BIOFEEDBACK AND INTERNAL AND
EXTERNAL LOCUS OF CONTROL

by

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ABSTRACT

The purpose of the study was to determine if biofeedback effects locus of control from external to a more internalized orientation.

Sixty-four subjects were divided into Experimental and Control Groups. Each group had equal number of external and internal male and female subjects, as determined by mean scores on the Rotter I-E Scale.

The Experimental Group was pre-tested on the Rotter I-E Scale and received four weekly sessions of electromyographic biofeedback. During the final session each subject was again administered the Rotter questionnaire.

The Control Group was pre-tested on the Rotter I-E Scale and four weeks later post-tested on the same questionnaire. The significance of the difference between pre-test mean scores, pre- and post-test mean scores and post-test mean scores were computed using a t-test for both groups.

Pre-test mean scores yielded no significant difference at or beyond the .05 level of confidence. Pre- and post-test mean scores for the Experimental Group yielded significance at or beyond the .05 level of confidence. Pre- and post-test mean scores for the Control Group yielded no significant difference at or beyond the .05 level of confidence.

Biofeedback appears to have an effect on locus of control from an external to more internalized orientation in the sample studied.
CHAPTER I

INTRODUCTION

Introduction to the Problem

The problem dealt with in this research is the effect of biofeedback on locus of control orientation.

Background

A current concern in the function of human beings is that of stress (Brown, 1974). Our complex society has effected the mind-body system in a way that stimulates individuals above the optimal stress tolerances. The result appears to range from truly psychosomatic problems to an exacerbation of physical illness and disease (Selye, 1976). Stress does not produce a single symptom; nor does it always produce negative effects (Pelletier, 1977). There appears to be an optimal amount of stress needed for organs to function and, therefore, for the mind-body system to deal with the environment (Selye, 1976). Selye, concludes what is optimal for one may have deleterious effects on another. Each individual is truly that, an individual, and treatment for stress related problems needs individual consideration.

It would seem an impossible task to cover all variables involved in individual stress reactions. One important variable related to stress adjustment clearly delineated in the literature is the effects of internal versus external locus of control.
Selye (1976) states no one can live without experiencing some degree of stress. Concurrently, our system must adjust to constant changes caused by stressors. Life, he concludes, is largely a process of adaptation to the circumstances in which we exist.

It would appear from a social learning model that an internally oriented person would be more likely than an externally oriented person to attempt to exercise self-control over bodily functions (Carlson, 1977). Self-control may refer to a set of procedures utilized to influence behavior, or to the process observed when certain behavior change has occurred. When self-control refers to a set of procedures, the defining characteristics of the procedures are that the variables which influence the response in question are controlled by the subject (Thoresen and Mahoney, 1974).

The definition proposed by Thoresen and Mahoney (1974) describes self-control of motoric and cognitive responses. This definition states that at a certain specified choice point a subject has several responses available and self-control is exhibited when the person consistently engages in the lower probability response without external influences. Epstein and Blanchard (1977) also concluded self-control can only be observed in the absence of external influences.

Practitioners dealing with stress reactions and self-control currently utilize numerous processes. These include: transcendental meditation, autogenic training, guided imagery and biofeedback (Pelletier, 1977). The present research project is utilizing the modality of biofeedback.
Biofeedback is based upon three basic principles: (1) any neurophysiological or other biological function which can be monitored and amplified by electronic instrumentation and feedback to a person through any one of his five senses can be regulated by that individual, (2) every change in the physiological state is accompanied by an appropriate change in mental state, conscious or unconscious, and conversely every change in the mental state, conscious or unconscious, is accompanied by an appropriate change in physiological state (Green, Green, and Walters, 1970), and (3) a meditative state of deep relaxation is conducive to the establishment of voluntary control by allowing the individual to become aware of subliminal imagery, fantasies, and sensations (Pelletier, 1977).

Biofeedback with its quantitative monitoring of bodily functions appears to be the most scientific method for monitoring physiological functions for research purposes. Brown (1977) concludes biofeedback is an unexplained, but scientific process for treating human illness because it evokes complex mental processes to regulate and normalize even the most complicated functions of the human body. She states:

... by some obscure capacity, cognitive faculties are set in motion to restore the mind and body to a state of balance and relieve the effects of stress.

Furthermore, the literature strongly indicates that the modality of biofeedback is enhanced by an internal rather than external locus of control (Reinking, 1976).
The process of biofeedback initially provides individuals with the awareness of body signals; secondly, provides feedback that allows conscious control of bodily functions; and finally, allows unconscious control of these functions (Budzynski et al., 1973).

Significance of the Study

The present research is concerned with utilizing biofeedback to change locus of control orientation from an external orientation to a more internalized orientation.

Studies at Ohio State University were designed to measure internal versus external control within numerous sub-sets of The United States population. The studies utilized Rotter's locus of control (I-E) 29-item scale. This was designed to measure the extent to which an individual believes he is self-motivated or directed, an internal orientation, versus the extent to which environment (luck, fate, chance, powerful others) exercise major influences in behavior, an external orientation (Valecha and Ostrom, 1974).

Substantial evidence confirms that biofeedback enables individuals to develop self-control over bodily functions once thought to be automatic. Research on the effects of I-E control on biofeedback has suggested that biofeedback may effect locus of control and further study is needed.

If biofeedback enables self-control over bodily functions and changes locus of control, individuals could ostensibly possess more control over their total functioning within their environment. This could
include more independent functioning and feeling of power over an individual's own destiny.

Purpose

The purpose of this study was to determine whether electromyographic biofeedback training changes locus of control from a more externalized to a more internalized orientation. This in turn would aid individuals in self-control over bodily functions and adapting to environmental stressors by increased self-motivation and direction.

Need

During the second half of the nineteenth century, the French physiologist, Claude Bernard, at The College de France in Paris, taught that one of the most characteristic features of all living things being in their ability to maintain the constancy of their internal milieu, despite changes in the surroundings (Selye, 1976).

The constant changes in our complex society include, but are not limited to: changes in traditional family structure, inflation, greater individual mobility, and employment. Individuals respond to these changes in specific ways.

An individual with an internal orientation would theoretically maintain control and power over the changes in the environment. An externally oriented person may feel powerless to control personal destiny and may project responsibility on external forces. By doing this an individual relinquishes control over personal circumstances.

If biofeedback can allow individuals awareness and control over mind-body functions and further awareness of personal control within the
environment, individuals may internalize responsibility for thoughts, feelings, and actions. The possibilities are far reaching. Individuals may gain insight into psychosomatic problems and purposeful, adaptive behavior may result. External forces would be perceived as less powerful and internal controls would be the contingency for change. Coping behavior would also be contingent on personal controls rather than projecting responsibility to outside influences.

Hypotheses

The present study is concerned with the effects of biofeedback on locus of control. The major question this research is concerned with is, does biofeedback change the locus of control from external to more internalized orientation?

The primary hypothesis to be tested by this study is:

Biofeedback training will influence a significant change in locus of control orientation, from external to internal, as indicated by changes on the Rotter I-E Scale Scores.

This hypothesis will be tested by using four null hypotheses. The null hypotheses to be tested are listed below.

It is hypothesized that:

1. There will be no significant differences between the pre and post test mean scores of the Rotter I-E Scale obtained by the Experimental Group.

2. There will be no significant difference between the pre and post test mean scores of the Rotter I-E Scale obtained by the Control Group.
3. There will be no significant difference between the pre test mean scores of the Rotter I-E Scale obtained by the Experimental and Control Groups.

4. There will be no significant difference between the post test mean scores of the Rotter I-E Scale obtained by the Experimental and Control Groups.

Assumptions

It is assumed that:

1. Locus of control reflects the extent to which an individual perceives reinforcing or punishning events to be under his personal control.

2. The Rotter I-E Scale measures locus of control orientation.

3. Having an internal locus of control will enable an individual to achieve homeostasis.

4. Internality is preferable to externality.

Limitations

The sample used in the study included seventy-two students from The University of Arizona. The students used do not necessarily represent a general population of The United States. The sample was not randomly chosen. The sample size is limited and is a selected sub-group with a limited age range.
Definition of Terms

The following terms are used in this study:

1. **Biofeedback**: The feedback of biological information to an individual.

2. **Internal locus of control**: A perception that events are contingent upon a person's own behavior or his own relatively permanent characteristics.

3. **External locus of control**: A reinforcement is perceived by the subject as following some action of his own, but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him.

4. **Stress**: Any interference which disturbs the functioning of the organism at any level, and which produces a situation which is natural for the organism to avoid.

5. **Mind-body system**: An integrated unit that does not separate parts into individually functioning entities.
CHAPTER II

SELECTED REVIEW OF LITERATURE

Biofeedback

There have been countless articles and books written on the process, and procedures of biofeedback. The researcher selected those most pertinent.

The process is solely dependent upon the kinds and quality, and accuracy of the information provided. The kinds of information are:

1. Biological information, which is the biofeedback signal.
2. Cognitively useful information, which is background information that facilitates use of the biological information, i.e., what the physiological activity does, how it behaves, how it is measured, what the instrument does and other relevant information.
3. Strategy information, i.e., clues or directions for changing physiological activity "by mental means".
4. Psychologically supporting information, which is encouragement and reinforcement of performance that acts to consolidate the learning experience.
5. Experimental information, which is the internally derived information from the biofeedback signal with internally perceived changes in mind and body states (Brown, 1977).

Brown (1977) asserts that the individual's role in biofeedback training is simply to learn, to supply essential information (subjective
reports), to become aware, either consciously or simply by performing, that he can perform and finally, to report evaluations. The individual's role is consistent in electromyograph, electroencephalogram, galvanic skin response or electrodermal (temperature) biofeedback training.

Electromyographic feedback (EMG) has been found most useful with the broadest range of problems. Basmajian (1976) delineates facts versus myths in EMG Biofeedback. He states that myopotentials are the electrical discharges from the surface membranes of the striated muscle fibers that make up the skeletal (voluntary) muscles. In normal whole muscles, these myopotentials are produced individually by a group of muscle fibers supplied by a single motor nerve fiber that runs from the body of a single motor nerve-cell in the gray matter of the spinal cord or brain stem. Each such group is a motor unit which produces a mechanical twitch which is a motor unit potential or myopotential. With surface-electrode placements single myopotentials can be detected. The results are a measure of the level of general muscular tension. Neither localization, nor specification serves a purpose in relaxation training, because general tension is the target. This is the condition most biofeedback practitioners are working to reduce.

The second most widely used biofeedback process is the monitoring of myo-thermal activity. Lacroix (1977) contends that a number of automatic responses can be brought under self-control or voluntary control as a consequence of temperature biofeedback training. He further states that subjects were unable to discriminate skin potential responses in the absence of training with exteroceptive feedback.
Feedback is necessary on an immediate and continuous basis for learning to occur. For optimal results, biofeedback is used in conjunction with other modalities.

An interesting facet of biofeedback is that the uninitiated tend to see it as a single modality. Stoyva (1976) states that those who begin to explore the clinical uses of EMG and temperature feedback soon realize they are not working with an isolated technique, but with an approach having many antecedents. Close examination of Jacobson's progressive relaxation first published in 1929, brings to light a great deal of material germane to biofeedback. For example, his concept of tensing and relaxing muscles in order to discriminate between relaxation and elevated muscle tension. It is important to note also a significant parallel development to biofeedback: the behavioral self-control techniques. Autogenics credited to Luthe and Schultz (1959) is a combination of hypnosis and yoga, a modality which enhances the relaxation principle of biofeedback.

Montgomery, Peskin, and Wise (1975) utilize biofeedback in conjunction with hypnosis, relaxation training, systematic desensitization, and classical conditioning when dealing with insomnia. The combination of hypnosis and biofeedback aids in narrowing the subject's focus and creating awareness of body signals.

Cognitive factors play a major role in the utilization of biofeedback therapy. Meichenbaum (1976) writes the role that the client's cognitions (i.e., his self-statements and images) play in each of the various phases of biofeedback training is conceptualized as including three phases: initial conceptualization, skills-acquisition and
rehearsal, and transfer of treatment. Cognitive-behavior modification procedures to alter or employ the client's cognitions are utilized at each of these phases of treatment. A cognitive theory of self-control is offered, postulating a three-stage mediational change process whereby:

1. The client must become an observer of his behavior and physiological responses.
2. This recognition becomes the cue to emit incompatible cognitions and behaviors; and, finally,
3. The content of the client's cognitions following change influences the generalization and persistence of treatment effects.

**Biofeedback and I-E Control**

The literature is sparse in the area of internal-external locus of control in conjunction with biofeedback. Carlson and Feld (1978) noted there were no major differences in EMG levels attributable to locus-of-control orientation. However, locus-of-control scores of some externally oriented subjects shifted significantly in the internal direction due to feedback.

Holliday and Munz (1978) studied EMG feedback training and changes in locus of control. Their study was designed to maximize the possibility of change by having large numbers of biofeedback sessions and home practice to compare differences in changes in locus of control between psychosomatic subjects and nonpsychosomatic subjects given biofeedback training. The study included six subjects in the
nonpsychosomatic group and seven in the psychosomatic group. The re-
sults showed a significant change to internality with the nonpsychoso-
matic group, but not with the psychosomatic group.

Kappes and Michaud (1978) studied contingent versus non-
contingent EMG feedback and hand temperature in relation to anxiety and
locus of control. Six subjects were given continent feedback and six
non-contingent feedback. Group I subjects tended to become more inter-
nalized following contingent feedback.

Thoresen and Mahoney (1974) have posited that a person demon-
strates self-control when in the relative absence of immediate external
constraints, he engages in a behavior whose previous probability has
been less than that of alternatively available behaviors.

Carlson (1977) studied locus of control and frontalis electro-
myographic response training. The main results included: 1) while
obtaining baseline data (no feedback), no consistent effects were at-
tributed to locus of control orientation; 2) internal subjects achieved
lower EMG readings with analogue feedback than external subjects ir-
respective of sex and ethnic background; 3) locus of control of ex-
ternals shifted significantly in the internal direction, though not
correlated with the change in EMG level; 4) finger temperatures were not
differentiated according to locus of control orientation and did not
parallel relaxation effects as seen in frontalis EMG changes due to
training; and 5) post-experiment questionnaire ratings of perceived re-
lexation were not significant due to feedback training, but did reflect
significantly less subjective relaxation in the internals provided
feedback. The shift in the internal direction on the locus of control
scale by external subjects with feedback was not evidenced by their counterparts in the control condition. Tentatively, it is suggested that perception of control may be enhanced by a feedback signal. However, the failure to find any correlation between the degree of change in EMG level and degree of shift in locus of control scores should temper any early conclusions regarding the effects of feedback upon locus of control expectancies. Finally, the fact that internal subjects receiving feedback reported the least relaxation suggest that in their efforts to perform well, internally oriented people may sacrifice their subjective state of general relaxation.

**Internal-External Locus of Control**

Rotter (1966) explains the locus of control dimensions of personality reflects the extent to which an individual perceives reinforcing or punishing events to be under his or her control. An external orientation is defined as a belief that reinforcing events are a function of chance or other persons or forces acting upon the individual. An internal orientation is a belief that reinforcers are a function of one's own actions.

The personality dimension of locus of control appears to be useful in predicting adjustment of individuals in American society. The extremes of locus of control are internal and external control. Internality, a sense of personal power in controlling personal satisfaction, is positively associated with social involvement, high morale, and good coping skills. Externality, a lack of personal influences over one's satisfactions and a belief in others controlling one's reinforcements,
is associated with defensiveness, disorganization, and fear (Rotter, 1966; Valecha and Ostrom, 1974).

External control is also related to the concept of alienation. The alienated individual feels unable to control his own destiny (Rotter, 1966). Merton (1949) has stressed alienation in the study of asocial behaviors. Seeman (1959) linked the concept of alienation as it refers to powerlessness to external control as a psychological variable. One of the major conceptions related to belief in internal versus external control of reinforcements is the need for achievement (Rotter, 1966).

Rotter states as follows:

"There is clearly an interaction between internality and experience of success. We might expect seriously maladjusted groups to have more variability on I-R Scores and probably more frequently to have high scores in the direction of externality."

The work of Witkin et al. (1954) suggests that individuals can be ordered on a continuum describing whether they perceive most of their cues from external or from internal sources.

The first attempt to measure individual differences in a generalized expectancy or belief in external control was begun by Phares (1957) in his study of chance and skill effects on expectancies of reinforcement. James (1957) revised Phares' test. He similarly hypothesized that within each of his groups, regardless of chance or skill instructions, those individuals who scored near the external end of the continuum would behave in each group in the same way as the difference between the chance group and skill group for all subjects. James found
a low, but significant correlation between his test and behavior in test situations.
CHAPTER III

METHODS AND PROCEDURES

Sample and Selection of Subjects

The sample included seventy-two male and female University of Arizona college students over eighteen years of age. Volunteers were requested from psychology, counseling and guidance, and rehabilitation classes. All volunteers signed the subject consent forms. All subjects were given the Rotter locus of control I-E Scale to determine locus of control. Subjects continued to be tested until thirty-six subjects were considered primarily internally controlled and thirty-six considered primarily externally controlled. Each subject received a mimeograph sheet explaining biofeedback.

Research Groups

There were two research groups consisting of thirty-six subjects each. Group I is the Control Group. Group II, the Experimental Group.

Research Group I

The control group was given the Rotter I-E Scale at the beginning of the project and post-tested at the end of the project. Group I included equal numbers of primarily internally and externally controlled individuals.
Research Group II

The group was pre-tested and post-tested on the Rotter I-E Scale. The group included equal numbers of primarily internally and externally controlled individuals. Each received frontalis EMG biofeedback with audio and visual feedback, for four successive weeks, each lasting twenty minutes in duration. Each subject was instructed to practice relaxation at home between sessions.

Locus of Control I-E Scale

The Locus of Control Index, commonly known as the I-E Scale, was developed by Rotter (1966). The purpose was to ascertain whether a person perceived a reinforcement following an action as a result of luck, chance, or under the control of others (external control), or if the reinforcement was perceived as contingent upon the person's own behavior or his own characteristics (internal control).

The I-E Scale used in this study is a 29-item forced choice test, including 6 filler items, intended to make the purpose of the test somewhat ambiguous. The I-E Scale is presented in Appendix A. Instructions for administering the test are presented in Appendix A. The letter preceding the external choice in every item is underlined. The score is the total number of external choices.

The items deal exclusively with the subject's belief about the world; the subject's expectations about how reinforcement is controlled. The test is considered to be a measure of general expectancy, not directly addressed to the preference for internal or external control (Rotter, 1966).
Originally, Rotter collected data for a larger group of subjects to provide item correlations with the Marlowe-Crowne Social Desirability Scale. Those items which either had a high correlation with the Marlowe Scale, a proportional split so that one of the two alternatives was endorsed more than 85% of the time, a non-significant relationship with other items, or a correlation approaching zero when both validation criteria were eliminated. The original 60-item test was reduced to 23-items and 6 filler items. The correlation for the new scale range from -.07 to -.35. The range may reflect differences in testing correlation. A correlation of -.22 represents the median for the different samples of college students where males and females are combined, shown in Appendix B.

Internal consistency estimates are relatively stable as shown in Appendix B. Reliability of about .70 was generally reported for the 29-item scale. The test is an additive one and items are not comparable. Consequently, split-half or matched half reliability tends to underestimate the internal consistency. Kuder-Richardson reliabilities are also somewhat limited since this is a forced choice scale in which an attempt is made to balance alternatives so that the probabilities of endorsement of either alternative do not include the more extreme splits.

The test shows reasonable homogeneity or internal consistency, particularly when it is taken into account many of the items are sampling a broadly generalized characteristic over a number of specific or different situations. Due to the homogeneity of the present research the test is limited in ability to discriminate individuals. Other populations may provide a greater spread of scores, but for college students
in the middle 50% of the distribution, the test is more suitable for investigations of group differences than for individual prediction (Rotter, 1966).

Rotter's I-E Scale used in this study is a 29-item forced choice test. Item analysis and factor analysis show reasonably high internal consistency for an additive scale. Test-retest reliability is satisfactory, and the scale correlates satisfactorily with other methods of assessing the same variable such as questionnaire, Likert scale, interview assessments, and ratings from a story-completion technique. Reliability is indicated by the low relationships with such variables as intelligence, social desirability, and political liberalness. Differences in means of selected populations is generally a weak criterion of validity. Nevertheless, differences obtained for different types of populations are generally consistent with expectancies (Rotter, 1966).

The most significant evidence of the construct validity of the I-E Scale comes from predicted differences in behavior for individuals above and below the median of the scale or from correlations with behavioral criteria.

A series of studies by Rotter provided strong support for the hypotheses that the individual who has a strong belief that he can control his own destiny is likely to: a) be more alert to those aspects of the environment which provide useful information for future behavior; b) take steps to improve his environmental condition; c) place greater value on skill or achievement reinforcements and be generally more concerned with his ability, particularly his failures; and d) be resistive to subtle attempts to influence him.
Treatment of the Data

The four null hypotheses will be tested by using the t-test for the significance of difference between the means of the scores of the groups on the Rotter I-E Scale.

For the purposes of this study the .05 confidence level was accepted as demonstrating the statistical significance of the differences between mean scores.

A one-tailed test of significance was employed because it is hypothesized the movement will be toward a higher level of internality.
CHAPTER IV

RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The analysis of the results of the study, conclusions, and recommendations are presented in this chapter. The chapter is organized into five main sections. General data are presented first. This section is followed by the presentation of the results as they relate to the individual hypotheses. The following section discusses the results of the study in relation to the specific question raised by the study. The fourth section discusses conclusions based on limitations of the study. The final section discusses recommendations for further study.

General Data

A total of seventy-two subjects was used in the study. These subjects constituted one Experimental Group and one Control Group. Two experimental subjects dropped out of the project after two weeks of research. For the purpose of keeping internal and external subjects equal sixty-four subjects were selected with equal numbers of male and female subjects for experimental and control groups. Internal and external subjects were determined by the pre-test Rotter I-E Scale mean scores. The mean score for the experimental group was 8.0. The mean score for the control group was 8.6. These mean scores, as illustrated in Table 1, show no significant difference.
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<td>Experimental</td>
<td>32</td>
<td>8.000</td>
<td>4.537</td>
<td>-.62</td>
<td>62</td>
<td>.541</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>8.6875</td>
<td>4.403</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level of confidence*
A t-test was computed between each group mean using the pre-test scores on the Rotter I-E Scale. The scores used were the number of external responses on the twenty-nine question forced-choice questionnaire (see Appendix A).

Thirty-two subjects in the Experimental Group completed four weekly sessions of electromyographic biofeedback, each lasting twenty minutes in duration. Following the last biofeedback session each subject completed the Rotter I-E Scale questionnaire. The thirty-two control subjects completed the Rotter questionnaire four weeks after the first questionnaire was administered. To compare the Experimental and Control Groups, t-tests were computed comparing pre-tests mean scores, pre and post-tests mean scores, and post-tests mean scores for each group. These results are discussed in relation to the null hypotheses presented in Chapter I.

The values reported in this chapter as needed for significance corresponding to the appropriate degree of freedom can be found in Downie and Heath (1965).

With the degrees of freedom associated with computed t-tests the pre-post Experimental Group presented in Table 2 reached significance beyond the .05 level of probability.

The data presented in the following tables are applicable to each hypotheses and will be referred to in the discussion of the individual hypothesis.
Hypotheses

Hypothesis 1

Hypothesis number one states that: There will be no significant differences between the pre- and post-test mean scores of the Rotter I-E Scale obtained by the Experimental Group.

Table 2 contains the mean values for the comparison of the pre- and post-test scores. With the degrees of freedom associated with the pre- and post-tests, a t value of 2.04 would be needed for significance at the .05 level. As indicated in Table 2, the t values reach significance at or beyond the .05 level. The t value has a significance beyond the .001 level. Therefore, hypothesis number one was rejected.

Hypothesis 2

Hypothesis number two states that: There will be no significant difference between the pre- and post-test mean scores of the Rotter I-E Scale obtained by the Control Group.

Table 3 compares pre- and post-test mean scores for the Control Group. With the degree of freedom of 31 a t value of 2.04 would be needed to reach significance at the .05 level of probability. As indicated in Table 3, the t value did not reach significance at or beyond the .05 level. Therefore, hypothesis number two could not be rejected.

Hypothesis 3

Hypothesis number three states that: There will be no significant difference between pre-test Rotter I-E Scale. With 62 degrees of freedom, a t value of 2.00 would be needed for significance at the .05
Table 2. Pre- and post-test mean scores, experimental group.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t Value</th>
<th>df</th>
<th>1-Tail Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>32</td>
<td>8.000</td>
<td>4.537</td>
<td>4.50*</td>
<td>31</td>
<td>.000**</td>
</tr>
<tr>
<td>Post</td>
<td></td>
<td>6.0625</td>
<td>4.515</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level of confidence.

**Computer statistics run at The University of Arizona.

Table 3. Pre- and post-test mean scores, control group.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Cases</th>
<th>Standard Deviation</th>
<th>t Value</th>
<th>df</th>
<th>1-Tail Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>32</td>
<td>8.6875</td>
<td>.778</td>
<td>.37</td>
<td>.356</td>
</tr>
<tr>
<td>Post</td>
<td></td>
<td>8.5625</td>
<td>.678</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level of confidence.
level of probability. As indicated in Table 1, the t value did not reach significance at or beyond the .05 level. Therefore, hypothesis number three could not be rejected.

Hypothesis 4

Hypothesis number four states that: There will be no significant difference between post-test mean scores of the Rotter I-E Scale obtained by the Experimental and Control Groups.

Table 4 contains the mean values of post test scores on the Rotter I-E Scale for the Experimental and Control Groups. With 62 degrees of freedom a t value of 2.00 would be needed for significance at the .05 level of probability. As indicated in Table 4, the t value did reach significance at or beyond the .05 level. Therefore, hypothesis number four was rejected.

Discussion of Results

The specific question asked in Chapter I will be used in discussing the results of the study.

Does biofeedback change the locus of control from external to a more internalized orientation?

As indicated above, there were significant differences between the two groups tested after biofeedback was applied.

The Experimental Group was pre-tested and post-tested as was the Control Group. Pre-test scores for each group showed no significant difference. Therefore, both groups were viewed as comprising two samples from the same population.
Table 4. Post-test mean scores, experimental and control groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>t Value</th>
<th>df</th>
<th>1-Tail Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>32</td>
<td>6.0625</td>
<td>4.515</td>
<td>-2.39*</td>
<td>62</td>
<td>.01</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>8.5625</td>
<td>3.835</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at the .05 level of confidence.
The Control Group was post-tested four weeks after the original questionnaire was administered. The mean scores for the Control Group were 8.6875 on the pre-test and 8.5625 on the post-test. The Control Group’s pre- and post-test mean scores showed no significant change. Therefore, it was concluded that no change of locus of control orientation occurred during the four week period.

The Experimental Group was pre-tested on the Rotter I-E Scale and then received four weekly sessions of electromyographic biofeedback each lasting twenty minutes in duration. Following the last session each subject was post-tested on the Rotter I-E Scale. The mean scores on the pre-test for the Experimental Group were 8.0000. The mean scores on the post-test after electromyographic biofeedback was 6.0625. Utilizing a t-test the statistical significance of change was at or beyond the .05 level of confidence.

The Control Group mean scores were comparable for both pre- and post-test questionnaires. The Experimental Group utilizing biofeedback showed a significant change in locus of control orientation in the expected direction, from the pre- to the post-test questionnaire scores.

Therefore, the question as to whether biofeedback changes locus of control orientation from external to a more internalized orientation appears to be yes as represented by the sample used in this study.

Conclusions

The results of the study lead to the conclusion that biofeedback effects locus of control from an external orientation to a more
internalized orientation. This conclusion should be viewed in light of the limitations of the research. These limitations are as follows:

1. The students used in the research did not necessarily represent a general population of The United States.

2. The sample size is limited and is a selected sub-group with a limited age range.

Recommendations for Further Research

It is recommended that further research be done in the following areas:

1. A larger sample utilizing biofeedback and its effect on locus of control to determine if this study's results will generalize to other populations.

2. Research that includes variables such as sex, age, educational level to determine biofeedback's effect on locus of control.

3. Psychosomatic and non-psychosomatic subjects to determine the effect of biofeedback on locus of control.

4. Research to determine the lasting effect of changes of locus of control utilizing biofeedback.
APPENDIX A

THE ROTTER I–E SCALE
Instructions for the I-E Scale

This is a questionnaire to find out the way in which certain important events in our society effect different people. Each item consists of a pair of alternatives lettered a or b. Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you are concerned. Be sure to select the one you actually believe to be more true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal belief: obviously there are no right or wrong answers.

Your answers to the items on this inventory are to be recorded on the inventory sheet. Print your name and any other information requested by the examiner on the sheet, then finish reading these directions.

Please answer these items carefully, but do not spend too much time on any one item. Be sure to find an answer for every choice. Place the letter which most appropriately describes you in the space provided on the inventory sheet.

In some instances, you may discover that you believe both statements or neither one. In such cases, be sure to select the one you more strongly believe to be the case as far as you are concerned. Also, try to respond to each item independently when making your choice; do not be influenced by your previous choices.
INTERNAL VERSUS EXTERNAL CONTROL OF REINFORCEMENT

1.a. Children get into trouble because their parents punish them too much.
   b. The trouble with most children nowadays is that their parents are too easy with them.

2.a. Many of the unhappy things in people's lives are partly due to bad luck.
   b. People's misfortunes result from the mistakes they make.

3.a. One of the major reasons why we have wars is because people don't take enough interest in politics.
   b. There will always be wars. no matter how hard people try to prevent them.

4.a. In the long run people get the respect they deserve in this world.
   b. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

5.a. The idea that teachers are unfair to students is nonsense.
   b. Most students don't realize the extent to which their grades are influenced by accidental happenings.

6.a. Without the right breaks one cannot be an effective leader.
   b. Capable people who fail to become leaders have not taken advantage of their opportunities.

7.a. No matter how hard you try some people just don't like you.
   b. People who can't get others to like them don't understand how to get along with others.

8.a. Heredity plays the major role in determining one's personality.
   b. It is one's experiences in life which determine what they're like.
9.a. I have often found that what is going to happen will happen.

b. Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10.a. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.

b. Many times exam questions tend to be so unrelated to course work that studying is really useless.

11.a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.

b. Getting a good job depends mainly on being in the right place at the right time.

12.a. The average citizen can have an influence in government decisions.

b. This world is run by the few people in power, and there is not much the little guy can do about it.

13.a. When I make plans, I am almost certain that I can make them work.

b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

14.a. There are certain people who are just no good.

b. There is some good in everybody.

15.a. In my case getting what I want has little or nothing to do with luck.

b. Many times we might just as well decide what to do by flipping a coin.

16.a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.

b. Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.

17.a. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.

b. By taking an active part in political and social affairs the people can control world events.
18. a. Most people don't realize the extent to which their lives are controlled by accidental happenings.
   
   b. There really is no such thing as "luck".

19. a. One should always be willing to admit mistakes.
   
   b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.
   
   b. How many friends you have depends upon how nice a person you are.

21. a. In the long run the bad things that happen to us are balanced by the good ones.
   
   b. Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a. With enough effort we can wipe out political corruption.
   
   b. It is difficult for people to have much control over the things politicians do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.
   
   b. There is a direct connection between how hard I study and the grades I get.

24. a. A good leader expects people to decide for themselves what they should do.
   
   b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.
   
   b. It is impossible for me to believe that chance or luck plays an important role in my life.

26. a. People are lonely because they don't try to be friendly.
   
   b. There's not much use in trying too hard to please people, if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.
   
   b. Team sports are an excellent way to build character.
28. a. What happens to me is my own doing.

   b. Sometimes I feel that I don't have enough control over the direction my life is taking.

29. a. Most of the time I can't understand why politicians behave the way they do.

   b. In the long run the people are responsible for bad government on a national as well as on a local level.
APPENDIX B

RELIABILITY AND DISCRIMINANT VALIDITY

ROTTER I–E SCALE
Table B1. Internal-external control test data: Reliability and discriminant validity.*

<table>
<thead>
<tr>
<th>Sample</th>
<th>Type</th>
<th>N</th>
<th>Sex</th>
<th>r</th>
<th>Source</th>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ohio State University Elementary</td>
<td>Split half</td>
<td>50</td>
<td>M</td>
<td>.65</td>
<td>Rotter</td>
</tr>
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<td>Spearman-Brown</td>
<td>50</td>
<td>F</td>
<td>.79</td>
<td>Rotter</td>
</tr>
<tr>
<td>Sample I</td>
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<td>100</td>
<td>combined</td>
<td>.73</td>
<td>Rotter</td>
</tr>
<tr>
<td>Ohio State University Elementary</td>
<td>Kuder-Richardson</td>
<td>200</td>
<td>M</td>
<td>.70</td>
<td>Rotter</td>
</tr>
<tr>
<td>psychology students</td>
<td></td>
<td>200</td>
<td>F</td>
<td>.70</td>
<td>Rotter</td>
</tr>
<tr>
<td>National stratified sample</td>
<td>Kuder-Richardson</td>
<td>1000</td>
<td>combined</td>
<td>.69</td>
<td>Franklin</td>
</tr>
<tr>
<td>Purdue opinion poll 10th, 11th, and 12th grades</td>
<td></td>
<td></td>
<td>M&amp;F approximately</td>
<td>Equal Ns</td>
<td>(1963)</td>
</tr>
</tbody>
</table>
Table B1, Continued.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Type</th>
<th>N</th>
<th>Sex</th>
<th>r</th>
<th>Source</th>
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<td><strong>Test-retest reliability</strong></td>
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<tr>
<td>Ohio State University</td>
<td>1 month</td>
<td>30</td>
<td>M</td>
<td>.60</td>
<td>Rotter</td>
</tr>
<tr>
<td>Elementary psychology students</td>
<td>Group</td>
<td>30</td>
<td>F</td>
<td>.83</td>
<td>Rotter</td>
</tr>
<tr>
<td>Administration</td>
<td></td>
<td>60</td>
<td>combined</td>
<td>.72</td>
<td>Rotter</td>
</tr>
<tr>
<td>Prisoners</td>
<td>1 month</td>
<td>28</td>
<td>M</td>
<td>.78</td>
<td>Jessor (1964)</td>
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<tr>
<td>Colorado Reformatory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ohio State University</td>
<td>2 months</td>
<td>63</td>
<td>M</td>
<td>.49</td>
<td>Rotter</td>
</tr>
<tr>
<td>Elementary psychology students</td>
<td>1st group</td>
<td>54</td>
<td>F</td>
<td>.61</td>
<td>Rotter</td>
</tr>
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<td></td>
<td>2nd individual</td>
<td>117</td>
<td>combined</td>
<td>.55</td>
<td>Rotter</td>
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Table Bl, Continued.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Type</th>
<th>N</th>
<th>Sex</th>
<th>r</th>
<th>Source</th>
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<tr>
<td><strong>Correlation with Marlowe-Crowne Social Desirability Scale</strong></td>
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<td></td>
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<td></td>
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<tr>
<td>Ohio State University</td>
<td>Elementary psychology students</td>
<td>166</td>
<td>M</td>
<td>-.16</td>
<td>Rotter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>140</td>
<td>F</td>
<td>-.32</td>
<td>Rotter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>306</td>
<td>combined</td>
<td>-.21</td>
<td>Rotter</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Elementary psychology students</td>
<td>136</td>
<td>M</td>
<td>-.22</td>
<td>Schwarz (1963)</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Elementary psychology students</td>
<td>180</td>
<td>F</td>
<td>-.12</td>
<td>Strickland (1962)</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Elementary psychology students</td>
<td>103</td>
<td>M</td>
<td>-.17</td>
<td>Watt (1962)</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Elementary psychology students</td>
<td>77</td>
<td>F</td>
<td>-.35</td>
<td>Rotter</td>
</tr>
<tr>
<td>Kansas State University</td>
<td>Elementary psychology students</td>
<td>113</td>
<td>45M, 68F</td>
<td>-.28</td>
<td>Ware (1964)</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Psychological Exam.</td>
<td>107</td>
<td>F</td>
<td>-.09</td>
<td>Strickland (1962)</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Psychological Exam.</td>
<td>26</td>
<td>M</td>
<td>-.03</td>
<td>Cardi (1962)</td>
</tr>
<tr>
<td>Ohio State University</td>
<td>Psychological Exam.</td>
<td>46</td>
<td>F</td>
<td>-.22</td>
<td>Rotter</td>
</tr>
<tr>
<td>Ohio Federal prisoners</td>
<td>Revised beta IQ</td>
<td>80</td>
<td>M</td>
<td>.01</td>
<td>Ladwig (1963)</td>
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<tr>
<td>Ages 18-26, 8th grade plus reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Reproduced from Rotter, 1966 (Table 2).
APPENDIX C

INFORMATION SHEET AND CONSENT FORM
Subject's Consent Form

Biofeedback and Internal and External Locus of Control

I am requesting your voluntary participation in the completion of a questionnaire and four sessions of electromyographic (EMG) biofeedback training. The purpose and objective of this study are to determine the effects of EMG biofeedback training on the degree of control individuals feel they have over personal events and those of society.

If you decide to participate, please answer as many of the questions as you are able to with confidence. You do not have to answer all the questions. Completion of the questionnaire will indicate your consent as a willing participant in this study. Participation or non-participation will not affect any grade in any courses you are taking at The University of Arizona.

You will receive a mimeograph sheet explaining EMG biofeedback training prior to receiving the questionnaire. After completion of the questionnaire you will be scheduled for four successive weekly sessions of EMG biofeedback training. These appointments will be scheduled at your convenience as to time and location. You can either be seen at The University of Arizona, Rehabilitation Center, College of Education, or at 4703 North First Avenue, North First Medical Plaza, depending upon your preference.

All data received will be treated with anonymity and confidentiality. You are free to withdraw from the study at anytime without incurring ill will.

Each session of biofeedback training will last twenty minutes and the questionnaire which will be taken prior to and after biofeedback training will take approximately ten minutes.

"I also understand that this consent form will be filed in an area designated by Human Subjects Committee with access restricted to the principal investigator or authorized representatives of the particular department."

Signature of Participant ___________________________ Date ____________

Witness ___________________________________________ Date ____________

This form is available upon request.
BIOFEEDBACK

Biofeedback is a training procedure utilized for the development of certain kinds of physiological control. In this procedure, subtle bio-electric signals originating in a particular bodily structure are monitored by sensitive electronic equipment. This signal, once monitored, is amplified and used to power an external stimulus display. The display used may be in the form of lights or tones or clicks. As the bio-electrical signal varies so also does light color, or tone frequency, or click rate. In this way the individual is supplied with immediate feedback relative to the "behavior" or the monitored bodily structure.

Biofeedback refers to any of a wide variety of techniques which use instrumentation to provide a subject with information about changes in bodily functions of which the person is usually not aware. The information provided is generally immediate and usually continuous. When this information is provided to the subjects, some of them use the information to learn to control these previously involuntary functions. The terms "self-control" or "self-regulation" are often used in similar context to connote the scientific study and clinical application of other techniques through which a person can control internal physiological states: mood, attention, emotions, or other normally involuntary functions. These techniques include operant learning approaches, hypnosis, autogenic training; and various forms and styles of meditation.
The most direct application of biofeedback procedures is the use of electromyographic (EMG) feedback. Surface electrodes are placed over the frontalis muscle of the forehead and subjects listen to a tone whose frequency changes in proportion to the EMG activity in the muscle. The subject is trained to decrease the frequency of the tone by relaxing the muscle group.
APPENDIX D

PROCEDURE OF EXPERIMENTAL SESSIONS
Each subject was seen in a Counseling room in the College of Education, Rehabilitation Center. Prior to sessions each received a Consent form, a biofeedback information sheet and the Rotter I-E Scale questionnaire.

The subjects were scheduled for twenty minute sessions, one time weekly for four weeks.

Electromyographic biofeedback was used with electrodes attached to the frontalis muscle. Each subject was greeted with "How are you today" and attached to the machine. Each was instructed to reduce the electromyographic level on the machine in whichever manner they felt most comfortable. Audio and visual feedback on frontalis electromyograph levels were given for each subject. The researcher wrote down these levels reached every 45 seconds.

At the conclusion of each session the researcher remarked on how well they had done and confirmed the following week's appointment.
LITERATURE CITED


