RELAXATION TRAINING FACILITATED BY BIOFEEDBACK FOR REDUCTION OF ANXIETY AND RELATED DYSPNEA IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

by

Patricia Viar Morrison

A Thesis Submitted to the Faculty of the COLLEGE OF NURSING In Partial Fulfillment of the Requirements For the Degree of MASTER OF SCIENCE In the Graduate College THE UNIVERSITY OF ARIZONA

1981
STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: [Signature]

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

[Signature]
ARLENE PUTT
Professor of Nursing

Date: DEC. 14, 1971
ACKNOWLEDGMENTS

The researcher would like to extend appreciation to her thesis committee for their guidance during this study: Dr. Arlene Putt, Chairman; Marilyn Abraham, Lillian Lynch, and Dr. Jessie Pergrin.

The investigator is indebted to Dr. Beverly McCord, Associate Dean, College of Nursing, for her support and guidance during this project.

Gratitude is expressed to Warren Taylor, Biomedical Engineer, College of Nursing, for his assistance in setting up and maintaining the biofeedback equipment utilized in this study.

A special note of gratitude is expressed to the five physicians who referred patients from among their practices to this investigator, and to the eight patients who served as subjects.

This thesis is dedicated to my husband, Bill Morrison, and to my parents, Charles and Marian Viar, for their encouragement throughout this project.

This study was supported in part by the Arizona Lung Association, Vivian Dodge Nurse Fellowship.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIST OF ILLUSTRATIONS</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>viii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>x</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Statement of the Problem</td>
<td>3</td>
</tr>
<tr>
<td>Significance of the Problem</td>
<td>3</td>
</tr>
<tr>
<td>Hypotheses</td>
<td>4</td>
</tr>
<tr>
<td>Theoretical Framework</td>
<td>5</td>
</tr>
<tr>
<td>Chronic Obstructive Pulmonary Disease</td>
<td>8</td>
</tr>
<tr>
<td>Anxiety</td>
<td>10</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>12</td>
</tr>
<tr>
<td>The Sympathetic Alarm Reaction</td>
<td>13</td>
</tr>
<tr>
<td>The Relaxation</td>
<td>14</td>
</tr>
<tr>
<td>Biofeedback</td>
<td>15</td>
</tr>
<tr>
<td>Operational Definitions</td>
<td>20</td>
</tr>
<tr>
<td>Limitations</td>
<td>21</td>
</tr>
<tr>
<td>Assumptions</td>
<td>21</td>
</tr>
<tr>
<td>2. REVIEW OF THE LITERATURE</td>
<td>22</td>
</tr>
<tr>
<td>Control of Ventilation</td>
<td>22</td>
</tr>
<tr>
<td>Anxiety and Dyspnea in COPD Patients</td>
<td>27</td>
</tr>
<tr>
<td>Studies in Relaxation</td>
<td>32</td>
</tr>
<tr>
<td>Training</td>
<td>35</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS—Continued

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3. METHODOLOGY</strong></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>42</td>
</tr>
<tr>
<td>Sample</td>
<td>42</td>
</tr>
<tr>
<td>Research Design</td>
<td>43</td>
</tr>
<tr>
<td>Procedures</td>
<td>45</td>
</tr>
<tr>
<td>Measurement Instruments</td>
<td></td>
</tr>
<tr>
<td>The State Trait Anxiety Inventory (STAI)</td>
<td>48</td>
</tr>
<tr>
<td>Dyspnea Scale</td>
<td>51</td>
</tr>
<tr>
<td>Maximal Voluntary Ventilation (MVV)</td>
<td>52</td>
</tr>
<tr>
<td>Protection of Human Subjects</td>
<td>55</td>
</tr>
<tr>
<td><strong>4. PRESENTATION AND ANALYSIS OF DATA</strong></td>
<td></td>
</tr>
<tr>
<td>Characteristics of the Sample</td>
<td>57</td>
</tr>
<tr>
<td>Findings Related to the Hypotheses</td>
<td>58</td>
</tr>
<tr>
<td>Biofeedback Parameters</td>
<td>58</td>
</tr>
<tr>
<td>State Trait Anxiety Inventory</td>
<td>62</td>
</tr>
<tr>
<td>Correlations between Dyspnea and Maximal Voluntary Ventilation</td>
<td>67</td>
</tr>
<tr>
<td>Summary of Statistical Analysis</td>
<td>68</td>
</tr>
<tr>
<td><strong>5. DISCUSSION OF FINDINGS</strong></td>
<td></td>
</tr>
<tr>
<td>Application of the Theoretical Framework to the Findings</td>
<td>71</td>
</tr>
<tr>
<td>Findings in Relation to the Literature Review</td>
<td>73</td>
</tr>
<tr>
<td>Anxiety and Dyspnea in COPD Patients</td>
<td>74</td>
</tr>
<tr>
<td>Studies in Relaxation Training</td>
<td>75</td>
</tr>
<tr>
<td>Studies in Biofeedback Training</td>
<td>75</td>
</tr>
<tr>
<td>Implications and Conclusions</td>
<td>76</td>
</tr>
<tr>
<td>Recommendations</td>
<td>77</td>
</tr>
</tbody>
</table>
## TABLE OF CONTENTS—Continued

<table>
<thead>
<tr>
<th>6. SUMMARY</th>
<th>Purpose of the Study</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Methodology</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Findings</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Conclusions</td>
<td>82</td>
</tr>
<tr>
<td>APPENDIX A</td>
<td>DATA COLLECTION FORM</td>
<td>83</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>SUBJECT CONSENT FORM</td>
<td>84</td>
</tr>
<tr>
<td>APPENDIX C</td>
<td>EXPLANATION OF THE PROGRAM TO PATIENTS</td>
<td>87</td>
</tr>
<tr>
<td>APPENDIX D</td>
<td>STANDARDIZED QUESTIONS FOR POST-SESSION INTERVIEWS</td>
<td>89</td>
</tr>
<tr>
<td>APPENDIX E</td>
<td>LETTER OF APPROVAL, COMMITTEE ON RESEARCH ON HUMAN SUBJECTS</td>
<td>90</td>
</tr>
<tr>
<td>REFERENCES</td>
<td></td>
<td>91</td>
</tr>
</tbody>
</table>
## LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diagramatic Representation of the Theoretical Framework for this Study</td>
<td>18</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Student's T-Test: Difference between the Means and Standard Deviation for Baseline, Control, and Experimental Sessions for Skin Temperature</td>
<td>59</td>
</tr>
<tr>
<td>2. Student's T-Test: Difference between the Means and Standard Deviation for Baseline, Control, and Experimental Sessions for Heart Rate</td>
<td>60</td>
</tr>
<tr>
<td>3. Student's T-Test: Difference between the Means and Standard Deviation for Baseline, Control, and Experimental Sessions for Respiratory Rate</td>
<td>61</td>
</tr>
<tr>
<td>4. Student's T-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for Trait Anxiety</td>
<td>63</td>
</tr>
<tr>
<td>5. Student's T-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for State Anxiety</td>
<td>64</td>
</tr>
<tr>
<td>6. Student's T-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for the Dyspnea Scale</td>
<td>65</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>7. Student's T-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for Maximal Voluntary Ventilation</td>
<td>67</td>
</tr>
<tr>
<td>8. Pearson Product Moment Coefficient of Correlation: Correlation between Dyspnea and Maximal Voluntary Ventilation</td>
<td>68</td>
</tr>
</tbody>
</table>
ABSTRACT

This study sought to determine whether the nursing intervention of relaxation training facilitated by biofeedback would reduce state anxiety and dyspnea related to anxiety in patients with chronic obstructive pulmonary disease. The researcher sought to effect the following changes in biofeedback parameters as indicators of general relaxation: increased skin temperature, decreased heart rate, and decreased respiratory rate.

Eight patients with COPD participated in four control sessions and in eight experimental sessions. Each subject served as his own control.

The findings of this study supported the hypothesis that relaxation training facilitated by biofeedback would significantly reduce state anxiety as measured by the State Trait Anxiety Inventory. Significant increases in skin temperature were demonstrated after the experimental phase of the study, as hypothesized. A weak correlation (0.27) was found between subjective reports of dyspnea as measured by the Dyspnea Scale and objective measurement of pulmonary function as measured by the pulmonary function text maximal voluntary ventilation.
The findings failed to support the hypothesis that dyspnea as measured by the Dyspnea Scale would be significantly reduced following the experimental phase. In addition, no significant reductions in heart rate and respiratory rate were found after the experimental phase, in opposition to the hypothesis.
CHAPTER I

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) refers to a syndrome encompassing two diseases, chronic bronchitis and emphysema. The term, "COPD" is usually employed in reference to these diseases, because they often co-exist in varying proportions. The insidious development of dyspnea, which is a subjective sensation of uncomfortable breathing, is the most prevalent symptom of COPD. The cause of dyspnea is usually explained by "a decrease in the functional capacity of the respiratory system, by an increase in demand upon the system, or both" (Dudley, Martin, and Holmes 1968, p. 335). Ordinarily, the lungs function out of conscious awareness, although breathing can be controlled within certain limits. When an individual experiences dyspnea, the process of respiration is brought into conscious awareness. Individuals with COPD often experience severe dyspnea which is out of proportion to the alterations in physiology present (Hargreaves, 1968). Hargreaves contends that such reactions are based upon fear and that "difficulty in breathing is frequently related to deep concerns about life
and death and primitive fears of suffocation" (Hargreaves, 1968, p. 481).

This association between dyspnea and psychological factors (i.e., anxiety) may become a significant problem to the individual with COPD. The individual may experience difficulty in dealing with anxiety, because anxiety imposes an additional burden upon a respiratory system that is already compromised by disease. The awareness that strong emotions increase difficulty in breathing may cause increased anxiety in the individual with COPD, thus perpetuating the anxiety-dyspnea-anxiety cycle.

The psychogenic stress induced by anxiety produces a generalized physiological reaction known as the sympathetic alarm reaction or the "fight or flight" response. Many clinicians believe that better physical and mental health as well as improved ability to deal with stress will result if the counterpart of the sympathetic alarm reaction, the relaxation response, can be induced (Benson, Beary, and Carol, 1974).

Various methods exist which can elicit the relaxation response. This researcher seeks to teach individuals with COPD a method of relaxation facilitated by biofeedback, in order to produce a concomitant reduction in anxiety. It is hypothesized that this reduction in anxiety will then decrease dyspnea, thus breaking the vicious cycle previously
decreased. It is not possible to alter the dyspnea level produced by physiologic changes resulting from the disease process by means of relaxation training facilitated by biofeedback. However, it is postulated that the component of dyspnea attributable to anxiety (i.e., to psychological factors) can be decreased by means of this technique.

**Statement of the Problem**

The following specific research questions were identified for study in patients with emphysema and/or chronic bronchitis. This researcher sought to determine whether learning of the relaxation response facilitated by biofeedback would result in: 1) significant changes in the parameters of skin temperature, heart rate, and respiratory rate; 2) reduction of anxiety levels; 3) reduction of dyspnea levels; 4) improvement in maximal voluntary ventilation (MVV); and 5) significant correlations between subjective reports of low dyspnea and objective measurements of high MVV.

**Significance of the Problem**

Chronic obstructive pulmonary disease is a growing health problem as evidenced by the existence of nearly fifteen million persons with the disease in the United States. COPD has become the second largest disease entity entitling individuals to disability benefits under the Social Security Act (Shapiro, Harrison, and Trout, 1975).
This disease produces considerable physical limitations, reduces occupational potential, and results in large expenditures of money for medical care. When significantly high levels of dyspnea are present, patients with COPD may experience further disability, resulting in further expenditures and further reduction in occupational potential. This high anxiety level may be accompanied by significant levels of dyspnea that may be partially attributable to psychological factors.

The role of the nurse includes assessment of the patient's physical, social, and psychological status. The nurse endeavors to evaluate and modify the patient's response to stimuli which affect his adaptation to disease. The problem identified by this researcher is therefore worthy of study, because this research is an attempt to provide the nurse with a means of assisting the patient in his adaptation to COPD.

Hypotheses

After the control phase of the study:

Ala. The subjects will exhibit no significant increases in skin temperature.

Alb. The subjects will exhibit no significant decreases in heart rate.

Alc. The subjects will exhibit no significant decreases in respiratory rate.

A2. The subjects will have no significant reductions in levels of trait anxiety as measured by the State Trait Anxiety Inventory (STAI).
A3. The subjects will have no significant reductions in levels of state anxiety as measured by the STAI.

A4. The subjects will have no significant reductions in levels of dyspnea as measured by the Dyspnea Scale.

A5. The subjects will have no significant increases in maximal voluntary ventilation (MVV) as measured by the Vanguard spirometer.

A6. There will be no significant correlation between low report of dyspnea as measured by the Dyspnea Scale and high MVV as measured by the Vanguard Spirometer.

After the experimental phase of the study:

B1a. The subjects will exhibit significant increases in skin temperature.

B1b. The subjects will exhibit significant decreases in heart rate.

B1c. The subjects will exhibit significant decreases in respiratory rate.

B2. The subjects will exhibit no significant reductions in levels of trait anxiety as measured by the STAI.

B3. The subjects will exhibit significant reductions in levels of state anxiety as measured by the STAI.

B4. The subjects will exhibit significant reductions in levels of dyspnea as measured by the Dyspnea Scale.

B5. The subjects will exhibit significant increases in MVV as measured by the Vanguard spirometer.

B6. There will be no significant correlation between low report of dyspnea as measured by the Dyspnea Scale and high MVV as measured by the Vanguard spirometer.

Theoretical Framework

The purpose of the theoretical framework is to present the psychological and physiological theories and
principles which support the basic premises of the research study. The highest level of the framework is the construct level. A construct is a general category of similar entities, for example, "physical impairment" is the first construct for this study. On the construct level, a physical impairment can produce an emotional response, which in turn can produce a somatic (physiological) response. This somatic response can then in turn produce a further emotional response, in a cyclic fashion.

The level of the theoretical framework below the construct level is the concept level. A concept is more specific than a construct, for example, the concept of "pulmonary impairment" is a type of "physical impairment". The concepts for this study are "pulmonary impairment", "anxiety", and "sympathetic alarm reaction". The same types of interactions exist among these concepts as those that exist among the constructs discussed above, as follows: the concept of "pulmonary impairment" can produce the concept of "anxiety". The concept of "anxiety" then leads to the concept of "sympathetic alarm reaction", which in turn leads to more "anxiety", in a cyclic manner.

The lowest level of the theoretical framework is the empirical level, which is the only level that can be measured in the real world. The components of the empirical level are as follows: 1) COPD as measured by symptoms
and pulmonary function tests; 2) anxiety as measured by the STAI; and 3) sympathetic alarm reaction as measured by heart rate, respiratory rate, skin temperature, dyspnea, and MVV. Each of these components is capable of being measured, in contrast to the more nebulous components of the concept and construct levels on the framework. Mind-body interactions exist on the empirical level in a similar fashion as those that were previously described for the concept and construct levels, as follows: COPD, which can be documented by symptoms and pulmonary function tests, can produce the emotional response of anxiety due to an individual's concerns regarding physical limitations, financial obligations, and changes in social and recreational outlets imposed by the disease. This anxiety, which can be documented by means of the STAI, can then produce a somatic response in the form of the sympathetic alarm reaction. This alarm reaction, which can be measured by the parameters of increased heart rate, increased respiratory rate, increased dyspnea levels, decreased skin temperature, and decreased MVV, can then produce more anxiety related to the individual's perception of increased dyspnea. In this manner, a vicious cycle with regards to anxiety and dyspnea is created. In addition, COPD may produce dyspnea due to physiological alterations, leading to increased anxiety. The dyspnea due to psychological factors is thus superimposed upon that due to physiological alterations.
The components to be discussed which are fundamental to the theoretical framework of this study are: 1) COPD; 2) anxiety; 3) dyspnea; 4) the sympathetic alarm reaction; 5) the relaxation response; and 6) biofeedback.

Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease is a term that is frequently applied to patients who have emphysema, chronic bronchitis, or a combination of the two diseases. Emphysema is defined as an anatomic alteration of the lung, characterized by distention of the air spaces distal to the terminal bronchioles with destruction of their walls (West, 1977). The etiology of this disease process is not known for certain. It has been suggested that several components of cigarette smoke and of polluted air reduce the ability of the lungs' macrophage system to clear inhaled microorganisms. (Burrows, Knudson, and Kettel, 1975). It is possible that recurrent low-grade pulmonary infections with leukocytic infiltration develop in such a situation. The leukocytes release proteolytic enzymes, possibly resulting in local tissue destruction (Burrows, Knudson, and Kettle, 1975).

Chronic bronchitis is defined in terms of symptomatology. This disease is characterized by excessive mucous production, with expectoration of large amounts of sputum. The criterion for diagnosis is accepted as expectoration.
on most days for at least three months in the year for at least two years (West, 1977). The etiology of chronic bronchitis is uncertain, although cigarette smoking appears to play a major role. Cigarette smoke produces irritation of the tracheobronchial tree, a factor common to all cases of chronic bronchitis. However, because not all cigarette smokers develop the disease, it has been postulated that immunologic and/or familial factors also play a role (Cherniak, Cherniak, and Naimark, 1972).

The functional disability resulting from COPD varies according to the dominant pathological change in the lung. Patients with predominant emphysema are characterized by severe shortness of breath with little cough or sputum. The mechanism of airway obstruction in emphysema operates upon expiration, when loss of lung recoil resulting from anatomic alterations allows excessive collapse of airways (Burrows, Knudson, and Kettel, 1975). Patients with a predominant chronic bronchitis are characterized by productive cough, but they are less troubled by shortness of breath (Cole, 1972). The mechanism of airway obstruction in chronic bronchitis, which operates upon both inspiration and expiration, is due to mechanical obstruction to airflow caused by secretions, inflammation, and hypertrophy of the mucus glands (Burrows, Knudson, and Kettel, 1975). The diagnosis of COPD is dependent upon symptoms, physical findings, and pulmonary function test results.
The major differences between emphysema and chronic bronchitis were delineated in the above discussion. However, "a large number, perhaps the majority, of patients appear to be between these extremes, showing the characteristics of both to a greater or lesser extent" (Cole, 1972). For the purposes of this study, patients with a medical diagnosis of emphysema, chronic bronchitis, or a combination of both were accepted as subjects.

Anxiety

Anxiety, which can be defined as a "diffuse apprehension", is generated by conflict between the personality and the environment (May, 1977). The central difference between fear and anxiety is that fear is a reaction to a specific danger, while anxiety is diffuse and nonspecific. In milder forms, anxiety can alert the individual so that he can function more effectively in stressful situations. However, severe forms of anxiety can produce a state of disorganization in the individual.

The basis for the concept of anxiety in the theoretical framework for this study will be Spielberger's theory of state and trait anxiety (1966). This theory was selected because of its differentiation between anxiety which exists as a transitory state subject to environmental influences (anxiety state), and anxiety which exists as a relatively stable
personality characteristic (anxiety trait). This discrimination diminishes ambiguity regarding the conceptual status of anxiety (Spielberger, 1966).

Anxiety state is defined as a condition which fluctuates over time and varies in intensity in an individual. Anxiety state is characterized by subjective, consciously perceived feelings of apprehension that are associated with arousal of the sympathetic nervous system. The anxiety state may develop due to either internal stimuli, such as thoughts, feelings, or biological needs, or due to external stimuli which the individual perceives as threatening.

Anxiety trait refers to stable individual differences in a relatively permanent personality characteristic. Measures of anxiety trait measure anxiety-proneness, i.e., differences among individuals regarding perception of a stimulus as dangerous, and a tendency to respond to threats of danger with state anxiety. Individual differences in anxiety trait presumably reflect residues of past experience. Spielberger's theory can be applied to individuals with COPD, in that individuals with high anxiety trait levels and a perception of dyspnea as threatening will most likely react to the stimulus of dyspnea with state anxiety.
Dyspnea

Dyspnea is defined as the subjective sensation of uncomfortable breathing. Therefore, dyspnea depends upon the patient's judgment and cannot be measured by any objective means. Although patients vary in their reports, the general theme is that of uncomfortable sensations arising in the chest or airways which are interpreted by the subject as interfering with his breathing (Dudley, 1969). Because awareness and communication of dyspnea are influenced by factors that are not necessarily related to organic disease, such as degree of intelligence and degree of preoccupation with health, report of dyspnea is not expected to correlate perfectly with objective tests of lung function (Gaensler and Wright, 1966).

Dudley, Martin, and Holmes (1968) demonstrated experimentally that dyspnea is associated with both emotional and physiological changes in subjects both with and without lung disease. Dyspnea was associated with decreased ventilation in depressive emotions, while subjects experienced dyspnea in association with increased respiratory rate and depth in response to anger or anxiety (Dudley, Martin, and Holmes, 1968).

The dyspnea associated with COPD can be attributed to both physiological and psychological factors. Physiologically, dyspnea is due to increased airways resistance, leading to an increase in the work of breathing with a
concomitant perception of dyspnea (Gaensler and Wright, 1966). The development of dyspnea in response to psychological factors is dependent upon past conditioning experiences and reactions to ongoing experiences. Once dyspnea develops, "... the resultant emotional changes produce positive feedback which increases and perpetuates the dyspnea" (Dudley, 1969, p. 237). This feedback is responsible for the development of the vicious cycle of anxiety-dyspnea-anxiety described previously.

The Sympathetic Alarm Reaction

When an individual is exposed to a physical or mental stressor, such as anxiety, the autonomic system "automatically" initiates a series of biochemical changes. Two distinct, interdependent divisions of the automatic nervous system regulate these changes: the sympathetic and the parasympathetic divisions. In general, the sympathetic system tenses and constricts involuntary muscles and activates the endocrine system. In contrast, the parasympathetic system generally initiates dilation of the smooth muscles and induces a state of relaxation.

Although most of the responses of the parasympathetic system are very specific, generally large portions of the sympathetic system become stimulated simultaneously during the phenomenon of mass discharge (Guyton, 1971). The effects of this discharge are of considerable value in
preparing the individual to cope with the emergency. For example, this discharge raises the blood pressure and accelerates the heart beat, providing better perfusion of the skeletal muscles and vital organs; constricts the blood vessels of the skin, thus limiting bleeding in case of injury; and increases the respiratory rate; providing a greater supply of oxygen (Ganong, 1977).

This physiological response for dealing with stress has become anachronistic. Much of the stress experienced by modern man cannot be handled by fighting or running away, because these behaviors are not acceptable in modern society (Pelletier, 1977). When the stress response continues unabated for prolonged periods, the physiological changes become potentially detrimental to health (Pelletier, 1977).

The Relaxation Response

The relaxation response in humans consists of changes which are opposite to those found in the sympathetic alarm reaction (Benson, Beary, and Carol, 1974). Therefore, the relaxation response is a state which is opposite to a state of anxiety. This response appears to be an integrated hypothalamic response which results in generalized decreased activity of the sympathetic nervous system. Physiologic changes which occur during the practice of various techniques used to elicit this response include decreases in heart rate, respiratory rate, oxygen consumption, and muscle tension (Benson, Beary, and Carol, 1974).
Four basic elements are usually necessary to elicit the relaxation response: a mental device, a passive attitude, decreased muscle tonus, and a quiet environment (Benson, Beary, and Carol, 1976). The mental device employed should be a constant stimulus, such as a word or sound repeated audibly or inaudibly, in order to shift from logical externally oriented thought. A passive attitude may be induced by ignoring distracting thoughts, and decreased muscle tonus can be achieved by assuming a comfortable posture requiring minimal muscular work. A quiet environment serves to decrease distracting environmental stimuli.

Techniques have existed for centuries which allow the individual to experience the relaxation response. Historically, most of these techniques have existed within a religious context, such as the Islamic practice of Dhikr and the Indian practice of yoga. Most of the modern techniques exist within a secular context, however, and include such techniques as autogenic training (Schultz and Luthe, 1969), Progressive Relaxation (Jacobson, 1938), and Transcendental Meditation.

Biofeedback

Biofeedback can be defined as a technique for learning voluntary control over reflexly-regulated body functions. The term "biofeedback" was devised to describe
the process of feeding back information to the individual generating the information (Brown, 1977). The technique of providing this feedback involves monitoring a selected physiological activity, such as heart rate or muscle tension, by means of electrodes or transducers. The sensed information is then amplified and used to activate signals that reflect changes in the physiological activity. The individual learns to control the physiological activity, guided by changes in the feedback signals (Brown, 1977).

Historically, medicine has taught the doctrine that neither animals nor humans can control the body's internal physiological activities. These functions, regulated by reflexes and by automatic control systems, were considered to be beyond the mind's control. However, studies conducted in the late 1950's yielded positive findings which began to change this mode of thinking (Kimmel, 1974). At the present time hundreds of biofeedback studies exist that have demonstrated man's ability to exert voluntary control over blood pressure, muscle tension, heart rate, or "... any internal biological function capable of being monitored" (Brown, 1977, p. 7).

The clinical use of biofeedback may be divided into two main approaches: direct and indirect (Basmajian, 1979). The direct approach involves instrumental or operant conditioning, in which overt behavior is systematically
altered by reinforcing a particular response. The indirect approach, which was utilized in the present study, is best exemplified by muscle relaxation used in anxiety and stress-related disorders. The use of muscle relaxation in this context assumes that it has effects on other body systems. For example, the primary goal for subjects with chronic anxiety is generally not in altering some specific or localized physiological response (Basmajian, 1979). Instead, some dampening of physiological activity is sought, which in turn, will act to diminish anxiety. This approach was used in the present study. It can be observed clinically that the anxious client shows high levels of arousal, as reflected in high levels of muscle tonus and sympathetic activity (Basmajian, 1979). Systematic relaxation training is an attempt to lower this arousal level. Biofeedback is used in conjunction with relaxation techniques, for the purpose of providing information to the client and to the therapist regarding achievement of the relaxation state.

The components of the theoretical framework for this study are summarized in Figure 1. The interrelationships that exist horizontally on each of the three levels were described previously. The arrows on the model in Figure 1 depict the direction of these interactions. In addition, interrelationships exist in a vertical fashion on the model. The concept level is related vertically to
CONSTRUCTS: Physical Impairment → Emotional Response ↔ Somatic Response

CONCEPTS: Pulmonary Impairment → Anxiety ← Sympathetic Alarm Reaction

EMPIRICAL LEVEL: COPD as Measured by Symptoms and PFT's ↔ Anxiety as Measured by the STAI Reaction as Measured by:
- Dyspnea as Measured by the Dyspnea Scale
- Heart Rate
- Respiratory Rate
- Skin Temperature

Relaxation Response Facilitated by Biofeedback Training as Measured by:
- Dyspnea as Measured by the Dyspnea Scale
- Heart Rate
- Respiratory Rate
- Skin Temperature

Figure 1. Diagrammatic Representation of the Theoretical Framework for this Study.
the construct level, in that each concept is more specific than its analogue on the construct level. That is, the concept of "pulmonary impairment" is more specific than its analogue construct of "emotional response", and the concept of "sympathetic alarm reaction" is more specific than its analogue, the construct "somatic response".

In the same manner, each component on the empirical level is related vertically to its analogous concept. The following statement exemplifies the vertical relationships that exist among the three levels: the component "COPD as measured by symptoms and pulmonary function tests" (empirical level) is a type of "pulmonary impairment" (concept level), and "pulmonary impairment" is a type of "physical impairment" (construct level).

The entity "relaxation response facilitated by biofeedback training" is depicted below the empirical level, because this entity is capable of being measured by the parameters. This entity forms the basis for the treatment to be administered during the experimental phase of the study, the purpose of which is to produce the relaxation response in individuals with COPD, in order to decrease anxiety and thus break the anxiety-dyspnea-anxiety cycle. On the empirical level, the relaxation response can be documented by changes in the parameters which are opposite to those found in the sympathetic alarm reaction, i.e.,
decreased heart rate, respiratory rate, and dyspnea levels and increased skin temperature and MVV. The arrows on the model connecting this component of the framework to the components "anxiety as measured by the STAI" and "dyspnea as measured by the Dyspnea Scale" are depicted in broken lines, because this relationship is hypothetical.

**Operational Definitions**

1. **Anxiety:** the degrees of state and trait anxiety were defined according to the score received on the State Trait Anxiety Inventory (Spielberger et al., 1966).

2. **Dyspnea:** the severity of dyspnea was defined according to the score received on the Dyspnea Scale (Gaensler and Wright, 1966).

3. **Maximal Voluntary Ventilation:** the MVV was measured in liters per minute by the Vanguard Electronic Spirometer. To record this measurement, the subject was asked to breathe deeply and rapidly for 15 seconds, and this number was then extrapolated to 60 seconds, corrected to body conditions, and expressed in liters per minute by the Vanguard spirometer.

4. **Biofeedback:** for the purposes of this study, the parameters of skin temperature, heart rate, and respiratory rate were monitored continuously and fed back to the subject. Skim temperature was fed back throughout each training session, while the remaining two parameters were fed back prior to the beginning of the next session.
Limitations

1. The subjective measures utilized in this study, i.e., the STAI and the Dyspnea Scale, are affected by the honesty of the subjects, the recall ability of the subjects, and by situational influences at the time of testing.

2. The measures of maximal voluntary ventilation are affected by the subjects' exerting maximal effort.

Assumptions

The following assumptions were made:

1. That the subjects are capable of learning the relaxation response facilitated by biofeedback.

2. That the subjects exerted maximal effort in learning the relaxation response facilitated by biofeedback.

3. That the dyspnea experienced by these subjects with COPD is partially attributable to psychological factors.
CHAPTER 2

REVIEW OF THE LITERATURE

The review of the literature includes a description of the control of ventilation, because this information is essential to the understanding of the elements affecting ventilation which are expected to be influenced by this study. Previous studies establishing the relationship between anxiety and dyspnea in patients with COPD are also presented. In addition, the review of the literature summarizes studies in relaxation and biofeedback training which are pertinent to the present research study.

Control of Ventilation

The neural and chemical control of breathing will be elucidated, in addition to the effect of voluntary control and psychological factors upon respiration. The act of breathing is spontaneous in that it is accomplished without conscious effort. However, in contrast to automatic functions such as contraction of the heart, breathing is subject to voluntary interference (Burrows, Knudson, and Kettel, 1975). In a state of rest, normal breathing has a rhythmicity that approximates that of the heartbeat, but the respiratory rate
is readily altered by both physiological demands and by emotional states, such as anxiety, anticipation, and excitement (Burrows, Knudson, and Kettel, 1975). Breathing can be altered voluntarily by hyperventilating or by breath-holding. In the present study, the researcher seeks to alter only the psychological influences, in order to diminish the perception of the dyspnea. Eliciting the relaxation response by means of biofeedback is not expected to alter directly the physiological influences on respiration that are related to the disease process of COPD. Although the psychological experience of anxiety induces a physiological response known as the sympathetic alarm reaction, the effects of this reaction upon ventilation are directly traceable to psychological factors rather than to alterations in physiology per se.

The centers in the body that influence respiration are widely dispersed (Cherniak, 1977). Nerve cell collections involved in the regulation of breathing may be found in the cerebral cortex, hypothalamus, medulla, pons, and carotid and aortic bodies (Cherniak, 1977). These centers affecting respiration can be stimulated or inhibited by reflex action, or they can be directly affected by chemical stimuli. Chemical control plays a larger role in the regulation of breathing than does neural control (Cherniak, 1977).
Groups of nerve cells scattered throughout the reticular formation of the brain stem have been identified as the centers responsible for rhythmic respiration (Burrows, Knudson, and Kettel, 1975). The medullary control center is composed of the reticular formation of the medulla oblongata. Although the specific mechanism of generating rhythmicity is not clear, it may be the result of two oscillating circuits, one for inspiration and one for expiration, which inhibit each other (Burrows, Knudson, and Kettel, 1975). The efferent impulses to the muscles of respiration arise from the medullary centers. However, it seems likely that centers in the pons as well as in the medulla participate in producing normal respiratory rhythm, because medullary breathing without pontine influence is not well coordinated (Burrows, Knudson, and Kettel, 1975).

The pons contains a neural mechanism identified as the pneumotaxic center. An increase in respiratory rate results from stimulation of this center, whereas rate is slowed when the center is ablated (Burrows, Knudson, and Kettel, 1975). The pneumotaxic center does not have intrinsic rhythmicity but appears to act by modulating the tonic activity of the apneustic center (Burrows, Knudson, and Kettel, 1975). Respiratory arrest results from stimulation of the apneustic center in the cat. Total removal of the pons in animals allows respiratory
rhythmicity, although the breathing is not well coordinated (Burrows, Knudson, and Kettel, 1975).

Alterations of the carbon dioxide and oxygen tensions or of the hydrogen ion concentration of the blood exert a major influence upon ventilation. Their effect on ventilation is mediated by peripheral chemoreceptors in the carotid and aortic bodies and by chemosensitive areas in the medulla (Cherniak, 1977). A rise in the carbon dioxide tension is the most potent influence on ventilation. Stimulation of the chemosensitive areas of the medulla accounts for the majority of the increase in ventilation produced by a rise in arterial carbon dioxide (Cherniak, 1977). The chemosensitive areas appear to be responsive to hydrogen ions rather than to carbon dioxide per se (Burrows, Knudson, and Kettel, 1975). Carbon dioxide diffuses readily into the cerebrospinal fluid, where it combines with water to release hydrogen ions. Hydrogen ions themselves do not readily cross the blood-brain barrier (Burrows, Knudson, and Kettel, 1975). Thus, while central chemoreceptors are sensitive to changes in pH, they are specifically responsive to carbon dioxide level through the mechanism just described (Burrows, Knudson, and Kettel, 1975). Some patients with COPD have a chronic elevation of carbon dioxide. The ventilatory response to carbon dioxide is markedly diminished in these
patients, and they depend to a large degree upon hypoxemia for their respiratory drive.

Peripheral chemoreceptors are primarily responsible for the hypoxic drive to ventilation (Burrows, Knudson, and Kettle, 1975). A decrease in oxygen supply leads to anaerobic metabolism in the cells of these chemoreceptors, which are located in the carotid and aortic bodies. The metabolites produced stimulate receptor nerve endings and lead to increased ventilation through signals conveyed to medullary control centers (Burrows, Knudson, and Kettel, 1975).

The peripheral chemoreceptors are also stimulated by a decrease in arterial pH. The effect of pH has been attributed to the dilatation of arteriovenous anastomoses located in the periphery of the chemoreceptor bodies. As a result, there is a reduction in blood flow to the chemosensitive cells (Burrows, Knudson, and Kettel, 1975). However, the effect of pH and indirectly of carbon dioxide through its effect on pH level is mediated by the peripheral chemoreceptors only to a limited extent (Burrows, Knudson, and Kettel, 1975).

The regulation of respiration becomes altered in conditions of respiratory disease. The activity of the respiratory centers may be modified when the work of breathing is high, as in the case in COPD (Cherniak, 1977). The minute ventilation falls even in healthy
subjects when they breathe through an artificial airway obstruction, an experimentally-created increase in the work of breathing. The body appears to tolerate the resultant hypercapnia rather than expend the effort to lower the arterial carbon dioxide to normal levels (Cherniak, 1977). In addition, lowering the carbon dioxide to normal might require so much oxygen that little would be available for non-ventilatory work (Cherniak, 1977).

In summary, this discussion has focused upon the neural and chemical control of ventilation. Chemical control plays the major role in control of breathing. However, in patients with respiratory disease, the activity of the respiratory centers may be modified when the work of breathing is high. Emotional states such as anxiety, which is being examined in the present study, can produce increases in the demand for ventilation.

**Anxiety and Dyspnea in COPD Patients**

The relationship of dyspnea to certain physiologic and psychologic variables was studied extensively by Dudley, Martin, and Holmes (1968). A total of 347 studies was carried out on 33 subjects, of whom ten were normal and 23 had chronic pulmonary disease (Dudley, Martin, and Holmes, 1968, p. 325). All subjects were volunteers selected because of their availability. Results of an exploratory group of subjects with pulmonary disease...
revealed no significant relationship between respiratory variables when comparing days on which the subjects experienced dyspnea to non-dyspneic days. A follow-up study of normal subjects and subjects with pulmonary disease, in which the emotional state of subjects was both manipulated and observed, revealed that dyspnea was associated with both physiologic and emotional change and was not limited to patients with pulmonary disease. With depressive emotion, the subjects experienced dyspnea in association with decreased rate and depth of ventilation. With strong action-oriented emotions such as anxiety and anger, the subjects experienced dyspnea in association with increased rate and depth of breathing. All reports of dyspnea were spontaneous and unsolicited.

A study by Oswald, Waller, and Drinkwater (1970) examined the relationship between breathlessness and anxiety in patients with asthma and chronic bronchitis. Two personality testing forms were completed by 471 hospital patients with asthma, chronic bronchitis, or both. Results of the study showed that asthmatic and bronchitic patients have higher mean ratings for anxiety and neuroticism than the general population. "This is to be expected in a group of patients most of whom had a moderate or severe chronic disability" (Oswald, Waller, and Drinkwater, 1970, p. 17). The degree of breathlessness appeared to be the main factor
affecting the scores. In addition, approximately one in five of the patients had abnormally high ratings for neuroticism and anxiety. These findings are indicators of the importance of personality in determining the course and severity of disease. "Both traits can aggravate symptoms and may even contribute to a vicious cycle between organic and psychological features" (Oswald, Waller, and Drinkwater, 1970, p. 17).

DeCencio and Leshner (1968) examined the personality characteristics of patients with chronic pulmonary disease. The subjects included in this study were 43 men admitted to a hospital pulmonary rehabilitation unit with a primary diagnosis of COPD. Results of the Minnesota Multiphasic Personality Inventory (MMPI) were compared to those of normals and of three other disability groups. They found that patients with COPD scored significantly higher than normals on nine of the ten clinical scales, with paranoia being the exception. The most striking differences were evidenced on those scales constituting the neurotic triad: depression, hysteria, and hypochondriasis. No attempt was made to establish a cause-and-effect relationship between COPD and personality characteristics.

Fagerhaugh (1973) sought to determine the processes which patients use in coping with problems of physical mobility and sociability. Data were obtained from interviews with 22 patients with advanced emphysema. She found
that "social situations that provoke anxiety tend to bring on attacks of shortness of breath. A characteristic of emphysema is that anxiety triggers dyspnea which brings on more anxiety, and a vicious cycle develops. Therefore, over the long haul, these patients tend to isolate themselves as a defense" (Fagerhaugh, 1973, p. 95).

Although a controlled study was not the basis for their report, Nett and Petty (1970) offered reasons for the behavioral characteristics of chronic pulmonary patients from their experience in a respiratory care unit. According to these authors, the psychopathology exhibited by emphysema patients includes primarily anxiety, depression, and an increase in somatic complaints. "The anxiety is rather diffuse and based upon sheer fear that death through suffocation is imminent" (Nett and Petty, 1970, p. 1253). Anxiety always resulted when there is interference with basic physiologic processes, according to these authors. "When the effort-free automatic respiratory control system is sufficiently burdened by airflow resistance due to obstructive airway disease, this system fails, and the problem becomes a conscious one. Obviously a number of psychic consequences result" (Nett and Petty, 1970, p. 1252).

The assumption that a comprehensive rehabilitation program could produce significant beneficial changes in patients with COPD was tested in a study by Agle, Baum,
This study also determined whether such changes correlated with physiologic or psychologic factors. Twenty-one patients with COPD were studied by psychologic and physiologic methods before, immediately after, and one year after an intensive in-hospital rehabilitation program. Significant physiologic improvement occurred in only one patient. However, 18 out of 21 patients improved their performance on the treadmill, and all of the patients showing improvement reported they were able to carry out activities of daily living requiring endurance with less discomfort. The results indicated that sustained improvement in function occurred in some patients without corresponding improvement in physiologic measures. Data obtained from psychiatric interviews and psychologic tests correlated positively with success in rehabilitation, while little correlation was observed with physiologic state. "Of particular importance in affecting positive change appeared to be the desensitization of the fear of dyspnea and increased patient autonomy in the control of symptoms" (Agle, Baum, Chester, and Wendt, 1973, p. 48). Fear of dyspnea had been the major obstacle to task-oriented efforts, and dyspnea was commonly associated with anxiety. "Anxiety made the perception of dyspnea more acute, and some patients avoided any activity in a phobic manner as though the resulting shortness of
breath meant that they would die" (Agle, Baum, Chester, and Wendt, 1973, p. 46).

Schnitzer (1977) sought to determine the levels of anxiety and depression in relation to the severity of dyspnea in patients with COPD. Fifty outpatients with COPD were given subjective measures of anxiety, depression, and dyspnea. The level of dyspnea was found to be positively correlated with the levels of state anxiety, trait anxiety, and depression. Those subjects with the highest levels of dyspnea demonstrated the highest state anxiety means, although there was a wide range of scores.

**Studies in Relaxation Training**

The number of relaxation studies with chronic pulmonary patients as subjects is limited in the literature. A study by Broussard (1979) investigated the use of relaxation techniques as a nursing intervention in clients with COPD. One client with severe emphysema was taught a relaxation exercise, which she used twice daily for 15 days. The client's daily heart rates, respiratory rates, and blood pressures were recorded for 22 days prior to relaxation training and for 14 days during the relaxation protocol. Results showed a significant correlation between the relaxation response and decreases in both heart rate and respiratory rate. Blood pressure was not significantly altered, however.
An investigation of the effects of Transcendental Meditation (TM) upon a group of patients with bronchial asthma was done by Wilson, Honsberger, Chiu, and Novey (1975). Twenty-one patients ranging in age from 14 to 57 years, who had had stable asthma under the care of a practicing allergist for at least one year, and who had neither psychological problems nor previous experience with TM, were studied. Results of the study revealed that TM is a useful adjunct in the treatment of asthma based on the following observations: reduction in symptom severity-duration index; improvement of pulmonary function abnormalities; and subject and physician evaluation. The exact mechanism underlying the beneficial effects of TM upon asthma remains speculative.

Johnson and Spielberger (1968) investigated the effects of a muscle relaxation training procedure versus the passage of time on empirical measures of state and trait anxiety. The subjects were 48 male Caucasian psychiatric patients, in whom chronic brain syndrome, mental retardation, and lack of contact with reality had been ruled out. Scores on all three anxiety-state measures (systolic blood pressure, heart rate, and the Affect Adjective Check List—Situational) declined significantly as a result of the relaxation training. In contrast, scores on the anxiety-trait measures (Taylor Manifest Anxiety Scale and the Affect Adjective Check List—General)
were not significantly altered by the relaxation training procedures. These findings are consistent with Spielberger's hypothesis that it is meaningful to delineate two anxiety constructs, anxiety-state and anxiety-trait, because operational indices of these constructs showed variations as a function of change in stimulus conditions (Johnson and Spielberger, 1968). However, this study failed to find the expected positive correlation between the physiological anxiety-state measures and the behavioral measures. This finding would seem to challenge the construct validity of anxiety-state (Johnson and Spielberger, 1968). However, other researchers (Lacey, Bateman, and Van Lehn, 1953; Lazarus and Opton, 1966) have interpreted this lack of positive correlations between physiological and self-report indices as a reflection of "response specificity." In other words, individual differences exist in the particular autonomic channel in which maximum response to stress is made. Lazarus and Opton (1966, p. 235) made the following statement: "The maximum correlations between various indicators of autonomic system reaction are probably only modest even under the most favorable conditions. The discrepancies between stress-reaction indicators are even more marked and obvious when we compare different levels of analysis, for example, the physiological response and the behavioral response."
The physiological changes which accompany the medi­
tative state were investigated by Wallace and Benson (1972). Detailed measurements were made on a group of 36 subjects ranging in age from 17 to 41 years, with the majority having had two to three years of meditation experience. Results of the study showed that Transcendental Meditation produced physiological signs of a "wakeful, hypometabolic" state: reductions in oxygen consumption, carbon dioxide elimination, and rate and volume of respiration. Additional physiological findings included a slowing of the heart beat, a marked decrease in blood lactate levels, a considerable increase in skin resistance, and an electroencephalographic pattern of intensification of slow alpha waves with oc­casional theta-wave activity. The pattern of changes suggests a response mediated by the central nervous system (Wallace and Benson, 1972). This hypometabolic state ap­pears to be a counterpart of the sympathetic arousal response.

Studies in Biofeedback Training

There are a limited number of studies in the litera­ture dealing with the use of biofeedback as a therapeutic technique for COPD patients. Sitzman (1978) investigated the use of biofeedback training to alter the breathing patterns of patients with COPD by voluntary control. She attempted to teach COPD patients to decrease their respira­tory rate and to increase their tidal volume through a
biofeedback training program. The subjects were four ambulatory adult males with a diagnosis of emphysema and/or chronic bronchitis who were selected from an outpatient chest clinic. Results of the study showed that three of the subjects demonstrated a significant decrease in respiratory rate by the twelfth training session. In addition, these three subjects also demonstrated a remarkable increase in their mean tidal volume scores as they decreased their respiratory rate. However, generalizability of the results of this study is limited by the small sample size.

A study to compare the effectiveness of routine Jacobsonian relaxation training with biofeedback-assisted modified Jacobsonian relaxation training as a treatment for asthma was done by Davis, Saunders, Creer, and Chai (1973). Twenty four subjects were selected on the basis of age and asthma severity from the population of a residential treatment center for children with intractable asthma. Twelve (50%) of the subjects were categorized as severe asthmatics, on the basis that they were receiving maintenance doses of corticosteroids at the time of the study, and the remaining half were categorized as non-severe asthmatics. The primary finding of this study was that a significant difference existed between treatment groups of non-severe asthmatic children. These children demonstrated a reduction in airway resistance, as measured by the Wright Peak Flow Meter,
that was significantly greater than that evidenced by the control group. The subjects who received routine Jacobsonian relaxation training showed improvement, but not to the extent shown by the group who received biofeedback-assisted modified Jacobsonian relaxation training. There were no significant differences between treatment groups for the severe asthmatics. Results of this study are limited by the fact that peak expiratory flow rate, which was measured by the Wright Peak Flow Meter in this study, predominantly reflects airways resistance in airways that are greater than two mm in diameter. Significant disease of the small airways less than two mm in diameter, which may be present in asthma, is not significantly reflected by measurements of airways resistance (Cherniak, 1977).

A study by Kostes, Glaus, Crawford, Edwards, and Scherr (1975) investigated the effects of operantly produced frontalis muscle relaxation on peak expiratory flow rates in asthmatic children. The subjects were 36 asthmatic children, ranging in age from 8 to 16 years, who participated in an eight-week summer camp program for chronic severe asthmatics. The evaluation of frontalis muscle activity revealed the presence of a strong conditioned effect, with the experimental group exhibiting reliably lower values than the control group over the course of the experiment. Group peak expiratory flow rates,
which were measured prior to the initiation of the biofeedback-assisted relaxation training and subsequent to training, improved substantially in the experimental group. The investigators concluded that operantly produced frontalalis muscle relaxation training may be of potential significance in the development of asthma therapies based on conditioning. However, the limitation that was cited in the discussion of the previous study regarding the use of peak expiratory flow rates is also applicable to this study.

The use of electromyographic (EMG) feedback as a relaxation technique was investigated by Coursey (1975). The experimental group was composed of ten undergraduate males, and there were two control groups of ten subjects each. The experimental group received variable-tone feedback from the frontalalis muscle. One control group was given only a constant tone, with no specific instructions or feedback. The second control group was given a constant tone and instructions about relaxation, but no feedback. Each subject had one baseline session and seven practice sessions of 21 minutes each over a two-week period. The results of the study showed that the feedback group achieved significantly lower EMG scores than the two control groups. Thus, it was demonstrated that EMG feedback is more effective in lowering tension in a specific muscle throughout
training than either simple verbal instructions or the reduction achieved by means of the subject's own unaided efforts. Measures of subjective anxiety showed significant differences between the beginning and end of each session for all three groups. However, only one of the six measures of state anxiety favored the feedback group. There were no significant differences between groups on measures of trait anxiety.

Raskin, Johnson, and Rondesvedt (1973) investigated the effects of daily deep muscle relaxation, achieved through EMG feedback training, on the symptoms of ten chronically anxious patients. The subjects were young adults with an average age of 27 years, who had been troubled by symptoms of anxiety for at least one year prior to being admitted to the care of the authors, and who had remained symptomatic despite two years of treatment with psychotherapy and medications. All ten subjects learned to sustain 25 minutes of profound relaxation of the frontalis muscle both with and without feedback. Three patients learned to use partial relaxation to control previously intolerable situational anxiety, and four patients learned to abort tension headaches in the same manner. However, only one patient had a marked lessening of his pervasive anxiety. Although most of the patients with insomnia learned to fall asleep by relaxing, most of these patients experienced frequent awakenings. The researchers feel that
these results are promising, "considering the fact that all of our patients were chronically ill and treatment refractory" (Raskin, Johnson, and Rondesvedt, 1973, p. 265).

Biofeedback training has been utilized in a number of other clinical applications. A study by Haynes, Griffin, Mooney, and Parise (1975) compared the effectiveness of relaxation instructions with frontal EMG feedback in the treatment of muscle-contraction (tension) headaches. Results of this study revealed that both relaxation training and biofeedback training produced significant decreases in reported headache frequency. A study by Welgan (1974), which suggested that gastric secretions may be controlled and altered by means of feedback to the subject of the pH of his gastric contents, has implications for peptic ulcer patients. Finally, a study by Shoemaker and Tasto (1975) showed that muscle relaxation training facilitated by biofeedback brings about lowering of systolic and diastolic blood pressure.

In summary, this chapter has reviewed select literature dealing with control of ventilation; anxiety and dyspnea in COPD patients; relaxation training; and biofeedback training. Studies in relaxation training concerned the use of this technique as a treatment for COPD, as a treatment for asthma, and for decreasing anxiety. In addition, a study dealing with the physiologic changes
which accompany the meditative state was presented. Studies in biofeedback involved the use of this technique to alter the breathing patterns in patients with COPD; as a treatment for asthma; and as a relaxation technique. Studies regarding the use of relaxation training and biofeedback training as a treatment in COPD are limited in number in the literature.
CHAPTER 3

METHODOLOGY

This chapter contains a description of the population, sample, and criteria for sample selection. The research design is presented, in addition to a description of the measurement instruments. The biofeedback training program is also delineated.

Population

The population consisted of the patients under the care of one of five private physicians specializing in either internal medicine or pulmonary medicine in a metropolitan area of the Southwest. The physicians were selected on the basis of their medical specialty and on their willingness to participate in the study.

Sample

The sample consisted of eight patients who were under the care of the private physicians described above, and who agreed to participate in the study. These patients served as both the experimental group and as their own control. The first eight patients who agreed to
participate in the study and who met the following criteria were selected as subjects:

1. Medical diagnosis of emphysema and/or chronic bronchitis.
2. $\text{FEV}_1$ of 1 to 1.5 liters.
3. Ambulatory adult patients able to read and to speak English.
5. Absence of readily apparent psychosis.

Failure to meet all of these criteria eliminated a patient from inclusion in the study. When it was ascertained that the stated criteria were met, the purpose and hazards of the study were explained (see Appendix C), the consent form was given to the patient to read (see Appendix B), and the patient was asked if he were willing to participate in the study. Patients who consented to participate were given the Subject's Consent Form to sign.

**Research Design**

The design of this study was the single group repeated-measures design (Campbell and Stanley, 1963). The independent variable in this research study was the
biofeedback training, and the dependent variables included anxiety, dyspnea, and maximal voluntary ventilation. The eight subjects serves as both the experimental group and as their own control. The measurement instruments (STAI, Dyspnea Scale, and MVV) were administered prior to and following both the control and the experimental periods. There were a total of three administrations: 1) prior to the control period; 2) following the control period (this administration also served as the pre-experimental administration); and 3) following the experimental period.

Each of the subjects received one baseline session, four control sessions, and eight experimental sessions. Subjects came to the laboratory for four additional time periods for orientation and testing according to the following schedule: Period I. Administration of measurement instruments (pre-control); orientation to lab and equipment; Period II. Recording of baseline parameters; additional orientation; Periods III through VI. Four control sessions; Period VII. Administration of measurement instruments (counts as both post-control and pre-experimental); Periods VIII through XV. Eight experimental sessions; and Period XVI. Administration of measurement instruments (post-experimental).
**Procedures**

The control sessions for this study occurred under the same laboratory conditions as the experimental sessions, except that the use of relaxation tapes and feedback to the subject were omitted. Subjects sat in a La-Z-Boy reclining chair for a time period analogous to that of the average experimental session, i.e., 23 minutes. The same physiological parameters were recorded during the control sessions as during the experimental sessions, but no feedback regarding these parameters was given to the subject. The parameters utilized in this study are described below.

The eight experimental sessions were carried out by the researcher while the subject rested comfortably in a reclining chair. At the beginning of each session, the monitoring devices were connected to the subject. This procedure required approximately five minutes. A thermistor transducer for monitoring skin temperature was taped loosely to the middle finger of one hand. A thermistor transducer was taped just above the upper lip so that it sensed the temperature changes occurring with inhalation and exhalation, in order to record respiratory rate. A photocell-based pulse probe was taped to the distal end of one finger in order to record heart rate.

After connecting the monitoring devices, the researcher dimmed the lights in the room and closed the
door, after leaving the room. The researcher remained in
the adjoining room throughout each session and observed
the subject through a sliding glass window between the
rooms. Throughout each of the first six sessions, a
relaxation tape by Thomas H. Budzynski was played. The
subject attempted to produce the relaxation response by
following the instructions on the tape and by observing
the biofeedback. During the final two sessions, the subject
used his own imagery by imagining scenes which were moder­
ately distressful to him. The subject attempted to produce
the relaxation response during the final two sessions by
observing the biofeedback and by utilizing the techniques
which he had learned from the tapes in previous sessions.
Continuous feedback was given throughout each session of
the subject's skin temperature by means of a digital read­
out on a Digitec thermometer. The researcher recorded the
Digitec readings manually every 60 seconds, by observing the
Digitec through a sliding glass window.

Although the temperature readings were recorded
manually, heart rate and respiratory rate were recorded
on graph paper by the polygraph. Feedback regarding the
latter two parameters was given to the subject immediately
prior to the beginning of the next session, in order to
prevent the confusion that might result if the subject
attempted to attend to several different parameters during
the actual relaxation session.
When the relaxation tape concluded, the subject was allowed to remain seated for an additional two minutes, in order to record the final response. The researcher then entered the subject's room and encouraged him to move his limbs prior to arising from the chair, in order to prevent any possible complications. Descriptive data was then recorded regarding the subject's feelings about the session, i.e., how well he was able to relax and what methods he used to induce relaxation. In addition, the subject was interviewed briefly regarding his progress with home relaxation and his emotional status during the previous week. A standard set of questions was utilized (see Appendix D).

The time period for each experimental session varied according to the length of the tape, from a minimum of 19 minutes to a maximum of 30 minutes. An additional 30 minutes was allotted for each session for the purposes of connecting the equipment before the session and for interviewing the subject after the session. In addition to the weekly training sessions, each subject was expected to practice relaxation at home at least twice each day for a period of 15 to 20 minutes per session. For this purpose, the text from Tape 2 was typed and given to the subject, with the instructions to read the text aloud while practicing relaxation.
The apparatus used in this study was the six-channel Grass Model 7D Polygraph, using a 7P1E pre-amplifier and a 7DAF driver amplifier. This machine has integral opto-isolaters to assure patient safety. After the signals have been amplified by the pre-amplifier, the driver amplifier will drive the pens that record heart rate and respiratory rate.

The Digitec 5810 Thermometer was used to display skin temperature continuously in digital form. The Digitec was placed so that it could be easily read by the subject while he was seated in the reclining chair.

The relaxation tapes utilized in this study were a series of six tapes by Thomas H. Budzynski. For the purpose of this study, tapes one through six were played in consecutive order for the first six sessions. As previously discussed, the subject utilized his own imagery during the final two sessions.

**Measurement Instruments**

The instruments used in this study to collect data were the State Trait Anxiety Inventory, the Dyspnea Scale, and the pulmonary function test maximal voluntary ventilation.

The State Trait Anxiety Inventory (STAI)

The STAI was developed to provide easily administered, easily scored, objective self-report measures of both state
and trait anxiety (Spielberger, Gorsuch, and Lushene, 1970). The STAI consists of two 20 item scales (forms X-1 and X-2), based on a theoretical distinction between state anxiety, which is a transitory condition of perceived apprehension, and trait anxiety, which is a relatively stable condition of anxiety proneness. Directions for this inventory are self-explanatory, and a period of 20 minutes is generally the maximum time period required for completion of all 40 items. Most individuals with fifth or sixth grade reading ability respond spontaneously to all of the STAI items without prompting or special instructions (Spielberger, Gorsuch, and Lushene, 1970). Scores for both state and trait scales can range from 20 to 80, with the higher scores corresponding to higher levels of anxiety.

The Anxiety-State Scale (Form X-1) is designed to measure a transitory emotional condition of perceived apprehension by assessing "how you feel right now, that is, at this moment". However, instructions for this scale may be altered in order to focus upon a particular time period. In fact, "... instructions may be modified to evaluate the level of A-state intensity for any situation or time interval that is of interest to the experimenter or clinician" (Spielberger, Gorsuch, and Lushene, 1970, p. 4). For the purposes of the present study, instructions were modified to assess "how you feel when you are short of breath".
The Anxiety-Trait Scale (Form X-2) is designed to measure a relatively stable personality characteristic of anxiety proneness by assessing "how you generally feel". This measure reflects individual differences in tendency to respond to situations perceived as threatening with increases in anxiety-state intensity. The trait measure was given following the administration of the anxiety-state scale. This order of testing is recommended by the authors when both scales are given together, because the measure of state anxiety can be influenced by the emotional atmosphere that may be created if the trait measure is given first (Spielberger, Gorsuch, and Lushene, 1970).

The construct validity of the STAI is documented by numerous studies cited in the STAI Manual. College students, high school students, and various patient populations served as subjects for these studies. Research with psychiatric patients conducted by Graham (1969) and by Parrino (1969) and with obstetrical patients by Edwards (1969) contribute to the construct validity of the STAI.

Concurrent validity of the trait scale was established by correlations with the Institute for Personality and Ability Testing (IPAT) Anxiety Scale, the Taylor Manifest Anxiety Scale (TMAS), and the Zuckerman Affect Adjective Check List (AACL), General Form. Correlations of the STAI with the IPAT and the TMAS are moderately high
(.75 and .80, respectively), while correlations of the STAI with the AACL are moderate (.52). These studies were done on 126 college women (Dreger, 1978).

Test-retest reliability (stability) of the STAI is also discussed in the STAI Manual. As anticipated, test-retest correlations for the trait scale are relatively high (ranging from .73 to .86), while such correlations are low for the state scale due to the influence of situational factors existing at the time of testing. Due to the transitory nature of anxiety scales, measures of internal consistency such as the alpha coefficient would seem to provide a more meaningful reflection of the reliability of anxiety state scales than test-retest correlations (Spielberger, Gorsuch, and Lushene, 1970). Alpha coefficients were found to be high for both trait and state scales, indicating that the internal consistency of both subscales is reasonably good. Item-remainder coefficient correlations provide further evidence of the internal consistency of the STAI scales (Spielberger, Gorsuch, and Lushene, 1970). Both the item-remainder correlation coefficients and the alpha reliability coefficients tended to be higher for the anxiety state scales when given under conditions of stress.

Dyspnea Scale

The dyspnea scale utilized in this study was developed by Gaensler and Wright (1966). A standard set of questions
is used in this scale to evaluate the degree of breathlessness. The dyspnea scale is a forced-choice scale in which the subject selects one of five categories to indicate which category applies to him at the present time. Class 0 is comprised of individuals with no measurable pulmonary impairment. Class I consists of individuals with minimal impairment, whose functional performance falls somewhat below that of the theoretical normal, but who retain sufficient respiratory capacity for all occupations. Individuals in Class II have moderate impairment which generally interferes only with strenuous physical activities. Class III includes severely impaired individuals in whom respiratory insufficiency may be the sole reason for total disability. Class IV includes patients with very severe impairment, who have difficulty in caring for themselves. For the purposes of this study, Class II is interpreted as being equivalent to an FEV₁ of 1 to 1.5 liters, which is a criterion for subjects accepted.

Maximal Voluntary Ventilation (MVV)

The MVV measures the amount of gas which can be exchanged per unit of time during maximal voluntary hyper-ventilation (Gaensler and Wright, 1966). This measure, which is affected when the mechanical properties of the lungs or chest wall are altered, is an index of the maximum ventilation achievable (Cherniak, 1977). In contrast to
single breath maneuvers, performance of this test is affected by the integrity of the chest bellows as a whole, including factors such as fatigue, progressive trapping of air, and blood supply to the respiratory muscles (Gaensler and Wright, 1966).

Performance of this test should be carried out with the subject in a standing position. The subject is instructed to breath as fast and as deeply as possible for 15 seconds (Cherniak, 1977). The volume of air moved over this time is then extrapolated to 60 seconds; corrected to body conditions of temperature, saturation with water vapor, and ambient pressure; and expressed in liters per minute (Cherniak, 1977).

In order for the subject to perform adequately, considerable coaching and some practice are required (Gaensler and Wright, 1966). However, a study by Gaensler (1961) showed that the "learning effect" causes increments of only 7.5 to 8 percent between first and second effort measurements. Although it might be anticipated that the MVV would be affected by spirometer resistance and inertia as well as by variations in rate and depth of breathing, research has shown that the actual influence of these factors is small (Gaensler, 1961).

Ventilatory function studies such as the MVV do have certain limitations which are due to the following
factors: (1) requirement of maximal effort, and (2) considerable variation of capacities among normal persons (Gaensler and Wright, 1966). Involuntary variation of "maximal effort" may result from low intensity of motivation, mood, state of physical training, or from illness not related to the pulmonary disorder (Gaensler and Wright, 1966). Additional causes of severely depressed performance in the absence of correlating ventilatory impairment include inability to comprehend instructions, fear of hemoptysis, or fear of a coughing episode (Gaensler and Wright, 1966).

Normal variations of capacities exist among the population. The volume of the lungs may be related to certain variables, including age, sex, and height, which can be controlled through the use of nomograms with varying predicted values (Gaensler and Wright, 1966). However, other factors that cannot be quantitated, such as respiratory muscle development, physical training, and mode of life, are difficult to control (Gaensler and Wright, 1966). These latter factors will be partially controlled in the present study by comparing each subject's performance with his own previous performance.

The Vanguard Electronic Spirometer, which is manufactured by the Life Support Equipment Corporation of Woburn, Massachusetts, was utilized to measure the MVV in this study. According to the manufacturer, the accuracy of this
instrument is within 2.5 percent of the reading; calculations are accurate within the least two significant digits; and the sensor is corrected to BTPS (body conditions of temperature, saturation with water vapor, and ambient pressure) within 2.5 percent.

Protection of Human Subjects

Provisions were made for the protection of human subjects in this project. The necessary steps have been outlined in the Subject's Consent Form (see Appendix B). The title and purposes of the study are stated on this form, in addition to a description of the subject population. The project was conducted in the biological studies laboratory of the University of Arizona College of Nursing, Tucson, Arizona. An explanation of the procedures as well as the time involved is provided in the consent form.

The only potential discomforts arising from the activities include transient fatigue, fainting, or disorders of the heart beat. In addition, performance of the MVV may produce transient dizziness or shortness of breath. The investigator was present at all times to meet emergent needs. During the control and experimental sessions, the investigator observed the subject through a sliding glass window from the adjoining room. There were no monetary costs to the subject except for travel to the laboratory, and time costs are described in the consent form.
was no monetary renumeration to the subject. The subject may benefit from the project in that he may learn to improve his relaxation ability and thereby reduce anxiety. Such reduction of anxiety may lessen the amount of dyspnea experienced by the subject.

The subject was free to ask questions at any time and to withdraw from the study at any time without jeopardizing his care or his relationship with any person or institution. Confidentiality will be maintained by limiting access to the identity of the subjects with regards to test results to the principle investigator. Information obtained in the study will be treated as privileged and confidential.
CHAPTER 4

PRESENTATION AND ANALYSIS OF DATA

In this chapter are presented a description of the characteristics of the sample, and an analysis of the data derived from the Dyspnea Scale, the State Trait Anxiety Inventory, and the pulmonary function test maximal voluntary ventilation, as related to the hypotheses. In addition, an analysis of data derived from the biofeedback parameters of skin temperature, heart rate, and respiratory rate is presented. Data collection took place from November 18, 1980, through August 20, 1981.

Characteristics of the Sample

The sample consisted of eight subjects, of whom six subjects had the diagnosis of COPD and two subjects had the diagnosis of emphysema. There were seven males and one female. The subjects ranged in age from 50 years to 70 years, with a mean age of 59.8 years. All of the subjects met the criteria of the study. The subjects were all volunteers who were identified by five private physicians in the Southwest from their office practices at the request of the investigator.
Findings Related to the Hypotheses

The findings related to the hypotheses are presented in the following sections. The paired t-test was applied to the data derived from the pre- and post-control scores and the pre- and post-experimental scores, to determine whether the hypotheses were supported. In addition, the Pearson Product Moment Coefficient of Correlation was applied to the data derived from the Dyspnea Scale and the maximal voluntary ventilation test to determine the degree of correlation between subjective report of dyspnea and objective measurement of pulmonary function.

Biofeedback Parameters

The biofeedback parameters of skin temperature, heart rate, and respiratory rate will be discussed in the following sections.

Skin Temperature. Hypothesis A stated that the subjects would not exhibit significant increases in skin temperature after the control phase of the study. Hypothesis B stated that the subjects would exhibit significant increases in skin temperature following the experimental phase of the study. Values regarding skin temperature are presented in Table 1. This table presents information regarding the means, standard deviations, and t-test values.
Table 1. Student's t-Test: Difference between the Means and Standard Deviation for Baseline, Control, and Experimental Sessions for Skin Temperature.

<table>
<thead>
<tr>
<th>Total Group Mean for Baseline Sessions</th>
<th>Total Group Mean for Control Sessions</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.06</td>
<td>33.15</td>
<td>1.06</td>
<td>0.26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Group Mean for Control Sessions</th>
<th>Total Group Mean for Experimental Sessions</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.15</td>
<td>34.09</td>
<td>0.61</td>
<td>4.31*</td>
</tr>
</tbody>
</table>

*p<.005 (t value of 3.49 with 7 degrees of freedom).

Hypothesis A1a is accepted, because the subjects did not exhibit significant increases in skin temperature after the control phase. Hypothesis B1a is also accepted, because the subjects did exhibit significant increases in skin temperature after the experimental phase of the study, as evidenced by a t value of 4.31, which is significant at the p<.005 level for a one-tailed test with seven degrees of freedom.

Heart Rate. Hypothesis A1b stated that the subjects would not exhibit significant decreases in heart rate after the control phase of the study. Hypothesis B1b stated that the subjects would exhibit significant decreases in heart rate after the experimental phase of the study.
Table 2 presents the values for heart rate. Information regarding the means, standard deviations, and t-test values are presented in this table.

Table 2. Students t-Test: Difference between the Means and Standard Deviation for Baseline, Control and Experimental Sessions for Heart Rate.

<table>
<thead>
<tr>
<th>Total Group Mean for Baseline</th>
<th>Total Group Mean for Control</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>80</td>
<td>4.88</td>
<td>1.62</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Group Mean for Control</th>
<th>Total Group Mean for Experimental</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>77</td>
<td>3.46</td>
<td>1.61</td>
</tr>
</tbody>
</table>

Hypothesis Ala is accepted, because the subjects did not exhibit a significant decrease in heart rate following the control phase. Hypothesis Blb is rejected, because the subjects did not exhibit a significant decrease in heart rate after the experimental phase. It had been hypothesized that heart rate would decrease following the experimental phase of the study.

Respiratory Rate. Hypothesis Alc stated that the subjects would not exhibit significant decreases in respiratory rate after the control phase of the study. Hypothesis Blc stated that the subjects would exhibit
significant decreases in respiratory rate after the experimental phase. Table 3 presents the values for respiratory rate. Information regarding the means, standard deviations, and t-test values can be found in this table.

Table 3. Student's t-Test: Difference between the Means and Standard Deviation for Baseline, Control and Experimental Sessions for Respiratory Rate.

<table>
<thead>
<tr>
<th>Total Group Mean for Baseline Sessions</th>
<th>Total Group Mean for Control Sessions</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>17</td>
<td>0.87</td>
<td>1.59</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Group Mean for Control Sessions</th>
<th>Total Group Mean for Experimental Sessions</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>16.8</td>
<td>0.52</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Hypothesis A1c is accepted, because no significant reductions in respiratory rate were evidenced after the control phase. Hypothesis B1c is rejected, because no significant reductions in respiratory rate were evidenced after the experimental phase. It had been hypothesized that respiratory rate would decrease following the experimental phase due to achievement of the relaxation response. However, respiratory rate changed very little following the experimental phase of the study.
State Trait Anxiety Inventory

The subscales for trait and state anxiety of the State Trait Anxiety Inventory will be discussed in the following sections.

**Trait Anxiety.** Hypothesis A2 stated that the subjects would have no significant reductions in levels of trait anxiety as measured by the STAI after the control phase. Hypothesis B2 stated that the subjects would exhibit no significant reductions in levels of trait anxiety as measured by the STAI after the experimental phase, because trait anxiety is theoretically a stable characteristic which is independent of environmental influences. Values for trait anxiety are presented in Table 4. Information regarding the means, standard deviations, and t-test values can be found in this table.

Hypothesis A2 is accepted, because no significant reductions in levels of trait anxiety were evidenced after the control phase. Hypothesis B2 is rejected, because a t value of 2.31 is significant at P<.05 for a one-tailed test with seven degrees of freedom, thereby demonstrating that a significant reduction in levels of trait anxiety was evidenced after the experimental phase. It had been hypothesized that no significant reductions in levels of trait anxiety would be demonstrated, due to the stability of this personality characteristic.
Table 4. Student's t-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for Trait Anxiety.

<table>
<thead>
<tr>
<th></th>
<th>Total Group Mean:</th>
<th>Total Group Mean:</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Control</td>
<td>40</td>
<td>Post-Control</td>
<td>41</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Experimental</td>
<td>41</td>
<td>Post-Experimental</td>
<td>36</td>
<td>4.75</td>
</tr>
</tbody>
</table>

*P<.05 (t value of 1.89 with 7 degrees of freedom).

State Anxiety. Hypothesis A3 stated that the subjects would not exhibit significant reductions in levels of state anxiety as measured by the STAI after the control phase of the study. Hypothesis B3 stated that the subjects would exhibit significant reductions in state anxiety as measured by the STAI after the experimental phase. Values for state anxiety are presented in Table 5. This table presents information concerning the means, standard deviations, and t-test values.

Hypothesis A3 is accepted, because no significant reductions in levels of state anxiety were found after the control phase. Hypothesis B3 is accepted, because significant reductions in levels of state anxiety were exhibited
Table 5. Student's t-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for State Anxiety:

<table>
<thead>
<tr>
<th>Total Group Mean:</th>
<th>Total Group Mean:</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Control</td>
<td>Post-Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>57</td>
<td>1.63</td>
<td>0.40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Group Mean:</th>
<th>Total Group Mean:</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Experimental</td>
<td>Post-Experimental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>51</td>
<td>6.13</td>
<td>2.29*</td>
</tr>
</tbody>
</table>

*P<.05 (t value of 1.89 with 7 degrees of freedom).

after the experimental phase, as evidenced by the t value of 2.29 which is significant at the P<.05 level for a one-tailed test with seven degrees of freedom.

Dyspnea Scale. Hypothesis A4 stated that the subjects would not have significant reductions in levels of dyspnea as measured by the Dyspnea Scale after the control phase of the study. Hypothesis B4 stated that the subjects would have significant reductions in levels of dyspnea as measured by the Dyspnea Scale after the experimental phase of the study. Values for the Dyspnea Scale are presented in Table 6. This table presents information regarding the means, standard deviations, and t-test values.
Table 6. Student's t-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for the Dyspnea Scale.

<table>
<thead>
<tr>
<th>Total Group Mean:</th>
<th>Total Group Mean:</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Control</td>
<td>Post-Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>0.62</td>
<td>3.42*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Group Mean:</th>
<th>Total Group Mean:</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Experimental</td>
<td>Post-Experimental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*P<.01 (t value of 2.99 with seven degrees of freedom).

Hypothesis A4 is rejected because the subjects did exhibit significant reductions in levels of dyspnea as measured by the Dyspnea Scale after the control phase, as evidenced by the t value of 3.42 which is significant at the p<.01 level for a one-tailed test with seven degrees of freedom. It had been hypothesized that the subjects would not exhibit significant reductions in levels of dyspnea after the control phase of the study, because no treatment was administered during the control phase. The reason for this reduction in dyspnea after the control phase is unknown, although it can be speculated that an intervening variable, such as improvement in physiologic status, could be responsible.
Hypothesis B4 is also rejected, because the subjects did not exhibit significant reductions in levels of dyspnea as measured by the Dyspnea Scale after the experimental phase. It had been hypothesized that levels of dyspnea would be significantly reduced following the experimental phase. The reason for this lack of reduction of dyspnea levels is unknown, although it can be speculated that physiologic variables due to the disease process involved in COPD may be responsible for the subjects' perception of dyspnea. This physiologic variable may override the independent variable in this study of relaxation training.

Maximal Voluntary Ventilation. Hypothesis A5 stated that the subjects would not exhibit significant increases in MVV as measured by the Vanguard spirometer after the control phase of the study. Hypothesis B5 stated that the subjects would exhibit significant increases in MVV as measured by the Vanguard spirometer after the experimental phase of the study. Values for MVV are presented in Table 7. This table presents information regarding the means, standard deviations, and t-test values.

Hypothesis A5 is accepted, because no increases in MVV were exhibited after the control phase. Hypothesis B5 is rejected, because no significant increases in MVV were exhibited after the experimental phase. However, as discussed in the literature review, patients sometimes experience a subjective feeling of improvement even though no significant
Table 7. Student's t-Test: Difference between the Means and Standard Deviation for Pre- and Post-Control and Pre- and Post-Experimental Values for Maximal Voluntary Ventilation.

<table>
<thead>
<tr>
<th>Total Group Mean:</th>
<th>Total Group Mean:</th>
<th>Standard Deviation</th>
<th>t-Test Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Control</td>
<td>Post-Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>115</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------</td>
<td>--------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Pre-Experimental</td>
<td>Post-Experimental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>118</td>
<td>7.5</td>
<td>0.89</td>
</tr>
</tbody>
</table>

objective improvement is demonstrated (Agle, Baum, Chester and Wendt, 1973). Maximal voluntary ventilation is an objective measurement of pulmonary impairment.

**Correlations between Dyspnea and Maximal Voluntary Ventilation**

Hypothesis A6 stated that there would be no significant degree of correlation between subjective reports of low dyspnea as measured by the Dyspnea Scale and objective measurements of high MVV as measured by the Vanguard spirometer, after the control phase of the study. Hypothesis B6 also stated that there would be no significant degree of correlation between dyspnea as measured by the Dyspnea Scale and MVV as measured by the Vanguard spirometer, after the experimental phase.
The Pearson Product Moment Coefficient of Correlation was applied to this data, and the values are presented in Table 8. This table presents information regarding the means, the Pearson Values, and the P levels.

Table 8. Pearson Product Moment Coefficient of Correlation: Correlation between Dyspnea and Maximal Voluntary Ventilation.

<table>
<thead>
<tr>
<th>Total Group Mean for Dyspnea Scale: Post-Control</th>
<th>Total Group Mean for MVV: Post-Control</th>
<th>Pearson Value</th>
<th>P level</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>115</td>
<td>0.22</td>
<td>0.64</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Group Mean for Dyspnea Scale: Post-Experimental</th>
<th>Total Group Mean for MVV: Post-Experimental</th>
<th>Pearson Value</th>
<th>P level</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>118</td>
<td>0.27</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Both Hypotheses A6 and B6 are accepted, because a weak correlation between dyspnea as measured by the Dyspnea Scale and MVV as measured by the Vanguard spirometer was demonstrated after both the control and experimental phases of the study.

Summary of Statistical Analysis

As a result of statistical analysis, the following conclusions are drawn from this study:

1. After the control phase of the study, as hypothesized, there were:
a. no significant increases in skin temperature.
b. no significant decreases in heart rate
c. no significant reductions in respiratory rate
d. no significant reductions in levels of trait anxiety
e. no significant reductions in levels of state anxiety
f. no significant increases in MVV
g. no strong correlations between dyspnea and MVV

2. After the control phase of the study, in antithesis to the hypothesis, there was a significant reduction in levels of dyspnea as measured by the Dyspnea Scale, from a pre-control mean of 4 to a post-control mean of 3.

3. After the experimental phase of the study, as hypothesized, there were:
   a. significant increases in skin temperature, from a mean of 33.15 for the control sessions to a mean of 34.09 for the experimental sessions.
   b. significant reductions in levels of state anxiety, from a pre-experimental mean of 57 to a post-experimental mean of 51.
   c. no strong correlations between dyspnea and MVV

4. After the experimental phase of the study, in antithesis to the hypotheses, there were:
   a. no significant reductions in heart rate
   b. no significant reductions in respiratory rate.
c. no significant reductions in levels of dyspnea

d. no significant increases in MVV

5. After the experimental phase, in antithesis to the hypothesis, there was a significant reduction in levels of trait anxiety, from a pre-experimental mean of 41 to a post-experimental mean of 36.

6. Descriptive findings: six of the eight subjects expressed a subjective feeling of decreased anxiety and of a general increase in feeling of "well-being".
CHAPTER 5

DISCUSSION OF FINDINGS

This chapter contains a discussion of the findings with regards to the theoretical framework and to the literature review. In addition, implications and conclusions of the study and recommendations for future investigation are presented.

Application of the Theoretical Framework to the Findings

The use of relaxation training facilitated by biofeedback for reduction of anxiety and of somatic manifestations related to anxiety is useful as a framework for nursing. This study explored the response of the individual with COPD to relaxation training facilitated by biofeedback as a method of reducing anxiety and dyspnea related to anxiety. In this study, the nurse served as the provider of relaxation training facilitated by biofeedback.

Anxiety evolves from the adaptive responses of man to physiological and psychological stimuli. In milder forms, anxiety can alert the individual so that he is able to function more effectively in a stressful situation.
However, severe forms of anxiety can produce a state of disorganization in the individual. In individuals with COPD, increased anxiety may lead to a perception of increased dyspnea. Once this type of individual develops dyspnea, the resultant emotional changes produce positive feedback which increases the dyspnea, thus developing a vicious cycle.

The findings of this research study showed that the nursing intervention of relaxation training facilitated by biofeedback significantly increased the biofeedback parameter of skin temperature. This parameter was continuously fed back to the subjects during each experimental session, and an increase in temperature served as an indicator of overall relaxation. In addition, the nursing intervention of relaxation training facilitated by biofeedback significantly decreased the manifestation of state anxiety. State anxiety presumably evolved from the physiological and psychological elements of COPD. In addition, six of the eight subjects expressed a subjective feeling of decreased anxiety and of overall increase in a feeling of "well-being" following the relaxation training.

However, the findings of this research study showed no significant decrease in levels of dyspnea according to self-report on the Dyspnea Scale. In addition, no significant reductions in the biofeedback parameters of
heart rate and respiratory rate were demonstrated. However, the findings with regards to these latter two parameters must be viewed in light of the fact that heart rate and respiratory rate were not fed back to the subjects continuously throughout each session. Instead, the investigator gave a summary immediately after each session of the heart and respiratory readings for the beginning, middle, and end of the session. This procedure was followed due to lack of equipment to provide continuous feedback of heart rate and respiratory rate and also due to the length of time (i.e., 45 minutes) required for counting heart and respiratory rates. Therefore, the investigator provided feedback at the beginning of the succeeding session for the heart and respiratory rate means for the previous session.

Findings in Relation to the Literature Review

In this study, relaxation training facilitated by biofeedback was utilized in each of eight experimental sessions for the purpose of reducing anxiety and dyspnea related to anxiety in subjects with COPD. Anxiety was measured by both the state and trait subscales of the State Trait Anxiety Inventory, and dyspnea was measured by the Dyspnea Scale. The biofeedback parameters of skin temperature, heart rate, and respiratory rate were monitored continuously throughout each session as an indication
of general relaxation. In addition, the pulmonary function test of maximal voluntary ventilation was utilized as an objective measurement of pulmonary impairment. Subjects were interviewed following each session in order to elicit subjective feelings regarding their progress in relaxation training.

Anxiety and Dyspnea in COPD Patients

The relationship between anxiety and dyspnea in individuals with COPD was delineated in Chapter 2. In addition, a study by Agle, Baum, Chester, and Wendt (1973) investigated the assumption that a comprehensive rehabilitation program produced significant beneficial changes in patients with COPD. These investigators found that significant physiologic improvement based upon pulmonary function testing occurred in only one patient out of a total of 21 subjects. Additional results of the study indicated that sustained improvement in function can occur in some patients without corresponding improvement in physiologic measures. This finding was borne out by the present study, in which six of the eight subjects expressed subjective feelings of improvement after the relaxation training sessions. However, a direct comparison cannot be made between these two studies, due to the differences in design and measurement tools.
Studies in Relaxation Training

As discussed in Chapter 2, the number of relaxation studies dealing with COPD patients is limited. Boussard (1979) investigated the use of relaxation techniques in clients with COPD. Results showed a significant correlation between the relaxation response and decreases in both heart rate and respiratory rate. However, the measurement tools used in the Boussard study were not the same tools used in this study, nor was biofeedback used in the Boussard study; therefore, a direct comparison cannot be made.

The remaining studies discussed in Chapter 2 are related to the present study in that relaxation training was the independent variable. However, because the subjects used in these studies were normal or asthmatic, a direct comparison cannot be made with the present study.

Studies in Biofeedback Training

The number of biofeedback studies dealing with COPD patients is limited in the literature. Sitzman (1978) investigated the use of biofeedback training to alter the breathing patterns of patients with COPD by voluntary control. Results of this study showed that three of the four subjects demonstrated a significant decrease in respiratory rate by the twelfth training session. However, this study cannot be compared directly to the present study due to differences in design and measurement tools.
The remaining studies discussed in Chapter 2 dealing with biofeedback training used asthmatic, chronically anxious, and normal individuals as subjects. For this reason, a direct comparison cannot be made to the present study.

**Implications and Conclusions**

The investigator of this study found that, in view of the significant findings with regards to decreased state anxiety and increased skin temperature, relaxation training facilitated by biofeedback is effective in decreasing state anxiety in patients with COPD. However, due to the lack of significant findings with regards to reduction of dyspnea, this study failed to uphold the hypothesis that relaxation training facilitated by biofeedback is effective in reducing dyspnea related to anxiety. Therefore, the investigator concludes that this intervention could be taught in nursing education and used in nursing service as a technique for reducing state anxiety in COPD patients. However, without further study, this investigator cannot conclude that this technique can be utilized to reduce dyspnea.

The investigator believes that, due to the limited amount of research that has been done in the area of relaxation training facilitated by biofeedback in patients with COPD, that further investigation should be done.
Recommendations

The investigator recommends that the basic design of the study be replicated with the following suggested changes:

1. A larger sample should be used.

2. The parameter of skin temperature could be used as the sole method of biofeedback.

3. The parameters of heart rate and respiratory rate should be used as biofeedback parameters only if a computer is available for calculating the rates per minute for each parameter.

4. If the parameters of heart rate and respiratory rate are used for biofeedback, continuous feedback of these rates should be displayed digitally to the subject.

5. A tape recorder should be available to all subjects for home practice using the relaxation tapes.

The investigator also recommends other studies that would expand the findings of this research, as follows:

1. an experimental study comparing the effects of relaxation training alone to the effects of relaxation training facilitated by biofeedback.

2. an experimental study comparing the effects of relaxation training facilitated by biofeedback in subjects with internal locus of control to subjects with external locus of control.
3. an experimental study comparing the effects of several therapies designed to reduce dyspnea (e.g., breathing exercises, desensitization therapy, and relaxation techniques).
CHAPTER 6

SUMMARY

This chapter summarizes the purpose of the study, the methodology utilized, the findings, and recommendations for future investigation.

Purpose of the Study

The purpose of the study was to determine whether the nursing intervention of relaxation training facilitated by biofeedback would be useful in reducing state anxiety and dyspnea related to anxiety in patients with COPD. Specifically, the problem investigated was whether this nursing intervention: 1) produced changes indicative of decreased general relaxation in the biofeedback parameters of skin temperature, heart rate, and respiratory rate; 2) produced reduction in levels of state anxiety as measured by the State Trait Anxiety Inventory; 3) produced reduction of dyspnea as measured by the Dyspnea Scale; and 4) produced improved performance on the pulmonary function test of maximal voluntary ventilation.

This problem is significant both to patients with COPD and to nursing. Chronic obstructive pulmonary disease is a growing health problem, and it has become the
second largest disease entity entitling individuals to disability benefits under the Social Security Act. This disease imposes considerable physical limitations and reduced occupational potential. Patients with significantly high levels of dyspnea may experience further disability. Relaxation training facilitated by biofeedback may enable the patient to reduce his anxiety and dyspnea related to anxiety and thus improve his quality of life. Secondly, the problem is significant to nursing in that the answer will affect nursing's use of relaxation training to assist the individual with COPD in his responses to stimuli which affect his adaptation to the disease.

The related literature reviewed in Chapter 2 links anxiety with dyspnea in patients with COPD. A limited number of studies have been done in which relaxation training and/or biofeedback have been used to reduce anxiety and the physiological changes associated with anxiety, i.e., increased heart and respiratory rate. However, none of these studies utilized the same methodology as that used in the present study.

**Methodology**

This study used a pre-test-post-test experimental design to investigate the effect of eight sessions involving relaxation training facilitated by biofeedback. The State Trait Anxiety Inventory was used to measure state and trait anxiety. The Dyspnea Scale was used to measure dyspnea.
The pulmonary function test of maximal voluntary ventilation as measured by the Vanguard spirometer was used as an objective measurement of pulmonary impairment. In addition, the biofeedback parameters of skin temperature, heart rate, and respiratory rate were used as indicators of the relaxation response.

Measurements taken before and after the experimental phase were compared to those taken before and after the control phase of the study. There were four control sessions prior to the eight experimental sessions. Each subject served as his own control.

The sample for this study included eight patients who are within the practices of five physicians in the Southwest. The first eight patients who agreed to participate in the study and who met the following ongoing criteria were selected as subjects:

1. Medical diagnosis of emphysema and/or chronic bronchitis.
2. FEV$_1$ of 1 to 1.5 liters.
3. Ambulatory adult patients able to read and to speak English.
4. Absence of acute exacerbation of the pulmonary disorder.
5. Absence of readily apparent psychosis.
Findings

The paired t-test was applied to the data derived from the pre- and post-control scores and to the pre- and post-experimental scores, to determine whether the hypotheses were supported. Significant increases in skin temperature were found after the experimental phase, in addition to significant reductions in state anxiety. The findings failed to support the hypotheses that dyspnea would be significantly reduced following the experimental phase, and that there would be significant reductions in heart rate and respiratory rate.

The Pearson Coefficient of Correlation was applied to the data derived from the Dyspnea Scale and from the pulmonary function test of maximal voluntary ventilation. As hypothesized, a weak correlation (0.27) was found after both the control and experimental phases.

Conclusions

Due to the significant findings with regards to decreased state anxiety and increased skin temperature, the investigator concludes that relaxation training facilitated by biofeedback is effective in reducing state anxiety in patients with COPD. However, there were no significant findings to uphold the hypothesis that this nursing intervention is effective in reducing dyspnea related to anxiety. Further investigation needs to be done in this area.
APPENDIX A

DATA COLLECTION FORM

Name ________________________________
Subject ID Number _______________________
Diagnosis ______________________________
Physician ______________________________
Address ________________________________
Phone _________________________________
Age ___________________ Sex ______________
Height ___________________ Weight __________
Previous Training in Relaxation of Biofeedback ______
APPENDIX B

SUBJECT CONSENT FORM

Subject's Consent

Project Title: Relaxation Training Facilitated by Biofeedback for Reduction of Anxiety and Related Dyspnea in Patients with Chronic Obstructive Pulmonary Disease

Conducted by: Patricia Morrison, RN, Graduate Student at The University of Arizona College of Nursing, Tucson, Arizona

The purpose of the project is to explore the effects of one set of relaxation techniques with biofeedback on shortness of breath in patients with emphysema and/or chronic bronchitis. For this purpose, I will have the interviewer, a registered nurse, as the data gatherer. The nurse will review my medical history, collect basic identifying data, and will ask me to answer one questionnaire about my shortness of breath and two questionnaires about my fears and anxieties. She also will ask me to take a breathing test called "maximal voluntary ventilation". The nurse will teach me relaxation techniques, and she will prepare me for and record each session my heart rate, respiratory rate, and skin temperature. Some of these measurements will be made by sensors taped to my skin and attached to an electronic recording device. The sessions will be approximately one hour in length, and there will be a total of 16 sessions. There will be 12 control and experimental sessions, with four additional sessions for me to become accustomed to the equipment and to complete the questionnaire and breathing tests. The total time is 16 weeks. After the training is completed, I will be asked to repeat the questionnaires and breathing test and to identify my progress. All of the sessions, questionnaires and breathing tests will be conducted in the biological studies laboratory of The University of Arizona College of Nursing, Tucson, Arizona.

I understand that I also will receive written relaxation instructions for my use at home. I will be expected to read these instructions aloud to myself while I practice.
relaxation at home at least twice per day for 15 to 20 minutes per session.

I understand that the subjects who participate in this project will do so voluntarily. I also understand that the subjects are all patients within the practices of private physicians in a metropolitan area of the Southwest. I am aware that patients who meet the following criteria will be selected as subjects:

1. Medical diagnosis of emphysema and/or chronic bronchitis.
2. FEV₁ of 1 to 1.5 liters (breathing test results).
3. Ambulatory (able to walk) adult patients who are able to read and speak English.
4. No readily apparent psychosis is present.
5. No diagnosed cardiac disease (angina) is present.
6. No acute exacerbation (serious worsening of symptoms) of the pulmonary disorder is present.

While no detrimental effects are anticipated to arise from the activities, I am aware that there exists the possibility of transient fatigue, fainting, or disorders of the heart beat which may be rapid or slow. In addition, I may become temporarily short of breath or dizzy after taking the breathing test. I am aware that the nurse will be present for the duration of each session, and that she will observe me from the next room through a sliding-glass window during the actual control and training times. If any problems arise, I may contact Patricia Morrison at 325-3569.

I am aware that the instruments have been checked by Biomedical Engineering, and that they meet O.S.H.A. safety standards for human subjects. For safety purposes, I will be electrically isolated from the machine, and the machine will be electrically isolated from the wall.

The only cost of this therapy to me will be my time and travel. I will not be paid for participation in this study.

The benefits that I may obtain are improved well-being and a reduction in my shortness of breath. The learning obtained from this study may benefit other persons with lung problems similar to mine, as well as myself.

I understand that I am free to ask questions about the study at any point in time. I can withdraw from the study at any time and without ill will or risk to my relationship with any institution or person.
The information which is obtained during this project will be treated as privileged and confidential. The information will not be released or revealed to any person outside the study without my express written consent. The information obtained may be used for statistical purposes, however, and so published without revealing my identity.

I am aware that this consent form and the data collected in this study will be kept for a period of seven years in the office of the Director of Research, University of Arizona College of Nursing, Tucson, Arizona.

"I have read the above 'Subject Consent'. The nature, demands, risks, and benefits of the project have been explained to me. I understand that I may ask questions and that I am free to withdraw from the project at any time without incurring ill will (or affecting my medical care). I also understand that this consent form will be filed in an area designated by the Human Subjects Committee with access restricted to the principal investigator or authorized representatives of the particular department. A copy of this consent form is available to me upon request."

I understand that there is no compensation for any adverse effects that may result from these procedures.

Subject's Signature ____________________________ Date_______

Witness' Signature ____________________________ Date_______
APPENDIX C

EXPLANATION OF THE PROGRAM

TO PATIENTS

I am a nurse who is interested in improving care given to respiratory patients like yourself. The purpose of my study is to explore the effects of relaxation training facilitated by biofeedback on anxiety (nervousness) and on shortness of breath. Today's high-pressure society bombards us with stressful situations, taxing our capacity to respond effectively. Such persistent stress on mind and body often produces undesirable effects (Stroebel, 1978). Training in relaxation offers you a safe, convenient, natural way to cope with stress more effectively. Relaxation training offers you a skill which you can eventually use to minimize the annoying effects of stressful situations whenever and wherever they occur.

When your ancestors lived in the wilds, they needed a "fight or flight" response for survival. When they came upon a tiger or an enemy, their bodies responded with an extra shot of adrenalin, faster breathing and faster heart rate. These reactions gave them the extra strength they needed for fighting or fleeing to safety. However, the sources of stress in modern life rarely involve physical threats. The stressful situations we encounter, such as the demands of a relationship or a job, require mental rather than physical arousal. However, many people have learned to activate the emergency "fight or flight" response at the slightest provocation (Stroebel, 1978). This emergency response may become a dominating pattern in people's lives. As a result, shortness of breath may become more frequent or worsen in severity in people with chronic lung disease.

Relaxation training will help you gain the capacity to recover quickly from excessive stress. During the course of this training, you will learn to recognize when you are overreacting to stress. You will learn techniques to bring your body back to a healthy level of activity. You will
learn to apply these skills consciously in everyday situations later in the training. Relaxation training may also improve your shortness of breath.

Biofeedback will be used during the training as a guideline to show how well you are able to relax. Throughout each training session, you will receive continuous information about your heart rate and breathing rate during the session. As you relax, both of these rates will decrease.

In order to take full advantage of this relaxation training, you must be prepared to take a large measure of responsibility for your own health. Ordinarily, your physician takes most of the responsibility for curing your symptoms. However, relaxation training differs from traditional medical care in this respect. You cannot expect to learn this response overnight, since your body learned its unhealthy response to stress over a period of years. It will take eight weeks of weekly training sessions to learn the relaxation response, and you will also need to practice twice daily at home.

During the course of the training, you may feel unusual sensations of heaviness or warmth in your limbs, or a feeling of floating. You may also experience unusual emotions or memories as you relax very deeply. Do not be concerned if you experience these sensations. They are all normal reactions which occur as your body relaxes, perhaps for the first time in years.
APPENDIX D

STANDARDIZED QUESTIONS FOR POST SESSION INTERVIEWS

The first three questions will be asked after each experimental session:

1. How well do you think you were able to relax during this session?

2. What did you think about when you were trying to relax? (i.e., what methods did you use to relax?)

3. How has your home practice been going this week?

The fourth question will be asked after each control session and after each experimental session.

4. How have things been going for you this past week?
APPENDIX E

30 September 1980

Patricia V. Morrison, R.N., B.S.N.
3401 North Columbus Boulevard
Apartment #35J
Tucson, Arizona 85712

Dear Ms. Morrison:

We are in receipt of your project, "Relaxation Training Facilitated by Biofeedback for Reduction of Anxiety and Related Dyspnea in Patients with Chronic Obstructive Pulmonary Disease", which was submitted to the Human Subjects Committee for review. We concur with the opinion of your Departmental Review that this is a minimal risk project. Therefore, approval is granted effective 30 September 1980.

Approval is granted with the understanding that no changes will be made in either the procedures followed or in the consent form used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and the Departmental Review Committee. Any physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

Milan Novak, M.D., Ph.D.
Chairman

MN/jm
cc: Ada Sue Hinshaw, R.N., Ph.D.
Departmental Review Committee
REFERENCES


