THE EFFECTS OF BIOFEEDBACK - ASSISTED RELAXATION
IN STRESS MANAGEMENT TRAINING WITH
TRAUMATICALLY HEAD INJURED ADULTS

THESIS

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

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Denton, Texas
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Lysaght, Rosemary, The Effects of Biofeedback-Assisted Relaxation in Stress Management Training With Traumatically Head Injured Adults. Master of Science (Rehabilitation Service Administration), May, 1989, 75 pp., 5 tables, 3 figures, bibliography, 35 titles.

This study investigated the use of biofeedback as part of stress-management training program with head injured adults. The single cases examined were four males with head injuries of moderate severity who were in the post-acute stages of recovery. Treatment involved bi-weekly relaxation training, using EMG biofeedback in combination with deep breathing, autogenic training and/or imagery. Individual subject response to relaxation training was examined during treatment sessions, as was the frequency of stress-related symptomatology outside of sessions, and overall functional adaptation. While all subjects showed evidence of relaxation during treatment sessions, such factors as the nature of the functional disturbance and personal motivation appear to be related to the degree of carryover to the external environment.
CHAPTER 1

INTRODUCTION

Rationale for the Study

The search for effective approaches to improve the long-term rehabilitative outcome of the traumatically head injured has become the focus of innumerable research efforts in recent years. The impetus for this work appears to be the significant social and financial impact of traumatic head injury, a condition which each year renders 50,000 to 70,000 Americans unable to resume their usual lifestyles (National Head Injury Foundation, 1987). With 70% of all head injuries involving those under thirty years of age (Fraser, McMahon, and Vogen, 1988), the potential impact of this disability in terms of lost work productivity and long term maintenance is immense.

The fact that the majority of this disability group are injured during their productive work years is of particular concern to those involved in vocational rehabilitation. Although there is some discrepancy in reports of vocational outcome among head injured populations (Ben-Yishay, Silver, Piatsky, and Rattock, 1987), there is evidence that impairment of work ability is an issue in a great number of cases. Results of a 1981 study, for example, revealed that although 68% of individuals with moderate to severe head
trauma were independent in self care, mobility, and recreation/leisure activity on long-term follow-up, and 86% lived independently, only 41% were involved in education or work activity (Jellinek, Torkelson, and Harvey, 1982). Problems in managing work responsibilities are also reported to occur with some frequency in cases of mild head trauma (Novak, Roth, and Ball, 1988).

Several studies have indicated that it is the residual cognitive, emotional, and behavioral deficits which are primarily responsible for the reduced ability of many head injured persons to maintain work roles effectively (Ben-Yishay, et al., 1987; Fraser, et al., 1988; Long, Gouvier and Cole, 1984; Novak, et al., 1988). Although the sources and manifestations of such problems vary greatly in individual cases, it is suggested by some researchers that emotional reactions are frequently responsible for exacerbating the effects of cognitive and/or physical impairment (Gronwall, 1986; Long, et al., 1984; Long and Novak, 1986; Novak, et al., 1988). As Long, et al. (1984) note, "post trauma behavior will be significantly influenced by how well the client understands, interprets, copes, and adjusts to these novel stressors" (p.41). Ben-Yishay, et al. (1987) report that some of the principle sources of successful vocational outcome in their efforts with previously unemployable head injured subjects were "improvements in self-awareness, discipline, and regulation
of emotional responses" (p.45).

Long and Gouvier (1984) identify a number of stress factors, both situational and organic, which complicate post-trauma adjustment. The individual with head injuries, whose ability to deal with stressors may be severely compromised due to the effects of injury, may be unable to make necessary functional adaptations. Poor management of environmental stressors frequently leads to decreased belief in personal potency, resulting in psychological complications, and client withdrawal from societal roles (Long and Gouvier, 1983). The need for stress management training in the rehabilitation of clients with head injury has been discussed by a number of researchers (Bach y Rita, 1981; Novak, et al., 1988). A limited number of researchers have included stress management as a component of behavioral retraining programming for head injured clients, with positive results (Gronwall, 1986; Legewie-Perzborn, Legewie, Fort, and Brinkman, 1977).

Statement of Problem

Despite the recognized role of biofeedback in anxiety management (Lazarus, 1977; Stoyva, 1983) there is no evidence that this modality has been used as a stress management tool with the traumatically head injured. Although success has been noted in the use of biofeedback in the reeducation of abnormal muscle tone in head injured and stroke patients (Basmajian, et al., 1977; Hogue and
McCandless, 1983) this approach does not appear to have received systematic application in behavioral training programs with head injured populations.

Purpose of the Study

The purpose of this study was to examine the effects of individualized biofeedback-assisted relaxation treatment as a stress management approach with head injured persons who are in the post-acute phase of recovery. Attention was devoted to determining whether this approach is effective in (1) control of specific stress-related symptomatology, and (2) reducing the overall impact of disability on functional adaptation.

Significance of the Study

Rehabilitation of traumatically head injured individuals requires a wide variety of available approaches, due to the degree of diversity in client problems encountered in clinical practice. As yet, treatment of head injured clients is at a largely experimental level, with a number of approaches to cognitive and behavioral management being implemented, and in various combinations and intensities.

This study examined the use of one approach, in the absence of other therapies, in the post-acute stage of recovery. As biofeedback has not previously been studied as an adjunct to stress management training with a head injured population, the results of this study may serve to
demonstrate the potential value of this modality in current head trauma rehabilitation approaches.

Assumptions and Limitations

Due to the nature of the intervention being utilized, and the unique characteristics of the population being studied, a single-subject, A-B-A design was utilized. This factor, combined with the limited number of subjects studied, allow for only tentative conclusions to be drawn from the results. Data were collected for the study in three ways: (1) client recording of daily progress outside of treatment, during all phases of the study (2) computer output displaying client performance during treatment sessions, and (3) pre- and post-testing on a self-report questionnaire. The need to rely on client self-report, particularly in the first instance, may have had some impact on the reliability of the dependent measures.

Research Questions

Specifically, this study addressed the following research questions:

1. Can head injured subjects in the post-acute phase of recovery be trained in methods of stress management through biofeedback-assisted relaxation training?

2. Can biofeedback-assisted relaxation training with head injured subjects reduce targeted stress-related symptomatology?

3. Can biofeedback-assisted relaxation training reduce
the overall impact of closed head injury, as measured by the Sickness Impact Profile?

4. Are the effects of biofeedback-assisted relaxation training, if achieved, maintained in the absence of further treatment?

Research Hypotheses

In order to address the aforementioned research questions, the following hypotheses were tested in null form:

H₀ 1: Head injured subjects receiving biofeedback-assisted relaxation training will show no difference within sessions in levels of relaxation, as measured by one feedback system (skin temperature or EMG recordings).

H₀ 2: Head injured subjects receiving biofeedback-assisted relaxation training will show no change in frequency of occurrence of individually targeted dysfunctional behaviors.

H₀ 3: Head injured subjects receiving biofeedback-assisted relaxation training will show no change from pre- to post-treatment in overall score on the Sickness Impact Profile.

H₀ 4: Subjects will show no change in the frequency of occurrence of the targeted dysfunctional behavior, or in scores on the Sickness Impact Profile four weeks following cessation of treatment sessions.
Definition of Terms

The following definitions have been developed for use within the context of this document:

**Autogenic Training:** A relaxation technique which requires the individual to review mentally a series of word phrases designed to promote physical and mental relaxation.

**Biofeedback:** The use of electronic monitoring instruments to measure, process, and feed back to individuals information concerning the activity of various body processes of which the individual is usually unaware.

**Closed Head Injury:** The altering of normal brain function due to an external and non-penetrating blow to the cranium.

**Electromyography:** The monitoring of the electrical activity in muscle groups through the use of surface electrodes and electronic equipment.

**Imagery:** The use of mental reconstructions of a past perception in order to experience covertly the emotions associated with that perception.

**Post Acute:** The period of recovery which follows the stage of rapid change in physical and/or cognitive functioning.

**Stress:** An external event or stimulus which causes some change in the equilibrium of the psychological or physical state of an individual.

Chapter Summary

The profound effects of head trauma on the functional adaptation of survivors make rehabilitation with the head
injured a primary focus of research and training efforts. Numerous sources of stress exist for survivors of closed head injury, the effects of which can be significant in terms of functional and psychological adjustment. Few studies have systematically applied stress reduction techniques to improve adjustment following head trauma. Biofeedback has not been utilized in this regard, and is proposed as a suitable technique for use in relaxation training with the head injured. The current study examines the effects of a six to eight week program of biofeedback-assisted relaxation training with head injured clients in the post-acute stages, using a single subject design.
CHAPTER BIBLIOGRAPHY


Biofeedback and Stress Management

Lazarus (1977) noted that "the various emotions arise from and reflect the nature of a person's or animal's ongoing adaptive commerce or transactions with his environment" (p.69). The emotional state is multidimensional, being manifested at physiological, behavioral, and experiential levels (Stoyva, 1983). The nature of the interaction between these is highly individual and variable, making accurate appraisal of an emotional state extremely difficult.

The somatic response associated with an emotion arises from the individual's impulse to respond to the perceived stressor, and follows a species-specific pattern of mobilization for adaptive reaction (Lazarus, 1977). Monitoring of physiological changes has been seen as valuable means of providing comprehensible information to the individual, who may then gain a greater understanding of their emotional response patterns (Lazarus, 1977; Stoyva, 1983).

Biofeedback is a training technique through which electronic equipment is used to provide humans with information concerning internal physiological events, by
means of visual and auditory signals (Basmajian, 1983). The information provided allows subjects to adjust otherwise involuntary events by manipulating the displayed signals, thus bringing them under voluntary control (Basmajian, 1983; Gatchel and Price, 1979). Various physiological systems may be monitored, including blood pressure, peripheral blood flow, galvanic skin response, and electromyography (Glasgow and Engel, 1981), the latter being the usual modality of choice in cases of generalized anxiety, stress pain, and neurological handicaps (Basmajian, 1983).

Biofeedback has been utilized as a primary treatment for anxiety reactions, or as an adjunct to other types of relaxation training (such as progressive relaxation, autogenic training, and meditation) for monitoring physiological activity (Fair, 1983; Stoyva, 1983). Advantages of using biofeedback in relaxation training are (1) the availability of clearly discernible feedback for the therapist and client, (2) the measurability of data, which permits scientific exploration and interpretation, (3) adaptability of the techniques, with regard to physiological processes monitored, feedback type and intensity, and (4) face validity and motivational factors (Stoyva, 1983).

Biofeedback is frequently used in conjunction with autogenic training, which incorporates mental exercises, helping the client focus thoughts during the training, and allowing eventual cessation of machine use by providing a
method of relaxation which is transferable to the natural environment (Stoyva, 1983). Although various approaches to relaxation have been found in controlled studies to be equally effective in reducing stress, it appears that a combination of approaches may be most effective, with adaptations depending upon individual response patterns (Gatchel, 1979). It appears that the many advantages of biofeedback may make it the approach of choice for stress reduction in clinical settings, where appropriate equipment and training personnel are available. This may be especially true in cases of neurological deficit, where the need for distinct sensory feedback systems is critical.

Applications of Biofeedback to Neurologically Impaired Populations

As Abreau and Toglia (1987) note, "a major thrust in treatment is helping the [head injured] client learn how to monitor and control his or her performance" (p. 444). They further state that "error detection can be facilitated by the therapist through use of feedback" (p. 444). Gatchel and Price (1979) elaborate on the role of feedback in the learning process, noting that accurate feedback is necessary if we are to be aware of the consequences of our behavior, and to then consciously modify our behavior so as to achieve the desired adaptive response. Bach y Rita (1986) endorses the use of biofeedback with neurologically impaired populations, calling it a "sensory substitution approach"
which can provide accurate sensory information to the brain through undamaged sensory systems, such as vision and hearing. He calls for research to be conducted in this area to determine the full potential of its application (1986).

Biofeedback has been employed to a limited degree with stroke and head injury patients in the reeducation of abnormal muscle tone and for pain management. Hogue and McCandless (1983) report on highly positive results obtained in using auditory biofeedback to control knee hyperextension in 13 stroke and head trauma subjects. Their work followed a 1979 study by Wolf, Baker, and Kelly, who employed EMG biofeedback in the muscle retraining of 52 hemiplegic patients. The results of this study showed biofeedback to have had a significant effect on training, irrespective of age, previous treatment, number of sessions, length of time post-stroke, or the body side affected (Wolf, et.al., 1979). Success rate was affected only by aphasia and degree of proprioceptive loss. An earlier study by Basmajian, Reginos, and Baker (1977) reported similar success in using EMG biofeedback to treat footdrop, shoulder subluxation, and hand function in stroke patients. They also experimented with both targeted and generalized relaxation therapy, believing it to be an appropriate method of management for this patient group, who were under "great emotional stress" (p.87).

Bach y Rita (1986) hypothesizes that the success of
these EMG sensory feedback attempts may have been due to "general relaxation, to supplying of accurate control information, and to the active participation of the patient in his program" (p. 257). Fernando and Basmajian (1978) also note the benefits of biofeedback in progress monitoring, evaluation, and as a general motivational tool. Bach y Rita (1986) cautions that the confidence and motivation building factors suggest some degree of placebo effect. Overall, however, biofeedback training has been found to be beneficial in cases where conventional approaches have failed, especially when used as an adjunct to traditional modalities (Fernando and Basmajian, 1978; Sufrin, 1984).

The Role of Stress Management Training in the Rehabilitation of the Traumatically Head Injured

The critical effects that stress and emotional volatility assert over the functional adaptation of the individual following head trauma have been widely acknowledged (Binder, 1985; Long, et al, 1984; Lynch, 1983, Novak, et al, 1988). Emotional changes seen in the head injured client in the post-acute phases may be attributable to neurological changes, to pre-injury characteristics, or to the presence of psychosocial stressors (Binder, 1986; Long, et al, 1984; Novak, et al, 1988). While numerous signs of reduced emotional control are evident during acute stages of recovery, signs of distress such as anxiety, irritability, and depression may not arise until several
months post-trauma (Long, et al, 1984; Novak, et al, 1988), and it is apparent that symptoms may worsen over time (Binder, 1985).

Emotional problems experienced after head trauma may often exacerbate the effects of both physical and cognitive impairment, and add to the overall pattern of dysfunction (Novak, et al, 1988). Gronwall, (1986) supports this view, citing research which indicates that head injured clients who are under stress recover more slowly, and suggesting that this is due to the depressive effects of anxiety on their information processing capacity. Researchers at the New York University Medical Center head injury program, who conducted a follow-up study on 94 moderately to severely injured participants in their vocationally-directed cognitive rehabilitation program, observed that improvements in functional performance appeared to be attributable to generalized improvements in the ability of clients to apply their residual information processing abilities, rather than an increment in the cognitive capacities themselves (Ben-Yishay, et al, 1983, 1987).

Despite recognition of the impact of stress and emotional adjustment on overall functional adjustment, there is limited evidence of relaxation or stress management training being used in a systematic manner in rehabilitation programs for the head injured. A rehabilitation program in New Zealand for clients with mild head trauma incorporates
stress management training, in conjunction with individual and group activities, assessment, and cognitive rehabilitation, as part of a three stage retraining program directed towards work reentry (Gronwall, 1986). Although results of this program have been highly positive, attempts at statistical analysis have been hampered by lack of suitable outcome measures.

The most controlled study of the use of stress management techniques with the head injured was conducted in West Germany, where a behavioral program was developed for head injured patients exhibiting long-term, non-specific symptoms of 'illness behavior', such as complaining tendency, depression, irritability, and problems in job performance and social interaction (Legewie-Pertzborn, et al., 1977). Two study groups of patients were trained in self control techniques, these consisting of relaxation, desensitization, self image training, analysis and control of illness behavior, assertiveness, and performance techniques. Patients in both groups showed significant reductions in illness behaviors, both upon completion of the program, and at three month follow-up.

Chapter Summary

Biofeedback is a method of monitoring some of the somatic changes associated with the emotional response to a given situation. The availability of clear feedback, the measurability of data, it's adaptability, and face validity
are advantages which make this approach attractive for use in stress management training, especially with neurologically impaired subjects. Research indicates impaired emotional control to be a limiting factor in the functional readaptation of many individuals following closed head injury. Positive results have been obtained in two programs employing stress management training with this population. Although biofeedback has been used successfully in physical reeducation with the neurologically impaired, it has not been systematically tested as a means of aiding stress-management training with a head injured population.


Press.


CHAPTER 3

DESIGN OF THE STUDY

Subjects

Subjects included four males who had sustained traumatic head injuries and who had completed the acute-phase of rehabilitative treatment. Inclusion criteria required that subjects be alert and oriented, and able to maintain concentration on a task for a minimum of fifteen minutes. Subject acceptance was not limited by severity of injury, primary hemisphere of damage, cognitive ability, or functional outcome. A final inclusion criterion was the identification of at least one area of stress-related functional disturbance as a problem area for the subject.

Subjects were obtained through the cooperation of the Texas Rehabilitation Commission (TRC). TRC counselors identified potential subjects from case files. These individuals were contacted, and suitability with regards to the inclusion criteria determined through interview with the researcher. Seven subjects were referred for consideration. Of those, one was found unsuitable due to her inability to identify any specific stress symptoms, and her apparent lack of interest in the program; two others did not pursue involvement due to difficulties they foresaw in attending regular treatment sessions because of work and school
involvements. The four remaining subjects proceeded through the screening process and agreed to participate in the program. All subjects completed a consent form (see Appendix 1) prior to commencement of the program.

All subjects who were admitted to the study were determined to have sustained injuries of moderate severity, based upon duration of post injury coma, (3 to 11 days) and functional outcome. A screening of cognitive functioning on selected scales of the Wechsler Adult Intelligence Scale also indicated average levels of functioning in all subjects, with variation evident only in the Similarities subtest, and in the Digit Span subtest in Subject 4 (see Subject Data, Table 1). The Similarities test is used to determine the ability of a subject to use abstraction, and also tests a subject's remote memory and capacity for associative thinking. The Digit Span subtest is generally considered to reflect short term memory functioning, and the ability to attend to verbal information (Maloney and Ward, 1976).

Functional recovery of all subjects was a Level 8 on the Rancho Scale (see Appendix 2). All subjects were living independently, with or without assistance, and none was employed at the time of intake. All were males, ages ranging from 22 to 35 years.
### Table 1

**Subject Data**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Subject 2</th>
<th>Subject 3</th>
<th>Subject 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>27</td>
<td>35</td>
<td>31</td>
</tr>
<tr>
<td>Time Elapsed Since Injury (Months)</td>
<td>74</td>
<td>26</td>
<td>61</td>
</tr>
<tr>
<td>Length of post-traumatic coma (Days)</td>
<td>7</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Hemisphere of Primary Damage</td>
<td>Both</td>
<td>Both</td>
<td>L</td>
</tr>
<tr>
<td>Dominant Hemisphere</td>
<td>?</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Physical Involvement</td>
<td>Spastic Quadriplegia</td>
<td>C-3 Quadriplegia (Incomplete)</td>
<td>Minimal Lumbar Fracture</td>
</tr>
<tr>
<td>Ranch Functional Level</td>
<td>8</td>
<td>8</td>
<td>8</td>
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<tr>
<td>WAIS Subtests Digit Span</td>
<td>10</td>
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<td>10</td>
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<td>Arithmetic</td>
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<td>7</td>
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</tr>
<tr>
<td>Similarities</td>
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</tr>
<tr>
<td>Picture Completion</td>
<td>12</td>
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<td>12</td>
</tr>
<tr>
<td>Pre-morbid Educational Level</td>
<td>13</td>
<td>13</td>
<td>12</td>
</tr>
</tbody>
</table>

### Research Design

Research concerning rehabilitative procedures with head
injured clients has been plagued by numerous difficulties inherent with this population. Bach y Rita (1981) identifies a number of factors which limit the potential for experimental research with stroke and head injury rehabilitation clients, including (1) problems in determining the location and extent of damage to the brain, (2) difficulty in obtaining sufficient numbers of patients with similar lesions and characteristics, which hampers the use of matched group studies, and (3) difficulty in accurately measuring progress (p. 81). Gronwall (1986) elaborates on these issues, and notes that the positive results of her studies at the Auckland hospital were largely inconclusive, despite the large size (N=237) and homogeneity of the patient sample, use of a structured treatment program, and quantifiable measures of progress, due to a myriad of uncontrollable contaminating variables. Given the limited availability of subjects for the current study, and the inability, therefore, to match subjects or to delineate subjects clearly according to background and specific characteristics of the injury, a single case design was determined to be the most appropriate research approach.

The nature of the intervention also presented a number of methodological concerns. As the procedure involved training subjects in a method of self regulation, requiring practice of learned techniques outside of actual treatment sessions, a significant return of targeted behaviors to
baseline levels following the withdrawal of structured training was not anticipated. Time restraints also limited the practicality of initiating treatment, returning to baseline, and later returning to an intervention phase, since an average of six to eight weeks of treatment are generally necessary in order to produce the effects of general relaxation (Gatchel, 1979; Glasgow and Engel, 1987). Overall, the success of the treatment depends upon the ability of subjects to learn the training procedures, and to show continued control of illness behaviors post-treatment.

The procedure for the study therefore involved a baseline assessment ('A' phase) during which daily observation of the target behavior(s) was conducted over a two week period (10-14 observations). The need for a sufficient baseline was critical, so that a reliable prediction of behavior during the intervention ('B') phase could be made. Also during this time, pre-testing on one of the dependent variables, (the Sickness Impact Profile) was conducted.

The intervention phase consisted of a maximum of eight weeks of relaxation training, with bi-weekly sessions. Daily observations on the targeted behavior continued during this phase. An outcome measure was taken at the conclusion of treatment, through readministration of the Sickness Impact Profile. Monitoring of the targeted behaviors continued during the four week follow-up period, and the Sickness
Impact Profile was administered once again at the termination of the follow up period. Subjects' symptom counts during the intervention phase (B) and the post-intervention phase (A1) were compared with the initial phase, in order to determine any significance in trend.

Although causality cannot be assumed through this research design, results allow for tentative conclusions and inferences to be drawn.

Instrumentation

The biofeedback instrument was the J & J 1-330 Personal Computer Monitoring System. The feedback modalities were measured using (1) an M-501 electromyograph module, with a finger band pass of 100-200 Hz and a range of 0-100 microvolts for EMG signals, and (2) a TW-600 thermal sensor with a T-601 module for monitoring of finger temperature. Feedback was provided to clients in the form of visual analog signals, and with digital readout at five second intervals. Sessions took place in a quiet room, with a minimum of environmental distraction.

Dependent Measures

During treatments, changes in biofeedback readout levels were recorded in order to determine any possible effects of the training. Baseline readings were collected for ten minutes at the beginning of each session, and the average level recorded. Averages were also taken of the EMG/thermistor readings during periods of peak stress and
maximal relaxation. Data from each session were recorded for later comparison of effects over time (see Data Recording sheet, Appendix 3).

A second dependent measure was each client's self monitoring on one identified stress-related functional disturbance. Clients were provided with individually-tailored monitoring sheets (suitable to the symptom described) (see Sample Symptom Log, Appendix 4) and were asked to record targeted behaviors as they occurred. The specific symptoms monitored by each client are seen in Table 2.

<table>
<thead>
<tr>
<th>Subject 1</th>
<th>Headaches (Daily Frequency)</th>
</tr>
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<tbody>
<tr>
<td>Subject 2</td>
<td>Periods of Anger/Irritation (#/Intensity)</td>
</tr>
<tr>
<td>Subject 3</td>
<td>Periods of Anger/Irritation (Daily Frequency)</td>
</tr>
<tr>
<td>Subject 4</td>
<td>Temper Outbursts (#/Frequency)</td>
</tr>
</tbody>
</table>

The third dependent measure was the Sickness Impact Profile (SIP), a symptom checklist which measures the effect of sickness or disability on behavior. It was designed to be sensitive enough to detect changes in health status over time or between groups (Bergner, Bobbitt, Carter, and Gibson, 1981). The scale measures actual performance of activities of daily living as an indication of health status, these being broken into 12 areas of activity. A
score is determined for each health dimension, for physical and psychosocial dimensions, and for overall sickness impact (The Physical Dimension score is determined by totaling the Body Care and Movement, Mobility, and Ambulation Scales, the Psychosocial Dimension score by totaling the Emotional Behavior, Social Interaction, Alertness Behavior, and Communication scales). The subject is required to endorse only those statements which describe him/her on a given day, and which are related to his/her health. High scores are associated with greater severity of dysfunction. Required administration time is approximately 20 to 30 minutes.

Reliability of the instrument was assessed in three field trials conducted in the three years following development of the instrument. The (final) 1976 sample showed high consistency of scores upon 24 hour test-retest, with a correlation of .92 for the total scale score, and of .50 for agreement of specific items. The Chronbach's alpha yielded an internal consistency of .94 (Bergner, et al., 1981).

Validity of the scale was determined through comparisons with other assessments of illness or dysfunction, and yielded correlations of .64 with the Self Assessment of Dysfunction, .55 with the Self Assessment of Sickness, and .57 with the National Health Interview Survey of Activity Limitation, Work Loss, and Bed Days (Bergner, et al., 1981). Although the clinical validity of the SIP was
determined for only selected disability types, it has since been used in at least one outcome study with head injured adults (Klonoff, et al, 1986).

Nature of the Intervention

Subjects were initially oriented to the program in an interview with the researcher, being told that they would receive biofeedback training, combined with autogenic training and/or imagery in order to assist them in managing stress in their lives. The basic principles and procedures underlying biofeedback training were explained, and equipment use demonstrated. The preliminary evaluation phase included (1) completion of an intake data sheet with the assistance of the researcher, and (2) completion of the SIP. Subjects identified problem behaviors during the initial meeting, and with the researcher selected one behavior for monitoring and reduction during treatment. Subjects were also instructed in symptom monitoring procedures, and commenced a 10-14 day baseline monitoring of targeted symptoms. Weekly review of client monitoring was done to encourage compliance.

Biofeedback training sessions of one hour's duration were conducted by a clinical intern in biofeedback therapy, who worked under the supervision of a licensed psychologist. During the initial biofeedback session, a physiological stress profile was obtained through monitoring of client reaction on two physiological measures in order to determine
which system would most clearly monitor biological stress response. The measures utilized during the testing were the electromyograph (EMG) and thermistor readings. The EMG electrodes were applied to frontalis and/or trapezius muscles, depending upon client report of characteristic areas of muscle tension. The finger thermistor was applied to the right index finger in all cases. Baseline readings were taken according to the procedure outlined by Stoyva (1983), as follows:

1. 14 minutes of relaxation
2. 6 minutes of stress (subtracting serial 7's)
3. 6 minute recovery period, during which the subject attempts relaxation

The system or electrode site which demonstrated the strongest response during the stress phases was selected for training. In cases where no clear distinction was evident, dual system monitoring was continued during the initial training sessions.

Relaxation biofeedback combined with deep breathing, autogenic training and imagery was conducted in biweekly sessions, each of one hour's duration. Clients were also encouraged to practice relaxation at home once daily during the program. Clients were counseled as to appropriate methods of doing home practice, including (1) establishing a regular and convenient practice time, (2) keeping the practice time separate from sleep time, and (3) conducting
the practice sessions in an appropriate location, with low likelihood of interruption. Sessions continued for a maximum of eight weeks (16 sessions), or until stress symptomatology appeared to be controlled.

Actual content of the training sessions varied, according to the nature of the life stressor identified, and the individual client's response to the training. Each session included a period of relaxation, during which deep breathing, progressive relaxation and guided imagery were used in conjunction with the biofeedback readout to assist clients in achieving deep relaxation. Imagery was individualized to match client preference, the nature of the relaxing scene being discussed with the client prior to beginning the relaxation phase. Environmental conditions were initially made conducive to deep relaxation, with lights dimmed, cushioned chair reclined, and quiet music playing. As training continued and client ability to relax progressed, these artificial conditions were gradually faded in order to simulate real living conditions under which the relaxation response might ideally be implemented.

Training sessions also included a period during which a stressor was applied, in order to desensitize the client to identified sources of stress. The approach to stress management training employed closely follows the 'stress inoculation' treatment of phobics described by Meichenbaum (1977) in which there are three goals of treatment: (1)
education of clients concerning the nature of their stressful reactions, (2) rehearsal of coping behaviors, and (3) provision of opportunity to practise new coping skills in a stressful situation. Although the current study did not directly involve the use of cognitive strategies to avert the stressful response to a stressor, it did require that subjects develop awareness of their visceral responses to a stressful situation, and to invoke the relaxation strategies being taught within sessions.

Stress imagery was employed to allow the subject to experience the stressor in cases where it appeared to be an effective medium. In two cases (Subjects 2 and 3) the clients were asked to verbally describe the stressful situation, as this proved the most effective means of assisting them to experience the emotional response associated with the situation. Subject 2, a quadriplegic, experienced ongoing frustrations with regards to his inability to perform many routine tasks. He would become visibly frustrated (this evidenced by his facial expression as well as rise in EMG levels) when talking about frustrations related to his attendant's inability to do things to his liking, and the arguments which would ensue. Subject 3 described a great deal of anxiety and hostility with regards to his brother, and would show physiological signs of stress when reviewing and anticipating meetings with him. Subject 4 demonstrated great facility in imaging
the stressful situation, and became visibly shaken and angry during the stress phase, with EMG levels rising dramatically in initial sessions.

Subject 1 showed little evidence of stress through the use of imagery, despite reports that he showed consistently negative reactions to the identified stressor (test taking). For this subject, actual simulation of the stressful situation was conducted. In the initial simulation sessions, the subject was presented with mathematical problems to compute mentally while seated in the soft recliner. The difficulty and the intensity of the questioning gradually increased as he appeared able to tolerate the level of demand presented, and at approximately the half-way point of treatment, he was moved to an upright position, seated at a desk, with an actual test booklet being presented to him.

Subjects were trained to use relaxation to control the somatic response to the stressor, as indicated by EMG or thermistor readout, during the treatment sessions, and in the external environment. Termination of the intervention was to occur when there was evidence within the sessions that the subject had become desensitized to the stressor being utilized in training, this being assumed to be true when there was no longer an appreciable rise in EMG level during the stress phase. During the intervention phase, clients were required to continue monitoring occurrences of targeted behavior, and to keep a record of practice
sessions. Actual biofeedback readings collected in treatment sessions were stored in a confidential subject file.

Following the final treatment session, the client was required to again complete the SIP. Monitoring of targeted behavioral symptoms continued during the follow up period, data being reported to the researcher weekly. The SIP was readministered four weeks following cessation of treatment.

Chapter Summary

Research procedures employed in administering a relaxation-assisted biofeedback program with four head-injured males in the post-acute phase of recovery are described. A single-subject research design was used in studying the individual responses of single subjects to the training. Dependent measures utilized were (i) levels of relaxation achieved within sessions, (ii) daily occurrence of stress-related symptoms, monitored across all phases of the study, and (iii) scores on the Sickness Impact Profile, a checklist of illness-related behavioral symptomatology.
CHAPTER BIBLIOGRAPHY


CHAPTER 4

RESULTS AND DISCUSSION

Data gathered within sessions and on the external dependent measures were analyzed with respect to the four null hypotheses. Hypothesis 1 was tested using data generated within sessions concerning the EMG levels achieved (relative to baseline) during the relaxation phase of the session, as well as the ability of the clients to control the rise in EMG level during the stress phase. Hypothesis 2 was tested through analysis of the change in symptom count over time, and across treatment phases. Hypothesis 3 was tested through comparison of Sickness Impact Profile scores obtained prior to initiation of treatment and following treatment, while testing of Hypothesis 4 required observation of both symptom count and SIP score at four week follow-up. The following is an evaluation of each of the four hypotheses:

H₀ 1: Head injured subjects receiving biofeedback assisted relaxation training will show no difference in within-session levels of relaxation as measured by at least one feedback system.

Consideration of the first research hypothesis required analysis of within-session response to the relaxation training procedures. Baseline EMG readings for each session
were compared with levels achieved during the relaxation phase of that session, in order to demonstrate the effectiveness of relaxation procedures implemented. Effort was made to ensure that baseline measurement was done with the subject in a body position consistent with that which he would assume during the relaxation and stress-induction phases. The body position assumed was not consistent over time, however, with client position gradually being changed over time, from a reclined position through progressively more upright postures. EMG readings from trapezius showed expected increases over time, as greater independent head support was required. This was particularly evident in Subject 1, who moved from a head-supported position midway through the training to a position in which he was sitting upright at a desk, leaning slightly forward to allow reading and writing. Only in Case 2 (a quadriplegic) was little alteration in body position seen throughout.

Visual inspection of the data in Figure 1 shows that the four subjects studied were able to achieve some degree of relaxation in the treatment sessions through utilization of the training procedure, this being a combination of deep breathing, autogenics, imagery, and observation of feedback. For each subject, EMG levels were seen to decrease relative to the baseline level in every treatment session. The magnitude of change achieved appeared to be related, in general, to the level of the baseline reading, with higher
FIGURE 1
Mean EMG Level Baseline/Relaxation

EMG Level (mvolts)

Treatment Sessions

SUBJECT 1
- Relaxation — Baseline

EMG Level (mvolts)

Treatment Sessions

SUBJECT 2
- Relaxation — Baseline
FIGURE 1 (Con't)
Mean EMG Level Baseline/Relaxation

SUBJECT 3
- Relaxation - Baseline

SUBJECT 4
- Relaxation - Baseline
readings allowing for a greater magnitude of change. Subject 1 showed variable ability to lower EMG levels, showing considerable reduction on some occasions (Sessions 4, 6, 9, 11, 12, and 16), while reducing levels only minimally on others. Relaxation levels achieved by Subjects 2 and 3 showed fairly consistent levels being achieved during the relaxation period. Although the absolute relaxation levels achieved by Subject 4 showed greater variance than the others, this is attributable to changes that were made in body position and in electrode placement in order to accommodate client training needs.

Although the relative influence of each element in the procedure cannot be determined, the combined effect appears productive in lowering EMG levels on a consistent basis. The need for structure in the training is evident, as EMG levels were noted to lower substantially, particularly in the early training phases, when clients were consistently 'guided' in the autogenics and imagery. Although absolute levels of relaxation did not reduce over time, the alterations in environmental conditions (darkened room, restful music, continuously guided imagery) were successfully faded over time, with no substantial increase in EMG levels seen.

Early in the training, it became evident that some alteration in training procedure was demanded by the tendency of two clients in particular to fall asleep during
the relaxation training. To overcome this difficulty, the order of the treatment was reversed on certain occasions, particularly when a client reported being fatigued at the beginning of the session. In some sessions (Condition 1), after a ten minute baseline period, subjects were given a period of relaxation, followed by induction of the stressor, and finally, a further period of relaxation. In other sessions, chosen at random, subjects ended the baseline period and immediately commenced a stress-induction period, which was then followed by relaxation (see Table 3).

Table 3
Treatment Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Baseline - Relaxation - Stress - Relaxation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition 1</td>
<td>Baseline - Stress - Relaxation</td>
</tr>
</tbody>
</table>

As a result, the efficacy of the relaxation training as applied to stress management could be examined through observation of client response to his personally-identified stressor, with and without prior relaxation. The percentage change in EMG levels during the stress phase for each condition is demonstrated in Figure 2.

In the initial sessions, significant differences can be seen in all cases between the levels attained under the two conditions, with the Condition 1 levels being consistently lowered relative to baseline. Statistical analysis of the
FIGURE 2

% EMG Change Under Stress

% EMG Change

# Sessions

SUBJECT 1

- Condition 1       - Condition 2

% EMG Change

# Sessions

SUBJECT 2

- Condition 1       - Condition 2
FIGURE 2 (Con't)
% EMG Change Under Stress

% EMG Change

0 2 4 6 8 10
# Sessions

SUBJECT 3

--- Condition 1  --- Condition 2

% EMG Change

0 1 2 3 4 5 6 7
# Sessions

SUBJECT 4

--- Condition 1  --- Condition 2
difference between the two conditions indicated a high level of significance in each case with regards to the effect of preceding stress induction with relaxation. A linear regression, matching Condition 1 (relaxation first) changes with Condition 2 (no prior relaxation) changes, revealed a negative effect with respect to rise in EMG level during the stress period. In Subject 1, for example, the difference between the effect of Conditions 1 and 2 is -45.489, Condition 1 having a negative effect on rise in EMG (although only marginally significant, with a p value of .0621 (see Table 4).

In all other cases, a similarly negative effect was seen, but with much higher levels of significance, each being significant at the .05 level (ranging from .0039 to .0216).

Table 4

Linear Regression of Percent Change in EMG Level Under Stress - Condition 1 / Condition 2

<table>
<thead>
<tr>
<th>Subject</th>
<th>Variable</th>
<th>Coefficient</th>
<th>STD Error</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Constant</td>
<td>38</td>
<td>17.734</td>
<td>-2.14</td>
<td>.053</td>
</tr>
<tr>
<td></td>
<td>Cond1/Cond2</td>
<td>-45.489</td>
<td>22.118</td>
<td>-2.06</td>
<td>.062</td>
</tr>
<tr>
<td>2</td>
<td>Constant</td>
<td>35.475</td>
<td>9.4012</td>
<td>3.77</td>
<td>.003</td>
</tr>
<tr>
<td></td>
<td>Cond1/Cond2</td>
<td>-60.882</td>
<td>16.283</td>
<td>-3.74</td>
<td>.003 *</td>
</tr>
<tr>
<td>3</td>
<td>Constant</td>
<td>33.475</td>
<td>9.4012</td>
<td>2.40</td>
<td>.033</td>
</tr>
<tr>
<td></td>
<td>Cond1/Cond2</td>
<td>-56.579</td>
<td>21.442</td>
<td>-2.64</td>
<td>.021 *</td>
</tr>
<tr>
<td>4</td>
<td>Constant</td>
<td>111.00</td>
<td>26.711</td>
<td>4.16</td>
<td>.006</td>
</tr>
<tr>
<td></td>
<td>Cond1/Cond2</td>
<td>-123.97</td>
<td>33.787</td>
<td>-3.67</td>
<td>.010 *</td>
</tr>
</tbody>
</table>

* p < .05
It should be noted that in all cases, however, the percentage rise during the stress period lessened as the training progressed, until in each case little or no change over baseline levels was seen. (Fewer observations were made of Subject 4 under stress, as he eventually refused to be subjected to the stressor during sessions, and continued to attend only for training in deep relaxation). These findings further demonstrate that clients were able to achieve a sufficient degree of relaxation during the relaxation phase of the session to reduce the negative reaction in the stress phase. As well, the positive effects of prior relaxation on the individual response to a stressful situation demonstrate that, at least in the clinical setting, relaxation can serve as a valuable means of stress inoculation.

On the basis of the above analysis, the null hypothesis is rejected.

H0.2: Head injured subjects receiving biofeedback-assisted relaxation training will show no change in frequency of occurrence of individually targeted dysfunctional behaviors.

Client self-monitoring of symptoms in each phase of the study disclosed highly variable patterns across cases. Subjects 3 and 4 showed substantial reductions in the targeted symptoms during the treatment phase relative to baseline, while Subjects 1 and 2 showed irregular variation throughout (see Figure 3). Statistical analysis of each case proved inconclusive, yielding little in the way of
FIGURE 3
SYMPTOM FREQUENCY

SUBJECT 1

SUBJECT 2

--- Frequency
FIGURE 3 (Con't)
SYMPTOM FREQUENCY

SUBJECT 3
--- Frequency

SUBJECT 4
--- Frequency
reportable significance. Testing for serial dependency showed no evidence of autocorrelation in symptom counts of Subjects 1 and 2 (where no trending in the data was evident), but did show autocorrelation in the data of Subjects 3 and 4. It is evident that there was some downward slope in the data of the latter two cases, but the fact that this trend had begun at the end of the baseline period reduced the significance of the outcome.

Particularly in Case 1, the validity of the monitored symptom as a stress indicator must be questioned. While upon initial investigation it appeared that daily headaches of fluctuating frequency were related to the subject's level of stress and anxiety in his role as a student, this connection became suspect over time, as the severity of the subject's visual disturbance (diplopia) was disclosed, as was his irregular sleep pattern.

The reliability of client report is also an obvious area of concern. Each client appeared to report daily incidence of symptom occurrence conscientiously, and it may be assumed that the tendency to fail to record an incident would be possible in any phase of the study. However, while Subjects 1 and 4 had distinct, readily quantifiable symptoms to report, those of Subjects 2 and 3 were less objective, and thus more difficult to rate consistently. Although the rater (self) was the same throughout, it is difficult to ascertain the consistency of judgement of the level of an
emotional response.

A factor which may have affected the carryover of the training to the natural environment is the amount of practice performed outside of treatment sessions. When clients were questioned as to the number of practice sessions done independently, Subjects 1 and 3 were less likely to have done consistent home practice. This, in turn, may have related to the clients' overall motivation to master the techniques, and to overcome the effects of stress in their everyday coping. It was apparent, for example, that the first subject was unconvinced concerning his tendency to become anxious in stressful situations (i.e. test-taking or other performance situations).

For the reasons noted, the null hypothesis is retained.

H0 3: Head injured subjects receiving biofeedback-assisted relaxation training will show no change from pre- to post-treatment in overall score on the Sickness Impact Profile.

The effect of the experimental treatment on overall functional adjustment to disability was measured through the Sickness Impact Profile. Scores on the SIP for each subject are presented in Table 5.

Results for Subject 1 show an overall improvement in total score between the first administration and the second (given at the end of the intervention period). Negligible change was evident in the Physical Dimension score (from 25.31
Table 5

**Sickness Impact Profile Scores**

<table>
<thead>
<tr>
<th></th>
<th>Subject 1</th>
<th></th>
<th>Subject 2</th>
<th></th>
<th>Subject 2</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Administration</td>
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<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sleep &amp; Rest</td>
<td>9.8</td>
<td>9.8</td>
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<td>21.44</td>
<td>21.84</td>
<td>21.84</td>
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<td>6.5</td>
<td>6.52</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Body Care &amp; Movement</td>
<td>25.36</td>
<td>24.01</td>
<td>9.59</td>
<td>70.69</td>
<td>75.44</td>
<td>66.0</td>
</tr>
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<td>Home Management</td>
<td>6.59</td>
<td>6.59</td>
<td>6.59</td>
<td>72.75</td>
<td>68.71</td>
<td>68.71</td>
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<tr>
<td>Mobility</td>
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<td>0.0</td>
<td>0.00</td>
<td>36.16</td>
<td>24.90</td>
<td>10.01</td>
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<td>46.79</td>
<td>40.14</td>
<td>33.73</td>
<td>33.73</td>
<td>44.89</td>
</tr>
<tr>
<td>Alertness Behavior</td>
<td>28.06</td>
<td>18.40</td>
<td>20.46</td>
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<td>16.22</td>
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<td>Communication</td>
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<td>31.59</td>
<td>21.10</td>
<td>29.93</td>
<td>29.93</td>
<td>18.48</td>
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<td>Work</td>
<td>70.10</td>
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<td>70.10</td>
<td>70.10</td>
<td>70.10</td>
<td>70.10</td>
</tr>
<tr>
<td>Recreation &amp; Pastimes</td>
<td>60.66</td>
<td>42.22</td>
<td>22.17</td>
<td>66.11</td>
<td>66.11</td>
<td>71.93</td>
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<td>24.96</td>
<td>24.96</td>
<td>10.92</td>
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<td>Total Scale</td>
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<td>15.45</td>
<td>40.10</td>
<td>40.67</td>
<td>36.20</td>
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<td>Physical Dimension</td>
<td>25.31</td>
<td>24.55</td>
<td>14.87</td>
<td>54.99</td>
<td>55.39</td>
<td>49.72</td>
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<td>Psychosocial Dimension</td>
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<td>13.81</td>
<td>11.81</td>
<td>17.56</td>
<td>19.42</td>
<td>14.71</td>
</tr>
</tbody>
</table>
Table 5 (con't)

**Sickness Impact Profile Scores**

<table>
<thead>
<tr>
<th></th>
<th>Subject 3</th>
<th></th>
<th>Subject 4</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
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<td>2</td>
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<tr>
<td>Administration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep &amp; Rest</td>
<td>22.04</td>
<td>12.02</td>
<td>12.22</td>
<td>33.67</td>
<td>42.89</td>
</tr>
<tr>
<td>Emotional Behavior</td>
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<td>8.79</td>
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<td>0.0</td>
</tr>
<tr>
<td>Body Care &amp; Movement</td>
<td>15.68</td>
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</tr>
<tr>
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<td>Mobility</td>
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<td>Social Interaction</td>
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<td>7.03</td>
<td>39.66</td>
<td>11.24</td>
</tr>
<tr>
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<td>18.53</td>
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<tr>
<td>Alertness Behavior</td>
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<td>Work</td>
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<td>0.0</td>
<td>70.10</td>
<td>70.10</td>
</tr>
<tr>
<td>Recreation &amp; Pastimes</td>
<td>31.75</td>
<td>52.36</td>
<td>0.0</td>
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<td>32.55</td>
</tr>
<tr>
<td>Eating</td>
<td>6.10</td>
<td>0.0</td>
<td>0.0</td>
<td>5.25</td>
<td>5.25</td>
</tr>
<tr>
<td>Total Scale</td>
<td>27.09</td>
<td>13.52</td>
<td>7.83</td>
<td>26.86</td>
<td>11.67</td>
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<tr>
<td>Physical Dim.</td>
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<td>1.35</td>
<td>3.14</td>
</tr>
<tr>
<td>Psychosocial Dimension</td>
<td>41.48</td>
<td>23.24</td>
<td>19.74</td>
<td>42.17</td>
<td>4.46</td>
</tr>
</tbody>
</table>
to 24.55), while the Psychosocial Dimension showed a reduction to less than one-half the original score upon repeat administration (from 28.30 to 13.81). Maximal change was seen in the Emotional Behavior, Social Interaction, Alertness Behavior, Communication, and Recreation and Pastimes subscales. Examples of items endorsed on the initial administration but not on the second administration "I act irritable and impatient with myself", "I make many demands", "I act disagreeable to family members", and "I do not speak clearly when under stress".

Subject 2 showed little change between first and second administration in overall score, nor on the Physical or Psychosocial Dimension scores. Subscale scores remained stable, except for the Home Management and Mobility scales, which showed moderate decreases, and the Alertness Behavior scale, which showed a small increase.

In Subject 3 considerable reduction was seen in the overall report of symptomatology between the two administrations. The total scale score was reduced by over one half (27.09 to 13.52), with most change being seen in the Psychosocial Dimension, this reducing to 23.24 from 41.48. The Physical Dimension showed a small change, from 11.31 to 6.17. Subscales showing the greatest overall change were Emotional Behavior, Body Care and Movement, Social Interaction, and Communication. Sample items endorsed on the first but not the second administration include "I say how
bad or useless I am" "I act irritable and impatient with myself", "I am clumsy in body movement" and "I stay alone much of the time". The large reduction in the total number of items endorsed, and the nature of the changes made appear to reflect a change in overall outlook, rather than specific improvements in functioning.

Subject 4 showed substantial reduction in report of disability-related disturbances between administrations 1 and 2. His total score was reduced from 26.86 to 11.67, again the greatest change being seen in items relating to the Psychosocial Dimension, which lowered from 42.17 to 4.46. (The Physical Dimension increased negligibly, from 1.35 to 3.14) The most notable change was in the Emotional Behavior scale, where he did not endorse any of the five items previously checked (i.e. "I say how useless I am", "I often moan and groan in discomfort", "I act nervous and restless"), and in the Social Interaction scale, where five of eight items were not checked on second administration.

The SIP scores are particularly interesting when one notes the consistency of report on items which one would expect to be unaffected by relaxation training. Scores on the Physical Dimension remained quite stable in all four cases. Clear evidence of change in overall SIP scores from pre- to post-test allows for rejection of the null hypothesis for each subject.

Overall, the large reductions in scores for the
Emotional Behavior and Social Interaction items, and more moderate score reductions in the Alertness Behavior scores for each of Cases 1, 3, and 4 are of interest, and may allow some speculation concerning the ability of relaxation training to effect change in psychosocial adjustment.

Ho.4: Subjects will show no change in the frequency of occurrence of the targeted dysfunctional behavior, or in scores on the Sickness Impact Profile 4 weeks following cessation of treatment.

Since there was insignificant trending in symptom count during the intervention phase, the pattern observed in the follow up phase A1 is of little interest. Visual inspection of Figure 3, however, shows no overall increase in symptom count relative to the treatment period except in the case of Subject 3, where a moderate degree of increase was apparent.

The Sickness Impact Profile scores showed a continued reduction in total score between the B and A1 phases in each subject. The amount of change seen in the follow up period was not substantial, however, except for in the case of Subject 4. It is evident that the greatest overall change occurred between administrations 1 and 2 for each subject, but what the change was maintained or increased during the follow up period.

While on the basis of these findings it is not possible to reject the null hypothesis, due to the insignificance of the changes in symptom count, it may be
concluded that any positive changes observed through the SIP were maintained or increased during follow up.
CHAPTER 5

SUMMARY AND CONCLUSIONS

This study examined the potential value of biofeedback assisted relaxation training with a small group of traumatically head injured subjects in the post-acute phase of recovery. Since no previous study had examined the use of biofeedback-assisted relaxation with the head injured, the initial function of this study was to determine the suitability of this approach as a modality with this population.

Upon examination of within-session biofeedback data, it is apparent that the four subjects involved in this study were able to demonstrate the ability to learn relaxation skills within the treatment sessions. Each subject was able to lower EMG readings during the relaxation phase of each session relative to baseline, and showed little change in EMG level during the stress phase when achieving a relaxed state prior to stress induction. While the use of environmental conditions conducive to general relaxation, such as dimmed lighting, reclined posture, and soft music appeared to be helpful in the initial sessions, the general fading of these conditions over time did not appear to have any negative impact on EMG readings. It did appear that
continual verbal 'guiding' by the therapist of the relaxation process was necessary to obtain maximal reduction of EMG levels in the initial training sessions. This finding is consistent with the assumption that head injured subjects may have difficulty with sustaining concentration while engaged in covert mental processing, a problem overcome with continuous cuing. Subjects appeared able to achieve relaxation with the use of only biofeedback readings and covert mental processing in the terminal stages of the intervention phase, when presumably skill in reaching a relaxed state had developed. On the basis of these results, the conclusion may be drawn that the subjects involved in this study were able to demonstrate within-session response to a program of biofeedback assisted relaxation training, and that relaxation effected reductions in EMG readings when subjects were exposed to a stressor in the clinical setting.

It is more difficult to draw conclusions based on this research with regards to the effects of relaxation training on client functioning outside of treatment sessions. While analysis of symptom self-monitoring showed positive, if not significant results in two of the four cases, the validity of these findings could be questioned on several points, as previously discussed. Analysis of SIP ratings indicates general improvement in three of four cases, and do support the alternative hypothesis that positive effects may be seen
in the overall adjustment to disability following training in relaxation. This result concerning the general effects of relaxation training on functional adaptation provide sufficient evidence to encourage further examination of this relationship. While only short term follow up has been done in this study, it appears that some of the improvement in SIP scores was maintained following cessation of training, as was the overall effect of symptom reduction in cases where symptom reduction actually occurred during the intervention phase.

One qualitative result of this research came from client report. Upon termination of treatment, three of the four clients reported, without prompting, that the training had had positive effects on their abilities to tolerate stress:

Client 2: "I'm a lot better now at dealing with all of the irritations that come along. I don't get as frustrated as I used to. I try to use the techniques that I learned here."

Client 3: "I tell myself I have to stop letting things bug me. Slowly, but surely I'm learning not to get upset about things."

Client 4: "I think differently now. I start to get mad, then think no, I don't want to get mad...stay calm... and I get over it. I feel much more positive about the future, about getting a job; I know things will work out."
As previously noted, the changes seen in the SIP responses, and the nature of the verbal report of these subjects may bear no direct relation to the training, which focused specifically on reducing the stressful response to a perceived environmental stressor. It is possible, however, the training in a technique of self management may have added to each subject's sense of control over the environment, and to his feeling of mastery in general, with this leading to an overall improvement in self concept. May (1969) discusses the feeling of "powerlessness", which he believes can lead to a sense of "futility and despair". Thorensen and Mahoney (1974) discuss the question of control, and link the individual's sense of purpose with the ability to see one's actions and experiences as being under one's own control. They recognize biofeedback as one means of enhancing the sense of self-control, along with such practices as autogenic training, yoga, and meditation (Thorenson and Mahoney, 1974). This possible link between biofeedback, control, and sense of mastery and well-being presents an area meriting further examination.

Several points of clinical importance may be made with regards to procedural concerns when attempting biofeedback-assisted relaxation with a head injured population, based on the results with this limited sample.

1. Due to differences in client deficits and personality
tendencies, an individualized approach is necessary in order to maximize the response to training. Although the overall protocol utilized was consistent throughout, the degree to which clients benefitted from the various components of the relaxation program (i.e., autogenics, guided imagery, deep breathing, and biofeedback) was extremely individual.

2. Reduced concentration skills on the part of subjects may require that relaxation be carefully guided, with consistent cueing to the mental or physiological procedure being implemented.

3. In cases where subjects show limited ability to benefit from mental imagery, use of direct simulation of natural situational stressors may be the most effective means of training in stress management.

4. Attempts must be made to accommodate the sensorial changes often associated with brain injury. These changes may include visual and/or auditory deficits, as well as problems in general arousal. Clients who fatigue easily, or who have established irregular sleep patterns may be especially prone to falling asleep during relaxation training. This may necessitate changes in positioning (having them maintain an upright posture), lighting (avoiding a darkened room), and timing of sessions in order to allow for maximum training benefits.

5. Home practice sessions should be carefully structured
with regards to establishment of a regular practice time, and recording of frequency in order to encourage compliance. If available, the assistance of a family member should be enlisted to provide prompting and encouragement.

6. A key element of a successful relaxation training program with head injured clients is the clients' motivation to succeed. As Binder-Macleod (1983) notes in his review of the use of biofeedback with stroke patients, motivation and cooperation are essential, due to the need for client responsibility in learning to control the response, and to practice the use of that control. The most successful program will involve clients who perceive stress-management as a serious factor, and one which has practical implications in terms of successful independent functioning.

The results of the study suggest that biofeedback-assisted relaxation may be a valuable adjunct to training programs with head injured clients in the post-acute stage of recovery, specifically in cases where stress-management is seen by the client as a critical factor. Future research efforts should focus on the generalized effects of relaxation in terms of psychosocial adjustment, and the long term carry-over of treatment effects. Research concerning the specific benefits of individual aspects of the relaxation training protocol used in this study will also serve to identify the most beneficial approaches to
relaxation training with head injured subjects of various functional levels.
CHAPTER BIBLIOGRAPHY


APPENDIX 1

SUBJECT CONSENT FORM
Subject Consent Form

I, ________________________________, agree to participate in a study involving the use of relaxation biofeedback with individuals who have sustained closed head injuries. The purpose of this study is to determine whether head injured persons can learn to better control emotional responses by doing biofeedback-assisted training. It is hoped that the information obtained from this study will add to the scientific knowledge concerning rehabilitation of the traumatically head injured.

I understand that I will be required to complete a variety of questionnaires at the beginning of the study, and to keep a log of my progress while receiving training, and for four weeks afterwards. I will be required to attend scheduled biofeedback sessions, lasting approximately one hour, for a maximum of two times per week. I understand that the training will continue for approximately 6-8 weeks, and that my progress will be assessed upon completing the training, and approximately four weeks afterwards. The nature of the treatment and expected procedures have been fully explained to me.

I have been told that all information disclosed through questionnaires will be confidential, as will my progress during and after training. At the conclusion of the study all information bearing my name will be destroyed. Under this condition, I agree that any information obtained from this research may be used in a fit manner for publication or education.

I understand that there is no personal risk or discomfort directly involved with this research and that I am free to withdraw my consent and discontinue participation in this study at any time.

_________________________  ____________________________
Date                                      Study Participant

_________________________
Date                                      Investigator
APPENDIX 2

LEVELS OF COGNITIVE FUNCTION (LEVEL VIII)
LEVELS OF COGNITIVE FUNCTION
(LEVEL VIII) *

Level VIII  PURPOSEFUL AND APPROPRIATE

Patient is alert and oriented, is able to recall and integrate past and recent events and is aware of and responsive to his culture. He shows carryover for new learning if acceptable to him and his life role, and needs no supervision once activities are learned. Within his physical capabilities, he is independent in home and community skills, including driving. Vocational rehabilitation, to determine ability to return as a contributor to society (perhaps in a new capacity) is indicated. He may continue to show a decreased ability, relative to premorbid abilities, in abstract reasoning, tolerance for stress, judgement in emergencies or unusual circumstances. His social, emotional, and intellectual capacities may continue to be at a decreased level for him, but functional in society.

* Rancho Los Amigos Hospital, 1974
APPENDIX 3

TREATMENT SUMMARY SHEET
## Treatment Summary Sheet

### STRESS PERIOD

<table>
<thead>
<tr>
<th>Date</th>
<th>B/L</th>
<th>Max/min Achieved</th>
<th>Average (Treatment)</th>
<th>Net Change (B-M)</th>
<th>Av. Change (B-A)</th>
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APPENDIX 4

DAILY SYMPTOM LOG
Daily Symptom Log

Name ______________________  Start date ________

Targeted behavior ____________________________________

Please record a check ( ) for each time the targeted symptom occurs in a morning or afternoon period.

<table>
<thead>
<tr>
<th>Date</th>
<th>AM</th>
<th>PM</th>
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