



1981

## Cognitive Processing Style and Relaxation Training: A Comparison of EMG Biofeedback Versus Directed Imagery as a Relaxation Technique

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207

COGNITIVE PROCESSING STYLE AND RELAXATION TRAINING:  
A COMPARISON OF EMG BIOFEEDBACK VERSUS DIRECTED  
IMAGERY AS A RELAXATION TECHNIQUE

by

David J. Wakely

A Dissertation Submitted to the Faculty of the Graduate  
School of Loyola University of Chicago in Partial  
Fulfillment of the Requirements for the Degree of  
Doctor of Philosophy

February

1981

## ACKNOWLEDGMENTS

Grateful appreciation is extended to all who have assisted me. My committee members, Drs. Alan DeWolfe, John Shack, and Daniel Barnes, each provided valuable guidance, support, and encouragement. Dr. Frank Slaymaker provided timely advice with regard to the statistical design. Dr. George Meschel, Chief, Psychology Service, West Side VA Medical Center, worked tirelessly for the establishment and maintenance of the Biofeedback clinic. His energy and optimism were an inspiration.

Many thanks are also conveyed to the cooperative patients and personnel of West Side VAMC, especially the staff (past and present) of the Day Hospital unit: Dr. James Watzke, Ms. Arpie Colin, Ms. Susan Cairns, Dr. John Keenan, Ms. Marianne "Mo" Olenych, Dr. Bruce Roberts, Dr. Stanley DeLoach, Ms. Kristin Lopez, and Dr. Joseph Morello. Dr. John Mendoza, Consult/Liason team, was most helpful in providing patient referrals for the study, and Mr. Jeffrey Kunka, Psychology Intern, performed admirably in recording the imagery tape.

Several personal friends were particularly supportive throughout this undertaking. They are Ms. Sherry Tucker, Mr. Robert Szymanski, Mr. Robert Linkowski, and Ms. Carol Linkowski.

And very special thanks to D. J., who knows what it's like, and whose warmth, caring, and charm have always made the difficult seem easy.

## VITA

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## TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS . . . . .	ii
VITA . . . . .	iv
LIST OF TABLES . . . . .	viii
LIST OF FIGURES . . . . .	ix
CONTENTS OF APPENDICES . . . . .	x
INTRODUCTION . . . . .	1
REVIEW OF THE LITERATURE . . . . .	7
Biofeedback . . . . .	7
EMG Biofeedback . . . . .	9
EMG Biofeedback as a Relaxation Technique . . . . .	10
Mental Imagery . . . . .	16
Imagery and Physiology . . . . .	19
Measurement and Validity of Mental Imagery . . . . .	22
Imagery as a Relaxation Technique . . . . .	29
INVESTIGATIVE AREAS . . . . .	32
Physiological and Subjective Correlates of Cognitive Style . . . . .	32
Muscle Tension . . . . .	32
Locus of Control . . . . .	32
Anxiety . . . . .	34
Experimental Hypotheses . . . . .	35
Differential Treatment Effects of Cognitive Style . . . . .	36
Verbalizers . . . . .	36
Visualizers . . . . .	37
Experimental Hypotheses . . . . .	37
Differential Cognitive Effects of Treatments . . . . .	38
Locus of Control . . . . .	38
Anxiety . . . . .	40
Experimental Hypotheses . . . . .	40
METHOD . . . . .	42
Subjects . . . . .	42
EMG and Temperature Apparatus . . . . .	44

Measures . . . . .	45
Imagery Scales . . . . .	45
Locus of Control . . . . .	51
Cognitive-Somatic Anxiety Questionnaire . . . . .	54
Treatments . . . . .	56
EMG Biofeedback . . . . .	56
Directed Imagery . . . . .	56
Procedure . . . . .	57
Data Reduction . . . . .	60
Cognitive Style . . . . .	60
Physiological Measures . . . . .	60
Statistical Design . . . . .	61
RESULTS . . . . .	64
Pretreatment . . . . .	64
Treatment and Posttreatment . . . . .	68
Physiological Measures . . . . .	68
Cognitive Measures . . . . .	75
DISCUSSION . . . . .	82
Cognitive Style . . . . .	82
Treatments . . . . .	86
Physiological Effects . . . . .	86
Cognitive Effects . . . . .	89
SUMMARY . . . . .	95
REFERENCE NOTE . . . . .	97
REFERENCES . . . . .	98
APPENDIX A . . . . .	113
APPENDIX B . . . . .	115



LIST OF TABLES

Table	Page
1. Correlation Matrix of Imagery Test Scores, I-E Scale, Anxiety Questionnaire, and Physiological Measures . . . . .	65
2. Pretreatment EMG and Peripheral Temperature Means, Standard Deviations, and $t$ -test Comparisons Between Subjects Grouped by Cognitive Style . . . . .	67
3. Analyses of Variance for Pretreatment Measures	69
4. Analysis of Variance for EMG Change During Training . . . . .	70
5. Means and Standard Deviations for Physiological Measures Pre- and Posttraining . . . . .	72
6. Analyses of Variance for Physiological Measures	74
7. Means and Standard Deviations for Cognitive Measures Pre- and Posttraining . . . . .	77
8. Analyses of Variance for Cognitive Measures . .	78

LIST OF FIGURES

Figure	Page
1. EMG values during and following training. . . .	76
2. I-E scores across treatments. . . . .	80

CONTENTS OF APPENDICES

	Page
APPENDIX A Information Sheet . . . . .	113
APPENDIX B Imagery Tape . . . . .	115

## INTRODUCTION

Stress has been defined by Hans Selye as "the non-specific response of the body to any demand made upon it" (Selye, 1974, p.14). This nonspecific response is seen as encompassing a pattern of nervous system arousal which includes changes in heart rate, a rise in blood pressure, and muscular tension. Frequently, awareness of muscular tension is the first subjective indication of a stress state. The feeling of being "uptight" or having a stomach "tied in knots" can be seen as apt subjective descriptions of a physiological process such as excessive muscle tension.

Selye's theory of stress, the most popular current theory of maladaptive muscle tension, states that when the individual perceives a demand the body responds with a stereotyped physiological arousal which prepares the body to take action. This response is nonspecific in the sense that the nature of the demand (e.g. perceived threat) does not determine the nature of the response. The muscular tension takes place to prepare the individual to fight, to freeze, or to flee from any number of situations (or people) perceived as threatening.

Brown (1977) has described this preparation as a kind of muscle "bracing" and notes that this tensing is seldom recognized consciously, as an enormous amount of partial

tightening can occur before it is recognized and labeled as muscle tension. The spontaneous relaxation following a stressful situation occurs slowly according to this theory, and hence repeated exposure to stress results in an accumulation of residual muscle tension. The individual then adapts to this increased tension level and it can remain outside awareness, building up with repeated exposures to stress until some body system or organ breaks down.

As any number of social commentators have pointed out, we live in a highly "stressful" environment in terms of the numbers of demands for change and/or adaptation placed on us. One result of this social situation has been a virtual explosion of "stress-related" disease, that is, chronic disorders such as heart disease, cerebrovascular disease, respiratory disease, etc., related to adaptation-demanding life-styles.

Stachnik (1980) has noted that the morbidity and mortality rates of Americans have changed dramatically within the past 75 years. No longer are they related to infectious diseases prevalent at the turn of the century, but rather to the chronic disorders noted above. Although in general life-spans are longer, Susser (1975) notes that half of all deaths in America in 1969 were the result of heart disease and strokes. As to the relationship between this finding and stress, Friedman and Rosenman (1974) have described what they call the "Type A" personality as a high risk for heart

disease. These individuals are characterized by cognitive attitudes such as striving for achievement and the need to maintain control over potentially uncontrollable situations as well as a characteristic tenseness of facial musculature, a physiological indication of stress.

Other disorders seen as related either directly or indirectly to stress-induced muscle tension, or which respond to muscle relaxation training, include anxiety, headache, insomnia, asthma "attacks," essential hypertension, bruxism, and a variety of intestinal disorders (Brown, 1977). In most of these disorders control has been sought via drug treatment, to a degree that indicates the alarming incidence of these disorders. Cole (1978) reports that antianxiety drugs, chief among which are the benzodiazepine (muscle-relaxing) compounds, were prescribed 80 million times in 1970. He notes that in a 1972 survey it was found that approximately 1 in 7 adults in the United States used an antianxiety drug at some time during the preceding year.

Cole also reports that all the sedative-hypnotic anti-anxiety drugs can induce physical dependence and that when patients come to psychiatrists for treatment of anxiety that they frequently report prolonged use of benzodiazepines and are very resistant to discontinuation of the drugs.

In the case of insomnia, Smith (1979) reports that approximately 25 million prescriptions are written annually for sleep disorders, and that 8 million use the drugs at

some time during the year. Smith also reviewed findings that indicated the reported safety of Flurazepam (trade name: Dalmane) and the other benzodiazepines in terms of fatal overdose potential may be misleading as most suicides involving pills also involve alcohol consumption, and that this combination is just as lethal as barbiturates and alcohol.

As an alternative to drug treatment of stress-related disorders, relaxation training has been proposed as a way to reduce chronic muscle tension levels. Stoyva (1979) has given the rationale for the use of muscle relaxation training in the treatment of tension, anxiety, and stress-related disorders. He notes that with these patients the goal is a generalized reduction in physiological activity rather than some specific or localized response. Also, voluntary relaxation has been seen as an anti-stress response via cultivated low arousal (Stoyva & Budzynski, 1974), as a coping skill to employ in stressful situations (Goldfried, 1977), and as incompatible with the sympathetic nervous system response of anxiety (Wolpe, 1958).

As an example of reduced physiological activity, Brown (1977) notes that relaxation appears to lead to a decrease in sympathetic tone in the cardiovascular system, leading to an increase in peripheral temperature. Peripheral temperature has been seen as a function of anxiety (Crawford et al., 1977) and to vary as a function of relaxation level

(Kappes & Michaud, 1978).

Voluntary relaxation has been used as a specific technique for relief from many of the stress-related disorders for over fifty years (Brown, 1977). Chief among the methods in use are Progressive Muscle Relaxation (PMR) and Autogenic Training (AT). As originally devised by Jacobson (1938), PMR is a series of exercises in which the patient first tenses and then relaxes various muscle groups in a systematic or progressive (hence the name) manner. According to Jacobson the patient then learns to discriminate smaller and smaller degrees of muscle tension and hence achieve control.

In Autogenic Training the patient is taught to use various self-statements concerning relaxation such as "My right arm is heavy" and other autogenic "phrases," which are seen as inducing a relaxed state by suggestion. Brown (1977) notes that this technique appears to be borrowed from hypnosis. She and others (e.g. Budzynski, 1977) also feel that one of the drawbacks of both AT and PMR is that in their original form they required months and even years to be effective. Stoyva (1979) feels that another reason these methods have not been more widely utilized is that while perhaps effective in the hands of their originators, they are less successfully used by their followers, and that reading about these techniques does not ensure mastery.

With the growing use of relaxation training as



treatment for a variety of disorders, the older techniques have been shortened in length and new techniques arisen to help patients bring about generalized relaxation rapidly and effectively. Among the newer techniques, biofeedback-assisted relaxation training has received the most attention. Yet the mechanism(s) by which relaxation training is learned by patients has never been adequately explained.

In certain applications of biofeedback training the argument is still continuing as to whether or not control of functions such as heart rate or blood pressure represents a case of "pure" instrumental autonomic conditioning, previously thought impossible (Kimmel, 1974). Alternately, it has been proposed that changes in these functions may be mediated cognitively or via skeletal muscle changes (Katkin & Murray, 1968). Lazarus (1974) sees this argument in the larger context of what he considers the individual's "adaptive commerce" with the environment, which includes individual attitudes, beliefs, coping strategies, etc.

In line with this latter school of thought regarding voluntary control, but in keeping with the nomothetic approach of the former, the present study can be seen as an examination of individual differences in cognitive information processing styles and their impact on the learning of voluntary relaxation.

## REVIEW OF THE LITERATURE

### Biofeedback

The concept of feedback as part of a servo-control mechanism in self-regulation is well known in fields such as electrical engineering and physiology. It arose from the comparative study of electronic computers and the human nervous system, which encompasses the field of cybernetics (Wiener, 1948). In this context, a feedback loop is a closed system in which information is fed back from the output to the input of a system and utilized to increase control. As Ashby (1963) has stated, a variable cannot be controlled unless information about the variable is available to the controller.

In the human system, one means of increasing control would be by augmenting and/or processing physiological signals usually outside awareness, and making this information available to the subject, thus increasing physiological control. While this is reminiscent of the concept of homeostasis, or internal self-regulation feedback loops, in biofeedback the information is typically presented via some electronic device. Although some feel that a more precise term for this process would be external psychophysiological feedback (Gaarder & Montgomery, 1977), in common usage the term biofeedback has come to describe this particular

interface between human and machine. Hence, biofeedback may be defined as the technique of using equipment (usually electronic) to display physiological processes within the body and usually outside of awareness for the purpose of consciously altering these otherwise involuntary events by altering the displayed signal (Bakal, 1979; Basmajian, 1979).

Stoyva (1976), in commenting on the historical antecedents of biofeedback, notes that various researchers have used this method without recognition of the principles outlined above. For example, Jacobson occasionally allowed patients in PMR training to observe EMG activity on a crude oscilloscope as they tensed and relaxed various muscles, thus completing a feedback loop. Adrian (1934), in some of the earliest experiments with the EEG alpha rhythm, placed himself in a feedback loop with his own alpha activity. In the earliest known example, Bair (1901), in attempting to teach subjects the unusual muscle activity of wiggling their ears, found that learning only occurred when subjects viewed a kymograph stylus which was driven by a lever attached to the ear and which amplified and displayed small muscle changes.

Bakal (1979) notes that biofeedback has gone through a recent period in which its powers were greatly exaggerated and during which it achieved "fad" status. Unsubstantiated claims of health, happiness and well-being through "mind control" unfortunately contributed to a resistance to

biofeedback in medical settings. As this furor has died down, research in physiological control via biofeedback has continued, and there is now evidence of increasing use of biofeedback in medical settings with stress-related disorders (Corson, 1980).

### EMG Biofeedback

The lack of awareness of chronic muscle tension levels and their involvement in the stress disorders reviewed above (see Introduction) have made muscle tension feedback the clinical workhorse of biofeedback (Stoyva, 1979). In this application, surface electromyography (EMG), especially involving recording electrode placement on the frontalis muscle, has been widely used as a measure of arousal, sympathetic tone, and CNS activation (DiCara, 1974). Stoyva and Budzynski (1974) note that the striate musculature comprises more than 50% of body mass and most likely has effects on the entire organism.

Basmajian (1979) notes that diagnostic electromyography grew out of studies of neuromuscular and spinal cord functions. Adrian and Bronk (1929) were the first to observe that electrical responses in muscles provided an accurate reflection of the actual functional activity of the muscles. Maintained by Basmajian in the years following World War II, early uses of EMG were in terms of demonstrating control of individual motor units, and eventually in practical applications such as rehabilitation of stroke

patients by neuromuscular re-education (Andrews, 1964). Used in this manner, the biofeedback device senses muscle tension too small to be detected by the patient and presents this information to the patient in a form (such as an oscilloscope tracing) which corresponds to the degree of muscle contraction. The patient thus learns to gradually increase this tension in muscles rendered flaccid by cerebrovascular impairment. Thus the biofeedback device provides a positive feedback loop to increase the gain of the system.

#### EMG Biofeedback as a Relaxation Technique

Shortly after the clinical application of biofeedback in rehabilitation medicine, Budzynski and Stoyva (1969) developed the use of an instrument to train patients in relaxation. Their device amplified and integrated muscle action potentials over time and this signal then modulated a tone which varied in pitch proportional to muscle tension, giving subjects a meaningful feedback loop with muscle activity. They demonstrated that subjects achieved deeper levels of relaxation with this device than when no feedback or irrelevant (not contingent on muscle tension) feedback was given.

Recently, Basmajian (1976) has given the rationale for using this procedure by noting that it is the myopotentials, or electrical discharges from the surface of striate muscle fibers which are sensed by the device, and that as muscle

contraction increases in strength these myopotentials occur in increasing numbers and frequency.

This biofeedback-assisted relaxation training is seen as reducing stress-produced tension in part by making the patient aware of muscle tension levels to which he may have become habituated (see Introduction) via a negative feedback loop, thus increasing control over tension. Staudenmayer and Kinsman (1976) have shown that subjects in biofeedback training were more aware of changes in EMG level across training trials than subjects who received no feedback or verbal feedback as to performance.

Stilson, Matus, and Ball (1980) found differences in accuracy of tension control for the frontalis (forehead) and forearm muscles, and speculate that these muscles may operate via somewhat different control mechanisms. They note that Gellhorn (1964) feels that the frontalis and other facial muscles have a special role in emotional expression not shared by other skeletal muscles. This would appear crucial for establishing a relationship between anxiety and other subjective states and muscle tension. This may also explain the occasional failure to find generalization from frontalis relaxation to other muscles (e.g. Shedivy & Kleinman, 1977).

Stilson et al. conclude that muscle relaxation may depend less on afferent (inflow) information from muscles than it does on efferent outflow (or lack thereof). In

this theory a stored image of the relaxed state is compared to actual outflow and adjustments made until the perceived efferent activity matches the image. The biofeedback device then confirms the reduction in efferent activity by feeding back this information to the subject.

This theory impinges on various cognitive conceptions of relaxation, particularly the concept of relaxation as a cessation of striving. Coursey (1975) has observed that subjects attend to the feedback less as the training progresses and achieve their deepest levels of relaxation when they stop trying to influence the feedback but instead engage in hypnogogic imagery or "drifting." He points out that this is consistent with the view of relaxation as a passive, control-abandoning, non-goal-directed, noneffortful state.

In reviewing the uses of EMG biofeedback as a relaxation technique it should be noted that in some studies there is little or no correlation between the specific effects of EMG biofeedback and subjective relief from tension. This can be seen in studies of the effectiveness of biofeedback in reducing tension headache, one of the first stress-related clinical applications of muscle tension feedback.

Budzynski et al. (1973) demonstrated in a controlled outcome study that their EMG biofeedback procedure was significantly more effective than no feedback or pseudo

feedback in reducing tension headache, a finding which has been replicated several times. However, Cox et al. (1975) found no difference between EMG biofeedback and other relaxation techniques in terms of their effectiveness in reducing headache. In fact, in this study frontalis muscle tension was actually lower in the non-biofeedback relaxation group. Regardless of method, Budzynski (1978) recently reviewed the findings on tension headache treatment and found that decreasing frontal EMG is effective in reducing headaches in approximately 80% of patients. He also feels that EMG biofeedback may be more effective in terms of the speed with which relaxation is learned.

Since tension headaches have been seen as resulting in part from excessive contraction of cephalic muscles (Haynes et al., 1975; Hutchings & Reinking, 1976; Vaughn et al., 1977), relaxation training can be seen as specific with regard to the etiology of the disorder. The success rate has been impressive enough that the American Association for the Study of Headache recently approved biofeedback as a valid form of headache therapy (Board of Directors, 1978). Other disorders in which muscle tension feedback has been seen as specific to the problem are neck muscle pain, lower back spasm, torticollis, and writer's cramp (Gaarder & Montgomery, 1977).

Such specificity does not occur in EMG biofeedback treatment of many of the stress-related disorders. This is



especially true in the case of highly subjective states such as anxiety and/or "tension." Brown (1977) points out that the difficulty in evaluating the effectiveness of biofeedback in these disorders is that of determining the relative contributions of muscles, the autonomic nervous system, and the subjective aspects.

In an oft-cited study, Raskin et al. (1973) selected thoroughly screened and documented chronic anxiety cases and gave them EMG biofeedback training followed by 8 weeks of daily practice of muscle relaxation at home. Of the ten patients in their study, only four showed any improvement at the end of the study in terms of reported anxiety.

Raskin found this encouraging, however, in that the patients had been troubled by anxiety for a minimum of two years at the time of their study, despite having received psychotherapy and taking medications. The most significant finding was that the relaxation training markedly improved the sleep difficulties of five of the six patients with this problem, and all four patients with headaches reported a marked reduction in headache frequency and intensity.

What was paradoxical about these findings was that almost no correlation could be found between EMG activity and anxiety ratings, even in patients who benefitted from the training. They concluded that the effects of the relaxation training, while beneficial, were too transient to be fully incorporated into the lives of the patients.

In examining individual differences between patients, as in the present study, LeBoeuf (cited in Brown, 1977) found EMG biofeedback effective in reducing both generalized anxiety and specific symptoms in patients reporting predominantly muscle symptoms, but no change in patients reporting predominantly autonomic (visceral) symptoms. Once again the determining factor appears to be the specificity of the treatment with regard to the symptom complaint. This effect, however, may be clearer for EMG biofeedback than for other relaxation techniques. Brown (1977) notes that studies in which biofeedback has been compared with PMR in anxiety states typically find a lack of correlation between measured muscle tension and subjective feelings for EMG biofeedback, but a high correlation for PMR training. Among other hypotheses, this may indicate different cognitive strategies are employed in different relaxation techniques, and that these strategies are an essential factor in controlling generalized anxiety.

Finally, Connor (1974) found that brief relaxation training (a modified form of PMR) did not affect either verbal reports of anxiety or autonomic level (heart rate and skin conductance) in a mildly anxiety-arousing situation. The relaxation training did affect autonomic reactivity, with subjects who received the PMR training reacting less to the anxiety condition than control groups.

Connor concluded that the primary effect of muscle

relaxation training is on autonomic reactivity rather than arousal level following exposure to anxiety situations. Therefore he feels that this is primarily a cognitive effect rather than a muscle effect, and that this need not be accompanied by subjective awareness. Connor rightly points out that in part his results could be accounted for by the use of a mild anxiety condition and normal subjects, and hence few subjects in any group reported feeling anxious.

Both theories and effects of EMG biofeedback on stress, tension, and anxiety can be seen as incompletely conceptualized. In the above review there are suggestions that cognitive strategies, that part of the individual which evaluates, synthesizes, plans, etc. can and do influence the course and outcome of relaxation training. Many of the gaps in the research literature concern such strategies in biofeedback training, especially with regard to individual differences, or the personal cognitive "styles" by which people may be classified. It is to one such cognitive variable that the review now turns.

### Mental Imagery

The role of mental imagery in Psychology was once prominent. It provided the raw material of the psychological laboratories of the introspectionists. McKellar (1972) notes that Fechner, as early as 1860, was interested in the phenomenon, but scientific study of imagery and images usually dates from Galton and his interest in individual

differences.

The demise of the study of imagery can be traced to Watson's behavioral revolution in the United States. The introspectionists were concerned with the internal processes underlying imagery, based on the self reports of their subjects. It was this approach which was so successfully attacked by the behaviorists, arising from the philosophical position of classical materialism and the reductionistic scientific approach it engendered. As Holt (1972) puts it, in this approach mental events are dependent variables or effects rather than independent variables or causes. More importantly, this position has led even current critics of mental imagery (Pylyshyn, 1973) to see it as nothing more than an epiphenomenon of consciousness, unworthy of scientific study.

Holt postulates that for this subjective, phenomenal concept (mental imagery) to be studied scientifically, it must be seen in the context of a philosophical monism which states that mental phenomena and their neurological counterparts (e.g. perceptual apparatus) are different aspects of a complex whole. Thus, consciousness may make a considerable difference in the understanding of "observable" human behavior. To underscore its importance, Holt (1964) declared that mental imagery was returning from the ranks of the ostracized.

Approaches to mental imagery within the past two

decades have concerned themselves with the definition of the image. The philosophical positions outlined above seem as responsible as any others for the definitions of mental imagery chosen by various researchers. Thus, Paivio (1971) takes an operational definition of imagery as an intervening variable tied to measurable behavior such as spatial abilities, while Richardson (1969) regards what he calls "memory imagery" as an internal representation of an external object or event. Horowitz (1970), while also taking a phenomenal approach, favors a dynamic (and dualistic) position of images as either conscious or unconscious. In the unconscious realm he sees images as primarily composed of signs, fantasies and introjects found in close relationship to emotional processes.

Ultimately, the question of whether mental imagery is some sort of internal picture or "merely" the excitation of neurophysiological structures concerning perception, and the relation of both to external events is unimportant. Proposing an equivalence between perceptual process and imagination, Shepard (1978) postulates a "second-order" isomorphism in which the functional relationships among imagined objects must copy the functional relations among perceived objects, and hence subjects may report on an imagined object with as much "objectivity" as when objects are directly perceived by them. This also suggests a definition of mental imagery usable for the present study.

An image is a sense-experience in one or other of the sense modalities which can only be distinguished from a percept, hallucination, or illusion, according to (a), the context in which it occurs, and (b), the attitude of the experiencer, including his ability to construct it. (Short, 1953, p.39)

Hence, mental images can be defined in terms of the concrete external objects to which they correspond, a position with which Bugelski (1977) agrees, and this allows empirical investigation, in which mental imagery is an independent variable and its functional relationship to various dependent measures may be studied.

#### Imagery and Physiology

Mental imagery may be seen as an ability which most of us possess. McKellar (1957) reported that 95% of his subjects were able to form a visual image in full wakefulness when given specific instructions to do so, and Brower (1947) found that this was true of 97% of his sample. There is also evidence, however, that individuals differ in their degree of voluntary imagery ability. It was this difference which interested Galton (1907), with particular attention to various kinds of sensory images. Griffitts (1927) developed tests of individual differences in imagery across sense modalities, and his results led him to conclude that those who most frequently utilized visual imagery were concrete thinkers and those who used auditory-motor imagery were verbal thinkers.

Gradually, researchers began to discover that a

subject's rated vividness of imagery was more of a determinant to imagery performance than the particular imagery mode he utilized (auditory, kinesthetic, etc.). Sheehan (1966) found high intercorrelations among the modes of imagery, but also found that he could reliably measure voluntary imagery ability using his own revised form of Betts' (1909) Questionnaire upon Mental Imagery (QMI). Sheehan's (1967) revision of this test has since been known simply as the Betts' QMI and is currently the most widely used measure of imagery vividness according to White, Sheehan, and Ashton (1977) in their review of imagery assessment.

In this switch from intra- to interindividual differences in voluntary imagery ability, the visualizer-verbalizer dichotomy emerged. Reminiscent of Griffitts' concrete and verbal thinkers, it was utilized as early as 1929 by Golla and Antonovitch, who found that a visual imagery style was associated with regular breathing patterns and a verbal-auditory imagery style with irregular breathing. They designated the "types" by questioning their subjects. They also found that a "visual" task, such as mental cube manipulation, led to more regular breathing, and that states of emotion and intellectual tension are accompanied by respiratory disturbances. Through their questioning, they felt that a verbal or visual style is relatively permanent, with their subjects reporting using a

consistent style since childhood. Most of these basic findings have been replicated, especially the basic difference in respiratory regularity.

Wittkower (1934) studied the breathing regularity of psychotic patients and found that 80% of the schizophrenics he measured were regular breathers, and that among normals 60% were regular and 40% irregular. Wittkower used a wooden box in which subjects sat and which sealed airtight around the neck. A tube running out of this box provided a column of air which was displaced by the breathing of the subject. The air drove a stylus attached to a paper roll. Interestingly, if Wittkower had turned the device around so that it faced the subject, it would have provided a feedback loop, and hence been a biofeedback instrument.

Using more advanced technology, Short (1953) measured breathing span by placing a thermocouple beneath the nostrils of his subjects and using temperature variations as an index of respiration. He also found the expected relationship between breathing patterns and cognitive style, classifying the "visualists" and "verbalists" (his terms) as each representing roughly half of his sample.

Chowdhury and Vernon (1964), while replicating this physiological finding, also postulated relationships between visual and verbal styles and variables such as interest and vocational choice. Recently, Hiscock (1978) found



that subjects who report visual imagery usage tended toward aesthetic, social, and religious values.

Finally, Richardson (1977) using his own imagery measure, the Verbalizer-Visualizer Questionnaire (VVQ), demonstrated that verbalizers have significantly more irregular breathing patterns than visualizers in both rest and work (mental) conditions.

A dissenting note in this seeming relationship between a cognitive preference and a reliable physiological measure is the finding of Zikmund (1972) who reported that in his study a variety of autonomic measures (heart rate, respiration, peripheral vasomotor changes, EEG, and eye movements) were unrelated to visual imagery. In his study he instructed subjects for visual and verbal imagery, and then measured their effects on autonomic function. If voluntary imagery is indeed a trait characterized by differential ability, then presumably it was randomly distributed in his samples, and its effects were not seen independently. This is the importance of the work of Sheehan in his use of the Betts' questionnaire, and shortly afterwards the work of Paivio (1971) in his development of the Individual Differences Questionnaire (IDQ) to categorize thinking modes as imaginal or verbal.

#### Measurement and Validity of Mental Imagery

In her review of imagery ability and cognition, Ernest (1977) examined three approaches to the measurement

of imagery: self-ratings, spatial tests, and performance measures. The questionnaires and tests referred to in the present study, such as the Betts' QMI and the IDQ are examples of self-report measures, while spatial tests typically utilized in imagery assessment include the Flags test, the Minnesota Paper Form Board, Space Relations, the Primary Mental Abilities Space Test, and others.

Performance scales usually involve tasks such as image generation speed or memory code tests, but with investigators typically constructing their own devices, and with little conceptual agreement as to what constitutes imagery performance. Those studies which have compared performance to self-report measure have shown little or no relationship between them (Danaher & Thoreson, 1972; Rehm, 1973; Rimm & Bottrell, 1969).

Ernest (1977) notes that while some researchers have found weak correlations between self-ratings of imagery and spatial tests, factor analytic studies typically show that they load on separate factors, with self-report measures correlating moderately among themselves and usually loading most heavily on a "general imagery" factor.

The moderate correlations between self-ratings of imagery are understandable in light of the variables they purport to measure. These scales can be divided into three types: those which claim to tap habitual styles (verbalizer or visualizer), such as the IDQ and VVQ; those claiming

to measure imagery vividness, such as the Betts' QMI and Marks' (1973) Vividness of Visual Imagery Questionnaire (VVIQ); and a test of imagery control, the Gordon (1949) Test of Visual Imagery Control (TVIC). Thus conceptually, these tests, sharing a general imagery factor, but measuring different aspects of it, can be expected to agree only moderately among themselves, and, as cited above, not necessarily with spatial ability measures.

Similarly, Hiscock (1978) found that tests of spatial abilities share little or no variance with visual imagery questionnaires, and, in the case of the IDQ in particular, feels that overall it is useful for investigating habitual styles of information processing and can be seen as a means of validating the concept of visual imagery as a cognitive style. Several other researchers have also found that spatial tests and imagery measures are not interchangeable (DiVesta et al., 1971; Neisser, 1970; McLemore, 1976). Hiscock concludes that whatever imagery questionnaires measure may be different from, but no less interesting than, that which visuospatial tests measure.

Aside from factor analytic studies, another way to view the validity of self-report measures of imagery is via conceptually relevant correlates of imagery function. White, Sheehan, and Ashton (1977) in their review, state that in addition to the physiological functions noted above, these scales have been positively related to a range of

variables such as intentional and incidental learning, stereotyped imagery, frequency of dream recall, laterality of eye movements, and others.

Sheehan's studies (1966, 1967, Sheehan & Neisser, 1969) appear to provide an indication that imagery is useful in the performance of certain cognitive tasks. These studies are concerned with imagery differences in recall, involving in part his subjects' manipulation of blocks into geometric shapes. While accuracy of recall was correlated within subjects with vivid imagery ratings, accuracy was not associated with differences between subjects who differed on reported imagery vividness. Thus, visualizers and verbalizers may be equally successful on many cognitive tasks, but Sheehan's data also suggest the possibility of differing information coding strategies.

This is the thrust also of Paivio's work on imagery and paired-associate learning (Paivio, 1971). By varying the concreteness and abstractness of paired nouns and instructing subjects to use imagery as a mediational process, as opposed to no strategy or rote repetition instructions, typically results in superior recall. From this, Paivio concludes that imaginal and verbal processes define different cognitive dimensions, but appear to function together in what he has called the "dual-coding" hypothesis (Paivio, 1972). In this theory, information stored in both imaginal and verbal systems enhances the probability of

recall in tasks requiring a verbal response, but Paivio also notes that visual imagery may be superior in other tasks, such as those involving spatial information.

Further, these imaginal and verbal systems have been related to lateralization of brain function. In constructing his test of verbalizer or visualizer tendencies, Richardson (1977) reviewed the findings on hemispheric specialization and laterality of eye movements, and came to some intriguing conclusions. He pointed out the evidence that the left hemisphere appears to be concerned with sequential processing and verbal labeling of incoming information, and the right hemisphere with associational processing and organizing information in terms of complex wholes via imaginal process. Other studies have shown that when questions are asked which require sequential processing, this results in observable right lateral eye movement, and left lateral eye movement results from asking spatial type questions. Presumably this is due to the contralateral control of eye movement. Perhaps unknown to Richardson, earlier Schwartz, Davidson, and Maer (1975) had asked subjects verbal and visual type questions and observed differential cortical (EEG) activation of the left and right brain, respectively.

Ernest (1977) reviewing this same literature, warns that this effect is clearest in right-handed males, as function appears less lateralized in females and the left-

handed, and hence these individuals may achieve high imagery scores for somewhat different reasons. Still, using his self-report measure, Richardson was able to identify individuals of both sexes who show habitual left or right eye movement regardless of the question content. Hence, being a verbalizer may not mean merely a visual imagery deficit, but rather represent an individual's habitual information processing mode or cognitive style. In terms of the adaptability of possessing one or the other style, intelligence scores do not correlate with self-report imagery measures (McLemore, 1976).

As to how the physiological data on respiratory regularity relates to cognitive style, Richardson notes that it is generally assumed that the minute tongue and laryngeal movements of verbalizers interfere with regular breathing, while Bugelski proposes a more central explanation:

There appears to be at least one identifying feature of imagery that may lead to a closer analysis, namely, the lack of movement of the gross musculature. This finding may in part explain some negative reports of individuals who claim they have no imagery. They may be hyperkinetic types, restless, twitchy, or otherwise motorically engaged....Any activity of the body is likely to interfere with imagery and prevent it. (Bugelski, 1971, p.56)

It is interesting that this hypothesis is consistent with the literature on dreaming (imagery state) and lack of muscle tonus (Zubek et al., 1963; Morgan & Bakan, 1965).

The reliability of self-report imagery scales has ranged from moderate to high in terms of test-retest

correlation coefficients (McKelvie & Gingras, 1974; Westcott & Rosenstock, 1976). While White, Sheehan and Ashton (1977) point out that these reliabilities tend to drop somewhat with lengthening time intervals (e.g. TVIC test-retest  $r = .62$  after one year), they also note a surprising degree of internal consistency both in terms of Cronbach's alpha and split-half measures.

Critics of self-ratings of imagery point to the study of DiVesta et al. (1971), who concluded that self-ratings, such as the Betts' QMI and the TVIC, are contaminated by a social desirability response set. To counter this, proponents note that McLemore (1976) found a very low correlation between self-reported imagery and the Marlowe-Crowne (M-C) social desirability scale.

Richardson (1977) found no relationship between the M-C and his test (the VVQ), but he reports that the QMI may be vulnerable to social desirability response sets in males only (reported in White, Sheehan, & Ashton, 1977). Hiscock (1978) examined the relationship between social desirability and five self-report imagery measures (including the QMI and TVIC), among other variables. None of the measures correlated higher than .20 with the M-C, and that variable was sex, with females tending to endorse items in a socially desirable direction to a greater degree than males, or just the opposite of Richardson's findings. The average of the correlations with the five imagery measures was exactly

zero. Thus, no evidence has been found for a social desirability response set for several self-report imagery measures, and in those cases where it has been found, other researchers have either failed to replicate the results or have found contradictory results.

With regard to one other hypothesis for individual differences in self-reported imagery, Wagman and Stewart (1974) found a generally low relationship between imagery self-report measures and hypnotic susceptibility. Sutcliffe (cited in Richardson, 1969) feels that imagery may be necessary, but is not sufficient, for the characterization of the hypnotizable personality.

Overall, there appears to be general agreement that self-report imagery measures show acceptable psychometric properties and conceptually relevant functional correlates, and cannot be lightly dismissed (McLemore, 1976).

#### Imagery as a Relaxation Technique

Fair (1979) has noted that "pleasant" images, such as imagining one's self on a warm, sunny beach, are frequently used to induce relaxation. Occasionally this has been observed as a cognitive strategy patients use even in the absence of instructions to do so. For example, Schwartz (1973) reports a serendipitous finding of the effectiveness of imagery as a relaxation strategy.

In the process of training a patient for temperature control, pleasant slides were used as positive reinforcement.



At one point the projector jammed, and the patient, who was a psychoanalyst, took this as a cue to free-associate to the blank white screen. He thought of the sun, warmth, beaches, etc., and reported that these images were most helpful in the establishment of the temperature control. Schwartz's equipment confirmed the patient's report concerning the effectiveness of these images. Schwartz feels that imagery may be an even more effective method of exercising physiological control than biofeedback. Agreeing with this conjecture, Meichenbaum (1976) notes,

One wonders whether the biofeedback therapist could enhance the client's attentional processes by using task-appropriate imagery. Clients could be encouraged to visualize the physiological changes as reflected on a printout, or perhaps more powerfully, imagine the actual changes to the specific bodily area or organ....The biofeedback therapist may be able to employ the client's cognitive processes as tools to enhance the training process. (p.207)

Task-appropriate, or a "directed imagery" procedure has been used recently with quite good results. In his well-publicized study, Simonton (1972) used directed imagery to have patients picture their immune systems "attacking" their cancer cells, and claimed significant results in terms of reductions in tumor size and freedom from symptoms. More in line with autonomic functioning, Minsky (1977) instructed hypertensives to imagine their blood vessels expanding, and to "see" the blood flowing smoothly and easily. He demonstrated significant reductions in mean diastolic blood pressure compared to groups receiving no

treatment or general relaxation instructions, which incorporated more general relaxation images.

Relaxation itself appears to be a good candidate for training via this method, and may have a reciprocal relationship with imagery. Bugelski (1971), as noted earlier, feels that a lack of gross movement is necessary for the occurrence of visual imagery, and Matthews (1971) speculates that relaxation may augment both vividness and the autonomic effects of imagery. Schwartz (1973) has stated that muscle training may be a likely candidate for cognitive control as it is already under some control as part of the motor system.

The review of differences in imagery ability suggests that for certain individuals this may be the technique of choice, and the learning of relaxation using different cognitive strategies is thus the major thrust of the study.

## INVESTIGATIVE AREAS

### Physiological and Subjective Correlates of Cognitive Style

Muscle tension. The studies on imagery and respiratory regularity suggest a link between cognitive style and physiological arousal. It has been suggested that those individuals who report low imagery usage may exhibit gross muscular involvement, interfering with imagery. Recently (Wakely, 1980), this has also been demonstrated with frontal EMG, a measure of muscle tension and related to a maladaptive response to stress. In this study visualizers exhibited less muscle tension, and hence more relaxation than verbalizers.

Locus of control. An alternative explanation of the relationship between tension levels and cognitive style is in terms of the nature of the measures used. As these are self-report measures, and, as noted earlier, they tend to correlate weakly with spatial ability measures, it appears feasible that an individual's belief in his control over imagery may be more responsible for a lower arousal state than his actual ability.

In this regard, studies utilizing the I-E scale (Rotter, 1966), a measure of the attitude toward either an internal or external locus of control over the source of reinforcement for an individual, have examined its

relationship to anxiety. While "internals" on this scale show greater verbal fluency than "externals" (Brecher & Denmark, 1969), it is the externals who report greater anxiety (Watson, 1967), apparently contradicting the expectation that they are visualizers, hypothesized to be more relaxed.

Examination of internal or external tendencies and physiological findings clarify the nature of this relationship. Houston (1972) found no differences in anxiety between internals and externals in avoidable and unavoidable threat (shock) conditions, but did find that internals exhibited increased heart rate to a greater degree than externals in both conditions. Similarly, Ollendick and Murphy (1977), while finding greater reported anxiety among externals, as Watson demonstrated, also found that internals exceeded externals on "baseline" heart rate, again indicating greater physiological arousal. Houston suggests that externals, seeing events as essentially outside their control, are more resigned, while internals became physiologically aroused in his threat conditions.

An explanation for this finding of increased reported anxiety among externals and increased physiological arousal among internals may be represented in the studies of Tolor and Reznikoff (1967) and Altrocchi et al. (1968), who found that external scores were related to sensitization and internal scores to repression. Hence, stress,

threat, or conflict, for example, may find its expression in the sensitizing external in reported anxiety, while the repressing internal may tend toward physiological expression, keeping awareness low and belief in control intact. Interestingly, one sequela of this pattern is that it is not inconsistent with the hypothesis of Bugelski that verbalizers (repressors-internals in this context) are motorically engaged, as an example of just this physiological activity, with implications for cognitive style.

In an earlier study, Wakely (1980) found that visualizers tended to believe in external control, and verbalizers in internal control, with these verbalizer-internals exhibiting higher resting muscle tension levels. This pattern was seen as consistent with a cognitive style which emphasizes an active, hyperalert, controlling, striving for achievement mode of interaction with the world.

Anxiety. As all patients in the earlier study, as well as the present study, presented with complaints of anxiety and tension, it becomes confusing that visualizers who report anxiety exhibit lower frontal EMG than verbalizers. In part, this and other failures to find consistent correlations between muscle tension and subjective states may indicate that when patients report anxiety they may not all use the same criteria in defining this term. Recently, it has been suggested that anxiety may not be a unitary construct, and that patients may experience varying

degrees of either cognitive or somatic components of anxiety (Schwartz, Davidson & Goleman, 1978).

If, as Richardson (1965) has suggested, the visualizer operates in terms of his visual intrapersonal experience, then images (a right hemisphere process) may be his primary mode of awareness, and anxiety experienced as maladaptive "worry" or cognitive rumination. These disturbing or frightening images can then be seen as external, or outside of his control. This may characterize the "sensitizer". Conversely, the verbalizer represses awareness of discomfort under stress and strives via the left hemisphere functions of logical, sequential information processing to overcome or take control of the situation. This may then result in significant somatic tension.

The interactions of these various cognitive styles and strategies lead to the following experimental hypotheses.

Experimental hypotheses.

1. Imagery scales correlate moderately with each other, and positively with frontal EMG.
2. Imagery scales correlate positively with the I-E scale.
3. Imagery scales correlate positively with cognitive anxiety and negatively with somatic anxiety.

4. Visualizers exhibit lower resting frontal EMG than verbalizers.
5. Externals exhibit lower resting frontal EMG than internals.
6. Visualizers exhibit higher resting hand temperature than verbalizers.
7. Externals exhibit higher resting hand temperature than internals.
8. Subjects tend to fall into either a visualizer-external or verbalizer-internal cognitive pattern.

#### Differential Treatment Effects of Cognitive Style

Verbalizers. It has been suggested that individuals who are poor in imagery ability may do particularly well in biofeedback training, which can be seen as tapping the logical and sequential information processing mode of the verbalizer. Rickles (Note 1) has described this type of individual as characterized by 1) operational thinking, or life as witnessed rather than experienced; 2) representational inhibitions, characterized by a lack of fantasy or daydreams; 3) reduplication, or others seen as self-duplicates or stereotyped people. What is especially relevant for the verbalizer/visualizer dichotomy is the belief that for these individuals stress-related illness is a dissociative split maintained to avoid anxiety. Rickles, labeling this personality pattern "alexithymia," notes that these

individuals act as if they had a "functional commissurotomy," with feelings locked into an inaccessible right brain. This can be seen as entirely consistent with the view of the verbalizer presented earlier, and with biofeedback seen as a "match" for these individuals in terms of the demands of the task and the characteristics of the person.

Visualizers. Similarly, it has been suggested that individuals who can evoke at will the clearest image of physiological changes taking place demonstrate control over these functions by the non-effortful, non-goal directed, associational processing mode of the visualizer (White, Sheehan & Ashton, 1977). While this is consistent with the review of imagery as a relaxation technique presented earlier, White et al. note that this hypothesis has never been tested directly. Hence, a directed imagery relaxation procedure constitutes a match between treatment and cognitive style in the case of the visualizer.

The predictions regarding a match between treatments and cognitive style lead to the following experimental hypotheses.

Experimental hypotheses.

9. Verbalizers exhibit lower average frontal EMG under biofeedback training than under directed imagery relaxation instructions.
10. Visualizers exhibit lower average frontal EMG under directed imagery relaxation



instructions than under biofeedback training.

11. Verbalizers exhibit higher hand temperature under biofeedback training than under directed imagery relaxation instructions.
12. Visualizers exhibit higher hand temperature under directed imagery relaxation instructions than under biofeedback training.

### Differential Cognitive Effects of Treatments

Locus of control. In recent years a few studies have appeared examining the relationship of the locus of control concept to relaxation training. Holliday and Munz (1978) note that while some of these studies have shown that generally internals are better able to control physiological processes through feedback than externals, very few studies have reported the effects of training on this variable. Two studies have found that internals have higher resting muscle tension levels than externals (Fotopoulos & Binigar, 1976; Wakely, 1980).

Carlson (1977) found that subjects given EMG feedback shifted to a more internal (or belief in personal control) orientation following this training, but that the magnitude of the effect was not a function of EMG change. Stern and Berrenberg (1977) found that internals and externals did not differ on pre-training EMG and that internals were not more successful than externals in lowering

EMG levels. Muscle tension reduction was associated with receiving biofeedback rather than false feedback or no feedback, and only the true feedback resulted in a significant shift to an internal locus of control.

In an interesting (and revealing) comparative study, Zaichowsky and Kamen (1978) found that EMG biofeedback and two forms of meditation training for relaxation were all equally successful in lowering muscle tension levels compared to controls, but only subjects receiving biofeedback shifted to a more internal control belief.

All of the above studies used normal (college students) populations except for Holliday and Munz, who divided subjects into "psychosomatic" and "nonpsychosomatic" groups. They found that only the nonpsychosomatics shifted to a more internal control locus following biofeedback, even though both groups lowered frontal EMG.

Alternately, relaxation has been seen as a process of giving up control and ceasing the striving characteristic of the internal (see Introduction). In this view, relaxation techniques which emphasize passivity and a non-goal directed approach should lead subjects to a less controlling and hence more relaxed state. While this appears paradoxical with regard to the locus of control studies presented earlier, this hypothesis is consistent if it is supposed that there is an interaction between degree of control and tension, rather than the direction of control. Reinking

(1976) found that an internal control-high anxiety group acquired EMG skill more rapidly than other combinations of locus of control and anxiety level. Rotter (1966) has noted that extreme scores on his scale may be associated with pathology, with intermediate scores more desirable. While biofeedback may help extreme external subjects toward a more internal locus of control to increase physiological control, a cognitive relaxation procedure such as an imagery technique may help the striving internal give up control and relax.

Anxiety. The differences between biofeedback and imagery may also touch on perceptions of anxiety. It was noted earlier that individuals may differ in their degree of either cognitive (worry) or somatic (tension) anxiety. Muscle tension feedback can then be seen as a treatment for somatic anxiety, as its direct effects are on a somatic variable. Conversely, the maladaptive worry and cognitive rumination characteristic of cognitive anxiety may best be treated by a relaxation procedure which emphasizes replacing these cognitions with ones of relaxation.

The two treatments can thus be seen as having different cognitive effects and lead to the following predictions.

Experimental hypotheses.

13. Subjects become more internalized following biofeedback training.

14. Subjects become more externalized following directed imagery relaxation instructions.
15. Subjects report less somatic anxiety following biofeedback training.
16. Subjects report less cognitive anxiety following directed imagery relaxation instructions.

## METHOD

### Subjects

Subjects were right-handed adult male outpatients at the West Side Veterans Administration Medical Center, Chicago, Illinois. Located in a large urban medical center complex, this facility is a 500 bed general medical-surgical hospital serving veterans in the metropolitan Chicago area.

Thirty patients referred to the Biofeedback clinic and found suitable for relaxation training were used as subjects. They ranged in age from 23 to 64 years, with a mean age of 41.9 years. All patients were screened by the experimenter for symptom frequency, duration, and intensity as well as motivation for treatment and "ego strength". In this last regard, patients with treatment histories of psychotic and/or depressive episodes were excluded from treatment. Overall, this set of guidelines in the choice of patients is identical to that recommended by Gaarder and Montgomery (1977).

All 30 patients in the study presented with complaints of anxiety or tension and with problems seen as related to a maladaptive response to stress (see Introduction). This group of patients could be classified as chronic stress responders as the mean symptom duration was 5.52 years for

the group, despite medical and/or psychiatric treatment in all cases during at least part of their symptom history. Thus, all patients were deemed appropriate for relaxation training. During the treatment screening, patients were asked to participate in an investigation of cognitive style and relaxation training, and were given an information sheet (see Appendix A) describing the study, which involved a total of 12 sessions.

While all referrals were from physicians and were for treatment, in several cases referring physicians were reluctant or unwilling to discontinue patient's medications during the study. As a result, 4 of the 30 patients were receiving small ( $< 25$  mg./day) doses of benzodiazepine (muscle relaxing) drugs, but they were equally represented in each cognitive style (two each).

Although 30 patients were available for the initial phase of the study, a total of 20 patients completed the entire treatment course, and it is their data which are reported in hypotheses regarding treatments. Subjects left the study for a variety of stated reasons, chiefly centering around the distance they traveled to the clinic, and their departure appeared unrelated to the variables in the study.

Of the 10 who did not complete the study, five left after no more than three sessions and two others moved out of the Chicago area during the course of training.

Examination of the physiological and subjective measures used in the study revealed that these subjects did not differ from those who completed all sessions on initial EMG, temperature, imagery, locus of control, and anxiety (all  $t_s < 1$ ). The age of these subjects was also not a factor in their failure to remain in treatment ( $t(28) = 1.21$ ,  $p > .05$ ). Consequently, their scores were retained in examining pretreatment hypotheses.

After the completion of the study the patients received additional relaxation training as needed to help them control their symptoms.

#### EMG and Temperature Apparatus

Each subject's frontalis muscle tension and peripheral temperature were recorded throughout the experiment with a Coulbourn Instruments modular biofeedback system.

In this system 1 cm. (diameter) Ag/AgCl surface recording electrodes (S11-72) picked up frontalis myopotentials which were transmitted via an electrically shielded cable to a Bioamplifier unit (S75-01) set at 50 K gain and filtered for a bandwidth of 90-1 K Hz. This unit is characterized by low-noise, high-gain input amplifiers with high common mode rejection and high input impedance.

The processed signal was fed to a Cumulating/Resetting integrator (S76-22) where it was full-wave rectified, so that the signal consisted of all voltage amplitudes above zero. The reset frequency of the integrator was

determined by the voltage input over time. Since the integral represents the area under the curve of varying signal intensity, and the electrical representation of this intensity in the muscle has units of microvolts, the resultant integrator output was set in terms of microvolts of energy.

The unit provided analog EMG feedback by converting the varying EMG intensity into frequency oscillations and converting these oscillations into a tone which varied in pitch linear with muscle tension by means of an Audio mixer/Amplifier (S82-24).

Temperature was sensed by a thermistor (YSI Model 709) which, when combined with the signal conditioning circuits of the Temperature unit (S71-30) produced a varying resistance linear with temperature.

Muscle tension and temperature data were fed to high-speed serial Printout Counters (R21-01) which printed cumulative EMG and temperature values on paper tape at the end of each trial. Trial and session length were controlled by interval Timers (S53-21). Once a Switch Module (S22-02) was activated, sessions were entirely automated.

### Measures

#### Imagery scales.

1. Verbalizer-Visualizer Questionnaire (VVQ). The VVQ is a paper and pencil research instrument designed to measure individual differences in habitual modes of



processing cognitive events. This 15-item questionnaire was recently developed by Richardson (1977) from the 86 items of Paivio's IDQ. In attempting to select a subset of IDQ items based on their association with an index of hemispheric involvement (as noted in the Review of the Literature), Richardson administered the IDQ along with a test of directionality of lateral eye movements, and identified 11 items which discriminated eye movement criterion groups, with four additional items included because of their face validity and significant correlations with the total score. Item-total score correlations were then cross-validated on an independent sample for the 15 items. Scoring for the VVQ is arranged such that a low score indicates strong verbalizing tendencies and a high score strong visualizing tendencies.

Richardson reports retest reliabilities of .92 for both males and females over a one week interval. As noted earlier, Richardson also found no relationship between the VVQ and social desirability in two samples.

The evidence for relevant physiological data was also supplied in a test of breathing regularity. Verbalizers exhibited significantly more irregular breathing patterns than visualizers in both rest and work conditions.

Thus the VVQ, constructed in terms of a conceptually relevant variable (hemispheric brain function), exhibits adequate psychometric properties, and White, Sheehan,

and Ashton (1977) note that Richardson's claims for the questionnaire, if correct, have considerable practical and theoretical importance. Its inclusion in the present test battery can be viewed as a further test of its assumptions via the differential predictions regarding visualizers and verbalizers with regard to relaxation training.

2. Gordon Test of Visual Imagery Control (TVIC).  
Devised by Gordon in 1949 to discriminate subjects with autonomous imagery from those with controlled imagery, the TVIC in its original form consisted of 11 items scored either "yes" or "no" as to whether the subject could visualize the item described. One point is scored for each "yes" answer, hence higher scores indicate greater imagery control.

Richardson revised this scale in 1969, adding a twelfth item and a response of "unsure" worth one point, with "yes" now worth two points. This revision of the TVIC is now the most frequently used version, and the form used in the present study.

Reliability of the TVIC is surprisingly good for so short a measure. Internal consistency, as measured by Cronbach's alpha, of .88 has been obtained in an undergraduate sample (Juhasy, 1972), and split-half measures have yielded reliabilities ranging from .72 (Westcott & Rosenstock, 1976) to .84 (Hiscock, 1978), and a parallel form reliability of .73 (McKelvie & Gingras, 1974). Retest

reliabilities are high for shorter time periods--.84 for three weeks (McKelvie & Gingras, 1974), but drop somewhat with longer intervals--.62 for one year (White & Ashton, 1976).

Factor analytic studies have shown that the TVIC and Betts' QMI (a measure of imagery vividness) load on the same factor (DiVesta et al., 1971), casting some doubt on the claim that this scale is measuring imagery control. Lane (1977) also found a correlation of .47 between the TVIC and QMI, and McKelvie and Gingras (1974) an  $r$  of .67 between the TVIC and VVIQ (see below).

McLemore (1976) found that imagery control correlated with vividness of most sense modalities except visual imagery, and as the Betts' QMI is a multi-modal vividness scale, its association with control may be due to the contribution of non-visual components of the scale. Recently, White and Ashton's (1977) factor analysis of the TVIC revealed four interpretable factors which they labeled movement, misfortune, color, and stationary.

White, Sheehan, and Ashton (1977), summarizing the findings on the effects of social desirability on the TVIC, find only slight evidence for this response set, even when conditions and experimenter status were manipulated in attempts to demonstrate it.

The TVIC scale has been related to stereotyped imagery (Gordon, 1949); mental practice of gymnastic

performance (Start & Richardson, 1964), where a combined score on imagery style and imagery control gave the best results; paired-associate learning (Morelli & Lang, 1971); and dream recall frequency (Hiscock & Cohen, 1973). Wakely (1980), found the TVIC related to reductions in frontal EMG.

Ernest (1977), reviewing the TVIC, concludes that the evidence indicates the TVIC is an appropriate instrument for the measurement of the ability to manipulate or control visual imagery. In the present study, as a further test of its assumptions, the TVIC was included to again assess its effects on tension level.

3. Vividness of Visual Imagery Questionnaire (VVIQ). The variable of imagery vividness has usually been measured by Sheehan's (1967) revision of Betts' QMI, a scale which questions subjects as to their reported imagery across a number of sense modalities. Marks (1973), noting that most tasks utilized in examining this variable are visual tasks, constructed a 16-item self-rating scale of visual imagery vividness. Subjects are asked to rate the image evoked by each item along a five-point scale of vividness, ranging from "Perfectly clear and as vivid as normal vision," to "No image at all, you only 'know' that you are thinking of the object."

Marks reports a test-retest reliability coefficient of .74 and a split-half reliability coefficient of .85, with McKelvie and Gingras (1974) reporting a split-half

reliability of .93, and test-retest reliability of .67. Dowling (cited in White et al., 1977) reports reliability of .94 (Cronbach's alpha), and his factor analysis of the VVIQ yielded a simple unitary factor, not surprising given the scale's claim of unitary (visual vividness) content.

Marks' original study with the VVIQ (1973) was concerned with picture recall. Marks notes that Sheehan's studies on recall (see the Review of the Literature) found no difference between subjects who differed on reported imagery vividness, but felt that these studies were flawed by obtaining vividness ratings on each trial after recall, producing an artifactual basis for an accuracy-vividness relationship; by the use of the QMI as a self-report measure of vividness; and by the use of stimuli of low meaningfulness (geometric designs). Varying these factors in his study, Marks found a highly significant relationship between VVIQ scores and picture recall accuracy. Further, this was replicated on two independent samples.

Gur and Hilgard (1975), using the VVIQ, found that vivid imagers were able to make faster discriminations between slightly different pictures when they were presented both simultaneously and successively, the latter leading them to conclude that imagery vividness is especially useful when information is not immediately available. Wakely (1980) found that only the VVIQ, among three imagery measures used, did not correlate significantly with the

I-E scale (see below), and hence may be a relatively "purer" measure of imagery ability. Ernest (1977) concludes that vividness may be useful in memory content retrieval, but is less facilitative in the implementation of recall strategies, which perhaps can be seen as more characteristic of imagery control. The scale was included in the present test battery to again assess its relationship to other cognitive variables as well as its effect on tension level.

Locus of control. Rotter (1966) describes the Internal-External (I-E) scale as a 29-item, forced-choice test (including 6 filler items) dealing with a person's belief about the nature of the world. Specifically, he considers the test to be a measure of the subject's generalized expectancies for internal (self) versus external (independent of self) control of reinforcement. Subjects must choose from between two differing views, internal and external, on each item. Low scores indicate an internal orientation, and high scores an external one, with a possible range of 0 to 23.

Estimates of internal consistency, reported by Rotter (1966) range from .69 to .79, and test-retest reliability (1-2 months) from .49 to .83, with both of these estimates based chiefly on student samples. For psychiatric patients, a 6-week test-retest reliability of .75 has been found (Harrow & Ferrante, 1969), which compares favorably with

the student samples.

Rotter (1966) also reports negligible correlations between the I-E scale and the Marlowe-Crowne social desirability scale (range =  $-.07$  to  $-.35$ ) and in those samples characterized by higher correlations (prisoners), Rotter points out that the testing conditions probably accounted for the results. Intelligence and the I-E scale are likewise found to covary insignificantly (Hersch & Schiebe, 1967; Rotter, 1966).

While sample means on the I-E scale vary from group to group, one common procedure to assess its effects has been to divide subjects into internals and externals on the basis of splitting scores at the mean and then examining differences between these two groups across a variety of variables. Joe (1971), examining the internal-external control construct as a personality variable, reviewed the research in a variety of areas such as achievement, reactions to threat, risk-taking, anxiety, adjustment, and learning, and concluded that overall the evidence supports the validity of Rotter's concept.

Rotter himself (1966) summarizes the findings by concluding that the individual who has a strong belief in control of his own destiny is likely to be alert to those aspects of the environment which provide relevant information; will take steps to improve his condition; places greater value on his ability; and is resistive to attempts

to influence him.

Specific findings with regard to tension levels, as noted earlier, suggest that when stressed, internals, placing greater value in ability, become physiologically aroused, while externals, being more resigned to "luck" or fate, report more anxiety. While causes for this finding are only speculative, it should be noted that Coursey (1975) views relaxation as a passive, control-abandoning, non-goal directed, noneffortful state. This would support the view that the internal would have particular difficulty with instructions to abandon this control, and hence exhibit a higher tension level. Yet it has also been shown that locus of control scores may change as a result of treatments, specifically biofeedback.

When change has been noted on the I-E scale it has been observed that only certain items on the Rotter scale appear to be affected. Mirels (1970) notes that his factor analytic study of the I-E scale identified two subscales: personal control (a belief in control over the course of one's life) and political control (a belief concerning ability to influence political institutions such as the government). Stern and Berrenberg (1977) note that one's sense of personal control appears more relevant and sensitive to therapeutic interventions, and hence more appropriate in terms of measuring relevant change with this scale. Mirels has identified 9 items of the original Rotter



scale which correlated significantly with the personal control factor for both males and females, and for males alone 13 items could be identified which described this concept.

As the present study used only male subjects, the larger 13-item subscale of personal control was chosen based on Mirels' analysis. It was felt that the larger number of items would avoid possible "ceiling" effects and that a longer scale would increase reliability. This subscale consisted on the following items from the Rotter I-E: 4, 5, 6, 9, 10, 11, 13, 15, 16, 18, 23, 25, 28.

Cognitive-Somatic Anxiety Questionnaire (CSAQ).

Schwartz, Davidson, and Goleman (1977) have recently described an anxiety questionnaire which separately assesses cognitive and somatic components of anxiety. They note that when anxiety is elicited in an individual in response to a stressful event that some individuals may experience anxiety in one predominant mode, while others may become anxious in a different manner.

They selected 14 items from well-known anxiety questionnaires which three independent judges unanimously agreed reflected cognitive or somatic anxiety. Subjects were asked to rate the degree to which they typically experience each of the symptoms listed when they are feeling anxious on a 1 to 5 scale, with 1 representing "Not at all," and 5 representing "Very much so." The sums of these ratings are then separately computed for cognitive and somatic

items, giving a total score on each anxiety type. With 7 items under each anxiety mode, subjects can thus score from 7 to 35 on each component, giving relative information as to their typical response mode.

The authors report that in addition to the face validity of the items, the validity of the CSAQ was determined by computing the correlation between it and the Spielberger State-Trait Anxiety Inventory, trait form. They report the separate correlations of the scales with the STAI to be .67 and .40, respectively, for cognitive and somatic anxiety. The correlation between the two scales was .42. They note that this is lower than other, earlier attempts to devise separate scales for these anxiety modes, and feel that the shared variance is sufficiently low to establish the validity of the concept of separate scales.

As a further test of validity, and relevant for the present study, the authors hypothesized that a relaxation technique such as physical exercise would have its primary effect on somatic anxiety, and meditation training would have its primary effect on cognitive anxiety. These predictions were borne out when the CSAQ was administered to groups who regularly practiced these activities.

In the present study the CSAQ was included to assess the subjective consequences of certain cognitive processing styles and the differential effects of EMG biofeedback and mental imagery as relaxation techniques. Significant

findings would help extend the utility of the CSAQ, as the present study can be seen as prospective rather than the retrospective method of validation used by the authors of the scale.

### Treatments

EMG biofeedback. When subjects were receiving biofeedback training they heard a tone which varied in pitch proportional to muscle tension level, with lower tones associated with relaxation. The pitch thus varied depending on whether subjects tensed or relaxed. Subjects receiving biofeedback training have reported that knowledge that the tone is under their control is almost immediately obvious. In the present study, subjects were instructed at the beginning of each biofeedback session to lower the tone as much as possible. The tone was continuously available for the 24 minutes of each training session.

Directed imagery. When subjects received this relaxation treatment they heard a 24-minute cassette tape recording of an imagery relaxation procedure. The first few minutes of this tape contained general instructions for deep muscle relaxation, with suggestions about the muscles feeling heavy, loose, limp, etc. However, after these general instructions the tape consisted of instructions for subjects to visualize various muscles in their body relaxing (hence directed imagery).

Subjects were presented with several suggestions as

to ways they could mentally picture or visualize the relaxation taking place. The tape stressed the importance of picturing the relaxation actually taking place in subject's muscles. In addition to these specific images, instructions were given for subjects to visualize themselves being perfectly well.

As one argument for the success of biofeedback could be that it is specific in terms of providing feedback for the measured variable, muscle tension, the tape centered the instructions on the muscles of the head and neck. This can be seen as an attempt to roughly match the specificity of the biofeedback training. When receiving the imagery relaxation procedure, subjects were instructed to attend to the suggestions and follow them as closely as possible.

The tape was adapted from that used by Minsky (1977) in his study of blood pressure control. The voice on the tape was that of Mr. Jeffrey Kunka, a Psychology Intern at West Side VAMC during the initiation of the study. The complete transcript of the tape appears in Appendix B.

### Procedure

The study consisted of twelve 90-minute sessions per subject, two sessions per week for six weeks. Subjects referred for relaxation training were screened during the first session for symptoms relating to tension and anxiety, motivation for treatment, and treatment history. During this initial session subjects found suitable for relaxation

training were informed as to the study and asked to participate. All 30 subjects agreed to do so and then completed the test battery described earlier with the tests arranged in the following order: VVQ, TVIC, VVIQ, I-E, CSAQ.

As all subjects knew they were referred for relaxation training, no attempt was made to hide this as the aim of the study. Since the study was concerned with differential effects within subjects, and the test scores and differential predictions regarding cognitive styles were unknown to them, motivation and expectancy can be seen as held constant within subjects across treatments.

Subjects were scheduled to return at the same time of day 3 or 4 days later, and all subjects did so. At this time (session 2) subjects were seated in a recliner chair in a sound-insulated room and the surface recording electrodes filled with Lectron II conductive paste and attached with adhesive collars to alcohol-cleaned skin. For each subject the active electrodes were placed approximately two centimeters above the center of each eyebrow, with a reference electrode placed on an imaginary line equidistant between them. Resistance between each electrode pair was checked with a standard volt-ohm meter, and values kept below the equipment manufacturer's recommended maximum of 50 K ohms total, with no pair of electrodes differing more than 25 K ohms from any other pair. The temperature thermistor was attached with surgical paper tape to the palmar surface

of the first phalange of the non-dominant hand of each subject.

In this baseline (no-treatment) recording session, subjects were instructed to relax as much as possible for 24 minutes without falling asleep, and the room light dimmed to the same low level for all subjects. A ventilation system fan ran constantly during the study, further dampening sound. All subjects were observed unobtrusively from an adjacent room through a small window during each session. No subjects appeared to be sleeping during the study, and none reported falling asleep.

The same no-treatment procedure was repeated in sessions 7 and 12, or following each of the relaxation treatments, to assess the treatment effects on the dependent measures. The I-E scale and CSAQ were also readministered to subjects following sessions 7 and 12.

This session length (24 minutes) is somewhat longer than "baseline" recordings of other researchers, and was prompted by Kinsman and Staudenmayer's (1978) finding that a lengthy series of baseline trials is necessary to ensure that each individual is at a similar point in his unique range of physiological activity.

During sessions 3-6 and 8-11 subjects received either four 24-minute sessions of continuous analog EMG biofeedback or heard a directed imagery relaxation tape played through the same small speaker located approximately three

feet directly in front of them. The order of presentation of treatments (either biofeedback or imagery) was counter-balanced across subjects by alternating the initial treatment presentation as each subject entered training. Feedback and tape volume were adjusted to a comfortable level for each subject, and EMG values recorded as noted above during the treatment sessions.

### Data Reduction

Cognitive style. All tests were scored following the conclusion of the study, so that the experimenter was unaware of subjects' test performance during the course of training. Examination of scores on the imagery questionnaires used to classify subjects as visualizers or verbalizers revealed that the scale specifically designed to identify these individuals, the VVQ, gave an adequate range of scores and that dividing subjects according to the mean of this scale yielded an equal number of visualizers and verbalizers. The measures of imagery control and vividness, the TVIC and VVIQ, respectively, were both highly positively skewed, and while not used to classify subjects, were examined with regard to other hypotheses generated in the study.

The Mirels I-E personal control scale was similarly split at the mean to identify internals and externals.

Physiological measures. The initial four minutes of each session was considered an adaptation period, and the

microvolt and temperature totals from the last five trials (20 minutes) were divided by 1,200 seconds to yield an average microvolt/second and temperature value for each session.

### Statistical Design

Overall, the study conforms to what Campbell and Stanley (1966) have termed a counterbalanced quasi-experimental design. During the treatment phase of the study, the order of presentation of the two treatments was counterbalanced by alternating which treatment was first for successive subjects. This resulted in four groups determined by the interaction of cognitive style (visualizer-verbalizer) and order of treatments (EMG biofeedback followed by directed imagery, or vice versa). As a result of treatment "dropouts" (see "Subjects" section), there was an inequality in the Order variable, with 11 subjects receiving imagery followed by biofeedback and 9 receiving the opposite order. As noted, visualizers and verbalizers were equally represented (10 each).

As all subjects in the study were patients in treatment, for analyses of treatment effects within group changes and between treatments differences were the measures of interest. For each subject, across all variables, treatment or post-treatment scores were subtracted from pre-treatment scores and the resulting change scores were used as the dependent measure. It was felt this would be the most



sensitive measure of clinical relevance and would help control for initial differences between groups. To attempt to control for the confounding of one treatment with another, the initial posttreatment session (session 7) was also used as the pretreatment baseline for the second treatment.

The EMG data were examined for effects during treatments by a 2 X 2 X 2 X 4 repeated measures analysis of variance (ANOVA), with Cognitive Style and Order as between subjects factors and Treatments and Sessions as within subjects repeated measures factors. Temperature, EMG, locus of control, somatic anxiety, and cognitive anxiety were also examined for posttreatment effects by separate 2 X 2 X 2 ANOVAs with Cognitive Style and Order as between subjects factors and Treatments as the within subjects repeated measures factor. As the groups were of unequal size, an unweighted means analysis (Winer, 1971) was utilized for all ANOVAs.

Alpha levels were set at  $p < .10$  for all analyses for two reasons: 1) the study was largely exploratory in nature, 2) the strategy of using the initial post-treatment session as the baseline for the second treatment is quite stringent. While larger statistical effects could be obtained by subtracting each treatment mean from the initial session scores, to do so would completely confound the treatments with each other. It was not hypothesized that

non-matching treatments have no effects on relaxation level, and hence relaxation "carry over" effects were potentially large. The strategy employed in the study minimized these effects.

Specific hypotheses regarding treatment differences for physiological variables were examined by simple effects analyses of Treatments for each level of Cognitive Style (or for visualizers and verbalizers). Changes in cognitive variables were tested by main effects.

## RESULTS

### Pretreatment

Table 1 presents the intercorrelation ( $\underline{r}$ ) matrix of all pretreatment measures in the study. This table indicates that only the correlations between two of the imagery measures (TVIC-VVIQ  $\underline{r} = .45$ ,  $\underline{p} < .05$ ) and the two anxiety scales (Cog. anxiety-Som. anxiety  $\underline{r} = .56$ ,  $\underline{p} < .01$ ) were significant.

In terms of specific hypotheses; 1) none of the imagery scales correlate meaningfully with EMG; 2) only the VVQ scale correlates positively with the I-E scale ( $\underline{r} = .19$ ), but insignificantly; 3) as predicted, although the VVQ correlates positively with Cognitive anxiety ( $\underline{r} = .32$ ), giving partial support to hypothesis 3, it also correlates positively with Somatic anxiety, or opposite to hypothesis 3. Both correlations approach significance. Likewise, the TVIC and VVIQ both correlate as predicted with Somatic anxiety ( $\underline{r}_s = -.23$  and  $-.10$ , respectively), but opposite to prediction with regard to Cognitive anxiety ( $\underline{r}_s = -.26$  and  $-.15$  respectively). None of these correlations are statistically significant.

Thus, the data of Table 1 give no support for hypothesis 1, and only partial support for hypotheses 2 and 3, but at statistically insignificant levels. This partial

Table 1

Correlation Matrix of Imagery Test Scores, I-E Scale,  
Anxiety Questionnaire, and Physiological Measures

Variable	2	3	4	5	6	7	8
1. VVQ	-.03	-.08	.19	.32	.30	.08	-.02
2. TVIC		.45*	-.04	-.26	-.23	-.01	.08
3. VVIQ			-.25	-.15	-.10	-.20	-.12
4. I-E				-.03	-.05	.02	.26
5. Cognitive Anxiety					.56**	-.13	-.01
6. Somatic Anxiety						.00	.24
7. Temperature							.13
8. EMG							

\* $p < .05$

\*\* $p < .01$

support comes mostly as a result of the effects of the VVQ scale, giving some validity to the choice of this scale as a means of dividing subjects by cognitive style.

The only remaining correlation which can be seen as consistent with the earlier literature review is the positive correlation between Somatic anxiety and EMG ( $r = .24$ ). All others are either near zero or opposite to expectations.

Table 2 presents the means ( $\bar{M}$ ), standard deviations ( $\bar{SD}$ ), and  $t$ -test (one-tailed, independent samples) comparisons of EMG tension levels and peripheral temperature for visualizers versus verbalizers and internals versus externals. The differences between groups were in the expected direction only for EMG means between visualizer (4.83 uV/seconds) and verbalizer (5.51 uV/seconds) groups, however this difference was not significant.

Opposite to hypothesis 5, externals exhibited higher frontal muscle tension than internals (5.53 vs. 4.81 uV/seconds), but this difference was also not statistically significant. On both visualizer-verbalizer and internal-external variables subjects did not differ in age ( $t_s < 1$ ).

Differences between cognitive style groups on the autonomic relaxation measure, peripheral temperature, were quite small and clearly insignificant (hypotheses 6 & 7). Thus, while Table 2 reveals partial support for hypothesis

Table 2

Pretreatment EMG and Peripheral Temperature Means,  
Standard Deviations, and  $t$ -test Comparisons  
Between Subjects Grouped by Cognitive Style

Groups*	Mean	<u>SD</u>	<u>df</u>	<u>t</u>
Frontal EMG (Avg. uV/seconds)				
Visualizers	4.83	2.94	28	-0.62**
Verbalizers	5.51	3.05		
Externals	5.53	3.50	28	0.65**
Internals	4.81	2.38		
Peripheral Temperature (Avg. °C.)				
Visualizers	32.58	3.09	28	0.03**
Verbalizers	32.55	3.28		
Externals	32.46	3.41	28	-0.17**
Internals	32.67	2.94		

\* $n$  = 15 per group

\*\*ns.

4, hypotheses 5-7 cannot be confirmed.

The correspondence between visual-verbal and internal-external tendencies (hypothesis 8) was tested by Chi Square. Observed cell frequencies were nearly equal, and the test failed to reject the hypothesis of independence ( $\chi^2 = 0.13$ , ns.). Thus hypothesis 8 cannot be confirmed.

It was seen as important that the pretreatment selection process (counterbalancing to determine treatment order) not result in systematic differences between groups not predicted by the hypotheses. Consequently, the pretreatment scores of the four groups on all of the dependent variable measures in the study were examined for differences by two-way analyses of variance. Table 3 presents the ANOVA summaries for these pretreatment measures, and indicates that the four groups did not significantly differ on any of the dependent measures prior to treatment. This can be seen as both consistent with the results of hypotheses 1-8 and as indicating that the groups were well matched on all variables except for visualizer-verbalizer tendencies.

#### Treatment and Posttreatment

Physiological measures. The analysis of EMG changes during relaxation training is presented in Table 4. For this analysis, none of the main effects (Cognitive Style, Order, Treatments, Sessions) were significant. A significant Order X Treatments interaction,  $F(1, 16) = 6.08$ ,  $p < .05$ , and inspection of group means, indicates that since

Table 3

## Analyses of Variance for Pretreatment Measures

Variable	Source	<u>df</u>	<u>MS</u>	<u>F</u>
EMG	Style	1	15.09	1.55*
	Order	1	7.11	.73*
	St. X Ord.	1	2.94	.30*
	Within Cells	16	9.71	
Temp	Style	1	5.05	.47*
	Order	1	9.26	.87*
	St. X Ord.	1	.76	.07*
	Within Cells	16	10.69	
I-E	Style	1	.13	.02*
	Order	1	7.47	1.37*
	St. X Ord.	1	.93	.17*
	Within Cells	16	5.47	
Cog Anx	Style	1	113.32	2.70*
	Order	1	51.42	1.22*
	St. X Ord.	1	16.58	.40*
	Within Cells	16	41.98	
Som Anx	Style	1	49.84	1.08*
	Order	1	5.30	.11*
	St. X Ord.	1	5.30	.11*
	Within Cells	16	46.13	

\*ns.



Table 4

## Analysis of Variance for EMG Change During Training

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Between Ss	19		
Style	1	.54	.02
Order	1	10.93	.44
St X Or	1	.10	.004
Ss w. groups	16	24.64	
Within Ss	140		
Treatments	1	16.86	1.30
St X Tr	1	.05	.004
Or X Tr	1	78.74	6.08*
St X Or X Tr	1	6.81	.53
Error (Tr)	16	12.96	
Sessions	3	1.40	.80
St X Se	3	.26	.15
Or X Se	3	5.80	3.31*
St X Or X Se	3	3.30	1.89
Error (Se)	48	1.75	
Tr X Se	3	.57	.38
St X Tr X Se	3	1.50	1.00
Or X Tr X Se	3	1.73	1.15
St X Or X Tr X Se	3	2.24	1.49
Error (Tr X Se)	48	1.50	

\* $p < .05$

treatments were counterbalanced, whichever treatment was presented first accounted for the significant change in EMG level. A significant Order X Sessions interaction,  $F(3, 48) = 3.31, p < .05$ , and inspection of session means indicates that when subjects received biofeedback followed by imagery training their EMG level gradually declined over sessions, while when subjects received imagery followed by biofeedback, EMG changes were rapid and varied little over sessions.

The insignificant Cognitive Style X Treatments interaction, and specifically the simple effects analysis of Treatments for each style (Visualizer  $F(1, 16) = 0.56, ns$ ; Verbalizer  $F(1, 16) = 0.75, ns$ ) indicates that hypotheses 9 and 10 cannot be confirmed from changes in EMG levels during relaxation training.

Table 5 presents the group means and standard deviations of the physiological values on which subsequent analyses were based. Inspection of the table reveals that for EMG, visualizers were more relaxed during the baseline session following imagery than following biofeedback, and just the opposite effect can be observed for verbalizers. While visualizers achieved lower EMG values than verbalizers both prior to and during treatments, inspection of the table reveals that relative change in both groups was approximately equal, supporting the use of change scores as a dependent measure.

Table 5

Means and Standard Deviations for Physiological  
Measures Pre- and Posttraining

Style	Order*	Frontal EMG (Avg. $\mu$ V/seconds)		
		Pretreatment	Biofeedback	Imagery
Visualizer	B-I	4.65 $\pm$ 4.27	3.35 $\pm$ 2.41	2.85 $\pm$ 1.71
	I-B	4.22 $\pm$ 1.41	2.94 $\pm$ 1.22	2.89 $\pm$ 1.29
Verbalizer	B-I	7.18 $\pm$ 4.34	4.63 $\pm$ 3.27	5.95 $\pm$ 5.38
	I-B	5.20 $\pm$ 1.96	2.91 $\pm$ 1.40	3.33 $\pm$ 1.99
Peripheral Temperature (Avg. $^{\circ}$ C.)				
Visualizer	B-I	32.7 $\pm$ 2.98	33.7 $\pm$ 2.11	35.2 $\pm$ 1.50
	I-B	33.6 $\pm$ 1.82	33.5 $\pm$ 2.23	33.2 $\pm$ 3.03
Verbalizer	B-I	31.3 $\pm$ 5.57	30.5 $\pm$ 6.35	32.3 $\pm$ 4.14
	I-B	33.0 $\pm$ 0.97	31.5 $\pm$ 3.90	34.1 $\pm$ 1.02

\*B = Biofeedback, I = Imagery

Temperature values for both visualizers and verbalizers, also presented in Table 5, reveal little systematic change from pre- to posttraining. In general the temperature range for all subjects was small, and where mean changes are larger, variability is also larger.

The change score analyses of the pre-post physiological measures are presented in Table 6. For EMG the table reveals no significant main effects, but a significant Order X Treatment interaction,  $F(1, 16) = 4.93, p < .05$ . This again indicates that reductions in EMG were associated with whatever treatment was presented first. The simple effects analysis of Treatments for each level of Cognitive Style revealed that neither visualizers ( $F(1, 16) = .99, ns.$ ) nor verbalizers ( $F(1, 16) = 1.53, ns.$ ) achieved significant EMG reductions following their hypothesized matching treatment. The results however were in the expected direction in both instances, and the overall Style X Treatments interaction approached significance ( $F(1, 16) = 2.45, p = .13$ ), giving some support to hypotheses 9 and 10 for EMG reductions following training.

Table 6 also reveals no significant main or interaction effects for pre-post temperature scores. This is consistent with the mean score findings of Table 5, and hence hypotheses 11 and 12 cannot be confirmed.

The findings with regard to EMG changes under the two treatments for each cognitive style thus differ somewhat

Table 6

## Analyses of Variance for Physiological Measures

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Frontal EMG			
Between Ss	19		
Style	1	.54	.14
Order	1	.44	.11
St X Or	1	5.24	1.32
Ss w. groups	16	3.98	
Within Ss	20		
Treatments	1	.15	.03
St X Tr	1	11.61	2.48
Or X Tr	1	23.08	4.93*
St X Or X Tr	1	12.45	2.66
Error (Tr)	16	4.68	
* $p < .05$			
Peripheral Temperature			
Between Ss	19		
Style	1	5.59	.85
Order	1	16.71	2.54
St X Or	1	.00	.00
Ss w. groups	16	6.59	
Within Ss	20		
Treatments	1	22.64	1.18
St X Tr	1	25.58	1.34
Or X Tr	1	.00	.00
St X Or X Tr	1	3.04	.16
Error (Tr)	16	19.14	

for during versus posttraining measurements. Figure 1 reveals the findings and differences with regard to EMG performance for Cognitive Style X Treatment factors in terms of group means. The figure indicates that for both visualizers and verbalizers there was little difference between treatments during training, but following training, when each group had received their hypothesized matching treatment, EMG levels either remained the same or declined. Conversely, when each group had received the non-matching treatment, EMG levels increased above treatment levels.

Cognitive measures. Table 7 presents the group means and standard deviations for the cognitive variables pre- to posttraining. As noted earlier, the groups did not differ on pretreatment means, although visualizers exceeded verbalizers on cognitive anxiety, and this difference approached significance,  $F(1, 16) = 2.70, p = .12$ .

Changes across treatments are most easily observed for the I-E data in Table 7. If I-E scores are compared between biofeedback and imagery, for three of the four groups I-E scores are lower (more internal) following biofeedback rather than following imagery. For the anxiety measures, while scores declined generally, the pattern or variables responsible for the changes are not easily observed from the tabled data.

Table 8 presents the analyses of variance for the cognitive measures. For the I-E scale, this table reveals

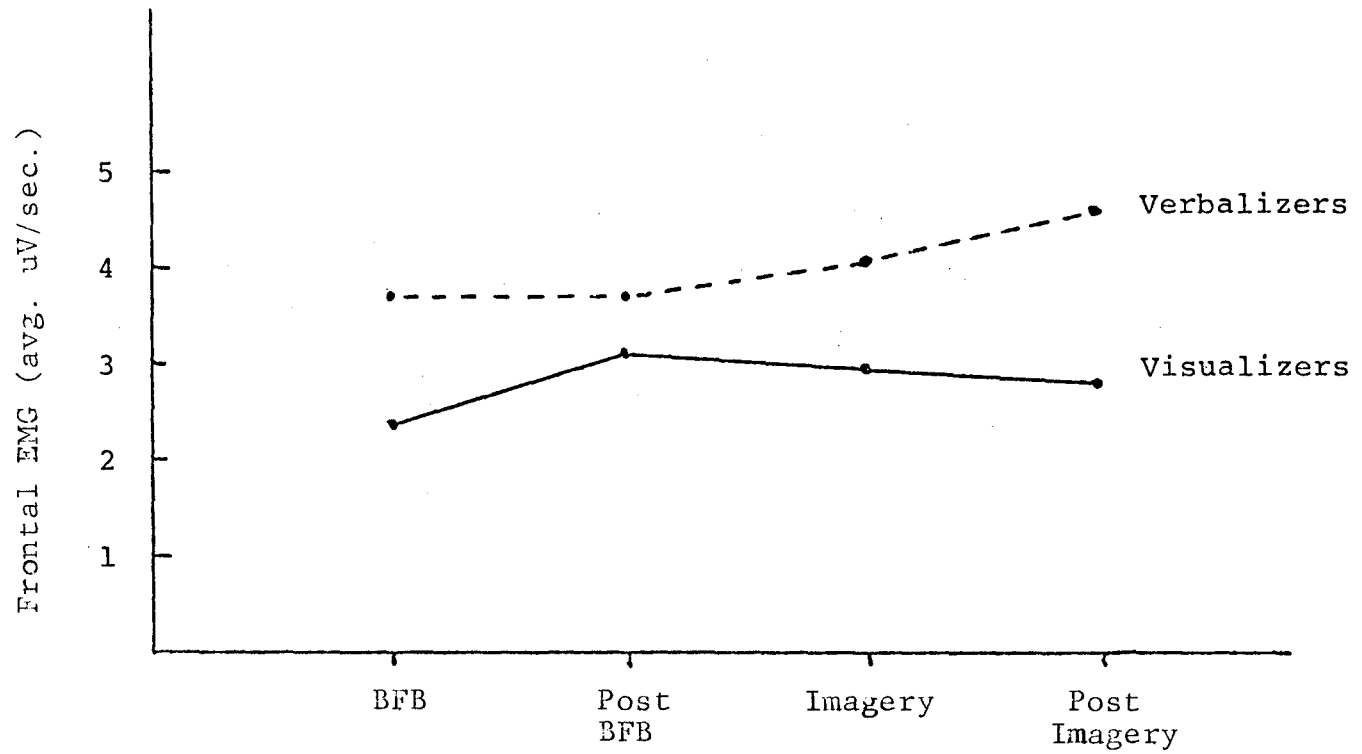


Figure 1. EMG values during and following training.

Table 7

Means and Standard Deviations for Cognitive  
Measures Pre- and Posttraining

Style	Order*	Pretreatment	Biofeedback	Imagery
		I-E Scores (Personal control)		
Visualizer	B-I	6.00 ± 1.41	5.00 ± 0.82	5.25 ± 2.06
	I-B	4.33 ± 3.44	5.83 ± 5.19	6.33 ± 5.01
Verbalizer	B-I	5.40 ± 2.19	2.60 ± 2.07	4.00 ± 2.45
	I-B	4.60 ± 0.89	5.40 ± 2.41	4.60 ± 2.30
Somatic Anxiety				
Visualizer	B-I	22.8 ± 9.07	24.5 ± 9.33	21.0 ± 9.13
	I-B	24.8 ± 4.02	18.0 ± 7.38	20.8 ± 6.05
Verbalizer	B-I	20.6 ± 9.07	17.6 ± 7.83	19.2 ± 5.81
	I-B	20.6 ± 4.51	20.8 ± 3.19	20.2 ± 4.15
Cognitive Anxiety				
Visualizer	B-I	28.3 ± 5.19	26.3 ± 10.47	22.0 ± 8.52
	I-B	23.2 ± 4.36	17.0 ± 9.27	21.0 ± 7.51
Verbalizer	B-I	21.6 ± 7.67	16.8 ± 4.44	19.4 ± 5.13
	I-B	20.2 ± 8.07	21.6 ± 6.80	19.4 ± 8.08

\*B = Biofeedback, I = Imagery



Table 8

## Analyses of Variance for Cognitive Measures

Source	<u>df</u>	<u>MS</u>	<u>F</u>
I-E (Personal control)			
Between Ss	19		
Style	1	1.13	.51
Order	1	12.15	5.52**
St X Or	1	.00	.00
Ss w. groups	16	2.20	
Within Ss	20		
Treatments	1	42.73	5.14**
St X Tr	1	.44	.05
Or X Tr	1	3.97	.48
St X Or X Tr	1	15.58	1.87
Error (Tr)	16	8.32	**p < .05
Somatic Anxiety			
Between Ss	19		
Style	1	33.32	2.13
Order	1	7.40	.47
St X Or	1	27.39	1.75
Ss w. groups	16	15.61	
Within Ss	20		
Treatments	1	4.85	.25
St X Tr	1	61.50	3.17*
Or X Tr	1	1.42	.07
St X Or X Tr	1	57.38	2.96
Error (Tr)	16	19.40	*p < .10
Cognitive Anxiety			
Between Ss	19		
Style	1	82.66	5.63**
Order	1	8.28	.56
St X Or	1	7.64	.52
Ss w. groups	16	14.67	
Within Ss	20		
Treatments	1	9.70	.19
St X Tr	1	14.26	.28
Or X Tr	1	24.25	.48
St X Or X Tr	1	128.38	2.54
Error (Tr)	16	50.52	**p < .05

significant main effects for Order,  $F(1, 16) = 5.52$ ,  $p < .05$ , and Treatments,  $F(1, 16) = 5.14$ ,  $p < .05$ . Feedback clearly leads to more internal scores on the I-E, especially when it is presented first, and imagery leads to more external scores in a similar manner. Both of these effects can be easily observed in Figure 2, which shows the changes in I-E scores across the time of testing for each group. Figure 2 also reveals that the significant findings are not due to change as a result of one treatment, but rather that scores move up or down as a specific function of each treatment. Thus, hypotheses 13 and 14 are substantially confirmed.

Table 8 also reveals that although none of the main effects for Somatic anxiety (Style, Order, Treatments) were significant, and thus hypothesis 15 cannot be confirmed, the Style X Treatments interaction was significant,  $F(1, 16) = 3.17$ ,  $p < .10$ . A post-hoc analysis of simple effects for Treatments revealed that for visualizers Somatic anxiety was reduced by imagery training, and for verbalizers by biofeedback training. This effect, however, was not statistically significant for verbalizers alone,  $F(1, 16) = 0.82$ , ns, but approached significance for visualizers alone,  $F(1, 16) = 2.60$ ,  $p = .13$ . The Style X Order X Treatments interaction also approached significance,  $F(1, 16) = 2.96$ ,  $p = .11$ , indicating that this effect is clearer when the matching treatment is presented first.

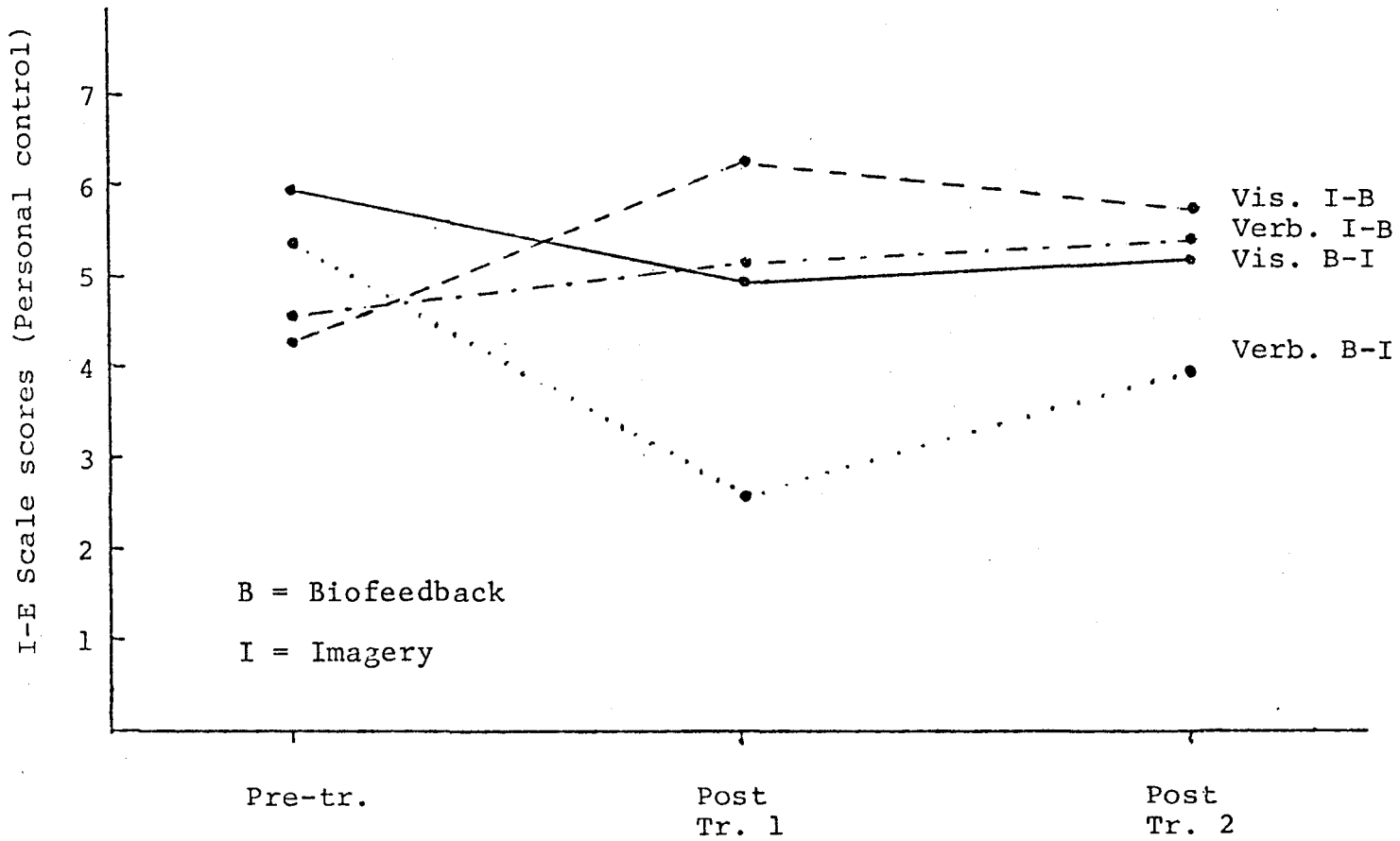


Figure 2. I-E scores across treatments.

For Cognitive anxiety, Table 8 reveals a significant main effect for Cognitive Style,  $F(1, 16) = 5.63$ ,  $p = .03$ , with visualizers reducing Cognitive anxiety to a greater degree than verbalizers regardless of treatment or treatment order. No other main effect or interaction achieved significance, thus hypothesis 16 cannot be confirmed.

Once again the Cognitive Style X Order X Treatments interaction approached significance,  $F(1, 16) = 2.54$ ,  $p = .13$ , indicating that for verbalizers there is a tendency for Cognitive anxiety to be reduced by biofeedback when it is presented first, and this anxiety reduction was associated with receiving imagery first for visualizers.

## DISCUSSION

### Cognitive Style

One aim of the present research was to establish the physiological concomitants, attitudes, and beliefs of two contrasting cognitive information processing modes. Characterized as "habitual visualizers" and "habitual verbalizers", these individuals were seen as differing in terms of their attempts to cope with stress.

The present research could not confirm pretreatment hypotheses regarding either physiological or cognitive differences between visualizers and verbalizers. While visualizers exhibited a greater initial muscle tension level than verbalizers, as predicted, this difference was not statistically significant.

This finding is in contrast to the results of an earlier study (Wakely, 1980), in which the same measures were used, but where highly significant differences were found between visualizers and verbalizers on tension level. What is also notable about the present research, which can be seen as a replication of the earlier study, is that the absolute tension level was higher for both cognitive style groups than in the earlier study.

In both cases, Veterans Administration hospital outpatients complaining of "tension" and anxiety were used as

research subjects, and the instructions and equipment were identical. Hence, the present study apparently utilized a physiologically "tenser" sample of patients. One possible reason for this difference between studies is that the present research coincided with the introduction of biofeedback training to the hospital where the study was conducted, a fact which was announced to the services which contributed the patient referrals. Thus, these may have been more chronic patients in terms of stress-related disorders and complaints. By contrast, in the previous study patients were selected from a hospital where biofeedback and relaxation training were well-established as part of the Psychology Service.

The higher tension levels in the present research may also be revealing in terms of the differences between visualizers and verbalizers. Muscle tension has been hypothesized to be a characteristic of the verbalizer, with this motor activity seen as disruptive of imagery (Bugelski, 1971). While the direction of the findings in the present research supports this hypothesis, this difference may be smaller at higher tension levels. In other words, when stress and tension become chronic conditions, physiological differences in cognitive modes may diminish. As an extension of this, habitual visualizing, as measured by the VVQ scale, correlated positively with both cognitive and somatic anxiety, where it had been hypothesized that this style

was associated primarily with cognitive anxiety.

The autonomic (visceral) relaxation measure, peripheral temperature, could not differentiate cognitive style groups. In part this can also be seen as a function of the absolute level of the variable. For the entire sample, peripheral temperature was as high (approximately 32.5° C.) as the target temperature occasionally used in temperature biofeedback training (Green & Green, 1969). Somewhat paradoxically then, these subjects complaining of tension and anxiety, and exhibiting high resting muscle tension levels, showed normal peripheral temperature values.

An explanation for this finding proceeds along two lines. Green and Green (1969) feel that temperature may be primarily a reactive measure, that is, during acute stress periods temperature may drop, only to rise when the immediate stress ends. Only in certain disorders, such as migraine headache, is it chronically depressed. Also, individuals are known to differ in terms of which physiological system responds to stress with some maladaptive function, yielding a characteristic "response patterning" (Schwartz, 1976).

Hence, the present research may indicate that individuals for whom maladaptive stress response has become chronic may exhibit abnormally high muscle tension rather than depressed peripheral temperature as their primary pattern. This also may indicate that muscle relaxation training is

an appropriate treatment for these individuals.

The findings with regard to the I-E scale appear especially confusing. Internals on this scale were hypothesized to exhibit higher muscle tension levels than externals via a hyperalert, striving, achievement-oriented view of the world (Rotter, 1966). While not statistically significant, externals exceeded internals on muscle tension in the present research, or just opposite to the prediction. Similarly, the hypothesized correspondence between the visualizer-external and verbalizer-internal concepts did not appear in the study. Both of these findings are in contrast to significant earlier results with these concepts (Wakely, 1980).

While, as noted earlier, the sample of patients in the present study exhibited higher overall tension than the earlier study, an intriguing explanation of these results may be seen in recent comments of Rotter (1980) regarding the locus of control concept. He feels that for externals, a subdivision exists between what he calls the "defensive external", who is low in trust and may have experienced disillusionment or trauma that has left him feeling powerless, and the "passive external", or those who have always felt their lives were in the hands of fate, such as followers of the Muslim faith.

While only speculative, the chronic nature of the patients in the present study may be an example of the



stress-traumatized individual who feels frustrated and powerless, while the earlier sample may have contained more relatively "passive" externals, in an earlier or acute phase of stress. This then may lead to quite different physiological consequences.

It is interesting to note that externals typically report more anxiety and internals exhibit greater physiological arousal (Watson, 1971; Ollendick & Murphy, 1977). Although this effect was not found in the present study in terms of locus of control (I-E) scores, this pattern was present with regards to visualizers and verbalizers, respectively.

An interesting future study could make use of variables such as visualizer-verbalizer, locus of control, acute versus chronic stress, and trust.

### Treatments

Physiological effects. The differential effects of relaxation techniques hypothesized to tap somewhat different cognitive information processing modes was the major purpose of the study. Biofeedback training, hypothesized to tap the left cerebral hemisphere functions of integrating and synthesizing incoming information (Brown, 1977), was compared to a directed imagery technique hypothesized to make use of the right hemisphere cerebral functions of associational and spatial information processing (Ernest, 1977).

The present research attempted to "match" these task

demands with individuals known to use these cognitive strategies (verbalizers and visualizers). Physiological measures could not confirm this hypothesis during relaxation training, as both cognitive style groups were equally successful on both relaxation methods with regard to muscle tension. While both groups showed declines in EMG level, the study employed a within-groups design so that patients would not be denied treatment, hence these declines could not be compared to a no-treatment condition.

During relaxation training it was found that when subjects received biofeedback training first, their EMG levels declined gradually over both biofeedback and imagery sessions. When subjects received the directed imagery relaxation procedure first, EMG declined dramatically within the first two sessions and then varied little, even during subsequent biofeedback training.

Hence, while biofeedback has been touted as advantageous in terms of the speed of learning which takes place (Stoyva, 1979), the relatively new technique of directed imagery demonstrated even more rapid declines in muscle tension in the present study. This finding is consistent with hypothetical claims for the efficacy of this technique (White, Sheehan, & Ashton, 1977).

It is interesting that this finding is also consistent with the theory of Stilson et al. (1979) that relaxation is a process of matching efferent output with a stored image

of what relaxation is, and then making adjustments until the muscle state matches the image. The directed imagery technique may have operated faster because it provided subjects with just such an image, and thus the findings may indicate that this concept is even more important for relaxation than having feedback about the state of the muscles. Also, the habitual use of imagery may be unimportant during the training itself. As most individuals have the ability to form an image (McKellar, 1957), this may be all that is required to make use of the technique.

The posttreatment sessions, where subjects no longer had the benefit of the biofeedback equipment or taped procedure, but were instructed to relax as much as possible to demonstrate learning, provided somewhat different results. Here the hypothesis regarding a match between verbalizer-biofeedback and visualizer-imagery appears more tenable.

While marginally statistically significant, visualizers were more relaxed following imagery, and verbalizers following biofeedback. Further, this was seen as a result of subjects' EMG level increasing following the non-matching treatment, while they were able to maintain relaxation, or further decrease it, following their hypothesized matching treatment.

It is as if subjects "lose" some of the effect of the training when it is not presented in their habitual cognitive processing mode, or conversely that they are more

likely to retain what was learned about relaxing when the match has occurred. This finding is completely consistent with Ernest's (1977) feeling that imagery ability may be most facilitative when conditions are less than optimal, such as when a task is difficult, or in the lack of highly concrete stimuli presented in conjunction with a set to use imagery--such as in the directed imagery procedure. As noted, during such conditions all subjects use imagery, regardless of absolute ability. This effect has not been reported in the literature on relaxation training, but if it proves reliable, it could have important implications for the generalization of relaxation training.

In teaching subjects to use relaxation outside the clinic (the ultimate goal of the training), therapists encourage "home practice" of relaxation (Fair, 1979). The present results suggest that the greater likelihood that subjects will retain, and hence be better able to use their training, is when it has been given in a manner which taps their unique style of assimilating information. The study also suggests that this may not be readily apparent during the course of the training itself.

Cognitive effects. The locus of control concept (Rotter, 1966), the extent to which an individual believes he controls what happens to him (internal control) versus control by fate or luck (external control), was clearly affected by the treatments. While reports of increases of

belief in internal control following biofeedback training have been noted (Carlson, 1977; Stern & Berrenberg, 1977; Zaichowsky & Kamen, 1978), the present study also confirmed the hypothesis that subjects become more external in belief following directed imagery.

This was seen as necessary to account for the description of the internal, given by Rotter, as active, striving, hyperalert, and resistive to outside influences. It has been noted (Wakely, 1980) that this description agrees remarkably well with what Friedman and Rosenman (1974) have described as the "Type A" personality, or people at high risk for heart disease, who respond maladaptively to stress.

Becoming more "external" also is consistent with Coursey's (1975) opinion that relaxation is a control-abandoning process, and hence subjects who wish to relax must give up this control to achieve it. While Rotter's recent comments on the locus of control regarding externals can be seen as describing the process of moving from a "defensive external" position to a more internal one following biofeedback, an equivalent theory suggests itself with regards to internals.

It can be hypothesized that internals may be similarly subdivided into "overcontrolled internals" and "active internals". Thus, the overcontrolled internal, striving, hyperalert, and tense, can benefit from a treatment which

encourages "letting go", such as imagery, and move to a more external position. Similarly, the feelings of powerlessness that are a consequence of the defensive external position are countered by biofeedback, which by its nature makes the possibility of control evident.

This theory then suggests that both externals and internals may exhibit significant tension, but for different reasons, or more specifically as a result of different cognitive strategies. Differential treatment strategies would then be indicated depending on the type or quality of internal or external belief. This would also account for the findings in both studies regarding the locus of control scale and tension.

The interesting finding with regard to the anxiety scales is that somatic anxiety reduction, as measured by the Somatic anxiety scale of Schwartz, Davidson, and Goleman (1978), was associated with imagery for visualizers and with biofeedback for verbalizers. In effect, it had been hypothesized that the treatment effects would "override" the cognitive style effect, and hence somatic anxiety reduction was seen as responding primarily to biofeedback. The differential prediction, made regarding EMG levels, proved a fairly accurate paradigm for describing somatic anxiety reduction as well.

While to some extent this was also true of Cognitive anxiety, a more significant finding was that visualizers

clearly reduced cognitive anxiety to a greater degree than verbalizers. This can also be seen as a property of cognitive style, as visualizers could be hypothesized to experience anxiety primarily in terms of maladaptive worry. This is not consistent with the findings regarding somatic anxiety, however, as in that case verbalizers should report more somatic anxiety and/or be more successful at reducing it than visualizers. This was not the case. The initially higher Cognitive anxiety scores of visualizers (not statistically significant), while intriguing, can also be proposed to be the primary reason their scores declined more.

The most significant overall finding with regard to anxiety is that these scores declined at the same time as EMG levels were reduced. Hence, Brown's (1977) comments regarding the lack of correlation between successful EMG biofeedback and subjective relief are not upheld in the present research.

The anxiety reduction reported by subjects can be seen as supporting the findings of Connor (1974), who found that autonomic reactivity was reduced following relaxation training. The instructions to subjects in the present study were to report the usual or typical degree to which they feel each of the somatic and cognitive symptoms when they are feeling anxious. Hence, this measure may be reactive with regard to experienced anxiety, and the findings

indicate that when in an anxious state, the degree of discomfort was reduced following relaxation training. This then provides a counterpoint to Connor's finding of reduced autonomic arousal, and contrary to his study (which used a different anxiety measure) indicates that subjects are aware of the subjective effects of the relaxation training.

The present study suffered in that it did not include a control group against which absolute change could be measured. By using differential predictions and a counterbalanced design, subjects served as their own controls. This did allow the use of patients, for whom learning relaxation may have vital importance in terms of their ultimate health (see Introduction).

The lack of an adequate follow-up period must be considered a major shortcoming of the study. Are subjects able to sustain their reduced muscle tension levels over any meaningful length of time? If so, what effect(s) does this have on symptom intensity and/or duration? Do the cognitive differences noted in the present research persist over time or diminish? Each of these questions could easily be incorporated into a research design, extending the present results.

The study can be seen as process, rather than outcome research, concerned with the ways patients learn relaxation in terms of measurable cognitive differences. It made use of concepts, such as the visualizer-verbalizer distinction,



and techniques, such as directed imagery, not previously utilized in research of this type. In this sense it provided a contribution to an individual differences approach to relaxation training, and gave some indications that relief from the individualized effects of stress may be best realized by utilizing the individual or typical ways that we relate to the world.

## SUMMARY

Individuals can be seen as utilizing one of two primary cognitive information processing modes of assimilating incoming information. These individuals, labeled "habitual visualizers" and "habitual verbalizers" were hypothesized to exhibit differences in the ways they respond to stress.

Male VA outpatients seeking relief from tension and anxiety were used as subjects. Contrary to predictions, there were no significant pretreatment differences between cognitive style groups on muscle tension, peripheral temperature, locus of control, and anxiety measures.

It was also hypothesized that visualizers and verbalizers respond differently to relaxation training techniques which tap different cognitive abilities. Biofeedback (EMG) was seen as a process of integrating and synthesizing the information (feedback) presented, and thus matched the cognitive ability of the verbalizer, while a directed imagery relaxation technique was constructed to tap the strengths of the visualizer.

All subjects received both treatments in a within-groups, counterbalanced research design. Eight treatment sessions (four of each type) and three no-treatment baseline sessions (one pre- and two posttreatment) were conducted over a six week period for each subject. During training

both groups reduced EMG tension levels using both treatments, but all subjects achieved reductions faster when the imagery technique was presented first ( $p < .05$ ). Analysis of posttreatment effects indicated that subjects tended to maintain a relaxed state if they had received their matching treatment, and to exhibit higher tension levels if they had received their non-matching treatment. This effect approached significance ( $p = .13$ ). This finding was discussed as indicating that cognitively matching relaxation training may be especially useful in the generalization of the effects.

For all subjects, locus of control scores became more internal following biofeedback, and more external following the imagery procedure ( $p < .05$ ), as predicted, and was discussed as being beneficial for "defensive externals" and "overcontrolled internals," respectively. Anxiety scores were divided into somatic and cognitive components. For all subjects, somatic anxiety reduction was associated with receiving the matching treatment ( $p < .10$ ), and cognitive anxiety reduction occurred almost exclusively among visualizers ( $p < .05$ ), regardless of treatment.

Overall, the results were discussed in terms of the importance of cognitive variables, or individual differences in response to relaxation techniques which tap different cognitive abilities.

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APPENDIX A

## Information Sheet

Many symptoms such as insomnia, hypertension, headaches, or just a chronic feeling of tension and anxiety can be controlled by learning to relax. Several techniques now exist to help patients learn to relax, but so far no method has been shown to be the best for everyone.

The purpose of this study is to identify which type of patient is most helped by one of two relaxation techniques. This information will help us select the treatment which is most effective for a patient in terms of learning this control. Patients who agree to participate will be required to take some paper and pencil personality tests both before and after treatment. All patients will receive both forms of treatment, but in a different order. This will be determined randomly.

One type of treatment is to listen to pre-recorded instructions on how to relax. The second is to receive biofeedback. In both treatments you will be attached to a device which measures the amount of tension in the muscle which runs across the forehead and the temperature in your hands.

During the recorded instructions you will be asked to follow the suggestions you hear. During biofeedback you will hear a tone which increases in pitch when the muscle is tense, and decreases in pitch when you relax. You will be asked to decrease the pitch. There is no known danger to your physical or psychological health from these treatments.

Participation is strictly voluntary. You can refuse to participate or withdraw at any time and you will lose no benefits to which you are entitled. Please sign below, indicating that you have read and understand this information.

\_\_\_\_\_  
Patient's Signature

\_\_\_\_\_  
Investigator's Signature

\_\_\_\_\_  
Date

APPENDIX B

## Imagery Tape

This tape is going to teach you how to become completely relaxed. It will help you to review your muscles, check them out for tension, and then relieve that tension and relax it. This is important, because the more relaxed your body is, the better you feel. You can teach your muscles to become relaxed hour to hour and day to day...I'd like you to begin by giving yourself a simple example of what muscle tension can feel like, so that you will be able to recognize it even in very small muscles...and also you will be able to feel the difference between minor muscle tension and relaxed muscles. So begin by tiring your eyes...by looking upward...by looking upward as far as possible, almost as if you were trying to see your own eyebrows. As you do this you might pick out a spot on the ceiling and focus your attention on this spot. Holding your eyes in this position is unnatural and it's going to get your eyes very tired. This is causing tension in the eye muscles and you may experience this as a feeling of getting sleepy, although you actually will not fall asleep. You may get the impression that your eyelids are getting heavier as your muscles become more and more tense and more tired. In a few moments this is also going to help you close your eyes so that you can focus your attention on the rest of these instructions...

So look at the spot and notice the tension in your eye muscles. You are finding that it is getting a little more difficult to keep your eyes fixated on the spot. Your eyelids are getting tired...the eye muscles are getting tired...it's harder and harder to keep your eyes open... Now I am going to count to 5, and I'd like each number to serve you as a signal to pay more and more attention to this increasing tiredness and fatigue of your eyes muscles. ..and to pay attention to a sensation similar to sleepiness and heaviness. And at the number 5, if your eyelids have not closed almost by themselves, close them voluntarily ...and then pay attention to the soothing relaxed feelings in your eye muscles as you relax them and relieve the tension...1...heavier and heavier...more and more...2...feeling this tension and fatigue increasing, harder to keep your eyes open...3...very tired, heavy...4...more and more ...heavier and heavier...5...ok, close your eyes. Now squeeze them very tightly shut. And then relax them completely, but keep your eyes closed. You'll find that you will be able to keep your eyes closed without any effort. You will be alert and able to listen to these instructions. Note the calmness of your eye muscles as you have relaxed...

And now, because exhaling is a relaxation reflex, you can prepare your body for total relaxation by taking a deep, deep breath. Go ahead, fill up your lungs now...deep, deep breath. Now, just let all the air go. Don't force it out, just let the air come out and feel that wave of soothing relaxation pass through your entire body...Take another deep, deep breath, and then just let it go...Again, feel the wave of relaxation spread throughout your body. Think of this relaxation spreading to all your muscles...very, very relaxed, even the tips of your fingers and toes. Notice how our muscles tend to follow our thoughts, and as you think of the relaxation spreading through the muscles, notice how you feel the relaxation also spreading through the muscles. Once more, deep, deep breath...and then just let it go...Feel the relaxation spreading to the tips of your fingers and to the ends of your toes.

And concentrate on the muscles of your neck...Make these neck muscles very loose and very relaxed...Pay special attention to the muscles in the back of your neck. We use these almost constantly for postural purposes. Think of your head as being free, as being very, very loose, resting very loosely, limp, free from all tension. Now focus on the muscles of your face. Concentrate on your jaw muscles, just let your mouth hang open. If you prefer to keep your lips loosely together, make sure your teeth are not clenched. Make your facial muscles very, very free from tension, very loose, very limp...the muscles around your lips, the muscles in your nose, your cheeks...Think of the little muscles around your eyebrows...your forehead...the muscles around your ears, even in the scalp...every muscle in your face and scalp, jaw, might get an extra degree of relaxation by feeling as if you are in a stupor, which is a relaxation of all facial muscles...you get very, very loose so that if you were asked to speak, it would be quite an effort and your speech would be sort of thick and mushy because all the muscles are so limp and so very, very loose, free, free from all tension...

And now I'm going to count to 5 and I would like each number to serve as a signal to put yourself into an even deeper state of relaxation, total relaxation, and as a signal to check out your body, reviewing the muscles to make sure no old habits of tension have returned. Make use of any special feelings that helped you get an extra degree of control over your body, feelings of getting heavy, and dull, hollow, or light and floating, a feeling of numbness...whatever helped you to relax...Make use of such feelings, get an extra degree of control in this way...1...more and more, down, limp, very, very relaxed, heavy...Check out the muscles in your neck, your face, and scalp...limp and loose,



very, very relaxed...2...deeper and deeper, very, very relaxed, very limp...3...deeper, deeper, state of complete muscle relaxation, very limp...4...more and more, deeper, deeper, very, very relaxed, heavy...5...completely free from all tension, a deep state of muscular relaxation...

...Now that you've put yourself into a state of complete relaxation, we shall go on to the second part of the relaxation exercises. And here you can use your powers of imagination to relax even more. Recall that your muscles stretch between almost all parts of your body. Recall the sketches which you may have seen in books. Picture the muscles. Note the size, shape, color and texture of the muscles in your body. You might think of muscles as a system of wide rubber bands running from one point to another point throughout the body. So picture this system of bands. Picture these bands in your mind. Imagine the muscles in your own body...Think of those bands strung out throughout your body...All the muscles you have controlled by making them deeply relaxed...They stretch across the forehead, support the neck, run through the arm...Recall pictures you may have seen...of the muscles in the arm...Focus your mind and attention on picturing these muscles, picturing these muscles or any muscles you like...the large muscle across the forehead...Focus on the muscles in the same way that you focused on them earlier, except I would like you to picture the muscle...The important thing is to have a clear image of the muscle in your forehead or wherever you choose ...

Think of these muscles as being like a sponge, very much like a sponge that can get softer as it soaks up warm water. ..As you relax the muscles, your muscles get softer...Imagine this, focus on the picture of the muscles relaxing, getting softer, plumper, very, very pleasantly relaxed... And the plumper your muscles get, the more easily your blood can flow through. The more easily your blood can flow through, the more relaxed you feel. And thus, you can picture in your mind the way it should be, relaxed...Muscles softer, blood flowing smoothly, very easily. Picture this in your mind any way you like. The important thing is to have a picture in your mind, an image of the muscles, getting plumper and softer, the blood flowing through easily, more and more easily...

The muscles are relaxed, getting softer, softer, the rubber band relaxing...You can focus on any one of your muscles, like the muscle in your forehead, or focus on muscles all throughout your body...Concentrate on those rubber bands or sponges or whatever, and relax them...Make these muscles loose and limp...Force out the tension in the muscles in

your forehead just as you do the other ones. As you do so, be sure to picture them getting softer...plumper...relaxed, Picture your muscles getting very free of tension...loose, blood flowing more easily and smoothly and calmly...through the soft muscles...Feel the blood flowing easily, calmly, smoothly, warmly through the softening muscles...You may concentrate on one muscle or a group of muscles, or you may shift your focus to any part of your body or the muscles all over your body...Remember the sketches or pictures of the muscles you may have seen, that showed how the muscles go from point to point, some large, some very small...

Think about these muscles, picture these muscles which stretch throughout your body...Feel them, make these muscles relaxed, see them softening, relaxing, feel the blood flowing very, very freely through them, as you picture this in your mind...as you picture this in your mind, and you make the muscles loose and limp, plumper and plumper, more and more relaxed, the blood flowing freely, more and more, the rubber band relaxing...the sponge filling with warm water, getting softer, getting so relaxed, permitting the blood flow to be more easy, calm...

It's as if there's an added warmth also spreading, spreading with the freely flowing, nourishing blood...Feel this relaxing pleasant warmth spread throughout your body...As you relax your muscles and picture them softening...As you do this, let the new inner deeper sensations pleasantly add to your already deeply relaxed state, so that you have loose, limp muscles...enjoying the feeling of deep, deep relaxation...And you have seen the blood flowing easily, warmly, the muscles plumper...Feel these processes and picture them in your mind, this health-giving process of relaxation and softening your muscles...the blood flowing easily...

What you're doing is focusing your attention on rebalancing the natural and normal way your body works. And by picturing this process, and by feeling it...by visualizing it and by experiencing it in your mind, you have the power to create a state of health...wholeness, normal pleasant health...Continue to relax the muscles...relax the muscles, continue to picture them thickening, feel them filling with warm nourishing blood...Let these new inner deep sensations pleasantly add to your very comfortably relaxed state...blood flowing easily, freely...As you are experiencing this relaxed process, you can actually feel that it is helping you...You are experiencing yourself being well, relaxed...

Consider this feeling of being well, this relaxed calmness, this healthful, positive sense of well-being. Picture yourself and feel yourself completely well and healthy. See yourself healthy and well. Let these feelings combine with your deep relaxation feelings...The muscles in the head relaxed...giving you a sense of healthy, positive well-being...deeply relaxed and feeling well...These are powerful health-giving feelings, as you picture yourself and you feel yourself healthy and well, this helps to make you well, As you experience these feelings you are actually helping to make yourself healthier...Experience these feelings... Allow yourself to feel a sense of being perfectly well as you relax...deeply relaxed as you see yourself well... Continue to picture yourself healthy and well...Picture yourself healthy and well...deeply relaxed...picturing yourself healthy and well...muscles limp...seeing yourself healthy and well...feeling well, picturing yourself healthy...feeling deeply relaxed and calm...

Still relaxed, picture the muscles in your body once again, imagine what they look like. Note the size, shape, color and texture of the muscles in your body...Note whether there is an area that appears different from the rest. If so, you can consider this area one of tension and can relieve the tension by changing the image so it appears the same as the rest in every way...Focus on these areas and imagine the muscle or rubber band relaxing, letting go, see the spongy tissue soak up the warm water, getting softer and more relaxed...As you do this, notice how the tense areas now feel more and more like the relaxed areas. In the future, when you see areas of your body that appear like the tense areas, you can use this technique to change them to resemble the relaxed areas and you will notice a change in the way these areas feel...

So now, just maintain your deep, deep relaxation, focus on your good feelings...Continue to see yourself healthy and well...

APPROVAL SHEET

The dissertation submitted by David J. Wakely  
has been read and approved by the following committee:

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of  
Philosophy.

2/2/81  
Date

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