THE EFFECT OF THOUGHT DETECTION ON ANXIETY RESPONSES

DISSERTATION

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By

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The problem of this study was to analyze the effects of contingent reinforcement on the presence of thoughts defined as anxiety responses. The two types of data, observed and introceptive, were used to determine the effects of reinforcement. The observed data from the peripheral physiological pre- and post-measures included heart rate, blood pressure, and the Taylor Manifest Anxiety Scale data. The introceptive data supplied by subjects were the daily percentages of anxious thought detections subsequent to a baseline period. The daily percentages were formed by the subject's monitoring his own thoughts, with the monitoring prompted by an automatic tone device which emitted a tone approximately every four minutes. The daily percentage of anxious thoughts was formed by dividing the number of tones the subject heard into the number of anxious thoughts occurring at the time of the tone.

Five of the ten subjects were involved in a baseline phase and following this an experimental (contingent reinforcement) phase. The remaining five subjects comprised the control group. Unlike the experimental group, they did not undergo a contingency phase. The subjects' data for the peripheral physiological tests revealed there were no

significant differences between the groups in heart rate and blood pressure, although the means of these measures were nonsignificantly lower on the post measures for the experimental group following the baseline period. The control group's scores on these measures were nonsignificantly greater than the pre-measure scores for that group. There were no statistically significant differences revealed in the Taylor Manifest Anxiety scores between the groups.

The statistical analysis for determining the effects of contingent reinforcement on the daily percentage of anxious thoughts, comparing the experimental with the control group, revealed no significant differences between the groups. Although the group statistical analyses would tend to evoke a rejection of all differences between the groups in detection responses, when the data trends of individuals were inspected, that inspection suggested further analysis should be undertaken. Accordingly, the data of individuals were subjected to the time-series analysis. The analysis revealed significant intervention effects for three of the five members of the experimental group. Two members of the control group also made significant shifts in the direction of a decrement in the frequency of anxious thoughts. As two of the five subjects with significant data were control subjects and had not received contingent reinforcement, it is not likely that reinforcement could be singularly credited with the significance found for each of the five subjects.

The main findings in this study were

1. Although not statistically significant, the experimental subjects were found to demonstrate consistently lower mean heart rate and blood pressure following the experimental period. The control subjects' scores were nonsignificantly greater for heart rate and blood pressure at the conclusion of the study.

2. The results further suggested that contingent reinforcement alone did not produce the significant shifts found in the thought frequency of individual subjects. It is likely that both reinforcement and thought monitoring had effects due to the subjects' past history of reinforcement.

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CHAPTER I

INTRODUCTION

Traditionally, psychologists have been ambivalent about how the study of the internal states of the person relate to the field of psychology. The controversy revolves about the question of whether or not human physiological conditions are legitimate phenomenon for psychological study. This disagreement which has continued for many years has been heated and bitter. As a matter of fact, the argument has become so acrimonious that two polar groups have formed. The psychologists in one camp argue that phenomena such as feelings, thought, perceptions, and ideas are the very essence of human nature and, as such, should be the major focus of psychological studies (8, 18). This group feels that psychology is the total study of human beings and as such it should be most concerned with those things that are uniquely human such as feelings and thoughts. In the other camp, the psychologists state that these phenomena are not observable behavior and therefore are not suitable for psychological study (7). The latter psychologists believe that psychology is the science of behavior. Thus, they feel that nonobservable phenomena should be excluded from the study of psychology as the phenomena would then exist upon self-report rather than observable behavior.

Contemporary theoretical and technical developments may allow for these two camps to become depolarized and to coordinate their efforts in the study of internal events. Skinner, a leading behaviorist, has recently developed a theory that accounts for these phenomena within a behavioral framework consistent with the theory of operant psychology (23, 24, 25). His theory is important because many psychologists who formerly shunned the study of internal phenomenon will now accept the study of internal events in the field of psychology and begin to study these events themselves.

Another significant development in this area concerns the work of Goldiamond (9), another noted behaviorist. Goldiamond extended a conceptual analysis developed in research involving overt behavior to explain these covert phenomena. His model is based on Signal Detection Theory. Historically, the Theory of Signal Detection was developed in engineering. Goldiamond related the theory to clinical phenomena including classical psychophysics. Goldiamond's analysis and research is particularly important because it provides a model for behavioral research involving covert events.

Signal Detection Theory arose from the systematic analysis of the variables that result in an organism responding to (detecting) the presence of a stimulus (signal) in this environment. Under certain conditions, a stimulus or signal may be present in the environment and

the organism may respond to it (detect it). Under other conditions, the same stimulus may be present but not precipitate a response from the organism. Goldiamond (9) in his experiments was interested in the verbal detection response of humans to the presence of a specific stimulus. In his studies, the detection of a stimulus was equivalent to the person saying, "I see it," "I hear it," "I feel it," or "There it is." Using this model, a person is said to detect a stimulus when he becomes aware that it is present in his environment. Goldiamond would present his subjects with an overt stimulus such as a light or tone. He asked them to indicate when they were aware that they saw or heard the stimulus (detection response). He systematically varied the intensity level of the stimulus and measured the frequency of detections at each level.

This procedure is essentially equivalent to the procedures used to establish and measure physiological thresholds. Thresholds are traditionally thought to be solely dependent upon the intensity of the stimulus. The level at which a person detected the presence of a stimulus was believed to be a function of physiological limits of the person. Consequently, Goldiamond's most impressive findings were that he found that thresholds could be altered through the systematic manipulation of both intensity and reinforcement. Goldiamond manipulated two variables in studying the

detection response--the intensity of the stimulus (signal) and the payoff matrix for detection of the stimulus. He discovered that he could change whether or not a subject detected or was aware of a stimulus--that is, whether or not he heard, saw, or felt it by altering one or both of these two variables. The functional relationships were direct ones. The more intense the stimulus, the more likely the subject was to detect it; the greater the payoff (or reinforcement) for detecting the stimulus, the more likely the subject was to detect it. There were also interaction effects between the two variables. Thus, if the stimulus was not intense enough to produce a detection response, the experimenter could increase the probability of detection by increasing the payoff. Also, if the payoff was not great enough at a certain intensity, the experimenter could insure a detection response by raising the stimulus intensity.

The relationships of Goldiamond's finding to the empirical analysis of internal physiological phenomena is significant. The individual's concern with certain internal conditions involves detection responses such as I feel unhappy, I feel hungry, I feel upset. It is the individual's awareness of these internal stimulations that is of greatest interest and concern to psychologists. Therefore, it seems reasonable that if a person's ability to detect or be aware of external stimuli is related to the intensity of the

stimulus and the payoff matrix, then his detection of internal stimulation should be related to these two variables. Moreover, a person may say he feels hungry, i.e. he detects stimulation within the stomach. In other words, the person detects the presence of certain stimuli within the stomach. Whether or not the person detects the presence of these stimuli at any specified time should be a function of the intensity of the hunger pangs and the payoff (reinforcement) for saying he feels hungry. The stronger the hunger pangs, the more likely he is to feel hungry. Also, the more likely the individual will get something to eat, the more probable it is that he will experience hunger. If the signal detection analysis holds true, then, the same thing should occur with other internal events involving a detection response such as thirst, pain, or fear.

This theoretical framework if supported by empirical evidence has particular significance to the understanding and treatment of certain clinical populations. Many psychological syndromes are characterized by such symptoms as excessive feelings of anxiety, depression, pain, and so forth. Those clients who complain of pain, anxiety, and depression are probably responding to some form of internal stimulation. They may be detecting the presence of some physiological stimulus within their bodies. With internal pain, such as headaches or sore throats, the person is probably responding

to stimuli impinging upon a specific receptor located in one area of the body. On the other hand, awareness of anxiety, fear, and depression is probably related more to the fact that the person perceives activity in one or more parts of his autonomic nervous system. When the autonomic nervous system is activated, certain physiological responses increase, such as blood pressure, heart rate, and sweat production. These changes produce stimulation in various parts of the person's body. When these stimuli reach a certain intensity, the person becomes aware of these changes or detects them. According to Signal Detection Theory whether or not a person detects the presence of stimuli associated with either fear, depression, pain, or anxiety is a function of two variables--the intensity of the stimuli and the reinforcement for detecting the presence of these stimuli. The more intense the stimuli are, the more likely the person is to perceive them; the greater the reinforcement for detecting the presence of these stimuli, the more likely the person is to perceive them. It is important in a clinical population to recognize that the reinforcement for the detection response may be a positive or a negative. The detection of anxiety may be maintained if a person can escape from a certain aversive condition through detecting an internal phenomenon. Thus, a person may avoid taking a test because he or she detects a headache. If the person had not been scheduled to take a

test, the same level of internal stimulation would not have produced a detection response. Another important finding of Signal Detection Theory to detection of internal events by clinical populations is that detection responses will increase as detection thresholds decrease as more and more detection responses are made. So it is that the more detections a person makes of internal stimulation, the less intense the stimuli must be for the next detection response to occur, all other conditions being equal. Thus, the person may find himself or herself making detections at lower and lower levels of stimulation.

A very relevant point to consider in the treatment of clinical populations using this model is that the intensity of the internal stimulation associated with detection response may not be dehabilitative. For instance, increased arousal responses are functional in dangerous situations such as driving on a slippery road or running from danger and may even be functional in certain everyday activities. It may be the detection response itself that constitutes the major problem. It would be advantageous to enable people to adjust toward zero the rate of detections which tend to promote anxiety for fear or depression not associated with realistic considerations. However, if detection rates increase independent of realistic conditions, the result may be a costly and unnecessary escape or avoidance response. Thus,

it is evident that research founded upon the tenets of the Signal Detection Theory may prove very fruitful to the understanding of people's awareness of internal stimulation. If the data support the contentions proposed by this theory, a greater understanding of the etiology and treatment of many clinical populations would result. Initially research should evaluate the two basic functional relationships proposed by the Signal Detection model. First, research is necessary to find out if the frequency of detection responses in the presence of internal physiological stimuli is a function of the intensity of these stimuli. Secondly, research should be conducted to see if the frequency of these detection responses is a function of the consequences for the detection responses. If these relationships are empirically established, a more precise analysis involving parametric measures would be possible.

Statement of the Problem

The problem of this study was to analyze the effects of contingent reinforcement on the frequency of responses that indicate the presence of a state of anxiety.

Purpose of the Study

The purposes of this study were (1) to examine the relationships between the frequency of anxious thought detections and the frequencies of physiological indices

presumably correlated with the clinical entity "anxiety," (2) to attempt to modify the frequency of anxious thought detections by contingent reinforcement, (3) to analyze the implications of the effect of reinforcement on thought frequency for clinically presented problems of anxiety, and (4) to analyze the effects of a decrement of thought frequency on physiological measures associated with anxiety.

Hypotheses

To carry out the purposes of this study, the following hypotheses have been formulated:

1. The monitoring of anxious thoughts will stimulate an increase in autonomic responding as seen in the physiological measures of internal activity. The monitoring activity should also increase detections.
2. The contingent reinforcement for achieving a decrement in anxious thought will cause a decrement in the daily percentage of anxious thought detections.
3. Reducing the frequency of anxious thoughts will decrease the physiological responses associated with the phenomenon of anxiety and its conscious experience.

Background and Significance of the Study

The nature of anxiety has often been the focus of studies in the area of psychological inquiry. Traditionally, many

researchers and theoreticians in the field of psychology and counseling have been interested in the cause and effect of anxiety (6, 7, 8, 14, 18, 19, 20, 22, 26). It is a topic that has captured the fascination of a seemingly infinite number of researchers. Philosophers have similarly been impressed with this phenomenon. Existentialists write of pervasive anxiety as if anxiety were as much a part of life as breathing (14, 22). The sustained interest in the study of anxiety by individuals from divergent philosophies and concerns is due in part to the fact that anxiety is often a pervasive and debilitating condition. There are conditions or degrees of anxiety which appear to decrease profoundly the effectiveness of an organism's functioning (1, 2, 5, 7, 8, 10, 16, 17, 18, 21). Furthermore, its effects are felt by a large percentage of people in our culture. Reports show that 40-50 percent of the business of pharmaceutical houses is directly related to the sale of tranquilizers to reduce anxiety and tension (4). Thus, the fact that so many individuals in our culture are concerned with the causes and effects of anxiety is not surprising.

However, the only way in which the etiology and results of anxiety can be specified is through an empirical analysis of the subject to the present time. Much fruitful research has been conducted. However, one aspect that has not been analyzed is the relationship between man's thoughts and his

inner anxieties. That is to say, it has yet to be clearly demonstrated that there is a functional relationship between what one tells oneself is going on internally and what in fact is transpiring. This analysis is particularly important because of its implications for the clinical treatment of anxiety.

Recent developments may make it possible to approach the study of thought as precipitating anxiety states by employing the same operant procedures that are so readily effective with overt, observable behaviors. The idea that the world of inner activity need not be mutually exclusive from the external world has prompted some researchers to begin studies dealing with implicit behavioral processes in an explicit manner (3, 11, 12, 13, 15).

These latest trends, when viewed outside the more traditional paradigms on thought and anxiety processes may further the knowledge available to science. An understanding of these trends is a potential contributor to the increased effectiveness in the treatment of one of humanity's most pervasive problems, anxiety.

Definition of Terms

For the purpose of this study, the following definitions have been formulated:

Reinforcement.--The offering of money contingent upon and subsequent to the demonstration of a decrement in the

frequency of anxious thoughts (i.e., an increase in the non-presence of anxious thoughts); this decrement, it is believed, will act reflexively to further reduce anxious thoughts. Reinforcement, operationally defined, is the procedure of introducing a reinforcer subsequent to an event which increases the rate of that event. Payment will be in terms of the pay schedule outlined in the procedure section.

Thought.--A covert verbal statement by the person which labels or detects internal physiological stimulation impinging upon that person. A thought is counted whenever a person is "aware" that a certain physiological response is occurring within his or her body. The person's awareness is synonymous with the verbal statement that they are detecting their own internal physiological responses. An example of an overt statement reflecting the awareness of physiological stimulation would be the words, "I feel anxious." When a statement like this is made covertly, it constitutes a covert verbal statement or thought.

Anxious thought.--A covert detection of the autonomic anxiety response. A person counted an anxious thought whenever they detected or became aware of an autonomic response, e.g. an increase in blood pressure and heart rate, occurring within the body which the person labeled as anxiety. Detection of anxiety was counted as an anxious thought only if the

person made a covert verbal statement to themselves such as "I feel anxious" or "I am anxious."

Threshold.--The least amount of physical energy impinging upon an individual's receptors which result in the person's detecting or becoming aware of that stimulation. For example, a visual threshold for an individual is the least amount of light energy that would cause the person to say verbally, "I see light." The receptors of the person's eye may be electrically active at levels of stimulation lower than the level at which he detects the energy input. However, the threshold is synonymous with the person's labeling or detection of energy input. Thus, the anxiety threshold is the minimal amount of stimulation which causes an individual to detect autonomic responses which he or she labels as anxiety. It has been found that auditory and visual thresholds are sensitive to both the strength of the physiological stimulus and the effects that the detection response have on the environment, e.g. monetary reinforcement. The stronger the physiological stimulus, the more probable the detection response; the greater the pay off matrix for the detection response the more probable its occurrence (9).

S^D (discriminative stimulus).--A stimulus uniquely associated with reinforcement for a response. Once a stimulus is established as a discriminative stimulus for a

response the presence of that stimulus in the environment will increase the probability of the occurrence of that response. Consequently, once an individual has learned to respond in a certain way to the presence of a discriminative stimulus, introducing that stimulus in the environment will make it more likely that a person will make the designated response. For example, once a person has learned to say "girl" when she sees these four letters, that person will more likely say "girl" when the word is present in her environment. An individual's response to a discriminative stimulus may be a detection or labeling response concerning the presence of the stimulus such as, "I see it, I hear it, I feel it." The detection response may be overt or covert, that is the person may say it to others or to themselves. Thus, if a whistle is a discriminative stimulus for saying, "I hear a whistle," introducing the whistle sound into the person's environment will increase the likelihood they will say, "I hear a whistle." At the same time, the discriminative stimulus for a detection response may be extended to include the internal environment, as in anxiety. With anxiety, physiological stimulation from autonomic responses, e.g. increases in heart rate and blood pressure, function as the discriminative stimulus for a person to detect or label anxiety, saying, "I am anxious." Thereafter, once internal stimulation from these autonomic responses becomes established

as a discriminative stimulus for the anxiety response, the presence of these stimuli will increase the likelihood that the person will label or detect anxiety.

Anxiety.--The experience of anxiety is the detection by the individual of internal stimulation presumably associated with the autonomic nervous system. Their internal responses may result from situations or events in the external or internal environment. Events such as "failure" may precipitate internal activity detected as anxiety. At the same time, the person's own behavior, including thoughts, may act as precipitating stimulation for anxiety detection. The person's experiential feeling of anxiety comes about as a result of his or her detecting activity in this system.

Baseline period.--A period during which the frequency of anxiety detections is noted by the subject and recorded under standard conditions just prior to the experimental period and the implementation of reinforcement (24).

Signal detection.--An instance where a member of a defined class of responses (detection responses) is correlated with a stimulus input of a specific nature and intensity. Signal detection is produced conjointly by the stimulus input and the consequences associated with such responses in the past. In this study such discriminative responses are similarly governed by their consequences. There is a

probability that pay-offs, or consequences, bear greatly on the occurrence of thoughts which constitute anxiety detections (9).

Operant psychology.--The study of responses which generate consequences for the organism emitting them. The responses studied in operant psychology are not restricted by any other defining limits. As a result, physiological events are presumed under the control of consequences. The effects of these consequences on the response may be reflected in changes in the individual's physiological records and/or thought frequencies.

Limitations of the Study

Currently there is an insufficient data base from which to make statements about the generalization of this study. Findings obtained with the experimental population cannot be generalized in more than a statistical sense to other populations. The known limitations are those relevant to the relationship of sample size to the population.

Basic Assumption

The following assumption was maintained in this study: The subjects' intake of medication had a nonsystematic effect on the outcome of the study.

Treatment of the Data

Analysis of group data.--The statistical treatment involved the critical comparisons between the pre- and post-scores for the peripheral measures. These comparisons were made for each group as well as between groups. The analysis of variance with repeated measures compared the groups for anxious thought detections. An analysis of variance for split-plot designs was used to compare means and standard deviations on percent of anxious thought both across individual data days for each group and between the experimental and control groups. The analysis of covariance was utilized to compare the equality of the group means on the peripheral measures by accounting for the variability in the pre-tests. In this way, the post-test could be predictable, i.e. the scores would be the same as the pre-test scores, except in cases where the differences were due to the treatment effect.

Analysis of individual data.--The data were analyzed using each individual as their own control in a time series analysis. This analysis revealed statistical data shifts of significance if these shifts occurred across time. The *t*-test was used to test for the significance of the intervention effect.

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CHAPTER II

REVIEW OF RELATED LITERATURE

A search of the literature in the area of thought detection and its relation to anxiety revealed a paucity of studies. No studies with hard data were found which analyzed the effects of contingent reinforcement on the presence of thoughts detected as anxiety responses in a psychophysical experiment. Several reports speculating the existence of this relationship were extant, however. Research related to the basic concepts upon which this study was based was included in three major divisions: psychophysiology, operant technology, and the role of autonomic arousal in anxiety. Each of these areas was contributory in ascertaining certain formulations, both theoretical and experimental, which were relevant to this study.

Psychophysiology

Early in the development of psychophysiology, evidence gathered by Boring (3, 4, 5), Darrow (10), and Jacobson (32) was instrumental in establishing a basis for the relationship of thoughts to the occurrence of concomitant physical changes. With the rationales of psychophysics providing a base, it was possible for substantial contributions to be

made by Homme (30), Goldiamond (22, 23), Skinner (69), and Meichenbaum (53, 56), who are pioneers in operant technology. May and Johnson (51) gave support to the effects of thoughts on the individual's autonomic nervous system. A cue was utilized to signal the onset of a predetermined category. The cues were numbers and the subject generated thoughts (stressful, neutral, or relaxing) to the corresponding number cue. It was found that this external signal affected the subvocal activity and so changed the physiological record of the individual. May and Johnson also found heart rate to be the most sensitive physiological indice of an individual's subvocal processes. Hefferline and Bruno (27) recount detailed experimentation demonstrating subtle manipulations of the "mind-body relation," as they termed it. Subjects were taught to control covert activity of the muscles of the right hand through bio-feedback. The process involved an electromyogram for discrimination training. The electromyogram detected the hand's covert movement and these waveforms were projected on an oscilloscope where they were viewed by the subject. In discrimination training, the person learned to produce a waveform when he was cued with a red light visible to him. These and other similar psychophysical studies (38, 73) support the belief that the operant principles which apply to overt behavior are appropriate to the realm of private events, or covert behavior.

In McGuigan and Pavek's (42) experiment of a psychophysiological process, subjects were instructed to think silently yes or no to questions. It was found that physiological indices of horizontal eye movements and covert muscle activity of the arms, lips, and neck differed significantly if there were a series of yes thoughts or no thoughts. The question prompting the thoughts was judged to be neutral. In regard to the eye record the duration of eye response was significantly longer when the subjects thought yes than when they thought no, the mean difference being 40 milliseconds for eight subjects. These findings were generally consistent with Watson and Rayner's (80) discussion of covert nonvocal behavior patterns being associated with visceral responses.

Shock and Schlatter (66) suggested years ago that thoughts have a greater potential for affecting heart rate than do spontaneous sensory stimuli, while the latter have more obvious effect on galvanic skin response, electromyograph, and blood pressure. Darrow's (10) descriptions of the effects of ideation on physiological processes early lent support to the Shock and Schlatter (66) research.

Essentially, the literature strongly supports the notion that physiological changes occur to ideational stimuli. Although the type and degree of association prove to be peculiar to the individual's heart rate and blood pressure, these measures are the most sensitive indicators over all.

Data demonstrating this were presented by Duffy (13). The data showed that while the correlations between physiological measures are usually not high, the within or same subject designs show greater correlation. She also found greater reliability for within subject designs. Malmo (46), Martin (50), Lacey (37), and Duffy (13) report similar outcomes in that even as the stress situation varied, each person's autonomic arousal responses were highly individualized and the pattern consistent for that individual.

Operant Technology

Miller (57), Engel and Chism (14), and Engel and Hansen (15) obtained evidence to show that heart rate could be brought under operant control. Shapiro, Tursky, Gershon, and Stern (64) demonstrated that systolic blood pressure also could come under operant control. Both heart rate and blood pressure while traditionally labeled as involuntary and autonomic activities by physiologists and psychologists have been conditioned by contingent reinforcement (62, 63, 65, 82). This information has significance for a number of reasons. Research centers around the country are currently directing efforts toward the teaching clients self control of problematic physiological responses such as high blood pressure, migraine headaches, and heart conditions (59).

Mahoney (45) described the situation of covert responding (thinking) as having a privileged observer of one: the

person himself is his own highest authority. This public of one calls for the person to be his own monitor. This is consistent with the individual-as-his-own-control studies (25, 29, 41). In these studies the person can function as his own comparison by measuring his progress in the experimental period to the difference in an established baseline period. Sidman (67) describes this as splitting the subject into two matching organisms, each performing in regard to relevant controlling variables.

A behavioral analysis of the controlling variables was undertaken by Skinner (68, 69). He referred to the changes which take place in the person's "mental outlook" as due to the controlling variables in the environment. These variables are those changes or manipulations that take place in the world outside the skin. Just as there are externally generated variables or S^Ds, so are there internally generated S^Ds. Meichenbaum (56) outlines a process to modify these internal stimuli by changing what the client says to himself. Meichenbaum (55) uses reinforcement to modify client thoughts or self-statements. Positive phrases (coping behavior) were reinforced and negative phrases punished. He taught impulsive children to talk to themselves as a way to control their own impulsivity (54). Farber (17) noted that clients will frequently talk to themselves and he concluded that it is the things that are said to oneself that are the determiners of what one may do (p. 336).

While covert reinforcement has been used to modify self statements as internal stimuli, most treatment for anxiety has been done by desensitization which involves imagining (6, 7, 8, 9, 19). Meichenbaum's (55) research supports the theory that there is increased effectiveness in self-instructional training if that form of anxiety relief is used. Such training results in the subject's increased ability to decrease avoidance responses due to anxiety (55). Paivio (60) has suggested that conjuring up a visual picture of a stimulus event is quite different from describing or talking about an object or stimulus event, and that the picturing is a different procedure from verbalizing about the event. The treatment effects of talking to oneself will generalize across multiple phobias while specific-to-the-subject imagery leads to minimal treatment generalizations (52).

While Krasner (33) and Truax (78) have shown that the therapist has a significant impact on what the client says to the therapist, it may be appropriate to program words the client says to himself as a way to cope better with his or her anxieties (54). The research inferred that words which clients use in talking to themselves significantly influence whether their level of anxiety as manifested by their behavioral acts increases or decreases (34, 52).

Steffy, Meichenbaum, and Best (72) treated a group of smokers by making shock onset contingent upon self-statements,

thoughts, and images which accompanied the smoking act. Termination of shock was contingent upon the expression of self-instruction to put out the cigarette and so forth. Post-assessment and six-months follow-up found substantial improvement for those with whom covert verbalizations were accentuated. Cautela (7) used behavior therapy in modification of maladaptive behavior by asking the patient to perceive reinforcing stimuli in the imagination following a behavior that the client wished to change. The crucial assumption here was that manipulation of covert processes can influence overt behavior in a predictable manner. There is support for such an assumption (19, 59). Cautela's (7) procedure involved making both the response and the reinforcing stimulus in imagery. This covert activity is thought to be similar to the actual experiencing of the relationships between behavior and the reinforcing stimulus.

Homme (30) coined the phrase "coverants" which is a contraction of covert operant. It is emphasized that difficulties underlying many behavior disorders are excesses or deficits in thinking, imagining, and ruminating, reflecting, daydreaming, fantasizing, and so forth. Homme states that each subject can discriminate the occurrence or nonoccurrence of behavior in himself. Mahoney's (43, 44) impression coincided with that of Homme on this account in that Mahoney referred to the individual as his own privileged observer.

Cautela (6) researched covert extinction as well as covert reinforcement. The purpose of this type of extinction is to bring about a decrement in response probability. The hypothesis was that if the reinforcing situation is prevented from occurring, the former rate of responses decreases in frequency. This lack of a reinforcing event can occur *in vivo*.

Both covert extinction and reinforcement have the distinct advantage of being immediately available to the subject in the quantity and quality that the subject specifies. These advantages are not so easily acquired by external reinforcers. Because external reinforcers are so idiosyncratic and would present problems in availability, presentation and time beyond the scope of many studies, money is noted by Poppen (61), Swingle, Cody, and Moore (74), and Davis (11) as being the "penetrating solvent" that a person can use in the environment to get the culture to yield desired objects and activities. It was also seen by these authors as a way to provide a means to be with friends and to purchase those accompaniments which a person acquired to attract others to him or her.

In summary the contributions to this study from operant technology lie in the treatment of thoughts in much the same way behaviorists have been treating observable behavior. Thoughts have a rate of occurrence; the rate can be modified by reinforcement.

Autonomic Arousal in Anxiety

Mowrer (58) has argued that anxiety (fear) is the conditioned form of pain reaction. Sternbach (73) made a psychophysiological study of pain which is an analogue to the study of anxiety. When discussing the assessment outcomes of anxiety by physiological measures, Martin (49) proposed that the construct of anxiety be considered similar and perhaps identical to the reaction of fear. However, Martin discriminated between them by contrasting fear as a response to a realistic situation or person while anxiety may be a response to not knowing the outcome of a future event. Martin also stated that anxiety has the property of being easily learned.

While a positive relationship between anxiety and conditioning does exist as shown by Farber and Spence (18), the literature does not provide conclusive evidence that a definite pattern can be established either between individual physiological measures of anxiety or between self-report measures and physiological measures. However, it is suggested by Martin (49) that one might attempt to assess simultaneously, or nearly so, several physiological measures, and a few selected self-report measures when the subject was relaxed. An adaptation-to-the apparatus period acts to provide data about the subject at a more nearly accurate base rate. Martin further concluded that when more specificity is obtained pertinent to the physiological

behavioral response patterns of anxiety, self report scales can be designed that will more nearly predict the condition of anxiety.

Gunderson (26) said that it was not appropriate to compare studies in which anxiety was labeled by virtue of psychiatric diagnosis and those in which anxiety was experimentally induced. It appeared that measures at resting state were different from those cases whose scores were due to laboratory-induced stress. The point being that measures during resting states more nearly approximated the subject's conditions in the real world and as such may have more relevance for treatment paradigms (49). Patterns of situational or laboratory-induced autonomic responses were different from the chronically elevated responses likely to be found in persons who experience more continuous anxiety (50).

Martin's (49) research inferred the strength of the anxiety reaction by physiological measures, behavioral indices, and a single self-report measure. Martin, however, primarily concerned himself with physiological response measures. The physiological responses were measured by determining the subject's heart rate, systolic blood pressure, respiration rate, hand temperature, and the Galvanic Skin Response. The behavioral indices were obtained from eye blink conditioning, speech disturbance episodes, difficulty with memory task, and impairment of tachistoscopic perception.

All of these studies reported an adaptation-to-the-apparatus period, as this acted to alleviate responses to the equipment and the experimental setting and did then provide the subject's measures at a more nearly accurate base ratio.

Wenger (81) referred to three autonomic measures which exhibited sympathetic type tendencies: high heart rate, high systolic blood pressure, and low salivery output. While these tendencies were more prevalent in neurotic groups than normal groups, they were often found in psychosomatic patients and those with operational fatigue.

Intercorrelations on physiological measures were at best reported to be low and frequently insignificant (49, 50). However, Martin (49) and Martin (50) have suggested this should not be considered a deterrent when one is interested in using physiological measures to assess anxiety. Martin (50) stressed that it was a matter of idiographic process as it was apparent that for one person a particular measure will be more sensitive than for another. This idiosyncrasy as it accounted for individualized response patterns was seen as gaining clarity as they were compared with behavioral and self-report measures (36, 46, 49, 50).

Many studies have separated subjects into high and low anxiety groups on the basis of experimentally induced anxiety (28, 40, 70, 71, 77). However, only a few studies

have made use of real-life stress situations. For example, Beam (2) studied anxiety in doctoral students prior to their oral examinations, and Basowitz, Persky, Korchin, and Grinker (1) studied the anxiety of opening night. Martin (49) proposed that these situations produced more authentic anxiety than that which is experimentally induced.

In studies using group comparisons, Krugman (35) and Goldstone (24) found that for flicker fusion, anxious subjects had a lower threshold for detection of the fusion than the non-anxious subjects. The lowering of a detection threshold is descriptive of anxiety neurotics who after having once made a detectional response proceed to detect more often and under increasing subtle stimulation (12, 22, 31, 39, 46, 58, 63, 79).

Several authors (46, 47, 58, 83) have proposed that the quality of performance is an inverted U-shaped function of the arousal level of anxiety. Up to a point on the inverted U, anxiety improved performance and impaired results afterward. The impairment of performance was due to the earlier and increasingly more sensitive anxiety response detections. In conjunction with the notion of increasingly sensitive detection responses, Lacey (36) found that once the heart experienced stimulation of the cardiac-accelerator nerves or even small amounts of epinephrine, it would demonstrate even more sensitivity to vagal stimulation. Research by

Lacey and Smith (39) established conditioned cardiac responses to the word cow and reported that subjects with high scores on a version of the Taylor Manifest Anxiety Scale showed increased generalization to other words of rural connotation.

The experience of anxiety does not have to be conscious to be conditioned and for generalization to take place as was evidenced by many researchers (16, 21, 31, 39, 79). The studies concluded that the person's labeling of a previously undifferentiated feeling was learned and the labeling occurred relevant to the physiological stimulation with increasing sensitivity.

Mandler (48) contended that autonomic perception by the individual was part of the anxiety complex. He concluded that those who reported more somatic stimulation on the MAS (75, 76, 77) and on the Autonomic Perception Questionnaire were higher in manifest anxiety.

Traditionally, both the assessment procedures and the theoretical formulations concerning anxiety have, for the greater part, been written about from a mentalistic framework. Freud (20) divided mind and body by assuming that people were conscious, or aware, unless there was a psychic force working to make them unconscious. This point of view treated anxiety as if the anxiety originated within the person and could therefore best be treated by a therapy which did provide insights into the problematic condition to gain conscious awareness.

However, by reconceptualizing anxiety responses as operant responses, the responses that were not conscious become conscious to a point of diminishing returns if the contingencies of reinforcement are not implemented. These responses as operants were amenable to manipulation by environmental means so that the treatment mode proceeded differently than it has historically. The condition felt as anxiety by the person could be modified by the employment of operant reinforcement techniques to cause a decrement in conscious anxiety detections by the person.

The relevancy of the presence of anxiety to concomitant physiological changes was noted in the literature as was the concept that anxiety responses were easily learned from the environment becoming at times strong covert determiners of behavior.

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CHAPTER III

METHODS AND PROCEDURES

Subjects

The population of potential subjects from which the ultimate selection was made were referred to the investigator for treatment of chronic anxiety by three area counseling centers during the first two months of 1974. These agencies were two independent outpatient counseling facilities, both located on the campus of a large university near a metroplex area, and a community-based mental health treatment center located in the same general urban complex. These referring agencies were requested to make known any persons who would be both eligible and willing to act as subjects for this study. The nature of the study was made known to the directors of the agencies. No attempt was made to control for the variables of sex and educational status, as they were not believed to be crucial to the presence of anxiety (4). Potential subjects for this experiment were screened for a measure of anxiety prior to the onset of the experiment. Screening information relevant to selection of appropriate subjects was obtained by utilizing the Taylor Manifest Anxiety Scale (MAS) (Appendix A).

Potential subjects were asked if they would be willing to participate in a study about thought behavior. If they indicated a willingness to participate, they were then evaluated as to eligibility by the selection standards. Selection standards required that subjects were between the ages of 16 and 55 and had scored between 23 and 36 on the MAS (9, 10). These requirements were established by referring to the norms established for the Taylor Manifest Anxiety Scale. The norms reflected that individuals with high anxiety would have a score no lower than 23. The subjects selected ranged in age from 18 to 35 years with a mean age of 24 years and a median age of 23 years. Of the subjects in this study there were seven females and three males with occupations as follows: special education teacher, journalist, secretary, gunsmith, student of political science, musician, and four college students. Fifteen subjects were screened in all, with five of those not meeting the criterion for inclusion in the study, i.e. they did not score sufficiently high on the MAS.

All subjects were tested on a college campus in a classroom building for pre- and post-physiological measures. The MAS, typically labeled the Biographical Inventory for presentation to subjects, was administered during screening and immediately following the post-physiological measures. Arrangements were made with each subject individually concerning the date, place, and time of the pre- and post-testing.

Raw data for subjects' monitored events and reinforcements are presented in Appendix B.

Description of the Instrument

The Taylor Manifest Anxiety Scale (MAS), a self-report questionnaire, was chosen to be the primary screening instrument for one measure of anxiety because it has been widely used and validated in a variety of studies (1, 3, 4, 10, 11). It consists of fifty items describing overt or manifest symptoms of anxiety. Originally, the items were those from the Minnesota Multiphasic Personality Inventory. The items were selected as the most discriminating items by comparing the scores for a group of normal individuals compared with a psychiatric group (10). The MAS is the same instrument that is titled Biographical Inventory for presentation to the subject (see Appendix A).

The normative characteristics of this scale were finally derived from 103 neurotic and psychotic persons, including both in and out patient subjects (10). Taylor's (10) research showed that the distribution of scores was highly skewed toward the low anxiety end of the scale for that group. The median score for the psychiatric patients was 34. This score was equal to the 98.8 percentile for normal subjects. It seemed apparent that the two groups were decidedly different.

The reliability and internal consistency of this scale has been established (1). Eriksen (3) has defended its clinical validity.

The literature is replete with studies on anxiety that have used the MAS as a self-report measure (2, 6, 7, 8). In this study, the MAS was used as a screening device for subject selection as well as for its value in comparison with its own post-measure and the possibility of covariance with the physiological measures.

Procedure for Collecting and Processing the Data

An experimental procedure was implemented which was conducted in six phases following the procedure for selection of subjects. There was differential treatment of experimental and control subjects. Each member of the control group participated equally in the study with the single exception of receiving reinforcement.

Pre-measure phase.--The subjects were instructed, prior to the physiological pre- and post-measures, to avoid the smoking of cigarettes and the drinking of coffee. Four hours was given as the appropriate time interval before the taking of the physiological measures. Additional instructions were that strenuous exercise should be avoided two hours before the measures were instituted.

Peripheral measure pre-test phase.--After the subject arrived at the experimental site, he/she was asked to rest for fifteen minutes before the physiological measures were begun. (These requirements were set in accordance with medical consultation with a licensed physician who directed one of the referring agencies.) The subject's heart rate was taken for thirty minutes following the fifteen-minute rest period. The mean heart rate, in beats per minute, was determined by averaging the number of beats per minute that occurred during the last fifteen minutes of the thirty-minute interval. The subject's blood pressure was taken six times during the thirty-minute interval with three readings being taken the first fifteen minutes and three readings the last fifteen minutes. The blood pressure readings averaged for use in the study were the three readings taken during the last fifteen minutes of the thirty-minute interval. In summary, there were two peripheral physiological pre-measures and one psychological test of anxiety. The pre-measures were (a) blood pressure, (b) heart rate, and (c) the MAS. The pre-measures data were recorded at the time of administration.

Data collection for anxiety detection phase.--After the pre-measures phase, the subjects were instructed as to the use of the blipper and counters (see Appendix C for description of blipper and counter) and given the definition of

anxious thoughts. The baseline phase was instituted the following day. At no time were the subjects told that they were in the baseline phase.

Baseline phase.--Subjects were instructed in a standard method of monitoring and recording the presence of anxious thoughts on a daily basis.

Monitoring.--The subjects carried a blipper with them at all times during their waking hours. This unit is an automatic tone device (see Appendix C) set for an approximate interval of four minutes. Simultaneously with the tone, the subject monitored (noted) the presence or nonpresence of anxious thought. The subject was told that a thought was to be counted as an anxious thought whenever the subject was aware that a physiological stimulation, such as heart rate or blood pressure, was occurring within the body. The covert statement which reflected the physiological stimulation would be such words as "I feel anxious" or "I am anxious."

Recording.--Each subject wore two counters. The subject recorded on one counter each occasion in which he heard the blipper tone. He then immediately recorded on the other counter the presence of an anxious thought only if, at the tone presentation, he was thinking an anxious thought. The subjects recorded and monitored during their waking hours

each day. The subjects were instructed to take the totals from each of the counters and make a daily record by putting the numbers on a 3x5 card upon which was indicated the two data categories. Subjects reported daily data either by phone or by reporting it directly to the experimenter. The two categories recorded were used to compute a daily percentage by dividing the frequency of anxious thoughts over the number of times the subject heard the blipper signal. The baseline phase continued for seven to ten days. This time span allowed for the detection of any incremental or decremental trend in data frequency. Since this time interval took in all the days of the week, it tended to reflect trends in individual patterns. The time interval also covered a large percentage of the subject's waking hours.

The contingency phase followed baseline. It was continued from fourteen to twenty-one days, sufficient time for any trends to become apparent and to show contrasts that might appear relative to the baseline.

Contingency phase.--Two frequency counts were kept by all subjects. The subjects, both contingency (experimental) group and control group, were instructed to monitor and record the frequency of the occasions they both heard the tone and detected the presence of an anxious thought. They were also to record the occasions during which they heard the tone in the absence of an anxious thought. The data for

this phase were to be collected as they were in the baseline phase. However, during the contingency phase the subjects in the experimental group were given monetary reinforcement contingent on making fewer detections of anxiety than during baseline. The frequency of thoughts present was tallied daily and the percent present derived. The percent nonpresence of the thought was plotted daily by the experimenter. For example, if on a particular day the percent present was 40 percent, the percent graphed would be 60 percent nonpresence. The individual received reinforcement for increasing the nondetection of thoughts.

Each subject earned monetary reinforcement for increasing the percentage of the nonpresence of anxious thoughts (that is, for making fewer detections). After determining the average percentage of non-anxious thoughts occurring during the baseline period, the remaining percentage was divided up into four quarters. That is to say, four equal parts of any size comprised the quarters. For the first week, the subject was paid $1.25 for each quarter or part quarter of anxious thought percentage that was eliminated relative to the baseline percentage. For example, if a subject at the end of the baseline phase had 60 percent nonanxious thoughts, the remaining nonanxious thought percentage, 40 percent, would be divided into four quarters of 10 percent each. If at the end of the first week of contingency reinforcement the

subject had increased his percent of nonanxious thoughts from 60 percent to 75 percent, he would be paid $2.50, since he had eliminated over one-quarter of his anxious thoughts. If he increased the nonanxious percentage to more than 90 percent, he would be paid the full $5.00. Nonanxious percentage of 100 percent would result in reinforcement times two, or $10.00. For the second week's activity the individual's percentage of nonanxious thoughts which remained at the end of the first week was likewise divided into quarters, and the monetary contingent reinforcement schedule was retained as for the first week. Thus if the subject raised his percentage of nonanxious thoughts from 60 percent to 75 percent during the first week, the remaining 25 percent was likewise divided into quarters for measuring and rewarding improvement, following the second week. At the termination of the contingency period, the post-measure phase was instituted.

Post-measure phase.--The post-measure phase instructions and procedure was a repetition of the pre-measure phase. It involved the peripheral measures of (a) blood pressure, (b) heart rate, and (c) the MAS. The post-measures data were recorded at the time of administration. At the conclusion of phase six of the study, the data were punched into cards for automatic data processing.

Procedure for Analysis of Data

The tenability of the hypotheses of this study was determined by parametric statistical analysis for both group and individual subject comparisons. The .10 level of confidence was used to accept the hypotheses.

Analysis of group data.--The analysis of group data involved the comparisons made, such as the comparisons between the pre- and post-measures of heart rate, blood pressure, and the MAS by *t*-tests for each group. Other comparisons looked for were those between the two groups, experimental and control. Another basis for group comparison was each group's percentage of anxious thought detections. This was done by the analysis of variance with repeated measures, each day being a repeated measure. An analysis of variance for split-plot designs was used to compare means and standard deviations on percent of anxious thoughts both across each data day for the groups and between the control and experimental groups. The thought detection data were expressed in percent of thought presence relative to the number of observations made (tones heard), as well as in raw data form. The analysis of covariance was utilized to compare the hypothesis of equal means between the pre- and post-measures' scores. These were the scores of heart rate, blood pressure, and the MAS. The post-test scores were the

same as the pre-test scores except in cases where treatment created differences.

Analysis of individual data.--Lastly, an analysis by time series design involved the identification of a proper statistical model for each subject. An analysis was made for each subject's data with that model. These data were treated as a series of observations that varied across time. This analysis revealed, for some, significant shifts in the data. The t-test was used to test for the significance of the intervention effect (5).

Summary.--Hypothesis 1, Hypothesis 2, and Hypothesis 3 were tested by the analysis of covariance and the analysis of variance using the split-plot design. Tests of t were also employed to test the significance of these hypotheses. In addition the data for each individual were analyzed by the time series design to gain causal inference by scanning for significant shifts of data points. The estimated intervention effect for a subject was the value of the t-statistics which determined if that statistic was significantly different from zero (5).

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CHAPTER IV

STATISTICAL ANALYSIS OF RESULTS AND DISCUSSION

The problem of this study was to analyze the effects of contingent reinforcement on the frequency of responses that indicate the presence of a state of anxiety. The purposes of the study were (1) to examine the relationship between the frequency of anxious thought detections and the frequencies of physiological indices presumably correlated with the clinical entity "anxiety," (2) to attempt to modify the frequency of anxious thought detections by contingent reinforcement, and (3) to analyze the effects of thought frequency on physiological measures associated with anxiety.

Ten subjects were utilized in this study. Five of the ten subjects were involved in a baseline phase and subsequent to this an experimental phase. The remaining five subjects comprised the control group; these subjects monitored thoughts for the duration of the study. Conditions were not altered. Unlike the experimental group, they did not undergo a contingency phase. A summary table for all individual subjects' recorded data of monitored observational events, along with the earned reinforcement for experimental subjects, can be found in Appendix B.

The discussion of the statistical analyses will proceed in the same sequence as the actual experiment. However, the summary of the statistical analyses will deal with two divisions, that for the group measures followed by the statistical analysis of the data for each individual subject using the time-series design. Within each division the hypotheses will be accepted or rejected.

A set of data from each subject's pre-baseline and post-test measures was compiled. Treatment of these data is shown in Tables I, II, III, IV, V, VI, VII, and VIII. The first four tables are the analyses of covariance for heart rate, systolic blood pressure, diastolic blood pressure, and MAS scores, respectively. The analysis of covariance of heart rate scores revealed an F ratio of 3.3864 and an associated p of .1083, a nonsignificant finding. Systolic blood pressure had an F ratio of .7581 and a p of .4128. Diastolic blood pressure analysis yielded an F ratio of 1.7991 and a p of .2217. The analysis of covariance for the MAS was also non-significant. The outcome was an F ratio of .0036 and a p of .9538. Tables V and VI show data for the t-tests on the pre-post measures.

Probability levels for the t-test for correlated means of the pre- and post-measures for each group, experimental and control and between groups, is presented in Tables V and VI. In the experimental group's pre-post comparisons all

TABLE I

ANALYSIS OF COVARIANCE OF HEART RATE MEASURES

Source	DF	Adjusted Sum of Squares	Mean Square	F	P
Total	8	434.5173			
Within	7	292.8455	41.8351		
Between	1	141.6719	141.6719	3.3864	0.1083

TABLE II

ANALYSIS OF COVARIANCE OF SYSTOLIC BLOOD PRESSURE MEASURES

Source	DF	Adjusted Sum of Squares	Mean Square	F	P
Total	8	334.6431			
Within	7	301.9443	43.1349		
Between	1	32.6987	32.6987	0.7581	0.4128

TABLE III

ANALYSIS OF COVARIANCE OF
DIASTOLIC BLOOD PRESSURE

Source	DF	Adjusted Sum of Squares	Mean Square	F	P
Total	8	786.9202			
Within	7	626.0264	89.4323		
Between	1	160.8938	160.8938	1.7991	0.2217

TABLE IV

ANALYSIS OF COVARIANCE OF
TMAS SCORES

Source	DF	Adjusted Sum of Squares	Mean Square	F	P
Total	8	39.0709			
Within	7	39.0509	5.5787		
Between	1	0.0201	0.0201	0.0036	0.9538

TABLE V

t-TEST FOR CORRELATED MEANS OF PRE- AND POST-MEASURES FOR EACH GROUP

Experimental Group			Control Group		
Variable	t	p	Variable	t	p
Heart Rate	4.111	.01	Heart Rate	1.363	.125
Systolic blood pressure	1.792	.10	Systolic blood pressure	.049	-
Diastolic blood pressure	3.208	.025	Diastolic blood pressure	.940	.200
TMAS	2.269	.05	TMAS	.452	-

TABLE VI

t-TEST FOR PRE-POST DIFFERENCES IN PERIPHERAL MEASURES BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Variable	t	p
Heart Rate	3.185	.01
Systolic Blood Pressure	1.770	.10
Diastolic Blood Pressure	1.518	.10
TMAS	.008	-

TABLE VII

t-TEST FOR PRE-POST DIFFERENCES IN ANXIOUS THOUGHT DETECTIONS FOR EACH GROUP

Experimental Group	Test		Control Group	Test	
Variable	t*	p	Variable	t**	p
Anxious thought detections	1.74	.10	Anxious thought detections	1.73	.10

*Values during experimental period were decreasing from baseline period. **Values during noncontingent period were increasing from baseline period.

TABLE VIII

t-TEST FOR BASELINE AND EXPERIMENTAL/NONCONTINGENT PHASE FOR ANXIOUS THOUGHT DETECTIONS BETWEEN EXPERIMENTAL AND CONTROL GROUP

Variable	t	p
Anxious thought detections	2.28	.05

levels of probability were significant. Heart rate had a p of .01; systolic p was .10. Diastolic blood pressure presented a p of .025 while the TMAS's probability level was .05. Conversely, the control group's pre- and post-measure comparisons (see Table V) revealed no significance. Heart rate, however, approached significance with a p of .125. In Table VI, a t-test for pre-post differences in peripheral measures between the two groups, shows three of the four peripheral measures as significant. The three measures of heart rate, systolic blood pressure, and diastolic blood pressure had probability levels of .01, .10, and .10 respectively. The MAS t score was not significant in the comparison.

Computational data for the analysis of variance for anxious thought detections are presented in Table IX, along with the degrees of freedom, sum of squares, and the mean-squares. The F ratio was .42470 for between groups with a p of .5328. The F ratio within the treatment groups was 1.0983 with a p of .3559. The interaction within contained an F of .7727 and an attending p of .7430. Table X presents means and standard deviations on repeated measures for an analysis of variance by the split-plot design. These data are pertinent to the percent presence for anxious thoughts for twenty-one observational days. These findings are related to a nonsignificant outcome in the percent of anxious thoughts between groups and within groups.

TABLE IX

ANALYSIS OF VARIANCE FOR THE PERCENT OF ANXIOUS THOUGHT DETECTIONS WITH EACH DAY AS A REPEATED MEASURE

Source	DF	Sum of Squares	MS	F	P
Between Subject	9	8.32006			
Between Groups	1	0.41942	0.41942	0.42470	0.53288
Error Between	8	7.90064	0.98758		
Within Subjects	200	5.47039			
A (Treatments)	20	0.60866	0.03043	1.09830	0.35592
AB (Interaction)	20	0.42827	0.02141	0.77279	0.74305
Error Within	160	4.43346	0.02771		
Total	209	13.79045			

TABLE X

GROUP MEANS AND STANDARD DEVIATIONS ON REPEATED MEASURES FOR ANALYSIS OF VARIANCE FOR PERCENT PRESENCE OF ANXIOUS THOUGHTS, SPLIT-PLOT DESIGN

Data Days	Means		Standard Deviations	
	Experimental Group Means	Control Group Means	Experimental Group Av. SD	Control Group Av. SD
1	.6016	.8034	.3359	.2194
2	.5852	.8078	.3388	.2440
3	.6288	.8458	.3057	.1823
4	.5608	.7374	.3665	.1830
5	.5150	.7444	.3491	.1964
6	.5702	.6812	.3723	.2122
7	.6516	.7415	.3335	.2278
8	.8102	.8404	.2024	.1142
9	.6740	.8126	.3742	.1449
10	.7318	.7646	.2927	.1864
11	.6810	.6658	.3744	.3145
12	.7630	.6916	.2134	.2394
13	.6236	.8170	.3461	.1936
14	.7434	.8076	.3471	.1815
15	.6492	.7220	.3211	.2406
16	.8248	.7884	.1828	.2069
17	.7218	.7766	.2403	.2363
18	.6246	.6724	.3840	.3114
19	.6928	.7486	.2523	.1971
20	.7888	.7396	.2480	.2017
21	.7242	.8248	.3473	.1947
Average	.6746	.7640	.3108	.2108

Additional data for anxious thought detection are shown in Tables VII and VIII. Tests of t for pre-post differences in thought detections for each group, experimental and control, were completed as the analysis of variance did not take the baseline into consideration. The anxious thought detection of t score for the experimental group was 1.74 with an attending p of .10. The values during the experimental period were decreasing from the baseline period. The anxious thought detections for the control group analysis revealed a t score of 1.73 and a p of .10. The values for the control group during the noncontingent period were increasing from the baseline period (see Table VII). The results shown on Table VIII were the outcome of a t-test for differences in baseline and experimental/noncontingent phase for anxious thought detections between the experimental and control groups. The t value was 2.28 and the p .05.

Hypothesis 1 was not consistently supported by the statistical findings. For Hypothesis 1 there was no conclusive and prevailing evidence across all analyses for differences between the groups relative to internal activity or the percent of anxious thought detections. Thus, the monitoring of thoughts had no concomitant effect on physiological measures and anxious thought frequency. The t-tests do not provide evidence in light of the outcome of the analysis of covariance. Hypothesis 2 was also rejected due to the

same lack of consistently significant findings. Thus, it can be concluded that reinforcement did not act to bring about a decrement in thought frequency as the analysis of variance revealed no significance. The t-test significance must be questioned due to the error rate that could have accumulated. Hypothesis 3 was not supported following an analysis of covariance as this test revealed no significant reduction of physiological responses. The t-test significance does not provide conclusive support for the hypothesis.

Mean values of heart rate are listed in Table XI in terms of beats per minute. This table contains the pre-test means and post-test adjusted means. Other autonomic measures taken prior to the baseline and during post-testing included systolic and diastolic blood pressure. The mean pressure readings were obtained separately for both systolic and diastolic blood pressure. These adjusted means are located in Table XII. The score differences relevant to the pre- and post-test data for the self report instrument (MAS) are listed in Table XIII. Each pre-measure mean of heart rate, systolic blood pressure, and diastolic blood pressure of the control group is less than is post-measure mean. The reverse is true in the experimental group. The control group's adjusted mean for diastolic blood pressure was 8.11 mm Hg greater than the adjusted mean for the experimental group. Systolic blood pressure for the control group was

TABLE XI

PRE-TEST MEANS AND POST-TEST ADJUSTED MEANS FOR HEART RATE

Experimental Group	Pre-Measure Mean	Post-Measure Mean	Adjusted Means
Heart Rate	88.94	79.82	76.4249
Control Group	Pre-Measure Mean	Post-Measure Mean	Adjusted Means
Heart Rate	79.98	82.42	85.8151

TABLE XII

PRE-TEST MEANS AND POST-TEST ADJUSTED MEANS FOR SYSTOLIC AND DIASTOLIC BLOOD PRESSURE

Experimental Group	Pre-Measure Mean	Post-Measure Mean	Adjusted Means
Systolic	114.20	108.00	107.89
Diastolic	73.40	69.80	71.43
Control Group	Pre-Measure Mean	Post-Measure Mean	Adjusted Means
Systolic	114.00	115.40	111.50
Diastolic	75.60	81.20	79.54

TABLE XIII

PRE-TEST MEANS AND POST-TEST ADJUSTED MEANS FOR TMAS

Experimental Group	Pre-Measure Mean	Post-Measure Mean	Adjusted Means
TMAS	29.40	27.20	25.8474
Control Group	Pre-Measure Mean	Post-Measure Mean	Adjusted Means
TMAS	25.20	24.60	25.9525

also greater than that for the experimental group by 3.61 mm Hg. The post-measure adjusted mean for the heart rate in the experimental group was on an average less by 9.39 beats per minute (see Table XI).

Inspection of the pre- and post-test measures for individual subjects, shown in Table XIV, revealed a decrease in heart rate beats per minute for each subject in the experimental group. To the contrary, four of the five subjects in the control group increased heart rate in beats per minute on the post-measure. Similarly, for the experimental group, systolic blood pressure decreased for all but one subject whose systolic pressure mean registered one mm Hg higher on the post-measure. A decrement in diastolic blood pressure was observed for all but one of the experimental subjects whose pre- and post-measures were identical. It should be noted that the control group contained those individuals of whom three out of five had higher systolic pressure on the post-test. There were also three out of five who had higher diastolic blood pressure on the post-test. Table XIV also shows that the experimental group's MAS scores were lower post-measure, again with the exception of one subject. It was noted also that there was an increase in the scores of the two control subjects demonstrating an additional point gained in the post-administration of the test. Three control subjects scored fewer points in the post-test of the MAS.

TABLE XIV

SUMMARY OF PRE- AND POST-TEST MEASURES FOR INDIVIDUAL SUBJECTS

Subject No.	Heart Rate		Blood Pressure		TMAS	
	Pre	Post	Pre	Post	Pre	Post
			Experimental			
1	100.1	88.6	114/68	90/68	24	22
2	91.7	84.4	95/62	86/55	36	31
3	82.6	80.9	133/81	130/78	32	30
4	75.7	60.9	111/75	107/71	26	23
5	94.6	84.5	118/81	119/77	29	30
			Control			
6	78.5	83.4	112/68	117/73	23	26
7	83.5	84.2	112/79	109/83	28	23
8	85.9	79.5	114/79	115/75	24	23
9	69.2	81.1	123/83	133/111	23	24
10	68.0	84.0	109/69	103/64	28	27

Although the group statistical analyses tended to evoke a rejection of all hypotheses, when the data trends of individuals were inspected, that inspection suggested further analyses should be undertaken. Accordingly, the data of individuals were subjected to the time-series analysis (4, 5, 6). A brief explanation of the time-series analysis is given in the following paragraphs.

In the conduction of a time-series experimental analysis, the initial "no treatment" condition was the baseline for the variable under observation. A series of daily observation data points (percent nonanxious thoughts) for each of the ten subjects across time were plotted and significance of intervention effects were noted for each person rather than in comparison with a control group (4). The effects of the intervention or treatment were made relative to an individualistic prediction model that was identified for each subject's data. As the effects of interventions may be ephemeral, steady, or variable over time, it was important to monitor the intervention as well as the outcome (dependent) variable. By analyzing each individual's data over time to derive a proper time-series model irregardless of group assignment, there was less chance of obscuring significant within-subject differences of the intervention effect (5).

Time-series analysis is, in essence, a procedure which helps select a statistical model for each subject's data and

determines the intervention effect for each subject (4). The identification of the model for the analysis was determined by three procedures. (1) The autoregressive process which regressed upon itself one time point (i.e., data point) in the past so that any point in time, or any daily percent of anxious thoughts, was predictable from previous observations. This procedure was used because it was felt that no data point was independent of the data points that preceded it. This dependence was used to forecast future values (4). Glass (4) notes that observations are often dependent or autocorrelated and are often dependent on what has preceded rather than independent of antecedent events. This autoregression is a correlation technique to determine if time is relevant to the variable in question or just random fluctuations in the data. (2) The order of differencing was a way of noticing whatever differences in the last period of time have occurred again and if these would dominate over time. (3) The order of the moving averages was concerned with data trends. These may be labeled as first-order or second-order averages. This procedure averaged the percentages, for example, of five consecutive days, dropped the earliest percent (first-order moving averages), and took five more days. A second-order moving averages model would have dropped the earlier two percents. This process measured trend over time, smoothing the time line. The t-test was used to decide if there was

any significant difference in the two trend lines (baseline and experimental) for the individual subject. Tests of significance for the intervention effects were completed for each of the ten subjects in the study (see Table XV). Graphs of each individual's daily percent of nonanxious thought are presented in Figures 1 through 10.

The first subject was identified as following a model which is referred to as a second-order moving averages in the first differences. This model is identified by a series of numbers: 0, 1, 2. In sequence, these numbers refer to the autoregression, the order of differencing, and the order of the moving averages (4). A t-test, with 29 degrees of freedom, was used for testing the significance of the intervention effect. The estimated intervention effect was 34.72, that is, the increase in percent nonpresence of anxious thoughts was 34.72 percent due to the treatment. The value of the t-statistic tested whether 34.72 percent was significantly different from zero. That t-test outcome was 3.08, which is highly significant with a p of less than .001.

Subject two assumed a first-order moving averages model (0, 0, 1) for the data analysis. The degrees of freedom for this design equal 29. The value of 50.304 is the value of the minimum error variance. At this point in the data, the estimated intervention effect, or level change, was 9.10 percentage points. The t-statistic was 2.81 which was significant as p was .01.

TABLE XV

SUMMARY TABLE FOR TIME-SERIES INTERVENTION ANALYSIS

Subject's Identification No.	Experimental Group	Control Group	Identification of Time Series Model		Error Variance	Significance of Intervention Effect	Level Change (% Increase in Nonanxious Thoughts)	P
			df					
1	x		29	0, 1, 2	153.7917	t = 3.08	34.72	.001
2	x		29	0, 0, 1	50.3038	t = 2.81	9.10	.01
3	x		26	0, 0, 1	323.5144	t = 1.09	10.00	.10
4	x		27	0, 0, 1	77.8900	t = 0.25	1.35	-
5	x		19	0, 1, 1	174.2073	t = 0.21	2.29	-
6		x	29	1, 1, 1	3.7544	t = -.38	-.71	-
7		x	29	0, 1, 1	12.2223	t = 0.33	1.13	-
8		x	29	0, 1, 1	1378.6057	t = -.38	-5.47	-
9		x	27	0, 0, 1	36.9909	t = 2.33	7.55	.05
10		x	29	0, 1, 1	117.1234	t = 1.96	20.33	.10

Subject: #1, Experimental Group

Blood Pressure	Heart Rate	TMAS
Pre = 114/68	Pre = 100.1	Pre = 24
Post = 98/68	Post = 88.6	Post = 22

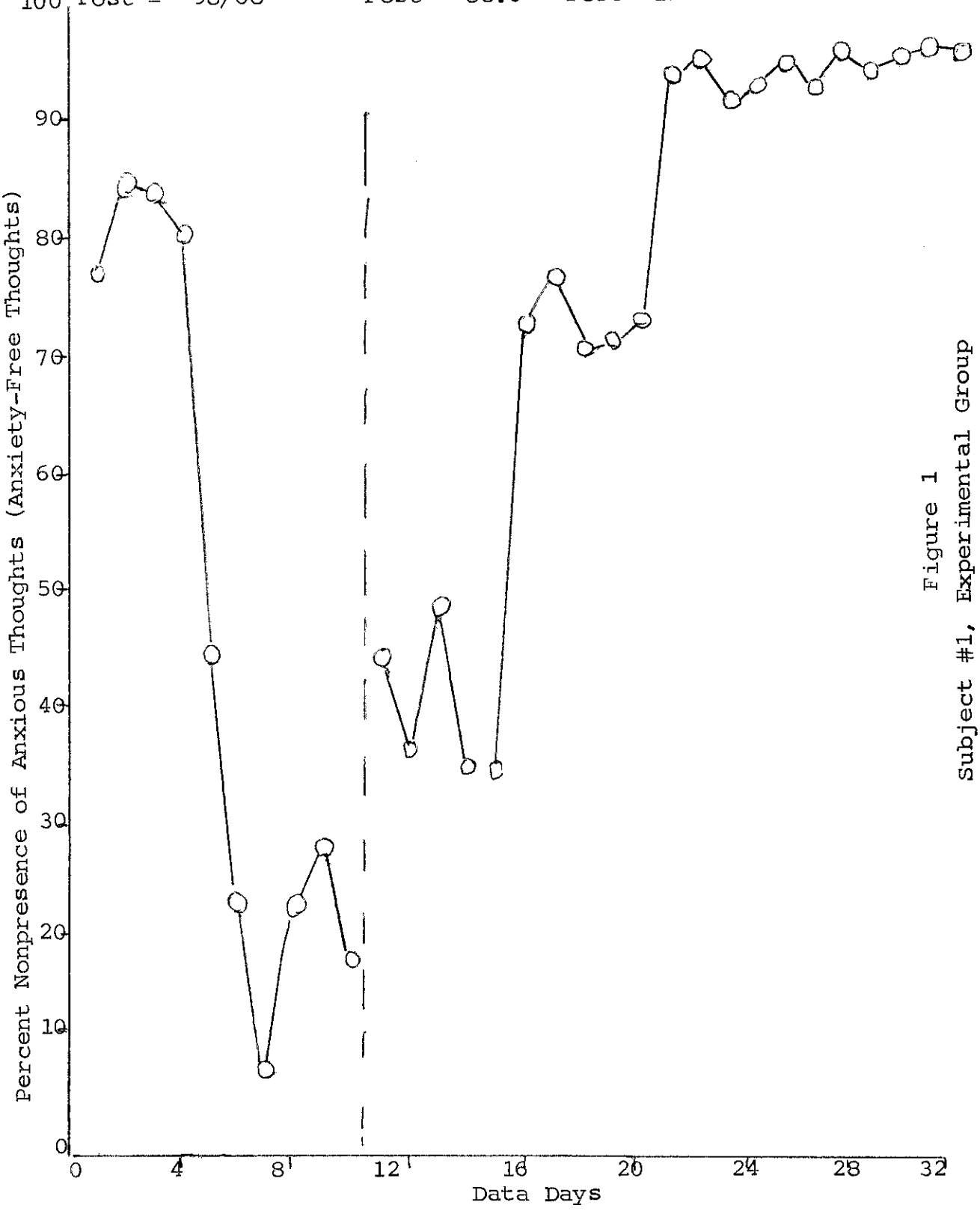

Figure 1

Subject #1, Experimental Group

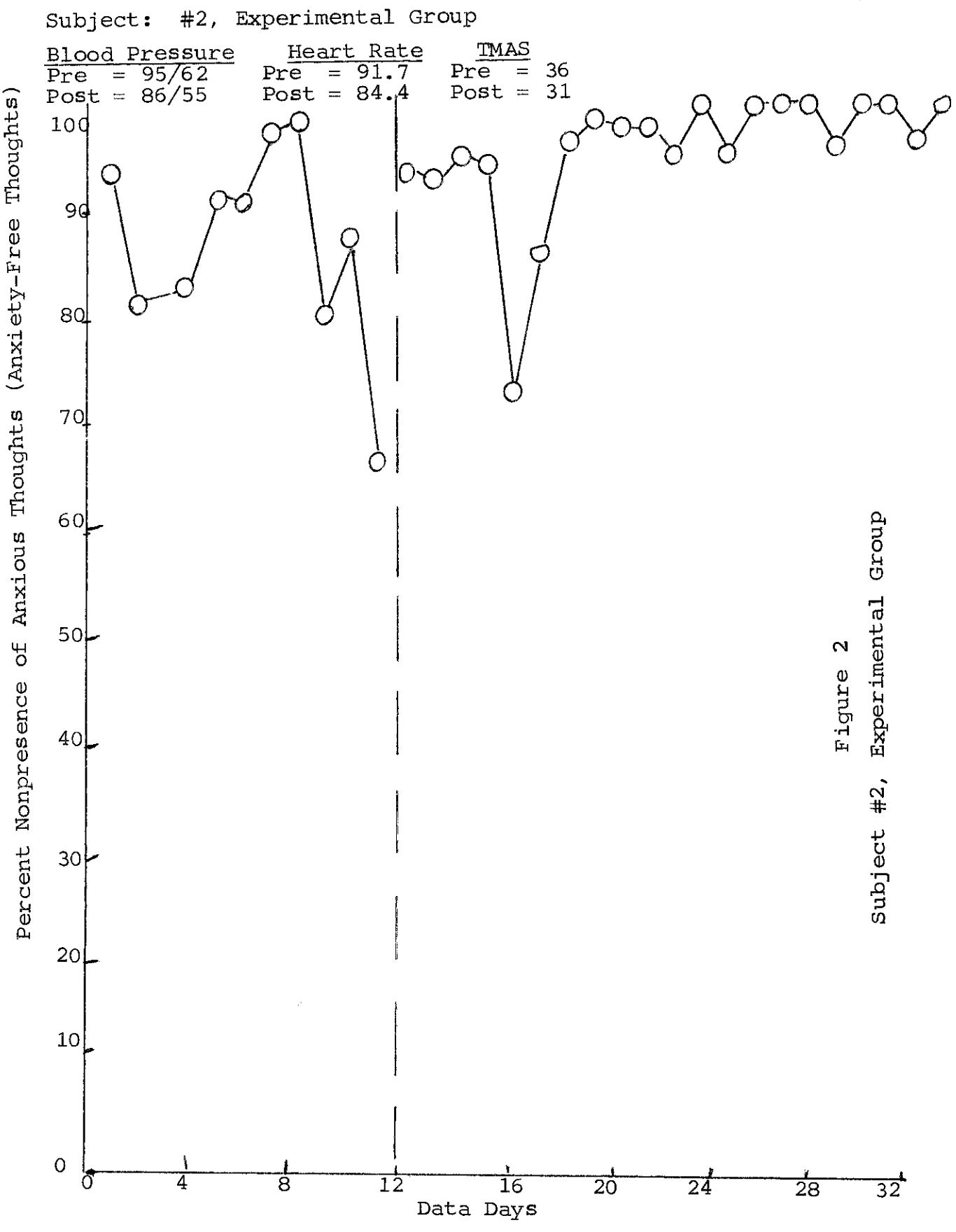

Figure 2

Subject #2, Experimental Group

Subject: #3--Experimental Group

Blood Pressure	Heart Rate	TMAS
Pre = 133/81	Pre = 82.6	Pre = 32
Post = 130/78	Post = 80.9	Post = 30

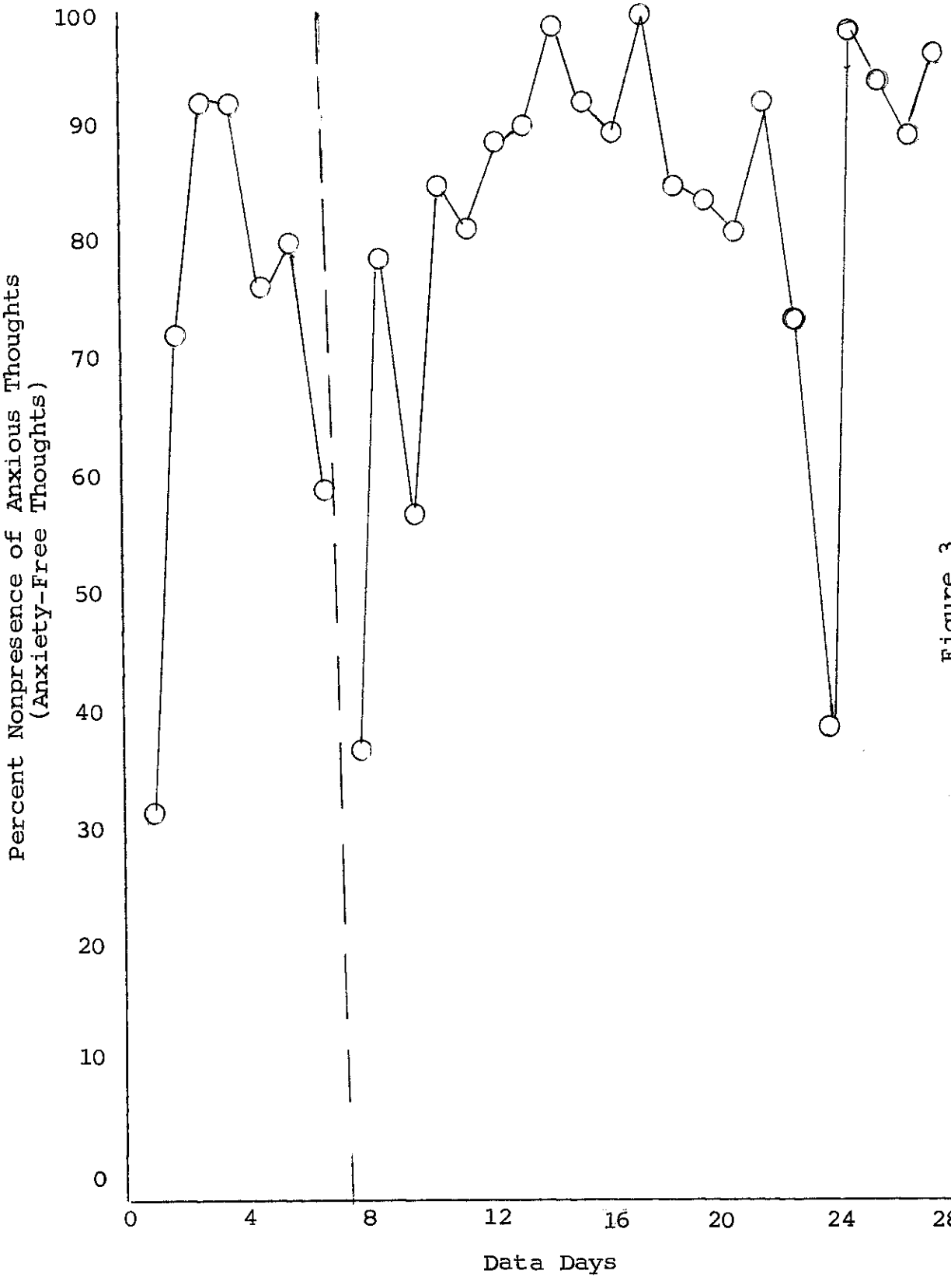

Figure 3
Subject #3, Experimental Group

Subject: #4--Experimental Group

Blood Pressure	Heart Rate	TMAS
Pre =111/75	Pre = 75.7	Pre = 26
Post =107/71	Post = 60.9	Post = 23

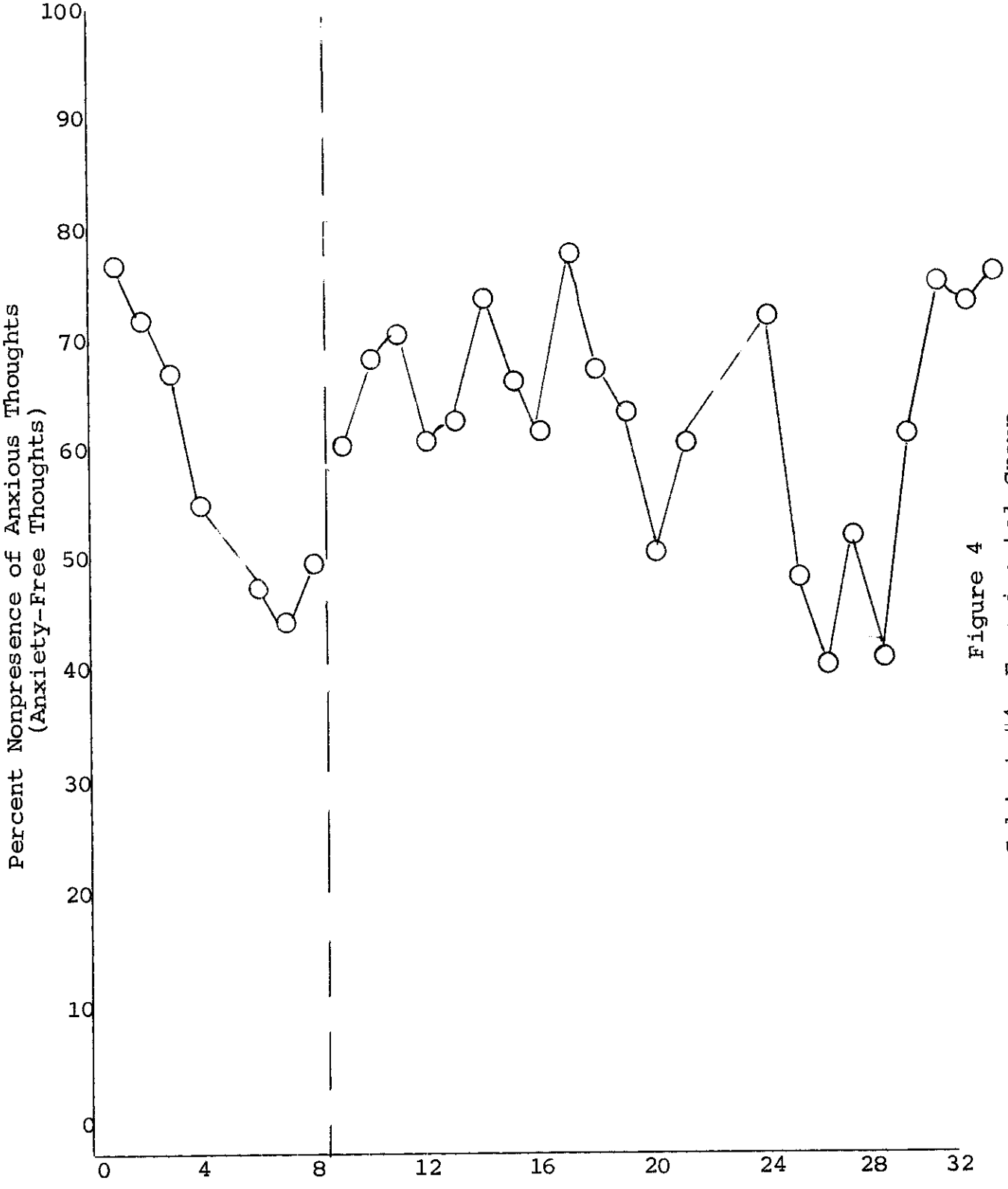

Figure 4
Subject #4, Experimental Group

Subject: #5, Experimental Group

Blood Pressure	Heart Rate	TMAS
Pre = 118/81	Pre = 94.6	Pre = 29
Post = 119/77	Post = 84.5	Post = 30

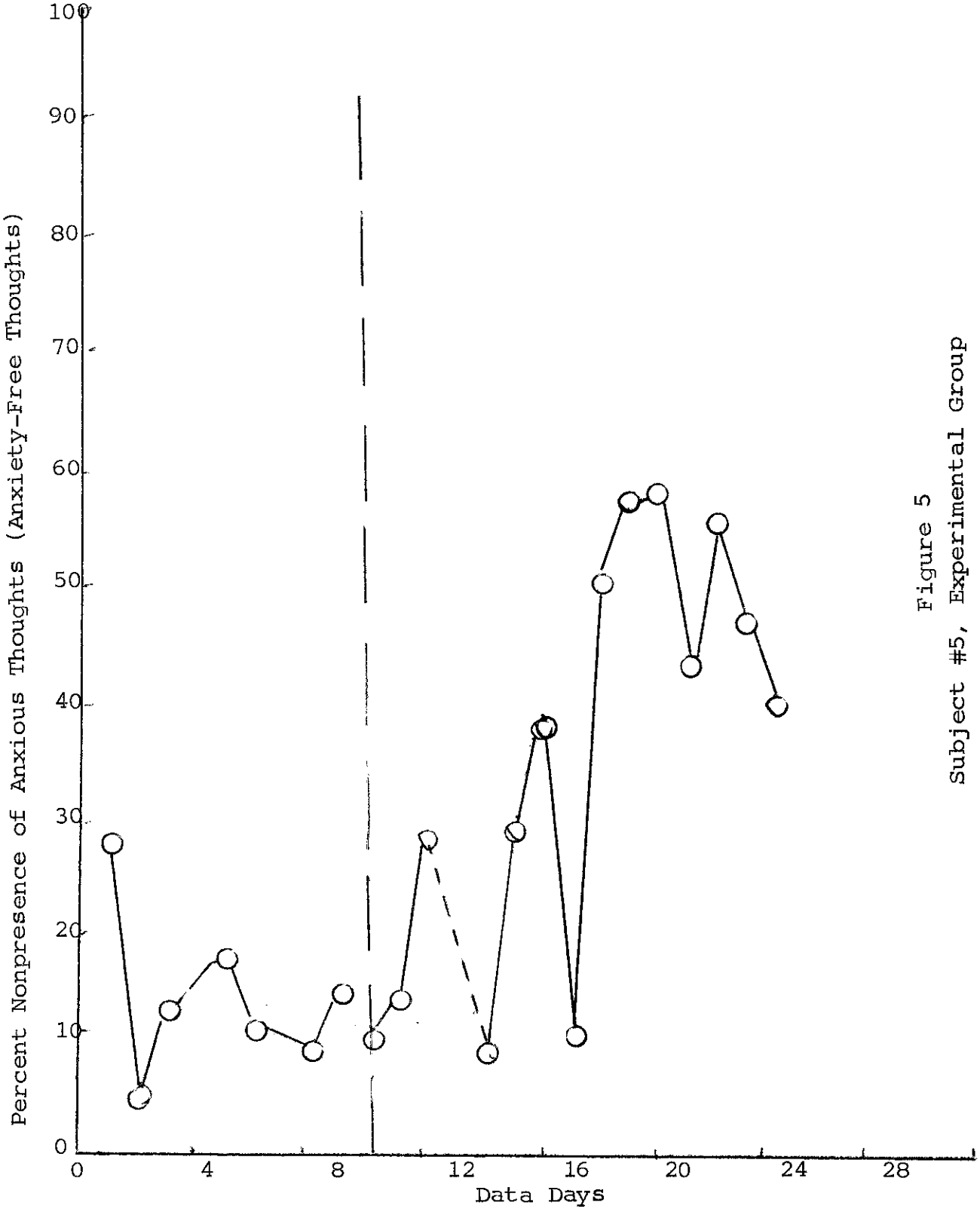

Figure 5
Subject #5, Experimental Group

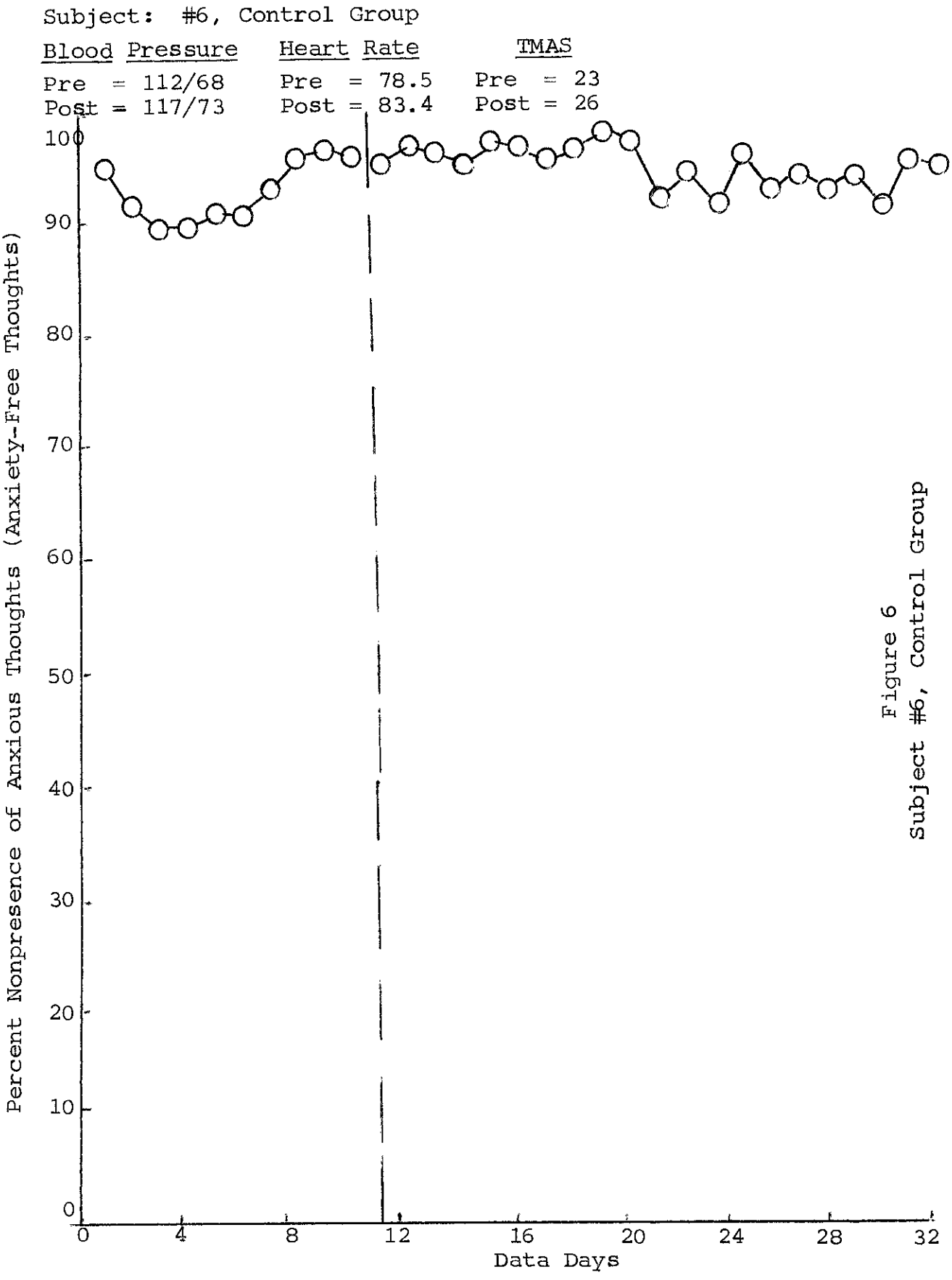

Figure 6
Subject #6, Control Group

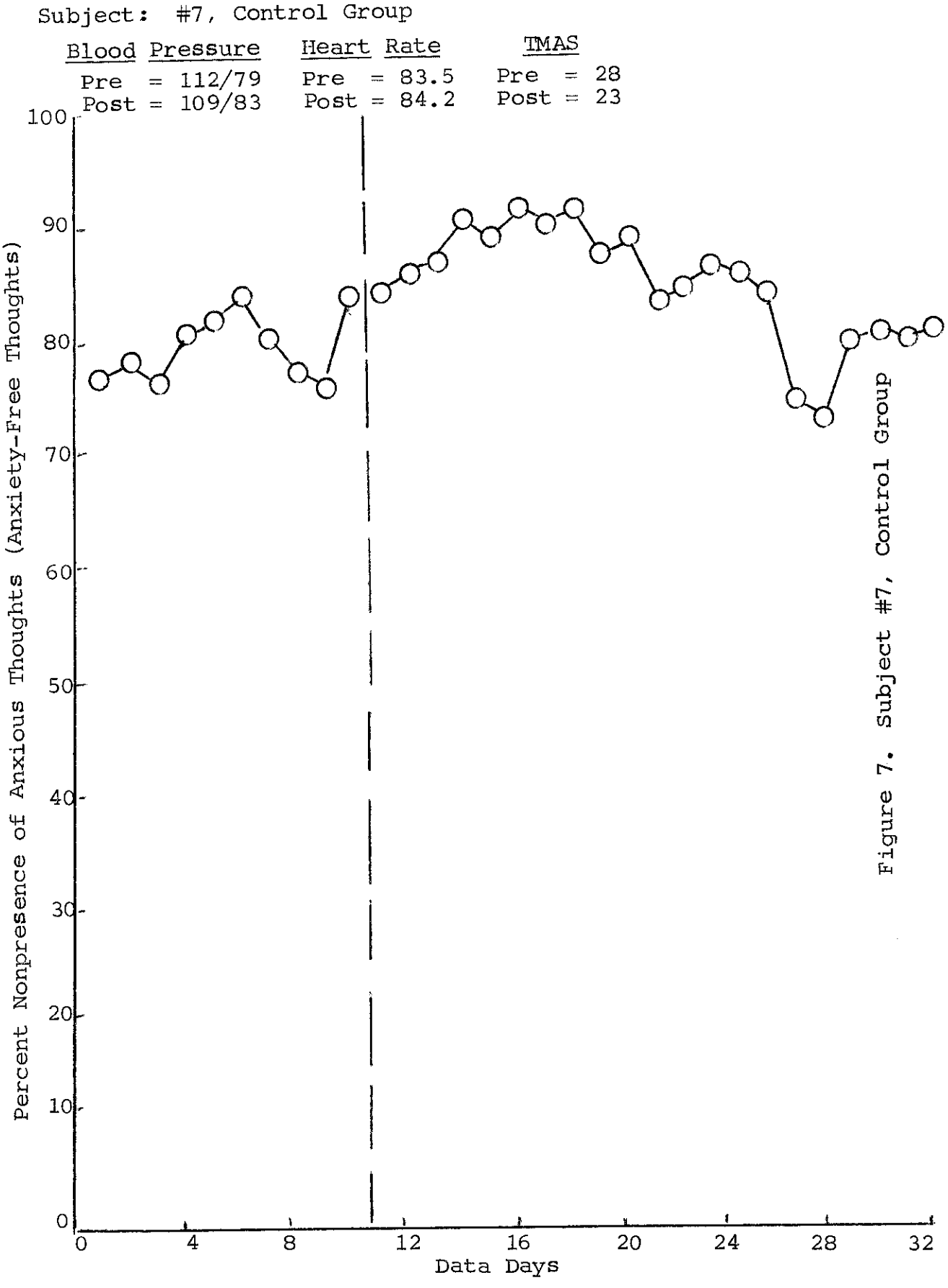

Figure 7. Subject #7, Control Group

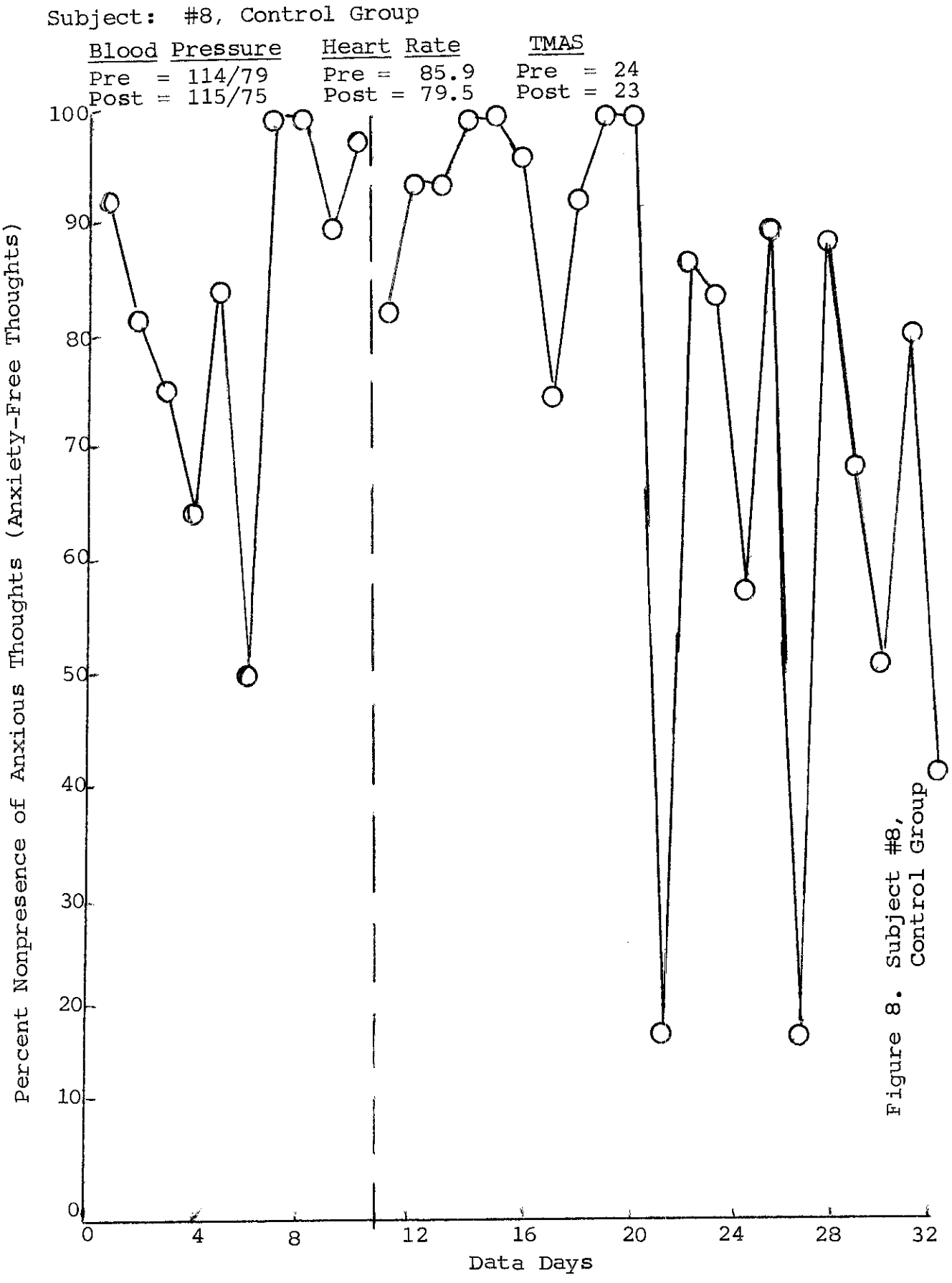

Figure 8. Subject #8, Control Group

Subject: #9, Control Group

Blood Pressure	Heart Rate	TMAS
Pre = 123/83	Pre = 69.2	Pre = 23
Post = 133/111	Post = 81.1	Post = 24

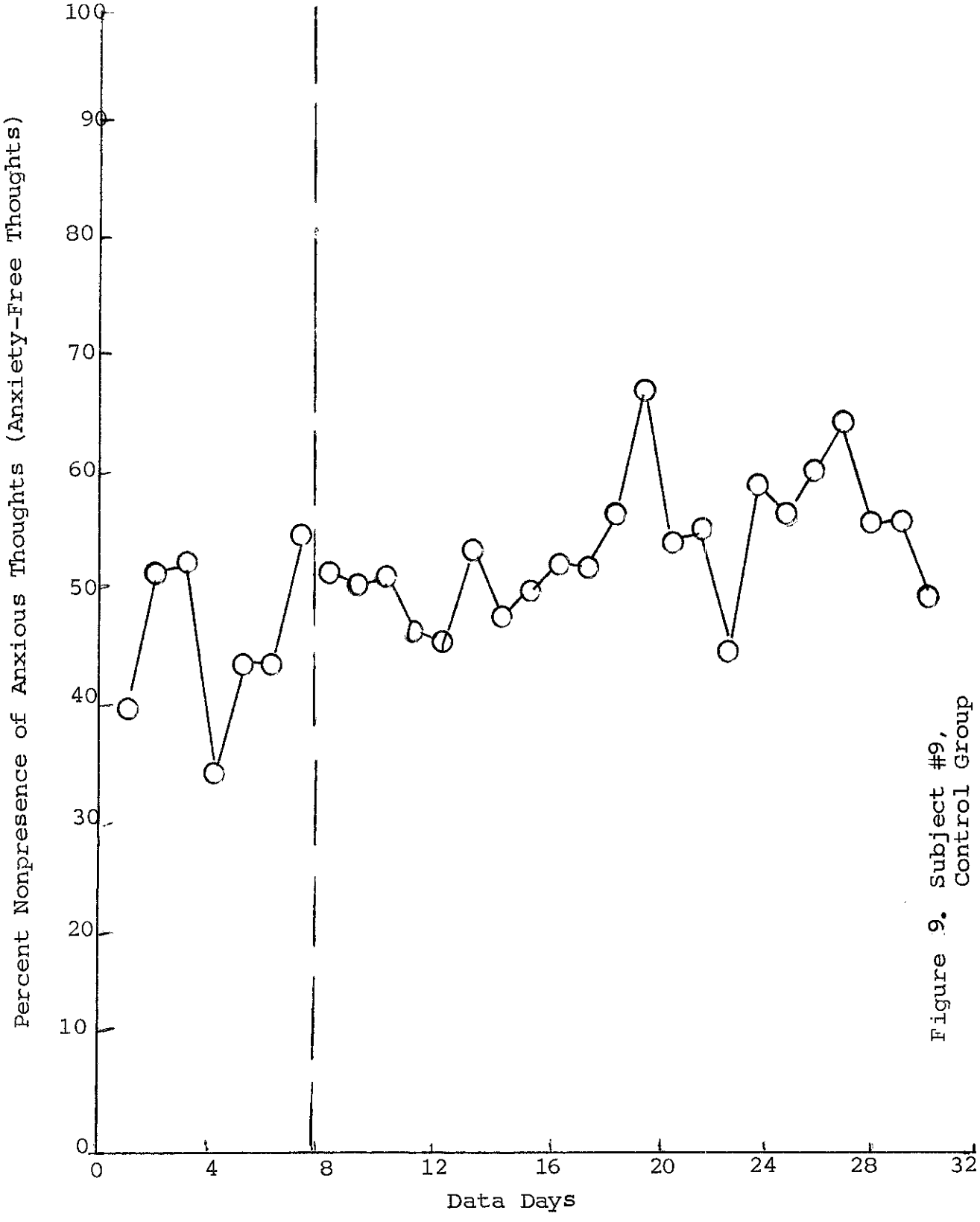

Figure 9. Subject #9, Control Group

Subject: #10--Control Group

Blood Pressure	Heart Rate	TMAS
Pre = 109/69	Pre = 68	Pre = 28
Post = 103/64	Post = 84	Post = 27

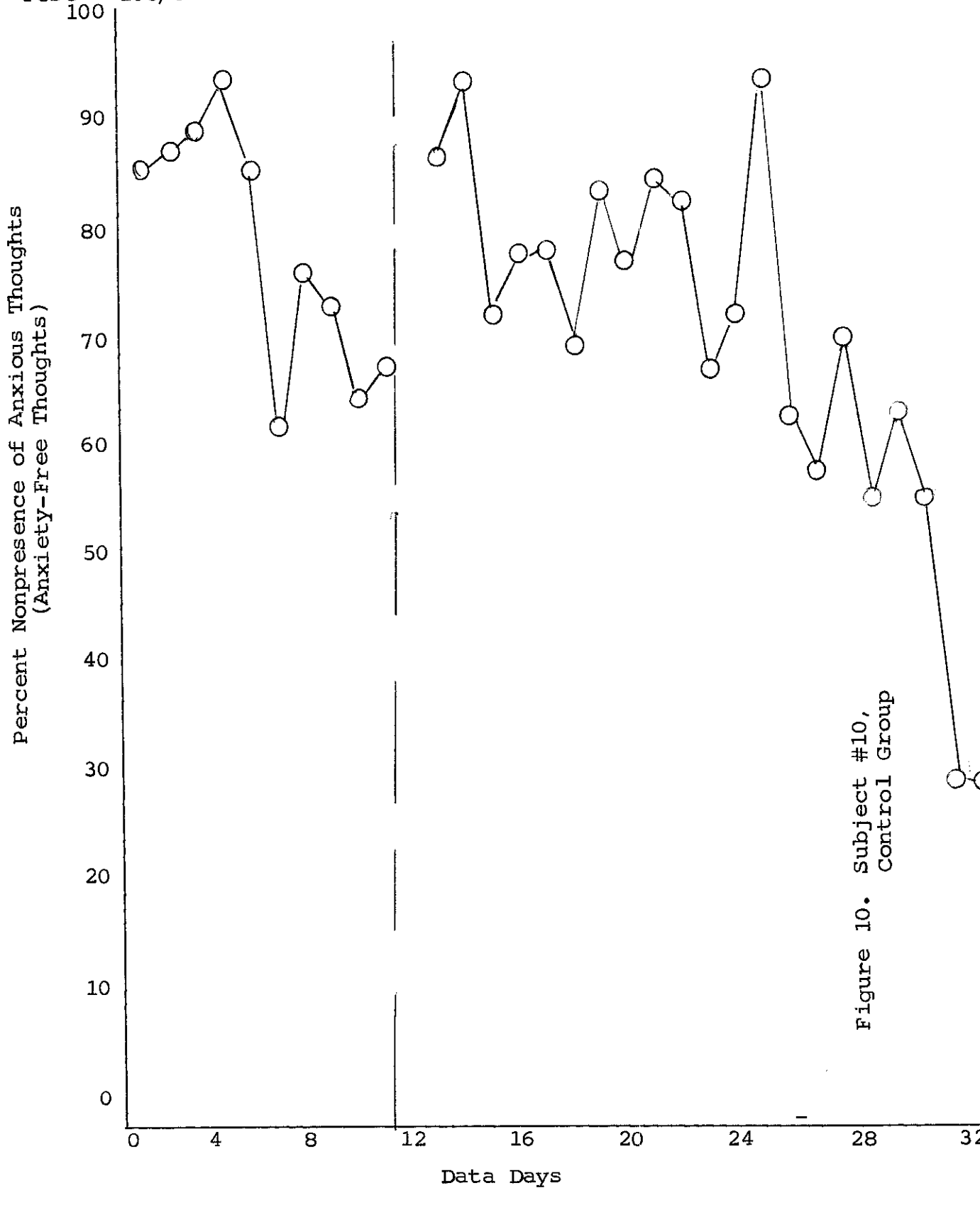

Figure 10. Subject #10, Control Group

The third subject in the experimental group showed 26 degrees of freedom for a first-order moving averages model (0, 0, 1). This analysis showed the intervention effect to be at 1.09 percent. The maximum error variance was 323.5144. The $\underline{t}$-test was equal to 2.81 with a significant p of .01.

The fourth subject had a minimum error variance of 77.8900 with an increase in percent nonpresence of anxious thoughts of 1.35 percent. The value of the $\underline{t}$-statistic for determining if 1.35 percent was significantly different was not significantly different from zero at .25.

For the fifth and final subject in the experimental group, the model 0, 1, 1 was identified. There were 19 degrees of freedom for this design. This model was categorized by Glass, Willson, and Gottman (4) as a nonstationary model with a minimum error variance valued at 174.207, a percentage increase in nonanxious thoughts of 2.29 percent. The $\underline{t}$-statistic was .21. The value of $\underline{t}$ was nonsignificant.

In the control group the subject numbered six carries a model identification series of 1, 1, 1. This data had a minimum error variance of 3.7544, a nonsignificant $\underline{t}$ of -.38. This showed a change level in percent increase of nonanxious thoughts of -.71 percent.

The seventh subject also presented nonsignificant treatment effects with the model for this series being 0, 1, 1. The level change was 1.13 percent with $\underline{t}$-statistic equalling .33.

The eighth subject was identified as having a model of 0, 1, 1. The error variance was 1378.6057. The $\underline{t}$-statistic was -.38 with the intervention effect being nonsignificant.

Subject nine, a member of the control group, presented puzzling data with the $\underline{t} = 2.33$ making this individual significantly influenced by the treatment with a p of $< .05$. There was a level change representing the increase of non-anxious thoughts by 7.55 percent due to the intervention.

The tenth and last subject's test of significance for intervention effects was significant at the .10 level, having a $\underline{t}$-statistic of 1.96. The model assumed was 0, 1, 1. The error variance was 17.1234. The increase in percent non-presence of anxious thoughts was 20.33 percent due to the treatment effects.

On the basis of the analysis by the time-series design for determining the significance of the treatment effect on individual percent of anxious thoughts, the second hypothesis (concerned with the hypothesized effects of reinforcement on thought frequency) found no overall trend to support it.

Experimental subjects 1, 2, and 3 made significant shifts in percentage of anxious thoughts. The values were decreasing from the baseline. This was not the case for subjects 4 and 5, although subject 5 does appear upon visual inspection to be "moving" to support Hypothesis 2. Subjects 6 through 10 comprised the control group and as such did not

receive contingent reinforcement. Two members of this group, however, made significant decreases in percent anxious thoughts. Thus, Hypothesis 2 received only partial support. As partial evidence is not tenable, the hypothesis was rejected on the basis of the time-series analysis.

In summary, some of the following critical questions were asked and, following statistical analysis, were answered in the negative.

1. Did the groups differ from one another in terms of physiological reduction of heart rate and blood pressure? (The analysis of covariance revealed no differences between the groups.)

2. Did the groups differ on their pre-post measures in terms of the physiological measures? (The analysis of covariance demonstrated no differences prevailed between the groups.)

3. Did the groups differ from each other in terms of thoughts being contingent on reinforcement? (The analysis of variance for repeated measure for percent of anxious thoughts did not reveal significant differences between the groups. The time-series analysis was not conclusive.)

4. Did the groups differ on the pre-post percentage of anxious thoughts? (The analysis of variance for repeated measures did not reveal significant differences within the groups.)

In the foregoing, an operant analysis of the data (14, 17) revealed significant intervention effects for three subjects in the experimental group and for two subjects in the control group. To the contrary, the analysis by group measures obscured the significance found for five individuals in the study. It could be that even when traditional comparative studies are applicable utilizing randomization (8, 14, 18) that the time-series design can provide unique feedback on effects of intervention (1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 15, 16). As a person has no set time to sow and reap, it is valuable to analyze behavior across time to determine if the effect is immediate, delayed, increasing, or subsiding, and at what points one can note significant shifts or fluctuations which are predictors of fluctuations of another variable or series (13, 16).

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CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purposes of the study were (1) to examine the relationship between the frequency of the detection of "anxious" thoughts and the physiological manifestation of "anxiety," (2) to attempt the modification of the frequency of anxious thought detection by contingent reinforcement, and (3) to analyze the effects of anxious thought frequency on the physiological measures associated with anxiety.

Ten subjects were employed in the study. Seven of these were female and three were male. The experimental group contained three males and two females. Prior to subject selection, the numbers one through ten were randomly assigned to the two groups, experimental and control, with the first number drawn being placed in the experimental group and the second in the control group. Number placement alternated between the groups until all subjects were placed in one of two groups. Each of the ten subjects met the age criterion (between 16 and 55 years) and had scored between 23 and 36 on the MAS. Following a session in which average heart rate and blood pressure measures were obtained, subjects counted the number of anxious thoughts on a daily

basis for the duration of the study. At the end of the thought monitoring period, the subjects' heart rate and blood pressure and response to the TMAS were again monitored, allowing for pre-treatment, post-treatment comparisons of these measures.

The following four critical comparisons were made by data analysis: (1) an analysis of covariance was conducted on pre- and post-physiological measures to test for significance in the hypothesized differences in the reduction of physiological indices within and between the groups, (2) an analysis of variance for repeated measures compared each group's anxious thought percentage, and, in addition, (3) any difference between the groups for thought frequency which was hypothesized to be contingent on reinforcement, and (4) the time-series analysis compared each subject as his own control in the reduction of anxious thoughts. The .10 level of confidence was employed as a statistical criterion.

Hypothesis 1 predicted that the monitoring of anxiety detection responses would produce a concomitant increase in the physiological activity associated with anxiety and anxious thought detection frequency. An analysis of covariance was conducted which related the level of autonomic activity before and after the experimental procedure to anxious thought detection. No significant F ratios were

forthcoming, indicating that the monitoring of anxious thoughts did not serve as a stimulus to increase internal or autonomic activity at a level discovered by the measures employed. The analysis of variance which employed days of experimental thought detection as a repeated measure also was not significant. In other words, according to the analysis of variance, the monitoring of anxious thoughts did not serve to increase anxious thought detection significantly.

Hypothesis 2 predicted that there would be a significant decrease in the percentage of anxious thoughts contingent upon reinforcement. Statistical treatment by analysis of variance revealed no significance, indicating that reinforcement did not produce a decrement in thought frequency. Neither was hypothesis 2 supported by the time-series analysis for within subject significance for percent of anxious thought. According to this test three of the five subjects in the experimental group showed significant shifts. However, since significant shifts were also found in the data of two members of the control group, these results cannot be construed to support the hypothesis.

Hypothesis 3 predicted that reducing the frequency of anxious thoughts would decrease the physiological responses associated with the phenomenon of anxiety and its conscious experience. The analysis of covariance did not reveal

significant reduction in the physiological responses or the MAS scores in either of the two groups. A t-test conducted on pre-post measures did support the hypothesis when each group's average baseline period (pre-test) was compared to its average experimental period (post-test). It cannot be concluded that this test provides conclusive support for this hypothesis, since the results of the analysis of covariance did not support the hypothesis. Support was, in addition, not forthcoming from the analysis of variance for repeated measures for anxious thought detection.

In summary, the findings of this research were as follows:

1. The subjects reflected no significant increases in physiological stimulation when anxious thoughts were monitored as the groups did not differ on the pre-post measures or within the groups, nor the between group physiological measures in the analysis of covariance.

2. The subjects did not demonstrate significantly lower percentages of anxious thought frequencies when reinforcement was made contingent on thought detection decrement. This was revealed by lack of differences for significance within and between the groups for the analysis of variance.

3. The subjects failed to show significant decreases in physiological stimulation when reinforcement was made contingent on thought decrement. This finding was demonstrated in the analysis of covariance within and between the groups.

4. When individual subject anxious thought data were analyzed, three of the experimental group's subjects reflected significant shifts over the experimental time period with a decrease in the daily occurrence of anxious thoughts. The frequency of the anxious thoughts of those subjects in the experimental group who did not demonstrate significant shifts, according to the time-series analysis, do show trends when the graphs are inspected. Their data evidenced a decrement in the frequency of anxious thoughts over days. In addition two of the subjects in the control group also showed significant shifts in the daily occurrence of anxious thoughts.

5. Observations of the graphed data show a decrease in the frequency of anxious thoughts on the first day of the experimental period for those subjects in the experimental group. This decrease always occurred within two days of the beginning of the experimental period. For the most part, the frequency graphs (Figures 7 to 11) for the control subjects did not show any such consistent decrease at that time.

6. Baseline periods reflected varying patterns. Nevertheless, some consistency was evident as half of the subjects increased their percentage of anxious thoughts while the remainder tended to decrease the frequency of anxious detections.

These findings are discussed and presented in the conclusion section, in light of the general areas--the operant paradigm, other research studies, and autonomic arousal in general.

Conclusions

The following conclusions were drawn from the findings in the study. Two divisions will be made with findings from the statistical analysis. Group comparisons form one section and the findings of the analysis for individual data form another section.

Group comparisons.--Although not statistically significant, the mean heart rate and blood pressure of the experimental subjects was lower following the experimental period. The control subjects' mean data showed increases in heart rate and blood pressure, but the increases were not significantly different from the experimental group. It can be concluded there were no consistent significant differences found between the groups relative to the percent of anxious thoughts or the physiological indices of anxiety.

Individual analysis by time-series.--This study gives no evidence that reinforcement either by itself or in

conjunction with monitoring had an effect on individual thought frequency.

Informal observational trends.--In addition to the findings and conclusions presented above, several tendencies or trends were observed in the plotted data of individuals which proved to be interesting.

By a simple inspection of Figures 1 through 10 (see pages 75-84) there are revealed some characteristics of the graphs for individuals. For example, subject 1 may have been experiencing some uncertainty as to how to monitor thoughts during the baseline period. The initial rates are much too high for a daily period. The data were set forth in the study as they seemed essential to the accurate recording of data as they were reported by the subject. Subject 2 has data which achieve a reduction in the variability after the sixteenth day. Subject 3 had an exceptionally anxious day on the twenty-fourth day of monitoring compared to the majority of the data points. Subject 4 initially demonstrated marked variability which became attenuated as monitoring progressed. Subject 5 had fewer anxiety free thoughts than the other subjects, but this subject did achieve an upward trend in the middle of the experimental period. There was less variability in general in the control group (with the exception of subject 8), although greatly increasing and decreasing monotonic trends were seen in the data of some subjects.

When commenting on the variability and/or stability of any one subject's daily rates of anxiety-free thoughts, it would be appropriate to say that, in general, observations that take place over time are characteristically variable and do not often attain perfect stability. The rates generally fluctuate from day to day. Behavioral measures are rarely absolutely stable. Any measure of behavior can range from total consistency or stability to extremely wide variability. Variability in the subjects' daily rates could be explained by the differences that exist in the stimulus conditions from one day to the next day. (The stimulus conditions involve the general setting, the antecedent events, and the consequences of the behavior.) In that way, events occur which may cause the rate on one day to be different from that on another. These differences in conditions could certainly exist not only within subjects but also between subjects. Thus, similarity in stimulus conditions would produce daily rates with less variability than those conditions which are highly discrepant between or within data days. To the contrary, when stimulus conditions vary the measure of that behavior will reflect the variability.

Recommendations

The following are recommendations which are for further research based upon the findings and conclusions of this study.

1. It might be beneficial to explore the differential effect of monitoring presence versus absence of anxious thoughts employing the same time sampling technique as used in this study. One group could count the presence and another group the absence of anxiety. Reinforcement could be made contingent in one group for lower percentage of thoughts (presence group) and the other group for a higher percentage (absence group).

2. Research could be designed to study the cultural practices whereby behavior becomes labeled as anxious. The phenomenon as it occurs in children (how they first learn it) as well as the effects of labeling on adult subjects would be extremely instructive for preventive therapy.

3. There needs to be an evaluation of money as a reinforcer. Individuals differ in their motivation according to the value, to them, of the amount of money they would have a chance to earn. It would be appropriate to determine the sum of money that would act as a reinforcer for each subject and individualize payment. An assessment of other things that could act as probable reinforcers could also be undertaken.

4. It is recommended that the subjects be asked if they have any prior knowledge about the outcomes of wearing wrist counters. The two subjects in the control group who indicated therapeutic intervention effectiveness by the

t-statistic had worn counters before to modify behavior in a positive direction.

5. It would be important to study the effects of conjugated schedules of reinforcement as it affects the detection rate increase or decrease.

6. A contractual agreement between the client and the experimenter or therapist could serve to structure hours monitored daily and the number of weeks that data would be taken.

7. The effects of monitoring on thought detection frequency needs to be studied to determine if that activity alone would be responsible for the significant findings for individual subjects.

8. A study could be conducted which included a follow-up study to assess the permanence of the effects of thought monitoring for any individual subject who demonstrated a significant shift as determined by the time-series analysis.

9. It is recommended that the point of diminishing returns for detecting anxiety be established on an individual basis. Bio-feedback devices, which could be carried on the person, could be developed as an aid in maintaining an optimal level of autonomic stimulation as the person goes about his daily activities.

10. Similar studies could test the therapeutic strategy with clinically presented cases of depressive thinking,

suicidal fantasizing, self-critical statements which have no basis in reality, and other forms of counterindicated responses.

11. The reliability of the physiological measures could be improved by having them conducted in a medical clinic or research setting where medical personnel could provide reliability checks.

12. A study could be designed to overcome the methodological weaknesses of this study by (a) utilizing external monitoring devices to detect the associated "skeletal" and "visceral" responses related to covert statements to determine the occurrence of an anxious thought rather than relying on the subject's self report, (b) improving the reliability of the physiological measures by the method suggested in number 11 above, and (c) utilizing either an N of one with a baseline, experimental phase, reversal to baseline design, or utilizing a larger N for future research.

APPENDIXES

APPENDIX A

TAYLOR MANIFEST ANXIETY SCALE

BIOGRAPHICAL INVENTORY

Name:

Age:

Sex:

Answer the following questions True or False by placing T or F in front of the item number.

1. I do not tire quickly.
2. I am often sick to my stomach.
3. I am about as nervous as other people.
4. I have very few headaches.
5. I work under a great deal of strain.
6. I cannot keep my mind on one thing.
7. I worry over money and business.
8. I frequently notice my hand shakes when I try to do something.
9. I blush as often as others.
10. I have diarrhea once a month or more.
11. I worry quite a bit over possible troubles.
12. I practically never blush.
13. I am often afraid that I am going to blush.
14. I have nightmares every few nights.

15. My hands and feet are usually warm enough.

16. I sweat very easily even on cool days.

17. When embarrassed I often break out in a sweat which is very annoying.

18. I do not often notice my heart pounding and I am seldom short of breath.

19. I feel hungry almost all the time.

20. Often my bowels don't move for several days at a time.

21. I have a great deal of stomach trouble.

22. At times I lose sleep over worry.

23. My sleep is restless and disturbed.

24. I often dream about things I don't like to tell other people.

25. I am easily embarrassed.

26. My feelings are hurt easier than those of most people.

27. I often find myself worrying about something.

28. I wish I could be as happy as others.

29. I am usually calm and not easily upset.

30. I cry easily.

31. I feel anxious about something or someone almost all the time.

32. I am happy most of the time.

33. It makes me nervous to have to wait.

34. At times I am so restless that I cannot sit in a chair for very long.

35. Sometimes I become so excited that I find it hard to get to sleep.

36. I have often felt that I faced so many difficulties I could not overcome them.

37. At times I have been worried beyond reason about something that really did not matter.

38. I do not have as many fears as my friends.

39. I have been afraid of things or people that I know could not hurt me.

40. I certainly feel useless at times.

41. I find it hard to keep my mind on a task or job.

42. I am more self-conscious than most people.

43. I am the kind of person who takes things hard.

44. I am a very nervous person.

45. Life is often a strain for me.

46. I am not at all confident of myself.

47. At times I feel that I am going to crack up.

48. I don't like to face a difficulty or make an important decision.

49. I am very confident of myself.

50. I do not smoke.

APPENDIX B

INDIVIDUAL SUBJECTS' RECORDED DATA

OF MONITORED EVENTS

AND

DETERMINATION OF EARNED REINFORCEMENT

SUBJECT 1, EXPERIMENTAL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts	Phase	Average % Nonanxious Thought	# Qtrs. Improve-ment	Amt. Earned
1	751	176	23.4	76.6	Baseline			
2	774	120	15.5	84.5	"			
3	836	137	16.3	83.7	"			
4	753	150	19.9	80.1	"			
5	73	41	56.1	43.9	"			
6	900	700	77.7	22.3	"			
7	840	773	92.3	7.7	"			
8	682	531	77.8	22.2	"			
9	438	319	72.8	27.2	"			
10	52	43	82.6	17.4	"	46.6		
11	316	178	56.3	43.7	Exp.Wk.1			
12	393	254	64.6	35.4	"			
13	376	195	51.8	48.2	"			
14	340	224	65.8	34.2	"			
15	385	254	65.9	34.1	"			
16	348	96	27.5	72.5	"			
17	387	90	23.2	76.8	"	49.2	1	$1.25
18	330	98	29.6	70.4	Exp.Wk.2			
19	359	104	28.9	71.1	"			
20	354	96	27.1	72.9	"			
21	302	18	5.9	94.1	"			
22	298	13	4.3	95.7	"			
23	283	23	8.1	91.9	"			
24	297	20	6.7	93.3	"	84.2	3	3.75
25	310	15	4.8	95.2	Exp.Wk.3			
26	298	21	7.0	93.0	"			
27	280	11	3.9	96.1	"			
28	296	16	5.4	94.6	"			
29	303	13	4.2	95.8	"			
30	310	10	3.2	96.8	"			
31	299	12	4.0	96.0	"	95.4	3	3.75
						Total Earned		$8.75

SUBJECT 2, EXPERIMENTAL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts	Phase	Average % Nonanxious Thought	# Qtrs. Improve-ment	Amt. Earned
1	387	26	06.7	93.3	Baseline			
2	224	42	18.7	81.3	"			
3	n.c.	n.c.	n.c.	n.c.	"			
4	197	34	17.2	82.8	"			
5	136	12	08.8	91.2	"			
6	136	13	09.5	90.5	"			
7	153	4	02.6	97.4	"			
8	112	2	01.7	98.3	"			
9	51	10	19.6	80.4	"			
10	137	17	12.4	87.6	Baseline	87.0		
11	78	26	33.3	66.7	Exp. Wk. 1			
12	92	6	06.5	93.5	"			
13	113	8	07.0	93.0	"			
14	83	4	04.8	95.2	"			
15	157	9	05.7	94.5	"			
16	97	26	26.8	73.2	"			
17	117	16	13.6	86.4	"	90.35	2	$2.50
18	143	5	03.4	96.6	Exp. Wk. 2			
19	138	2	01.4	98.6	"			
20	93	2	02.1	97.9	"			
21	141	3	02.1	97.9	"			
22	62	3	04.8	95.2	"			
23	62	3	04.8	95.2	"			
24	97	0	00.0	100.0	"	97.20	3	3.75
25	22	1	04.5	95.5	Exp. Wk. 3			
26	16	0	00.0	100.0	"			
27	58	0	00.0	100.0	"			
28	86	0	00.0	100.0	"			
29	53	2	03.7	96.3	"			
30	42	0	00.0	100.0	"			
31	31	0	00.0	100.0	"	99.0	3	3.75
32	59	2	03.3	96.7				
33	22	0	00.0	100.0				
						Total earned		$10.00

n.c. = no chance to monitor.

SUBJECT 3, EXPERIMENTAL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts	Phase	Average % Nonanxious Thought	# Qtrs. Improve-ment	Amt. Earned
1	114	77	67.5	32.5	Baseline			
2	145	40	27.5	72.5	"			
3	64	5	07.8	92.2	"			
4	100	8	08.0	92.0	"			
5	60	14	23.3	76.7	"			
6	106	21	19.8	80.2	"			
7	101	41	40.5	59.5	"	72.2		
8	115	72	62.6	37.4	Exp.Wk.1			
9	108	23	21.2	78.8	"			
10	70	30	42.8	57.2	"			
11	85	13	15.2	84.8	"			
12	96	18	18.7	81.3	"			
13	60	7	11.6	88.4	"			
14	98	10	10.2	89.8	"	73.9	1	$1.25
15	105	2	01.9	98.1	Exp.Wk.2			
16	24	2	08.3	91.7	"			
17	83	9	10.8	89.2	"			
18	80	8	10.0	90.0	"			
19	110	17	15.4	84.6	"			
20	121	20	16.5	83.5	"	89.6	3	3.75
21	175	34	19.5	80.5				
22	83	7	08.4	91.6	"			
23	115	31	26.9	73.1	"			
24	66	40	60.6	39.4	"			
25	107	3	02.8	97.2	"	83.2	0	0.00
26	86	6	07.0	93.0	Exp.Wk.3			
27	130	15	11.5	88.5	"			
28	102	5	04.9	95.1	"			
					Total earned			$5.00

SUBJECT 4, EXPERIMENTAL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts	Phase	Average % Nonanxious Thought	# Qtrs. Improve-ment	Amt. Earned
1	163	36	22.0	78.0	Baseline			
2	189	51	26.9	73.1	"			
3	241	77	31.9	68.1	"			
4	84	36	42.8	57.2	"			
5	n.c.	n.c.	n.c.	n.c.	"			
6	179	90	50.2	49.8	"			
7	165	89	53.9	46.1	"			
8	212	102	48.1	51.9	"	60.6		
9	174	66	37.9	62.1	Exp. Wk. 1			
10	89	27	30.3	69.7	"			
11	25	7	28.0	72.0	"			
12	64	24	37.5	62.5	"			
13	255	91	35.6	64.4	"			
14	163	41	25.1	74.9	"			
15	137	44	32.1	67.9	"	67.6	1	$1.25
16	114	42	36.8	63.2	Exp. Wk. 2			
17	165	43	26.0	74.0	"			
18	99	31	31.3	68.7	"			
19	186	65	34.9	65.1	"			
20	76	36	47.3	52.7	"			
21	128	48	37.5	62.5	"			
22	n.c.	n.c.	n.c.	n.c.	"			
23	n.c.	n.c.	n.c.	n.c.	"			
24	83	22	26.5	73.5	"	66.4	0	0.00
25	137	63	49.6	50.4	Exp. Wk. 3			
26	121	69	57.0	43.0	"			
27	131	60	45.8	54.2	"			
28	92	52	56.5	43.5	"			
29	138	51	36.9	63.1	"			
30	176	42	23.8	76.2	"			
31	140	36	25.7	74.3	"	58.4	0	0.00
32	86	20	23.2	76.8	"			
						Total earned		$1.25

n.c. = no chance to monitor

SUBJECT 5, EXPERIMENTAL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts	Phase	Average % Nonanxious Thought	# Qtrs. Improve-ment	Amt. Earned
1	26	19	73.0	27.0	Baseline			
2	19	18	94.7	05.3	"			
3	39	34	87.1	12.9	"			
4	n.c.	n.c.	n.c.	n.c.	"			
5	52	43	82.6	17.4	"			
6	36	32	88.8	11.2	"			
7	n.c.	n.c.	n.c.	n.c.	"			
8	43	39	90.6	09.4	"			
9	28	24	85.7	14.3	"	13.9		
10	59	53	89.8	10.2	Exp.Wk.1			
11	51	44	86.2	13.8	"			
12	33	24	72.7	27.3	"			
13	n.c.	n.c.	n.c.	n.c.	"			
14	32	29	90.6	09.4	"			
15	43	31	72.0	28.0	"			
16	49	31	63.2	36.8	"	19.4	1	$1.25
17	52	44	89.6	10.4	Exp.Wk.2			
18	59	30	50.8	49.2	"			
19	48	21	43.7	56.3	"			
20	37	16	43.2	56.8	"			
21	48	28	58.3	41.7	"			
22	57	26	45.6	54.4	"			
23	48	28	58.3	41.7	"	50.6	2	2.50
24	57	26	45.6	54.4	"			
25	46	25	54.3	45.7	"			
26	31	19	61.3	38.7	"			
						Total earned		$3.75

n.c. = no chance to monitor

SUBJECT 6, CONTROL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts
1	244	11	04.5	95.5
2	124	10	08.0	92.0
3	80	8	10.0	90.0
4	90	9	10.0	90.0
5	90	8	08.8	91.2
6	102	9	08.8	91.2
7	116	8	06.8	93.2
8	101	4	03.9	96.1
9	143	5	03.4	96.6
10	103	4	03.8	96.2
11	127	6	04.7	95.3
12	97	3	03.0	97.0
13	130	5	03.8	96.2
14	151	7	04.6	95.4
15	136	4	02.9	97.1
16	120	4	03.3	96.7
17	118	5	04.2	95.8
18	85	3	03.5	96.5
19	144	3	02.0	98.0
20	87	2	02.2	97.8
21	122	10	08.1	91.9
22	139	8	05.7	94.3
23	117	10	08.5	91.5
24	141	6	04.2	95.8
25	133	10	07.5	92.5
26	114	7	06.1	93.9
27	118	9	07.6	92.4
28	111	7	06.3	93.7
29	129	12	09.3	90.7
30	97	5	05.1	94.9
31	104	6	05.7	94.3

SUBJECT 7, CONTROL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts
1	315	73	23.1	76.9
2	288	63	21.8	78.2
3	242	57	23.5	76.5
4	320	61	19.0	81.0
5	297	54	18.1	81.9
6	302	48	15.8	84.2
7	293	58	19.7	80.3
8	318	72	22.6	77.4
9	343	82	23.9	76.1
10	285	45	15.7	84.3
11	307	48	15.6	84.4
12	283	38	13.4	86.6
13	314	40	12.7	87.3
14	243	22	09.0	91.0
15	258	28	10.8	89.2
16	238	19	07.9	92.1
17	240	23	09.5	90.5
18	283	23	08.1	91.9
19	265	32	12.0	88.0
20	248	27	10.8	89.2
21	263	38	16.1	83.9
22	276	42	15.2	84.8
23	248	33	13.3	86.7
24	277	39	14.0	86.0
25	293	74	25.2	74.8
26	293	74	25.2	74.8
27	288	78	27.0	73.0
28	264	53	20.0	80.0
29	273	52	19.0	81.0
30	283	56	19.7	80.3
31	258	49	18.9	81.1

SUBJECT 8, CONTROL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts
1	197	15	07.6	92.4
2	155	28	18.0	82.0
3	176	43	24.4	75.6
4	102	36	35.2	64.8
5	187	29	15.5	84.5
6	80	40	50.0	50.0
7	124	0	00.0	100.0
8	96	0	00.0	100.0
9	101	10	09.9	90.1
10	129	3	02.3	97.7
11	137	24	17.5	82.5
12	120	6	05.8	94.2
13	81	5	06.1	93.9
14	102	0	00.0	100.0
15	89	0	00.0	100.0
16	82	3	03.6	96.4
17	76	19	25.0	75.0
18	81	6	07.4	92.6
19	82	0	00.0	100.0
20	76	0	00.0	100.0
21	39	32	82.0	18.0
22	47	6	12.8	87.2
23	25	4	16.0	84.0
24	40	17	42.5	57.5
25	20	2	10.0	90.0
26	39	32	82.0	18.0
27	27	3	11.1	88.9
28	16	5	31.2	68.8
29	39	19	48.7	51.3
30	21	4	19.0	81.0
31	12	7	58.3	41.7

SUBJECT 9, CONTROL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts
1	112	68	60.7	39.3
2	106	52	49.0	51.0
3	120	58	48.3	51.7
4	122	81	66.3	33.7
5	175	100	57.1	42.9
6	168	96	57.1	42.9
7	100	46	46.0	54.0
8	157	77	49.0	51.0
9	150	75	50.0	50.0
10	152	75	49.3	50.7
11	146	79	54.1	45.9
12	149	82	55.0	45.0
13	108	51	47.2	52.8
14	125	66	52.8	47.2
15	130	66	50.7	49.3
16	122	59	48.3	51.7
17	138	67	48.5	51.5
18	125	55	44.0	56.0
19	126	42	33.3	66.7
20	75	35	46.6	53.4
21	128	58	45.3	54.7
22	115	64	55.6	44.4
23	138	57	41.3	58.7
24	121	53	43.8	56.2
25	92	37	40.2	59.8
26	100	36	36.0	64.0
27	87	39	44.8	55.2
28	92	41	44.5	55.5
29	129	66	51.1	48.9

SUBJECT 10, CONTROL GROUP

Day	Tones Recorded	Anxious Thoughts Detected	% Anxious Thoughts	% Non-anxious Thoughts
1	42	5	11.9	88.1
2	115	12	10.4	89.6
3	130	11	08.4	91.6
4	79	3	03.7	96.3
5	57	7	12.2	87.8
6	211	75	35.5	64.5
7	212	46	21.6	78.4
8	213	53	24.8	75.2
9	214	71	33.1	66.9
10	215	65	30.2	69.8
11	n.c.	n.c.	n.c.	n.c.
12	108	11	10.1	89.9
13	119	5	04.2	95.8
14	47	12	25.5	74.5
15	45	9	20.0	80.0
16	101	20	19.8	80.2
17	77	22	28.5	71.5
18	83	12	14.4	85.6
19	43	9	20.9	79.1
20	37	5	13.5	86.5
21	46	7	15.2	84.8
22	55	17	30.9	60.1
23	58	15	25.8	74.2
24	46	2	04.3	95.7
25	74	26	35.1	64.9
26	25	10	40.0	60.0
27	50	14	28.0	72.0
28	68	29	42.6	57.4
29	23	8	34.7	65.3
30	47	20	42.5	57.5
31	22	15	68.1	31.9
32	38	26	68.4	31.6

n.c. = no chance to monitor

APPENDIX C

SPECIAL EQUIPMENT USED IN THE STUDY

Desk Model Physiograph: The model DMP-4A is a desk model recorder that accepts up to four rectilinear or curvilinear recording channels and a time and event channel. A 12-fixed speed chart drive controlled chart speed by setting the chart drive in centimeters per second. The heart impulses occurred as momentary downward deflections of the time and event channel pen. The event marker pen would deflect upward at one minute intervals so that the number of heart beats per minute could be determined.

Cardiotachometer: Bio-Tach 4710C is nominally calibrated to plus or minus 2-1/2% at full scale deflection. That is to say, that near the upper end of the scale, the reading could possibly be inaccurate as much as ten beats per minute. This is within the required accuracy range for most physiological measurements.

Wrist counter: 99&9 counter that was worn on the wrist of the subject. There were two of these counters per subject. These counters are converted golf score counter devices operative by dial or plunger.

Bleeper: An automatic tone unit was used as an auditory signaling device. It consisted of a small battery powered electronic mechanism housed in a 1" x 2" x 3" plastic case. It contained a pulse generator and a speaker. The adjustive screw at the top of the plastic case permitted setting the time interval between the auditory signals. The device was set to emit signals at approximately every four minutes.

Tycose Blood Pressure Manometer: This model contained the pressure gauge in one unit with the hand pressure bulb.

Littman Stethoscope: This is the ordinary stethoscope that physicians use for physical examinations.

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