., & Beatty, J. (eds.), Biofeedback; Theory and Research. New York: Academic Press, 1977, 433-448.

Budzynski, T.H., & Stoyva, J.M. An instrument for producing deep muscle relaxation by means of analog information feedback. Journal of Applied Behavioural Analysis, 1969, 2, 231-237.

Budzynski, T., Stoyva, J., & Adler, C. Feedback-induced Muscle Relaxation: Application to Tension Headache. Journal of Behavioral Therapy and Experimental Psychiatry, 1970, 1, 205-211.

Carlton, M.L. The Eysenck Personality Inventory as a prognostic index for autogenic training and biofeedback procedures. Dissertation Abstracts, 1974, 34 (10-B), 5183.

Cattell, R.B., & Scheier, I.H. The meaning and measurement of neuroticism and anxiety. New York: Ronald, 1961.

Colquhoun, W.P. Temperament, inspection efficiency and time of day. Ergonomics, 3, 377-378.

Colquhoun, W.P., & Corcoran, D.W.G. The effects of time of day and social isolation on the relationship between temperament and performance. British Journal of Social and Clinical Psychology, 1964, 3, 226-231.

Coursey, R.D. Electromyograph Feedback as a Relaxation Technique. In T.X. Barber et al (Eds.), Biofeedback and Self-Control. Chicago: Aldine Publishing Co., 1976, 281-287.

Dale, A., & Anderson, D.E. Feedback variables (field dependence, heart rate perception, shock sensitivity, and analog biofeedback) in the experimental control of human heart rate. Proceedings of the Biofeedback Research Society, Monterey, Cal., 1975. (abstract).

Deaux, Edward. A psychophysiological influence on the choice of illicit drugs. Physiological Psychology, 1976, 4(3), 400-404.

Epstein, S. The Nature of Anxiety with Emphasis upon its Relationship to Expectancy. In Charles D. Spielberger (Ed.), Anxiety: Current Trends in Theory and Research, New York: Academic Press, 1972, Vol. 2, 292-338.

Eysenck, H.J. The Biological Basis of Personality. Springfield, Ill.: Charles C. Thomas, Publisher, 1967.

Eysenck, H.J. Crime and Personality. Boston: Houghton Mifflin, 1964.

Eysenck, H.J., & Eysenck, S.B.J. Manual of the Eysenck Personality Inventory. London: University of London Press, 1964.

Farley, F.H., & Sewell, T. Test of an arousal theory of delinquency - Stimulation Seeking in delinquent and non-delinquent black adolescents. Criminal Justice and Behaviour, 1976, 3(4), 315-320. (Journal Abstract)

Fotopoulos, S. Internal versus external control: Increase of heart rate by thinking under feedback and no-feedback condition. Dissertation Abstracts, 1970, 77, 43-54.

Freeman, G.L. The relation between performance level and bodily activity level. Journal of Experimental Psychology, 26, 602-608.

Gray, J.A. The Psychophysiological Nature of Introversion-Extraversion: A Modification of Eysenck's Theory. In Nebylitsyn, V.D., & Gray, J.A. (Eds.), Biological Bases of Individual Behaviour. New York: Academic Press, 1972, 182-205.

Green, E.E., Green, A.M., & Walters, E.D. Biofeedback training for anxiety tension reduction. Annals of the New York Academy of Science, 1974, 233, 157-161.

Gupta, B.S. Stimulant and depressant drugs on kinaesthetic figural aftereffects. Psychopharmalogica, 1974, 36, 275-280.

Hall, R.A. Tobacco and evoked potential. Science, 1973, 180, 212-214.

Hardt, J.V. Psychophysiology and the three Gunas. In Garfield, C. (Ed.), Rediscovery of the Body. New York: Dell Books, 1977.

Haslam, D.R. Individual differences in pain threshold and level of arousal. British Journal of Psychology, 1967, 58, 139-142.

Haynes, S.N., Moseley, D., and McGowan, W.T. Relaxation training and biofeedback in the reduction of frontalis muscle tension. Psychophysiology, 1975, 5(12), 547-552.

Hebb, D.O. Drives and C.N.S. (Conceptual Nervous System) Psychological Review, 62, 243-254.

Hess, W.R. The Relaxation Response. New York: Dell Books, 1976.

Jacobson, E. Progressive Relaxation. Chicago: University of Chicago Press, 1938.

Janisse, M.P. and Dumoff, R., cited in Barnes G.E. Stimulation Intensity Modulation, Drug Use and Sensation Seeking. Paper presented at the International Conference on "Temperament Need for Stimulation Activity". Warsaw, Poland, Sept. 1979.

Lader, M.H., & Matthews, A.M. Electromyographic Studies of tension. Journal of Psychosomatic Research, 1971, 15, 479-486.

Lazarus, R.S., & Averill, J.R. Emotion and cognition: with special reference to anxiety. In Spielberger, Charles D. (Ed.), Anxiety: Current Trends in Theory and Research. New York: Academic Press, 1972, Vol. 2, 241-283.

Lees, R.J. Personality and ability to control brain wave frequency. Dissertation Abstracts, 1976, 37(2-B), 1025-1026.

MacFarland, R.A., & Coombs, R. Anxiety and feedback as factors in operant heart rate control. Psychophysiology, 1974, 11(1), 53-57.

Mischel, W. Toward a Cognitive Social Learning Reconceptualization of Personality. Psychological Review, 1973, 80(5), 252-282.

Malmo, R.B. Activation: A neuropsychological dimension. Psychological Review, 1959, 66, 367-386.

Malmo, R.B., & Shagass, C. Physiological study of symptom mechanisms in psychiatric patients under stress. Psychosomatic Medicine, 1949, 11, 25-29.(b).

Malmo, R.B., Shagass, C., & Davis, J.H. Specificity of bodily reactions under stress: A physiological study of somatic mechanisms in psychiatric patients. Research Publications of the Association for Research in Nervous and Mental Disease, 1950, 29, 231-261.

Mandler, G., Mandler, J.M., & Uviller, E. Autonomic feedback: The perception of autonomic activity. Journal of Abnormal and Social Psychology, 1958, 56, 367-373.

Mangan, G.L., & Farmer, R. Studies of the relationship between Neo-Pavlovian properties of higher nervous activity and western personality dimensions. Journal of Experimental Research in Personality, 1967, 2, 101-106.

Maphet, H.W. EMG biofeedback utilization as a function of Eysenck's Introversion-extraversion and intelligence. Dissertation Abstracts, 1979, 39 (9-B), 4586.

Nowlis, V. Research with the Mood Adjective Check List. In S.S. Tomkins and C.E. Izard (Eds.), Affect, Cognition and Personality. New York: Springer, 1965, 352-389.

Otis, L.S., & Turner, A. EMG training and headache reduction: Some methodological issues. Proceedings of the Biofeedback Research Society, Montery, Cal.,1975. (Abstract)

Patkai, P. Laboratory studies of psychological stress. International Journal of Psychiatry in Medicine, 1974, 5(4), 575-585.

Pelletier, K.R. Mind as Healer, Mind as Slayer. New York: Dell Publishing Co., 1977.

Petrie, A. Individuality in Pain and Suffering. Chicago: University of Chicago Press, 1967.

Petrie, A., Collins, W., & Solomon, P. The tolerance for pain and for sensory deprivation. American Journal of Psychology, 1960, 73, 80-90.

Petrie, A., Collins, W., & Solomon, P. Pain sensitivity, sensory deprivation, and susceptibility to satiation. Science, 1958, 128, 1431-1433.

Petrie, A., McCulloch, R., & Kazdin, P. Perceptual characteristics of juvenile delinquents. Journal of Nervous and Mental Disease. 1962, 134, 415-421.

Poser, E. A simple and reliable apparatus for the measurement of pain. American Journal of Psychology, 1962, 75(2), 304-305.

Pushkin, V.N. Vigilance as a Function of Strength of the Nervous System. In Nebylitsyn, V.D., & Gray, J.A. (Eds.), Biological Bases of Individual Behaviour. New York: Academic Press, 1972, 310-324.

Roberts, A.H., Schuler, J., Bacon, J.R., Zimmerman, R.C., & Patterson, R. Individual Differences and Autonomic Control: Absorption, Hypnotic Susceptibility and the Unilateral Control of Skin Temperature. Journal of Abnormal Psychology, 1976, 84, 272-279.

Rotter, J. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs, 1966, 80, (1, no. 609).

Rotter, J. Social Learning and Clinical Psychology. New York: Prentice-Hall, 1954.

Ryan, E.D., & Foster, R. Athletic participation and perceptual augmentation and reduction. Journal of Personality and Social Psychology, 1967, 6(4), 472-476.

Ryan, E.D., & Kovacic, C.R. Pain tolerance and athletic participation. Perceptual and Motor Skills, 1966, 22, 383-390.

Sales, S.M. Need for stimulation as a factor in social behaviour. Journal of Personality and Social Psychology, 1971, 19(1), 124-134.

Sales, S.M., Guydosh, R.M., & Iacono, W. Relationship between "Strength of the Nervous System" and the Need for Stimulation. Journal of Personality and Social Psychology, 1974, 29(1), 16-22.

Sales, S.M., & Throop, W.F. Relationship Between Kinesthetic Aftereffects and "Strength of the Nervous System". Psychophysiology, 1972, 9(5), 492-497.

Schultz, J.H., & Luthe, W. Autogenic Training: a psychophysiologic approach to psychotherapy. New York: Greene and Stratton, 1958.

Scopp, A.L. Relaxation training: cognitive and affective components. Proceedings of the Biofeedback Research Society, Monterey, Cal., 1975. (Abstract)

Smith, P. Frontalis tension and personality. Psychophysiology, 1973, 10(3), 314.

Solon, J.A. cited in Petrie, A. Individuality in Pain and Suffering. Chicago: University of Chicago Press, 1967.

Spielberger, C.D., Gorsuch, R.L., & Lushene, R.E. Manual for the State-Trait Anxiety Inventory. Palo Alto, Calif.: Consulting Psychologists Press, 1970.

Stephens, J.H., Harris, A.H., Brady, J.V., & Shaffer, J.W. Psychological and physiological variables associated with large magnitude voluntary heart rate change. Psychophysiology, 1975, 12(4), 381-387.

Sternbach, R.A. Principles of Psychophysiology. New York: Academic Press, 1966.

Stoyva, J.M., & Budzynski, T.H. Cultivated low arousal: an anti-stress response. In Dicara, L.V., (Ed.), Limbic and Autonomic nervous system research. New York: Plenum Books, 1974, 265-290.

Strelau, J. Pavlov's Typology and Current Investigations in this Area. Nederlands Tijdschrift voor de Psychologie, 30, (1975) 177-200.

Strelau, J. Reactivity and Activity Style in Selected Occupations. Polish Psychological Bulletin, Vol. 6, (4) 1975.

Teplov, B.M. The Problem of Types of Human Higher Nervous Activity and Methods of Determining Them. In Nebylitsyn, V.D., & Gray, J.A. (Eds.), Biological Bases of Human Behaviour, New York: Academic Press, 1972, 1-10.

Townsend, R.E., House, J.F., & Addario, D. A comparison of biofeedback-mediated relaxation and group therapy in the treatment of chronic anxiety. American Journal of Psychiatry, 1975, 132(6), 598-601.

Vando, A. A personality dimension related to pain tolerance. Unpublished doctoral dissertation, Columbia University, 1969.

Wallace, R.K., & Benson, H. The physiology of meditation. Scientific American, 1972, 226, 84-90.

Witkin, A., & Oltman, K. Cognitive Style. International Journal of Neurology, 1967, 6(12), 119-135.

Zuckerman, M., Kolin, B.A., Price, L., & Zoob, I. Development of a sensation seeking scale. Journal of Consulting and Clinical Psychology, 1964, 32, 420-426.

APPENDIX A: VANDO R-A SCALE

Instructions: On the next page you will find a series of paired statements which you are asked to regard as choices. In some cases you will like both choices. In some cases you will dislike both choices. In other cases you will find the choices neutral. No matter how the items strike you, however, you are asked to choose between them. In each case you are to decide which of the alternatives you <u>prefer</u> in <u>comparison</u> to the other alternative and then to indicate your selection by drawing a circle around the (a) or (b) to the left of the statement. It is important to answer all items. Do not skip any. It is best to work as rapidly as possible.

1.
a. see a war drama
b. see a situation comedy

2.
a. play sports requiring endurance
b. play games with rest stops

3.
a. raunchy blues
b. straight ballads

4.
a. jazz combo
b. 1001 strings

5.
a. stereo on too loud
b. stereo on too low

6.
a. own a goldfish
b. own a turtle

7.
a. conservatism
b. militantism

8.
a. too much sleep
b. too little sleep

9.
a. danger
b. domesticity

10.
a. passenger car
b. sports car

11.
a. have several pets
b. have one pet

12.
a. be a shepherd
b. be a cowboy

13.
a. motorcycle
b. motor scooter

14.
a. see the movie
b. read the book

15.
a. cocktail music
b. disco music

16.
a. do research in the library
b. attend a classroom lecture

17.
a. a hot drink
b. a warm drink

18.
a. a drum solo
b. a string solo

19.
a. too much exercise
b. too little exercise

20.
a. loud music
b. quiet music

21.
a. prepare medications
b. dress wounds

22.
a. a driving beat
b. a nice melody

23.
a. hard rock music
b. regular popular music

24.
a. like athletics
b. dislike athletics

25.
a. unamplified music
b. electrically amplified music

26.
a. smooth-textured foods
b. crunchy foods

27.
a. wake-up pill ("upper")
b. sleeping pill ("downer")

28.
a. speed
b. safety

29.
a. the Beatles
b. Dean Martin

30.
a. soccer
b. golf

31.
a. excitement
b. calm

32.
a. a family of six
b. a family of three

33.
a. thrills
b. tranquility

34.
a. play contact sports
b. play noncontact sports

35.
a. live in a crowded home
b. live alone

36.
a. share intimacy
b. share affection

37.
a. games emphasizing speed
b. games paced slowly

38.
a. thinking
b. doing

39.
a. competitive sports
b. non-competitive sports

40.
a. emotionally expressive, somewhat unstable people
b. calm even-tempered people.

41.
a. be a nurse on an acute care ward
b. be a nursing supervisor

42.
a. be a NASA scientist
b. be an astronaut

43.
a. be a stuntman
b. be a propman

44.
a. a job which requires a lot of travelling
b. a job which keeps you in one place

45.
a. climb a mountain
b. read about a dangerous adventure

46.
a. body odors are disgusting
b. body odors are appealing

47.

a. keep on the move

b. spend time relaxing

48.

a. have a cold drink

b. have a cool drink

49.

a. being confined alone in a room

b. being free in the desert

50.

a. security

b. excitement

51.

a. continuous anesthesia

b. continuous hallucinations

52.

a. water skiing

b. boat rowing

53.

a. hostility

b. conformity

54.

a. traditional art (e.g. Renoir)

b. abstract art (e.g. Picasso)

APPENDIX B: SPIELBERGER STATE-TRAIT ANXIETY INVENTORY

SPIELBERGER TRAIT ANXIETY INDEX[a]

NAME______________________________________DATE______________

DIRECTIONS: Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel. There are no right or wrong answers.

1. almost never
2. sometimes
3. often
4. almost always

21.	I feel pleasant........................	1	2	3	4
22.	I tire quickly.........................	1	2	3	4
23.	I feel like crying.....................	1	2	3	4
24.	I wish I could be as happy as others seem to be............................	1	2	3	4
25.	I am losing out on things because I can't make up my mind soon enough......	1	2	3	4
26.	I feel rested..........................	1	2	3	4
27.	I am "calm, cool and collected"........	1	2	3	4
28.	I feel that difficulties are piling up so that I cannot overcome them.........	1	2	3	4
29.	I worry too much over something that really doesn't matter..................	1	2	3	4
30.	I am happy.............................	1	2	3	4
31.	I am inclined to take things hard......	1	2	3	4
32.	I lack self-confidence.................	1	2	3	4
33.	I feel secure..........................	1	2	3	4
34.	I try to avoid facing a crisis or difficulty...............................	1	2	3	4
35.	I feel blue............................	1	2	3	4
36.	I am content...........................	1	2	3	4
37.	Some unimportant thought runs through my mind and bothers me.................	1	2	3	4
38.	I take disappointments so keenly that I can't put them out of my mind........	1	2	3	4

[a] Referred to on test form as "Self-Evaluation Questionnaire".

SPIELBERGER STATE ANXIETY INDEX [a]

NAME____________________________________ DATE______________

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers.

1. not at all
2. somewhat
3. moderately so
4. very much so

1.	I feel calm..............................	1	2	3	4
2.	I feel secure............................	1	2	3	4
3.	I am tense...............................	1	2	3	4
4.	I am regretful...........................	1	2	3	4
5.	I feel at ease...........................	1	2	3	4
6.	I feel upset.............................	1	2	3	4
7.	I am presently worrying over possible misfortunes...............................	1	2	3	4
8.	I feel rested............................	1	2	3	4
9.	I feel anxious...........................	1	2	3	4
10.	I feel comfortable.......................	1	2	3	4
11.	I feel self-confident....................	1	2	3	4
12.	I feel nervous...........................	1	2	3	4
13.	I am jittery.............................	1	2	3	4
14.	I feel "high strung".....................	1	2	3	4
15.	I am relaxed.............................	1	2	3	4
16.	I feel content...........................	1	2	3	4
17.	I am worried.............................	1	2	3	4
18.	I feel over-excited and "rattled".........	1	2	3	4
19.	I feel joyful............................	1	2	3	4
20.	I feel pleasant..........................	1	2	3	4

[a] Referred to on test form as "Self-Evaluation Questionnaire".

SPIELBERGER TRAIT ANXIETY INDEX[a]

NAME____DATE____________

39.	I am a steady person......................	1	2	3	4
40.	I get in a state of tension or turmoil as I think over my recent concerns and interests................................	1	2	3	4

[a] Referred to on test form as "Self-Evaluation Questionnaire".

APPENDIX C: MOOD ADJECTIVE CHECK LIST

Beside each word indicate MUCH, or LITTLE, or DON'T KNOW, or NONE, as they presently pertain to you.

	MUCH	LITTLE	DON'T KNOW	NONE
jittery				
playful				
suspicious				
quiet				
detached				
defiant				
angry				
warmhearted				
sad				
fearful				
carefree				
affectionate				
regretful				
distant				
rebellious				
clutched up				
skeptical				
placid				
remote				
witty				
kindly				
sorry				
dubious				
still				

APPENDIX D: INSTRUCTIONS TO BE GIVEN TO SUBJECTS BEFORE THE EXPERIMENT

INSTRUCTIONS GIVEN TO SUBJECTS IN THE EXPERIMENT

This is an experiment on relaxation training using biofeedback equipment as a teaching aid. There is no deception or trickery involved in this experiment, and as in all experiments at the University of Manitoba you are free to leave at any time. What I am interested in is how effectively you can learn to relax by listening to some taped instructions and by watching the meter on the biofeedback equipment.

To explain a little bit about biofeedback: It is based on the fact that for every change in our thoughts and emotions, there are corresponding physical changes in our bodies, such as changes in breathing, heart rate, and muscular tension. By tuning in on these changes with equipment such as you see in front of you, we can learn to produce thoughts that make our bodies more relaxed. The machine you will be using is an electromyograph which measures muscular tension. In this experiment it will be used to measure the tension in your face and neck, as these muscles have been shown to be good indicators of how relaxed or tense people are at any moment.

About the safety of this equipment: the machine operates on batteries and is not connected to the wall current in any way so there is no danger at all of you receiving a shock. The machine merely measures the current coming from your muscles as they do their work.

For the machine to give an accurate reading of muscular tension you must remain as still as possible and avoid unnecessary movements which artificially increase tension level. Blinking your eyes or swallowing will produce a momentary increase in tension but that's all right. What should be avoided, though, is moving your eyes back and forth and especially avoid clenching your teeth or tightening your jaw muscles, which really increases the tension. Try biting your teeth together now for a few seconds and see how the needle moves to the right showing an increase in tension. Do it now. (5 second pause) When you relax again there is a decrease in tension and the needle moves to the left again.

For the next ten minutes you will hear a tape which will give you instructions on a method of relaxation called Autogenic Training. I would like you to listen to the tape and do what it tells you. At the same time try to keep the needle on the meter as low as possible.

When the tape is finished there will be another ten-minute period in which I would like you to practise using the Autogenic Training you have just learned, to relax even more. Are there any questions?