HEART RATE FEEDBACK AS A TREATMENT FOR ANXIETY DISORDERS

FEEDBACK TRAINING FOR HEART RATE AS A TREATMENT FOR ANXIETY DISORDERS

BY

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ABSTRACT

The present study investigated the efficacy of heart rate feedback training in the treatment of panic disorder. Eight patients with anxiety disorders participated in 7 feedback sessions, in which they were instrumentally trained to produce increases and decreases in heart rate in the presence of visual feedback. When they could successfully differentiate between the increase and decrease responses, subjects were instructed to use the decrease response to control anxiety and panic, and to avoid the increase response. Subjects were not made aware of the target responses until training was completed. Clinical improvement was measured through the administration of a psychometric test battery and a daily anxiety/panic diary. A non-anxious Control group, consisting of 10 subjects, was utilized to provide comparisons with the Anxiety group in the areas of feedback skill, baseline psychophysiology, and change in anxiety levels with the development of feedback skill.

As a result of feedback training, Anxiety patients learned to produce increases and decreases in heart rate in the presence and absence of feedback. They also reported a decline in anxiety and panic over the course of feedback training. To evaluate whether clinical improvement was related specifically to feedback skill as opposed to non-specific treatment factors, dose-response relations were examined, where a dose was defined as a subject's degree of differentiation between increases and decreases in heart rate, as measured by a t-test. Clinical improvement was measured

as the change in number of panic attacks per day, compared to baseline. A positive, significant correlation was found between subjects' degree of feedback skill and decline in panic at a one-month follow-up. A number of alternative explanations for the dose-response relationship are discussed, as well as the limitations of this study. It is concluded that further well-controlled studies will be required to confirm these findings, and to determine the source of the dose-response relationship, although this study provides encouraging evidence for the use of feedback training as a behavioral treatment for panic disorder.

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FEEDBACK TRAINING FOR HEART RATE AS A TREATMENT FOR ANXIETY DISORDERS

INTRODUCTION

Panic disorder is a psychological condition marked by periods of "intense and disabling fear that occur unexpectedly and are not a reaction to phobic situations or to circumstances that normally induce strong apprehension" (DSMIII-R). Common symptoms of this anxiety disorder include accelerated heart rate, palpitations or chest pain, choking, dizziness, lightheadedness, abdominal distress, feelings of depersonalization or derealization, hot or cold flushes, sweating, faintness, trembling and numbness (Hibbert, 1984). The average patient with panic disorder experiences two to four attacks per week, and this condition is often accompanied by anticipatory anxiety and agoraphobia (Weissman, 1990).

Epidemiological surveys have reported that at least 1.5% of the general population suffer from chronic panic disorder, while three times that many experience recurrent panic attacks (Weissman, 1990). As its symptoms are often a source of personal misery, many unpleasant consequences are associated with this condition, including substance abuse, suicidal behaviour and financial instability (Weissman, 1990). Considering these facts, it is not surprising that increased attention has been focused on understanding and treating this major clinical disorder.

Two Perspectives on Panic Disorder

A number of theories have been proposed regarding the etiology of panic symptoms (Clark et. al., 1986; Klein, 1964; Margraf et. al., 1986; Sheehan et. al., 1982). Klein's (1964) early biosocial

perspective suggested that panic attacks are biologically similar to the acute stress reaction experienced by young primates following the loss of a parent. This reaction, termed as "separation anxiety", involves two distinct stages, known as "protest" and "despair". The protest stage, which occurs immediately following parental loss, is characterized by acute distress, vocalization and physical agitation. The despair stage, which occurs 24 hours later, is quite different from the protest stage. During this time, the infant becomes quiet and despondent, displaying a general slowing of psychomotor activity. These stages may be adaptively significant, with the protest stage increasing the initial chances of parental relocation, whereas the later despair stage minimizes the likelihood of predatory attack on the lone infant.

With respect to humans, the protest stage is thought to resemble panic, while the despair stage is similar to depression. Consequently, proponents of this viewpoint have examined the biological link between panic and depression. Drug specificity studies have reported that tricyclic antidepressants alleviate the symptoms of panic disorder, while in comparison, these drugs are not generally successful in treating generalized anxiety disorder (Raskin et. al., 1982). Such findings led to the proposal that panic disorder is a unique biological dysfunction, amenable to treatment by specific pharmacological agents and distinct from other categories of anxiety disorder. This viewpoint has received criticism from authors who question the drug specificity argument

(Margraf et. al., 1986).

A more recent perspective, proposed by Margraf et. al. (1986) and Clark et. al. (1986), does not distinguish panic disorder as a unique biological entity. Rather, their theory states that in panic patients, the bodily fluctuations and sensations involved in normal anxiety responses are misperceived as signals of danger, such as an impending heart attack. Such interpretations produce further anxiety and an increase in bodily symptoms, resulting in a vicious circle of anxiety and somatic responses (Ehlers et. al., 1988; Hibbert, 1984; Ley, 1985; Ley, 1991; Pauli et. al., 1991). Evidence for this "misattributional" view includes studies in which biological agents normally thought to invariably induce symptoms in all panic patients led subjects to panic, only if bodily sensations were interpreted in a catastrophic manner (Clark et. al., 1986; Gelder, 1986; Shear et. al., 1991).

Both the biosocial and misattributional views acknowledge the physical nature of panic symptoms. Furthermore, current treatment practices are largely compatible with these two perspectives. For example, tricyclic antidepressants have been recommended for panic patients, notably because anxiety and depression often co-occur together, and also because panic disorder is seen by Klein's (1964) biosocial model to derive from the same biological process as depression. Other pharmacological interventions, including benzodiazepines, beta-adrenergic blockers and monoamine oxidase inhibitors have also been used to alleviate panic symptoms. Unfortunately, unpleasant side effects such as faintness and

persistent tachycardia (Sveback et. al., 1990; Roy-Byrne, 1992), and high rates of relapse (Clark, 1986) have been noted in many drug studies. Furthermore, high drop out rates averaging between 27% and 50% (Telch, 1988) emphasize the problem of compliance associated with drug therapy.

On the other hand, the misattributional view invites the use of cognitive-behavioural treatments in the management of panic disorder. Such treatments involving re-education and relaxation training have been shown to serve as effective substitutes for, or supplements to pharmacological treatment (Barlow, 1990; Craske et. al., 1991; Ley, 1985; Ley, 1991; Suinn, 1990). These interventions involve methods such as having patients hyperventilate voluntarily, explaining to them how hyperventilation induces panic, and then training subjects in slow breathing (Clark et. al., 1985). Additionally, patients are taught to develop more appropriate cognitive interpretations of bodily sensations (Barlow, 1984; Barlow, 1990; Salkovskis et. al., 1991).

Feedback Treatment for Panic Disorder

Despite an increased interest in cognitive-behavioural intervention, there has been little attention directed to biofeedback methods as ways of teaching voluntary control over the symptoms of panic disorder (Fahrion & Norris, 1990). "Biofeedback" is the collective term used to describe operant conditioning procedures by which subjects are trained to control a target physiological response by being given exteroceptive feedback for that response. Bodily responses trained in feedback experiments

have included heart rate, blood pressure, EMG activity, galvanic skin activity, and brain wave activity. Furthermore, clinical applications of biofeedback have been used in the management of hypertension, cardiac arrhythmias, headache, Raynaud's disease, epilepsy and anxiety (White & Turskey, 1982).

Since the symptoms of panic disorder are physical in nature, it follows that feedback methods might be useful in their management. First, one must determine the appropriate response to train in such patients. Though panic disorder is a heterogeneous phenomenon in terms of symptomatology (Lelliott and Bass, 1990), psychophysiological studies show that patients typically exhibit higher and more variable cardiovascular arousal than nonanxious people, even in nonthreatening situations (Anastasiades et. al., 1990; Hoehn-Saric et. al., 1991). Several studies have also linked cardiovascular problems to panic disorder (Katon, 1990; Mateos et. al., 1989). Since cardiovascular symptoms are considered a central feature in the diagnosis of panic disorder, heart rate seems to be an appropriate response to train through the feedback method.

It is well established that non-anxious subjects can learn to control cardiovascular responding through feedback methods (Roberts et. al., 1984; Williams & Roberts, 1988). Cheatle and Weiss (1982) provide an overview of such research, which is one of the areas most extensively studied by biofeedback investigators. As gathered from the analysis of subjects' verbal reports and measured response patterns, increases in heart rate are generally achieved through increased respiration and muscle tension, while decreases involve

respiratory control and muscle relaxation (Williams & Roberts, 1988). Thus, behaviours that are associated with heart rate increases (hyperventilation, muscle tension) appear similar to behaviours seen during panic attacks, whereas behaviours associated with heart rate decreases are incompatible with panic. Consequently, a useful treatment for panic disorder might involve teaching patients to decrease their heart rates when faced with panic, and to avoid behaviours that produce heart rate increases during those times. Although studies have shown that heart rate decreases are more difficult to train than increases, reliable decreases have been shown when measured from a pretrial baseline (Hughes & Roberts, 1985). Furthermore, such decreases are more pronounced if changes from baseline are measured as changes in heart period (interbeat interval), rather than as changes in heart rate.

Feedback Studies of Anxiety Management

These considerations give reason to apply feedback training for heart rate to the management of panic and anxiety disorders. Although such training has been reported to be successful in the treatment of speech anxiety in college students (Gatchel & Proctor, 1976; McKinney & Gatchel, 1982) and cardiovascular fears in patients with irregular heart rhythms (Hrachinova et. al., 1989; Vaitl et. al., 1988), only one study has applied heart rate feedback training to the treatment of patients with clinical anxiety disorders (Rupert & Holmes, 1978).

In this study, Rupert and Holmes (1978) trained anxious

psychiatric inpatients to increase or decrease their heart rates in the presence of visual feedback. Patients' level of anxiety was measured using the State scale of the State-Trait Anxiety Inventory (Spielberger et. al., 1970) and the Affect Adjective Checklist (Zuckerman, 1960). Feedback training was not found to influence subjects' self-reports of anxiety, whether they were trained for increases or decreases in heart rate. However, subjects' heart rate control in this study was poor. In the case of decreases, subjects showed similar changes in heart rate whether they received biofeedback instructions or whether they simply sat quietly in the absence of feedback. Furthermore, although decreases occurred in the presence of feedback, subjects were not able to produce the decrease response during a test period, when feedback was removed. It should be noted that subjects were specifically instructed to use only mental means in gaining response control, and were told that heart rates generally decrease with relaxation and increase with excitement. Other studies have shown that mental means are not sufficient, and that instructions to use such means are detrimental to achieving heart rate control (Williams & Roberts, 1988).

Rupert and Holmes' (1978) study is the only published one in which heart rate feedback was used. However, several studies have assessed EMG feedback as a treatment for anxiety disorders (Barlow et. al., 1984; Canter, 1975; Hiebert & Fitzsimmons, 1981; Townsend, 1975; Weinman et. al., 1983; Lavellee et. al., 1977; Lavellee et. al., 1982; Leboeuf & Lodge, 1980; Raskin et. al., 1980).

In an early study, Canter et. al. (1975) compared the efficacy of EMG feedback training to that of progressive muscle relaxation in the treatment of panic disorder and generalized anxiety disorder. Fourteen patients with panic disorder and 14 patients with generalized anxiety disorder were evenly distributed into two groups. The first group received 10 to 25 sessions of frontalis EMG feedback, and the other was given 10 to 25 sessions of progressive muscle relaxation, using the Jacobson method (Jacobson, 1938). Changes in anxiety symptoms were determined from global ratings by patients and their primary therapists. Following treatment, both groups were successful in reducing frontalis muscle tension. Furthermore, 85% of patients in the feedback group were rated as having significantly reduced their level of anxiety, whereas 50% of the progressive muscle relaxation group had shown similar improvement. This difference between improvement in the two groups was statistically significant. Interestingly, the patients who benefitted most from EMG feedback were those with panic disorder, whereas patients with generalized anxiety disorder benefitted less.

Another study by Townsend et. al. (1975) compared the effects of frontalis EMG feedback and group psychotherapy in treating chronic anxiety. Thirty patients were evenly divided into two groups, one receiving 9 sessions of EMG relaxation training, and the other receiving 16 sessions of group psychotherapy. Patients in the EMG group also engaged in two weeks of self-practise outside of the feedback laboratory, using progressive muscle relaxation via

tape recorded instructions. Subjects' anxiety was measured using the State Trait Anxiety Inventory (Spielberger et. al., 1970) and the Profile of Mood States (POMS). As a result, patients in the EMG group showed significant decreases in their frontalis EMG activity, as well as lowered levels of mood disturbance, state and trait anxiety. In comparison, subjects in the psychotherapy group experienced no such decreases, and the differences between the two groups were statistically significant.

In another study, Lavellee et. al. (1977) compared the effects of EMG feedback training, diazepam treatment, and their combination in treating chronic anxiety. Forty patients with chronic free-floating anxiety were divided into four groups. Ten subjects received eight biweekly sessions of feedback training to reduce frontalis EMG activity, as well as 15 mg of diazepam daily. Another 10 subjects received EMG feedback training, as well as a diazepam placebo. The remaining 20 subjects were divided into two EMG "control" groups, one of which received diazepam, and the other a placebo. Subjects in the EMG control groups received eight biweekly sessions identical to the feedback groups, except that they were asked to relax in the absence of feedback. Patients' level of anxiety was evaluated using the Hamilton Anxiety Scale (Hamilton, 1959), the Institute of Personality and Ability Testing Anxiety Scale (Cattell & Scheier, 1958) and the De Bonis Trait State Scale (De Bonis, 1973). All groups who received either EMG feedback, diazepam, or a combination of the two experienced significant reductions in their level of anxiety. Furthermore,

only subjects who received feedback training without diazepam maintained that reduction at a three-month follow-up.

In a later study, Lavellee et. al. (1982) trained 40 chronically anxious patients in reducing frontalis EMG activity over eight weekly feedback sessions. Patients' level of anxiety was evaluated using the Hamilton Anxiety Scale (Hamilton, 1959), and the Zung Self-rating Anxiety Scale (Zung, 1971). All subjects were successful in significantly reducing frontalis muscle tension by the end of treatment. 25% of subjects also reported a substantial decline in their level of anxiety.

Another study by Raskin et. al. (1980) evaluated the effects of EMG feedback training in chronically anxious subjects. Subjects were assessed during a six week baseline on measures of anxiety, social adjustment and physiological activity. They then received six weeks of EMG feedback training. Subjects were followed up for six weeks, then up to eighteen months. Raskin et. al. (1980) found that 40% of subjects experienced a significant decline in measured levels of anxiety. However, reduction in EMG activity was not completely maintained after the treatment phase was completed.

In the final clinical study to be described here, Leboeuf and Lodge (1980) applied frontalis EMG feedback to the treatment of chronic anxiety. Subjects received sixteen biweekly sessions of EMG feedback training, and were instructed to practise their learned relaxation skills for twenty minutes per day outside of the feedback session. Subjects' level of anxiety was measured using the Taylor Manifest Anxiety Scale (Taylor, 1953) and the Trait form

of the State-Trait Anxiety Inventory (Spielberger et. al., 1970). As a result, subjects were found to be successful at decreasing frontalis EMG activity. However, unlike the aforementioned studies, few subjects showed more than marginal improvement on the clinical measures following treatment.

In summary, with exception of the study by Lebeouf and Lodge (1980), studies using EMG feedback in the management of anxiety disorders reported decreases in subjects' anxiety symptoms. Furthermore, when subjects who received EMG feedback treatment were contrasted to relaxation controls, these decreases were significantly greater and more persistent in EMG subjects. In contrast, only one study evaluated heart rate feedback training as a treatment for anxiety disorder, with little benefit shown, but the feedback control used in that study was also poor (Rupert & Holmes, 1978).

What is the source of clinical improvement?

Although the data are not entirely consistent (Leboeuf & Lodge, 1980; Rupert & Holmes, 1978), the majority of studies applying feedback methods to the treatment of anxiety disorders have reported reductions in anxiety symptoms. One important issue that must be addressed is the source of existing clinical improvement. There are a number of factors that may have led to the reported therapeutic results. One possibility is feedback skill. Subjects' ability to control the target response as a result of feedback training, and to then produce the skill during times of anxiety, may have been important to therapeutic outcome.

Alternatively, possible confounds were involved in many of the forementioned EMG feedback studies. Subjects were often explicitly instructed on how to relax during training (Raskin et. al., 1980), or were given information about the target response and the direction of the desired change (Lavellee et. al., 1982; Leboeuf & Lodge, 1980). These factors may have also contributed to response control and clinical improvement, apart from any role of the feedback process. Another possibility involves the client's expectations during feedback treatment. Patients generally enter treatment with the expectation that they will improve, and through the feedback training experience, may have gained an increased sense of control over their anxiety symptoms, regardless of feedback skill.

This is a basic issue that has received much debate in the history of clinical biofeedback. In a comprehensive review of the clinical applications of biofeedback, it has been suggested that improvements in clinical state are largely uncorrelated with biofeedback performance (White & Tursky, 1982). In an article addressing the role of biofeedback in clinical practise, A.H. Roberts (1985) concluded that "there is absolutely no convincing evidence that biofeedback is an essential or specific technique for the treatment of any condition" (A.H. Roberts, 1985, p. 940). A.H. Roberts reasoned that if learning to produce a feedback response is important in the reduction of anxiety, then a correlation should exist between this skill and the therapeutic outcome. However, evidence of such correlations are lacking in the clinical feedback

literature (A.H. Roberts, 1985).

The aforementioned studies of anxiety disorders have provided conflicting evidence for the existence of a relationship between clinical improvement and feedback skill. In their feedback-diazepam study, Lavellee et. al. (1977) correlated patients' EMG levels with their clinical anxiety measures following treatment, and at a one-month follow-up. During these periods, subjects' EMG activity correlated significantly with the Hamilton Anxiety Scale, such that low levels of EMG activity were related to low ratings of anxiety. In their later study, Lavellee et. al. (1982) found further evidence of a relationship between EMG response control and therapeutic outcome, specifically among patients who had shown "marked" clinical improvement following feedback training. Similarly, Townsend et. al. (1975) examined the relationship between subjects' changes in EMG activity and changes in level of anxiety from baseline. When these correlations were performed, subjects' decline in mood disturbance and state anxiety were significantly related to reductions in EMG activity on days five and six of the treatment schedule.

In contrast, Leboeuf and Lodge (1980) and Raskin et. al. (1980) failed to demonstrate a significant relationship between subjects' reduction of EMG activity and reduction in anxiety. It will be recalled that Leboeuf & Lodge (1980) compared the degree of clinical improvement in a group of subjects receiving general relaxation training without feedback to the group who received EMG feedback, and found no significant difference between the two

groups.

Cournoyer (1986) addressed the question of a role for feedback skill in a study that provided the foundation for the present thesis. Cournoyer's (1986) goal was to examine the relationship between clinical improvement and feedback skill, with steps taken to ensure that response control derived from the feedback process and not from other factors such as verbal instruction or directional information that can influence response control in a feedback training situation. In this study, seven patients with anxiety disorders were given two feedback training sessions to produce two bidirectional responses, namely increases and decreases in heart rate. Feedback training was conducted using the AB procedure employed by Roberts et. al. (1984). In this procedure, subjects were told that they would be taught to control two visceral responses that were described as "Response A" and "Response B". Multiple electrodes were placed on various sites of the body, to prevent subjects from inferring the target responses. Subjects were instructed to move the letter A or B (depending on the trial) toward a target area on a visual display, using any method they wished. Successful responding led to upward movements of the cursor on both types of trials, whereas error responding moved the cursor downward. To test whether learning had occurred, subjects were given "transfer trials", in which they were instructed to perform the A and B responses in the absence of feedback. Since bidirectional responses were trained in each subject, feedback learning was assessed on an individual basis,

through the computation of a t-test between increase and decrease trials. Response control measured this way necessarily derived from the subject learning about his/her behaviour from feedback ("feedback skill"), and not some other source.

When they had completed the feedback training sessions, subjects were instructed to perform the decrease response when they felt anxious and to avoid the increase response. In her study, Cournoyer (1986) measured changes in subjects' level of anxiety through the Hamilton Anxiety and Depression Scale and the Cognitive-Somatic Anxiety Questionnaire (CSAQ), including a one-month follow-up. Significant reductions were found on both of these measures following feedback training. Furthermore, Cournoyer (1986) found a significant relationship between subjects' decline in anxiety (as measured by the CSAQ) and magnitude of feedback learning (as measured by the t-test between increase and decrease trials). These preliminary results suggested that the AB feedback training procedure was effective in reducing subjects' anxiety, and that clinical improvement was related to feedback skill, and not only to non-specific factors.

Present Study

Using the AB procedure employed by Cournoyer (1986), the present study evaluated the efficacy of heart rate feedback training in the treatment of panic disorder. Specifically, it was investigated whether feedback learning contributed to therapeutic outcome. In other words, a possible dose-response relation was examined, where a dose was defined as a subject's degree of

differentiation between increases and decreases in heart rate. Clinical improvement was defined as the change in frequency of patients' daily panic attacks from baseline. Patients completed a psychological assessment battery during various stages of the treatment protocol, as well as a daily anxiety diary. If clinical improvement occurred, but was uncorrelated with feedback skill, then one could conclude that the skill was not a factor contributing to therapeutic outcome. Rather, non-specific factors such as simple exposure and patients' expectations may be responsible for reductions in anxiety. On the other hand, a positive relation would open the possibility of feedback skill contributing to clinical improvement.

As well as recruiting patients with anxiety disorders, a non-anxious control group was employed for several purposes. First, these subjects served as a "baseline" against which to evaluate clinical improvement in the anxiety patients. Therefore, control subjects completed all of the psychometric test measures, as well as the daily anxiety diary. It was expected that anxiety patients would show elevated levels of anxiety at baseline when compared to controls, as determined from these measures. Furthermore, if feedback training was successful in reducing anxiety in the patient group, then patients' scores obtained on the clinical measures should begin to approximate those of the control group as training progressed.

Another purpose of the control group was to provide validation for the clinical measures used in the study. If these measures are

accurate in differentiating between clinically anxious and non-anxious individuals, then significant differences should be noted between the two groups at baseline.

A further comparison between the anxiety and control groups involved physiological recordings taken during the feedback training sessions. From previous studies, it was expected that anxiety patients would show physiological elevations compared to controls, particularly with respect to resting heart rate (Cournoyer, 1986). Additionally, a comparison would be made between the two groups with respect to feedback performance and learning. Judging from past studies (Cournoyer, 1986), it was expected that non-anxious controls would acquire feedback skill faster than anxiety patients.

To conclude, it was suggested that if feedback training was successful in alleviating the symptoms of panic disorder patients, it may serve as an effective alternative or complement to pharmacological treatment. The success of feedback training as a behavioural treatment for panic disorder might also encourage further evaluation of feedback as a possible therapy for other subcategories of anxiety disorder.

METHOD

Two groups of subjects were compared in this study: 1) an Anxiety Patient group[1] and 2) a Non-Anxious Control group. The study procedure for both groups is summarized in Table 1.

Subjects:

A total of fifteen patients from the Anxiety Disorder Clinics at McMaster University Medical Centre and St. Joseph's Hospital were contacted, and eleven agreed to participate in the study. Two of these patients completed one feedback session, and one completed three sessions before subsequently withdrawing from the study. Reasons for withdrawal included skin irritation in one subject due to electrode paste, depression in a second subject and personal difficulties in a third subject that interfered with participation in the study.

The remaining eight anxiety patients (7 with Panic Disorder; 1 with Obsessive-Compulsive Disorder) completed at least six feedback sessions, to the 30-day follow-up. This anxiety group was comprised of two males and six females, with a mean age of 43.50, and ranging from 28 to 63 years. Of these eight patients, seven completed the full seven sessions outlined in the protocol. Since one patient did not attend the seventh feedback session, follow-up

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[1] The Anxiety Patient group was originally intended to form two subgroups: 1) a Feedback condition and 2) a Wait-List condition, with the Wait-List subjects experiencing a three-week delay between their intake interview and first feedback session. Although a proportion of the anxiety patients entered the study as wait-list subjects, the total number of patients was not sufficient to provide an effective comparison between the two sub-groups. Therefore, no further distinction will be made between these subjects.

TABLE 1: PROTOCOL FOR ANXIETY PATIENTS

Days		
1	Interview*	D
8	Feedback Session 1*	D
12	Feedback Session 2	D
16	Feedback Session 3*	D
20	Feedback Session 4	D
24	Feedback Session 5*	D
		D
		D
54	Feedback Session 6* (Retention 1)	D
		D
		D
84	Feedback Session 7* (Retention 2)	D

PROTOCOL FOR CONTROL SUBJECTS

Days		
1	Interview*	D
8	Feedback Session 1*	D
12	Feedback Session 2	D
16	Feedback Session 3*	D
		D
		D
		D
		D
54	Short Battery (Clinical Follow-up)	D

* Short battery; D diary; Interview includes description of study, structured anxiety interview (adapted from the SCID), review of handout on anxiety responses, diary instruction, consent form.

information regarding panic and anxiety was obtained from this individual during a telephone interview.

Ten Control subjects participated in the study, including 2 faculty members, 4 graduate students and 4 alumni of the Psychology department at McMaster University. Four subjects were males and six were females. Their mean age was 32.20 years, ranging from 21 to 63. All ten subjects completed the study procedure. None of these subjects were receiving psychological counselling or intervention, nor were they taking psychoactive medication.

All subjects (anxiety and control) were unpaid volunteers. The nature of the study was fully explained to each subject. Subjects were required to read and write at the Grade 6 level and to sign a consent form. Consent forms were identical for the Anxiety and Control subjects, with the exception of the number of sessions described in the study schedule. The consent forms outlined the purpose of the study, the procedure, possible risks and benefits, issues of privacy/access to records and withdrawal privileges (Appendix II). Subjects were required to keep all appointments and to undergo all procedures required by the protocol. The original inclusion and exclusion criteria for Anxiety subjects are outlined below:

Inclusion Criteria:

1. Patients must meet DSM-III-R criteria for panic disorder or panic disorder with agoraphobia and have had at least one panic attack (spontaneous or situational) per week for three weeks prior to entry in the study.
2. Patients must have a six month history of panic disorder (with or without agoraphobia).
3. Male and female patients, between the ages of 18 and 64 years, in good physical health.

4. Patients must agree to keep all medications constant for the duration of the study.

Exclusion Criteria:

1. Depressed patients where depression is considered the primary diagnosis and/or patients who are suicidal.
2. Patients meeting DSM-III-R criteria for alcohol or substance abuse or dependence, dementia or any form of psychosis, bipolar disorder (or any history of these disorders).
3. Women who are pregnant, planning to become pregnant in the course of the study, or who are lactating.
4. Patients with a past history of convulsion.
5. Patients presently on alpha or beta adrenergic blocking agents, or who are receiving treatment for hypertension or cardiovascular disease.
6. Patients undergoing concurrent psychotherapy or behaviour therapy.
7. Patients whose panic attacks are related to metabolic triggers or deep relaxation.

Patients met these criteria, with two exceptions. Five Panic Disorder patients who experienced only sub-threshold attacks, but who had once been fully symptomatic, were admitted. The criteria were also broadened to accept one patient with Obsessive-Compulsive disorder into the study. This decision was prompted by the results of Cournoyer's (1986) pilot study. In her study, Cournoyer (1986) found that the patient who benefitted most from the feedback treatment and who was most successful at performing the feedback skill, was a patient with Obsessive-Compulsive disorder. Otherwise, all other inclusion/exclusion criteria were met.

Control subjects were required to be between the ages of 18 and 64, and in good physical health.

Anxiety measures:

Clinical measures consisted of a structured anxiety interview (adapted from the Structured Clinical Interview for DSM-III-R), anxiety diary, and psychometric assessment batteries.

Interview

On their first visit to the feedback laboratory, subjects in both groups were given the structured anxiety interview (Appendix I, adapted from the SCID, DSM-III-R). This short interview, which was tape recorded, assessed subjects' clinical status in the areas of panic, agoraphobia, social phobia, specific phobia, obsessive compulsive disorder, generalized anxiety disorder, performance anxiety and depression. Two report forms were filled out by separate investigators (Dr. L.E. Roberts and Linda Ploom), to test for reliability of assessment. Both investigators were present during the interview for all anxiety patients. In the case of control subjects, both investigators were present or one listened to the tape recording of the interview conducted by the other investigator. The interview provided a general clinical profile of each subject entering the feedback study.

Diary

While in the study, subjects were required to complete a daily anxiety diary (Appendix III). This diary was two-sided and consisted of three sections: 1) A section for number and intensity of all anxiety episodes experienced throughout the day, 2) a section for number and intensity of panic attacks, and 3) a section for type and amount of medication taken. Subjects received a page of instructions (Appendix IVa) on filling out the diary during their first visit, attached to a sample diary (Appendix IVb).

Psychometric Tests

A short psychometric battery (Appendix V) included the

following tests:

1) Spielberger State-Trait Anxiety Inventory (STAI)
2) Agoraphobic Cognitions Questionnaire (ACQ)
3) Body Sensations Questionnaire (BSQ)
4) Beck Depression Inventory (BDI)

The STAI (Spielberger et. al., 1970) consists of two self-rating scales: the State and the Trait. The State scale measures subjects' feelings at the moment of answering the questionnaire, and the Trait scale reflects feelings that have persisted over a period of time. Both scales consist of twenty statements relating to anxiety, that subjects rate as experiencing "not at all", "somewhat", "moderately so" or "very much so".

The Agoraphobic Cognitions Questionnaire (Chambless et. al., 1984) is comprised of 14 items that represent thoughts concerning negative consequences of experiencing anxiety, such as "I am going to go crazy" and "I am going to throw up". Each item is rated on a five-point scale, ranging from 1) this thought never occurs when I am nervous to 5) this thought always occurs when I am nervous.

The Body Sensations Questionnaire (Chambless et. al., 1984) is a 17-item scale, made up of items concerning sensations associated with autonomic arousal, such as "heart palpitations" and "dizziness". Subjects are asked to rate each sensation for how anxiety-provoking it is, on a scale ranging from 1) not frightened or worried by this sensation to 5) extremely frightened by this sensation.

Finally, the Beck Depression Inventory (Beck et. al., 1961) is designed to measure the behavioural manifestations of depression.

This questionnaire is composed of 21 categories of symptoms and attitudes relating to depression, which each consist of a series of 4 to 5 graded self-evaluative statements, such as: "1) I do not feel sad, 2) I feel blue of sad, 3) I am blue or sad all the time and I can't snap out of it, 4) I am so sad or unhappy that it is very painful and 5) I am so sad or unhappy that I can't stand it." For each of the 21 categories, subjects are asked to circle the item that most closely describes the way that he/she feels at the present time.

This assessment battery was designed to assess subjects' cognitions as well as behaviours and physical symptoms relating to anxiety. The Beck Depression Inventory was included for the reason that depression often co-occurs with anxiety. The anxiety diary and assessment battery were completed by subjects directly, eliminating the chance of experimenter bias. For the Anxiety group, the battery was completed at the initial interview session and at the beginning of feedback sessions 1, 3, 5, 6 and 7. Control subjects filled out the battery on their initial interview session, feedback sessions 1 and 3, and on their one-month clinical follow-up.

Treatment Schedules:

Procedures applied to the Anxiety and Control subjects are summarized in Table 1. All visits were held at the McMaster University Psychology Building in the feedback laboratory (room 334).

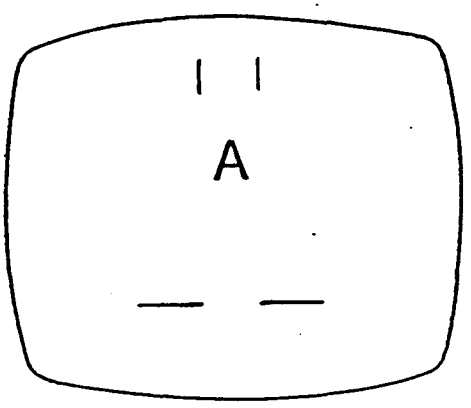
On their first visit, all subjects participated in the

following process, labelled as "Interview" on Table 1. To begin, they were asked to complete the short clinical assessment battery (Appendix V). Subjects were then introduced to the room where the feedback sessions would take place, including a sample computer feedback display (Figure 1). The feedback study was then described to them by Dr. L.E. Roberts, and subjects were given a consent form (Appendix II), which they were asked to read at home, sign and bring to their first feedback session (a second copy was signed at that session). The structured anxiety interview was then conducted (Appendix I), followed by a review of a short handout on anxiety responses (Appendix VII). This handout provided a brief summary on the body's natural reactions to stress, and how these reactions are related to the experience of anxiety. The main purpose of this handout was to ensure that all subjects had a common understanding of the nature of anxiety. This summary also included definitions of spontaneous and situational anxiety, a distinction which was important for subjects to understand in order to fill out the anxiety diary correctly. Very briefly, "spontaneous anxiety" refers to situations in which anxiety occurs spontaneously and unexpectedly, without apparent cause. In comparison, "situational anxiety" refers to anxiety that is triggered by a specific problem or situation. To conclude, the handout also stated how the investigators believed feedback training could intervene in the experience of panic and anxiety. Finally, subjects were instructed on how to fill out their daily anxiety diary.

Following the initial interview, Anxiety subjects and Control

Figure 1

Feedback Display



The display on an A-trial is shown (on B-trials the letter B replaces the letter A in the same location). The horizontal line depicts the subject's starting point on each trial (30 sec duration). The letter denotes the response pattern to be produced (A or B, heart rate increases and decreases, respectively) and is also a feedback cursor that moves up and down with changes in heart rate. The subject's task is to move the cursor toward the target area shown at the top of the screen on each trial. Computer algorithms equate heart rate increases and decreases for difficulty. On some trials (transfer), subjects are required to produce the A and B responses with feedback removed. On these trials only the letter A or B is presented. All sessions commence and conclude with a block of transfer trials.

Subjects are not told that the A and B responses involve heart rate increases and decreases or bidirectional opposites until after the fifth feedback session. Because only the relationship of feedback to behavior differs between A and B trials, response differentiation between the trial types means that feedback learning has occurred.

subjects were given seven feedback sessions and three feedback sessions respectively, as described in the study schedule (Table 1). All subjects completed the short psychometric battery at the beginning of sessions highlighted in the protocols. Due to work schedules, holidays and illness, it was sometimes necessary to deviate from these precise schedules, but effort was made to match the protocols as closely as possible (+/- 14 days).

Feedback training:

Apparatus

Feedback training was conducted in a dimly lit and sound-attenuated room. Visual feedback were displayed on a video-monitor (Mitsubishi Diamond Scan 14, 20x27 cm) situated 1.5 m in front of the subject at eye level. The feedback display (see Figure 1) consisted of a fixed horizontal line placed near the lower boundary of the screen, and a letter A or B (representing increases or decreases in heart rate) that moved in a vertical plane. A target gap, comprised of two vertical lines, was situated near the upper boundary of the screen. The lower horizontal line, which corresponded to the last pretrial cardiac interbeat interval, represented the subject's cardiac activity at the beginning of each trial. Movements of the letter A or B away from the horizontal line were proportional to the difference between the subject's most recent interbeat interval and this initial reference measure. Successful responding resulted in upward movements of the letter toward the target gap, whereas error responding led to downward movements of the letter.

The training procedure and data collection/analysis were carried out by a PDP-11 computer. Because heart rate decreases are more difficult to produce than increases (Roberts et. al., 1984), the sensitivity of the feedback display was increased by a factor of 2.5 on decrease trials relative to increase trials. This algorithm equated the excursions of the feedback cursor toward the target area on both trial types. As a result, 160 ms changes in interbeat interval were required for the letter to reach the target area of the display during decrease trials, whereas 400 ms changes were required for the letter to reach the target area during increase trials.

Electrophysiological Recording

The electrocardiogram was recorded by means of Nikomed disposable ECG electrodes of 4 cm diameter, which were attached to the sternum and lower left rib cage. This signal was fed to a circuit that discriminated the R-wave from muscle artifact (Williams & Roberts, 1988). A ground electrode was also placed on the lower ribcage to eliminate 60 cycle artifact.

Skin conductance was recorded via Beckman Ag/Cl disk electrodes of 1.5 cm diameter placed on the hypothenar eminence of the right hand. Reference electrodes were attached to the ventral site of the right wrist. Two Nikomed disposable ECG electrodes were placed on the right forearm, to measure electromyographic (EMG) activity. Inactive electrodes were placed on the left palm, wrist and forearm, as well as two at the hairline of the forehead. The purpose of these inactive electrodes was to prevent subjects

from inferring the target responses as a result of electrode placement.

Prior to instrumentation, the skin beneath each electrode site was rubbed gently with alcohol. For the EMG sites and skin conductance reference, the skin was also lightly abraded with sandpaper to reduce impedence. Prior to usage, all Ag/Cl electrodes were shorted to reduce bias potential to less than one millivolt. To eliminate the minimal risk of transmission of infectious disease, disposable gloves were worn by the experimenter and all electrodes sterilized between usage.

To measure respiration (amplitude, rate and volume), a mercury-filled strain gauge was fitted snugly around the upper torso. Gross body movement was measured by a built-in pressure transducer attached to an inflated cushion concealed in the feedback chair. Details for measurement of these responses are given by Marlin & Roberts (1990). All electrophysiological measurements were made by a Beckman Type R polygraph.

Feedback Procedure

Prior to each feedback session, a brief medical questionnaire was completed (Appendix VIII), including a measurement of subjects' blood pressure. Subjects were then instrumented with electrodes as described above. Once the electrodes were attached, subjects were led into the feedback room and seated in a large arm-chair. The electrodes were then plugged in and a small microphone attached to the subject's collar. The subject was assured that he/she would be in complete two-way communication with the experimenter for the

entire feedback session. Once the subject was comfortable, the lights were dimmed and the door partially shut. Due to some subjects' fear of enclosed spaces, the door was left open upon request.

At this point, an electrode test was performed (Appendix IX) via tape recorded instructions. This test informed the subject that the experimenter wished to test the physiological recordings prior to beginning the feedback session. First, subjects were asked to raise their arms from the chair and shake them a little. They were then asked to shake their head from side to side. In addition to testing the electrodes, this procedure provided subjects with some idea of the range of movement allowed during the feedback session.

Tape-recorded instructions were then played to the subject. These instructions told the subject that from time to time, the letter A or the letter B would appear on the television screen in front of them. These letters indicated which bodily response, A or B, should be produced. The subjects' task was to move the letter A or the letter B as far as possible in the direction of the target area at the top of the television screen. Subjects were also told that they would receive test (transfer) trials, where the letter A or the letter B would remain motionless on the screen. On these trials, subjects were told to produce the appropriate response as best they could, even though no feedback was available to indicate their degree of success. Subjects were told that they could use any method they wish to produce Response A or Response B, but that

they should avoid touching or putting pressure on the electrodes, since this would disturb the recordings. Finally, subjects were given the opportunity to have the instructions repeated. Sample displays accompanied these instructions in feedback session 1, but were not presented in subsequent sessions. For half of the subjects in each group, A represented increases and B decreases in heart rate, while this was consistently reversed for the other half.

Each one-hour training session included 34 trials, each consisting of a pretrial period of 30 seconds where no visual display was presented, and a trial period of 30 seconds where the display was shown. An initial transfer block of 4 transfer trials (2 increase and 2 decrease) was followed by 20 feedback trials (10 increase and 10 decrease) and a final transfer test (3 increase and 3 decrease). Increase and decrease trials were given in an irregular order, as defined by two counterbalanced trial sequences, which were randomly distributed across subjects. Two "Blank" trials on which no display appeared on the feedback console were also included in both transfer blocks. Blank trials measured heart rate changes in the absence of a task requirement. All trials were separated by variable inter-trial intervals that averaged 30 seconds (60 seconds between displays).

Anxiety Control Instructions

At the end of feedback session 2, a one-tailed t-test was computed on the cardiac "change scores" obtained from feedback increase vs. decrease trials, and on the second transfer block of

increase vs. decrease trials. "Change scores" were calculated by the PDP-11 computer for each trial by subtracting the mean cardiac interbeat-interval (distance between two R-waves) of the pre-trial period from the mean interbeat-interval of the trial period. This score was expressed in milliseconds. Positive change scores represented a lengthening in interbeat interval (IBI) (heart rate decrease) while negative change scores represented a shortening in IBI (heart rate increase). If the calculated feedback and transfer t's were significant at $p<0.05$, the subject was given a handout instructing them to perform the decrease response when they felt anxious, and to avoid the response associated with heart rate increases in such situations (Appendix XII). In cases where Anxiety subjects did not meet this criterion during session 2, the handout was presented at the end of the next session in which the feedback and transfer t's were both significant, or at the end of session 5.

The same procedure was followed for control subjects. When Controls failed to meet the above criterion during session 2, they were presented with the handout at the end of session 3.

Subjects were not told that responses A and B involved heart rate increases or decreases until all required feedback sessions were completed.

Verbal Reports and Debriefing

At the end of feedback session 2, all subjects were asked to complete an open-ended verbal report questionnaire describing their response strategies for A and B (Appendix X). At the end of

session 5, Anxiety subjects were asked to fill out another open-ended verbal report, as well as a second questionnaire rating the degree to which they used specific strategies in controlling responses A and B (Appendix XI). Control subjects filled out both questionnaires at the end of session 3, their final feedback session.

After their seventh feedback session, Anxiety subjects were given a brief interview, during which they were told that responses A and B represented increases and decreases in heart rate. They were then asked a number of questions regarding their subjective impressions of the feedback treatment (Appendix XIII). These questions addressed whether the feedback treatment had helped the subject with his/her anxiety problem, for which symptoms the treatment was most helpful, and whether anxiety symptoms became less intense or frequent. Subjects were also asked whether they would continue to use response A or B to deal with anxiety, and what part of the treatment package was most/least helpful. Finally, subjects were asked whether they would recommend this treatment to others with anxiety.

Statistical Analysis

In this study, feedback and treatment effects were evaluated by t-statistics. One-tailed tests were accepted where directional predictions were made. Because the basis for grouping multiple tests was not readily apparent, Bonferroni corrections were not applied. Finally, dose-response relations were calculated by using Pearson product-moment correlations.

RESULTS

The results of this study are presented in three main sections. The first section is a description and analysis of the physiological data gathered during feedback training sessions. Following this section, the results of the clinical measures are discussed. Finally, the section entitled "Dose-Response Relations" outlines the statistical analyses that were performed to relate subjects' feedback performance to the data gathered from the clinical measures.

Feedback Training

Acquisition of Feedback Skill:

Figures 2a to 2g illustrate the mean acquisition of heart rate control for Anxiety subjects from sessions 1 to 7, while figures 3a to 3c show this acquisition for Control subjects from sessions 1 to 3. The data shown in these figures were obtained by calculating the mean change in cardiac Interbeat Interval (IBI) across all subjects for the 20 feedback trials, 4 pre-feedback transfer trials, 6 post-feedback transfer trials and 4 blank trials for each session. Note that FBinc/FBdec refer to increase and decrease feedback trials, Test1inc/Test1dec refer to the first block of transfer trials, and Test2inc/Test2dec to the second block of transfer trials. Blank1 represents the 2 blank trials intermixed within the first transfer block, and Blank2 refers to the 2 blank trials intermixed within the second transfer block. Recall that a positive change in IBI indicates a decrease in heart rate, while a negative change in IBI represents an increase in heart rate. While

Figure 2a

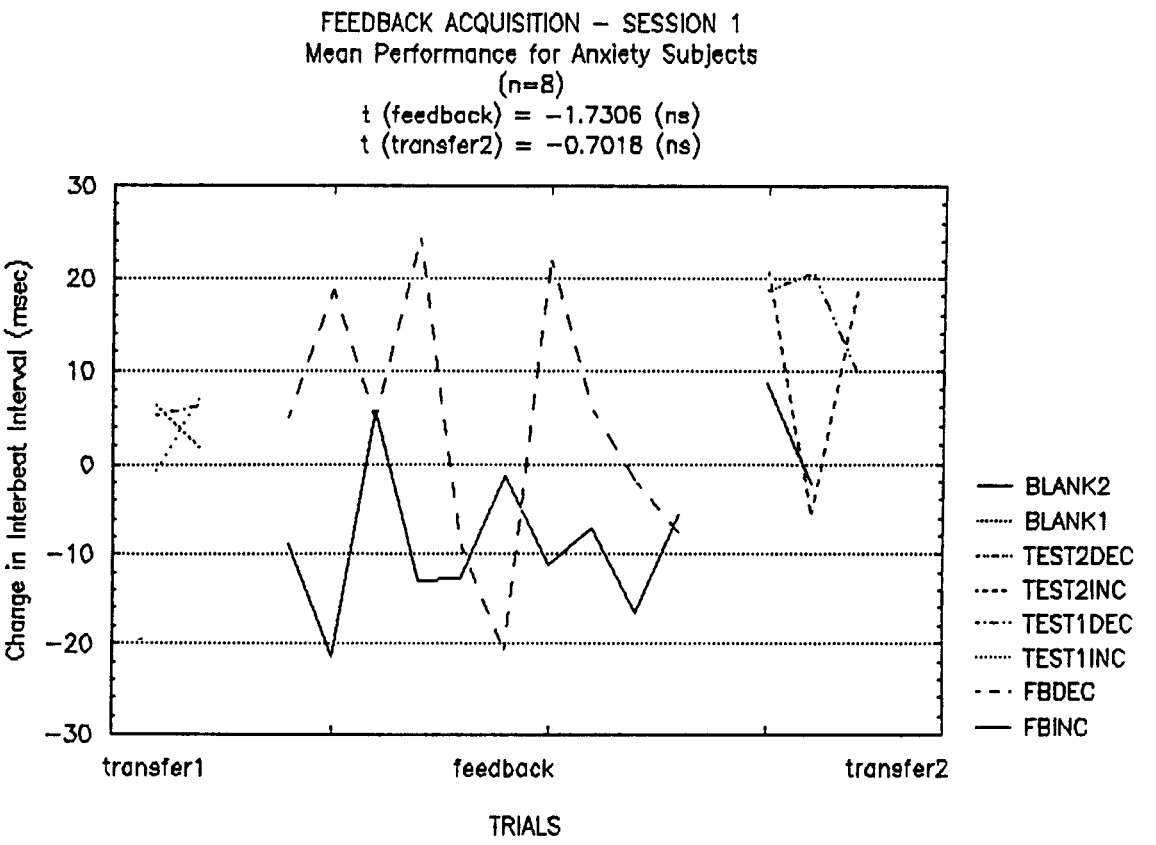


Figure 2b

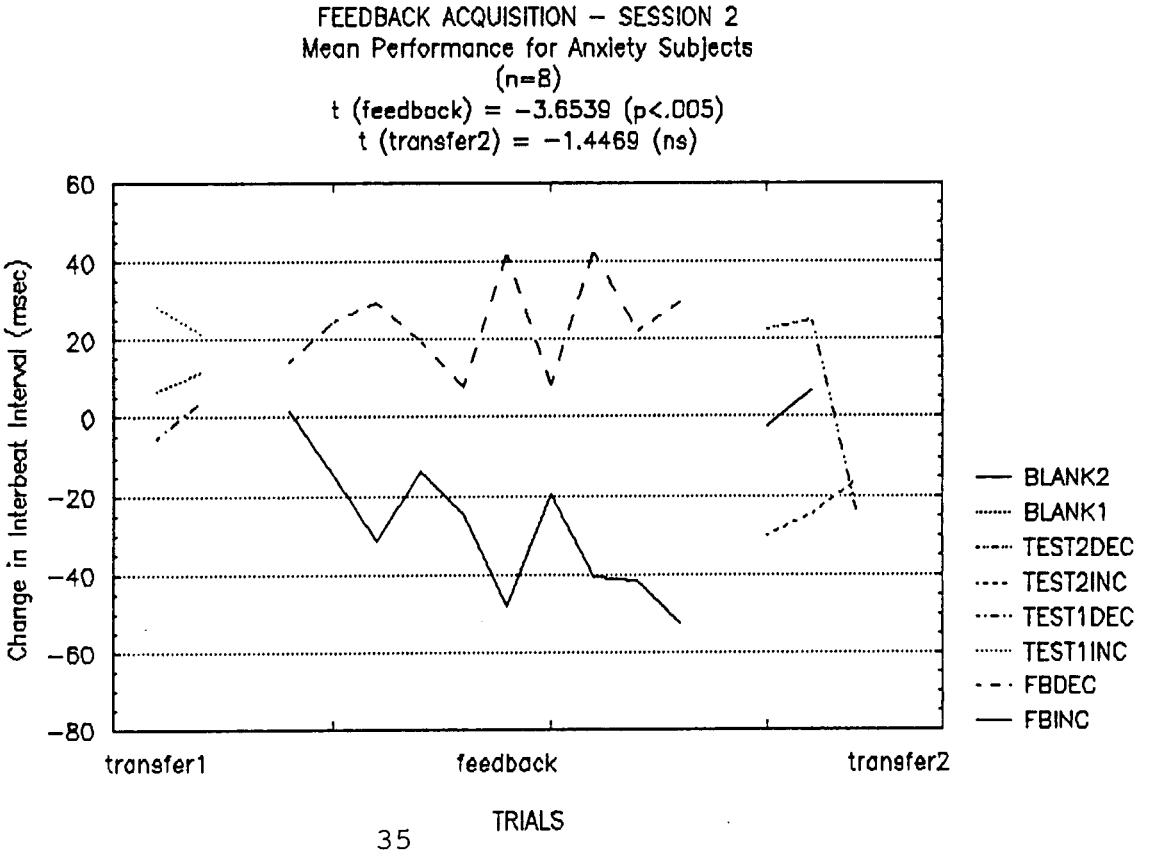


Figure 1c

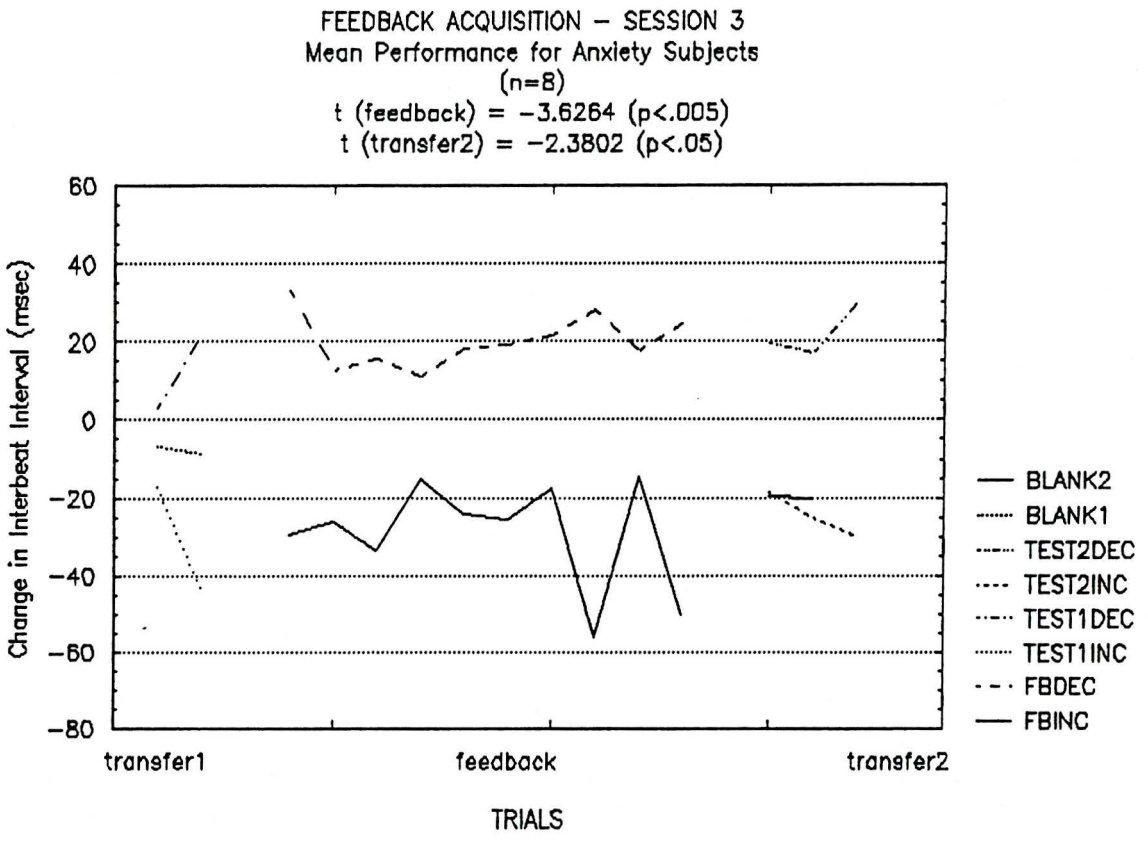


Figure 1d

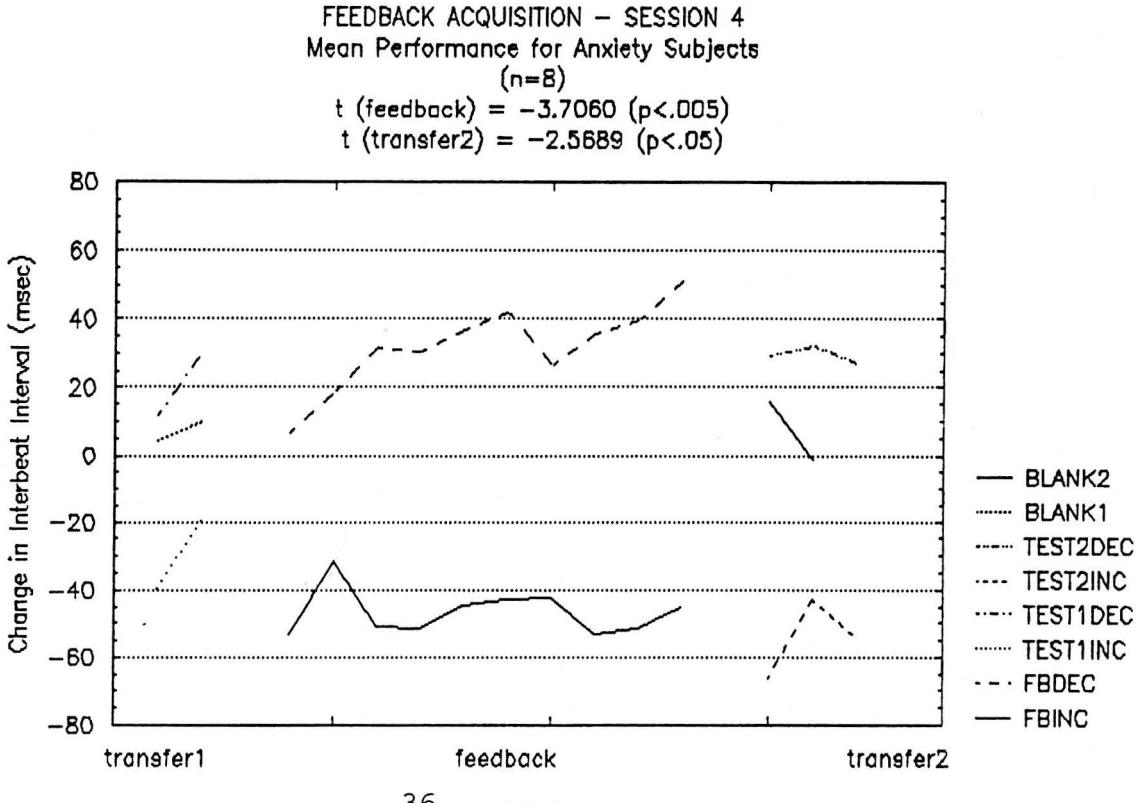


Figure 1e

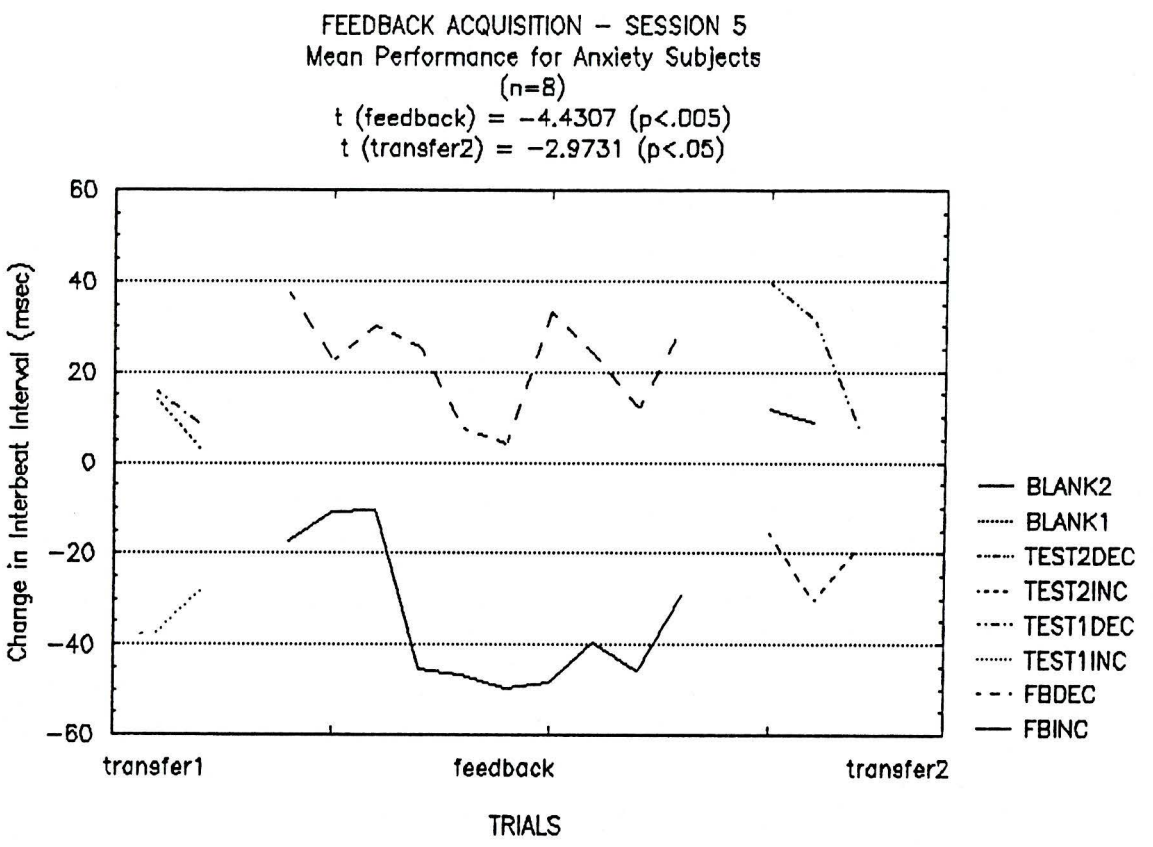


Figure 1f

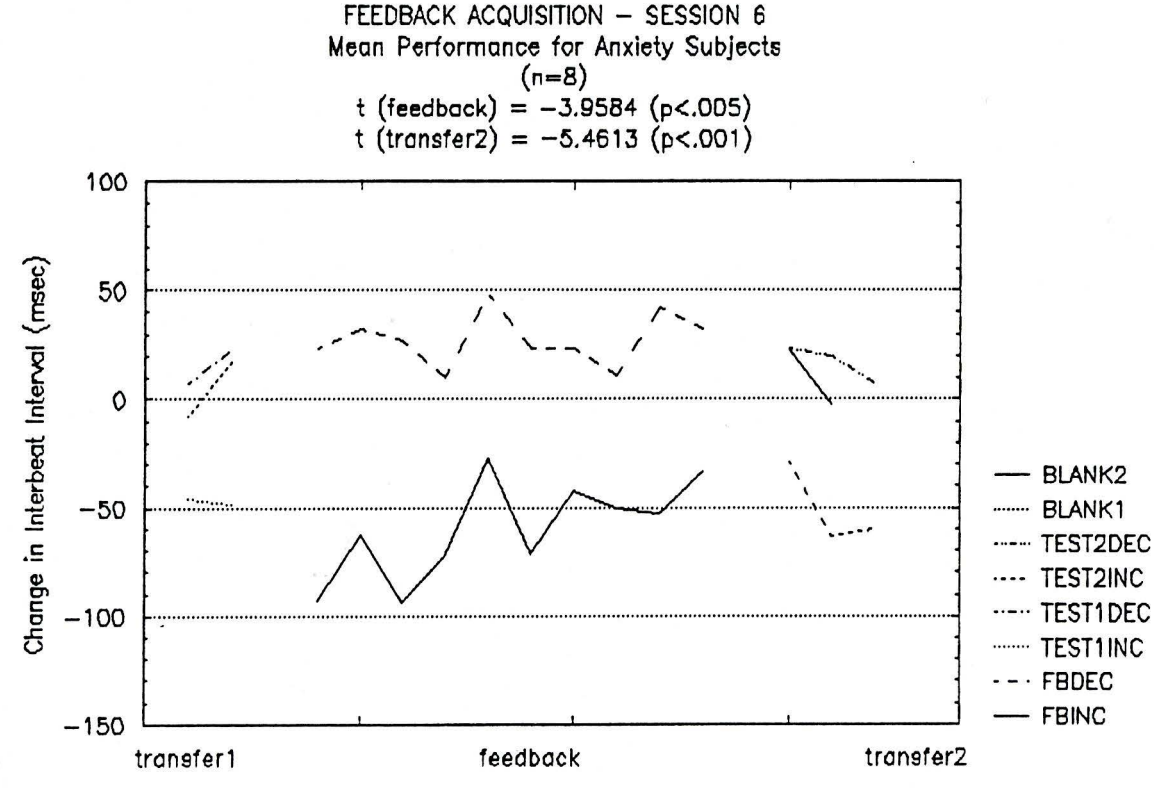


Figure 2g

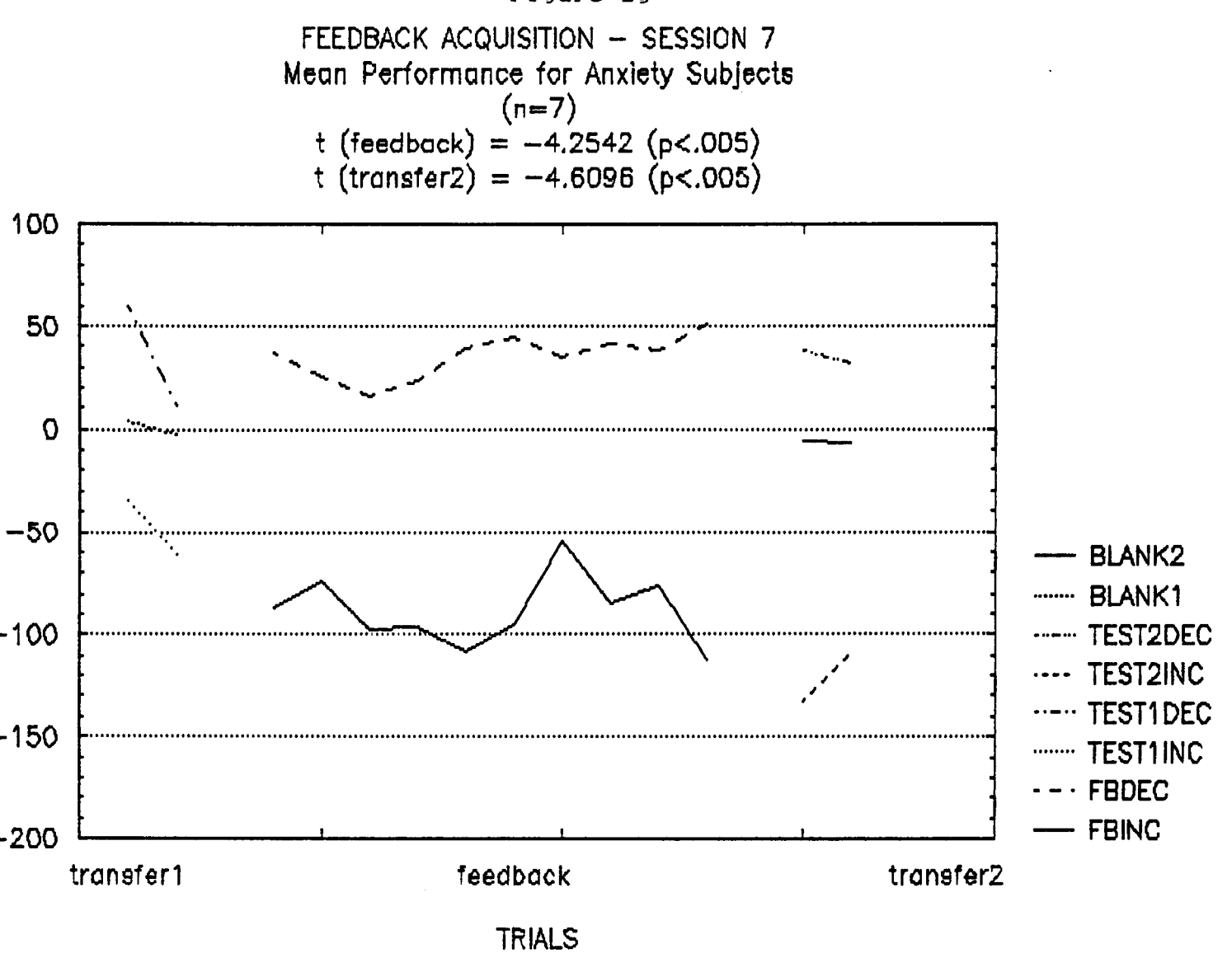

FEEDBACK ACQUISITION – SESSION 7
Mean Performance for Anxiety Subjects
(n=7)
t (feedback) = −4.2542 (p<.005)
t (transfer2) = −4.6096 (p<.005)
100
50
0
−50
−100
−150
−200
transfer1
feedback
transfer2
TRIALS
BLANK2
BLANK1
TEST2DEC
TEST2INC
TEST1DEC
TEST1INC
FBDEC
FBINC

Figure 3a

FEEDBACK ACQUISITION – SESSION 1
Mean Performance for Control Subjects
(n=10)
t (feedback) = −2.7807 (p<.05)
t (transfer2) = −3.0736 (p<.01)

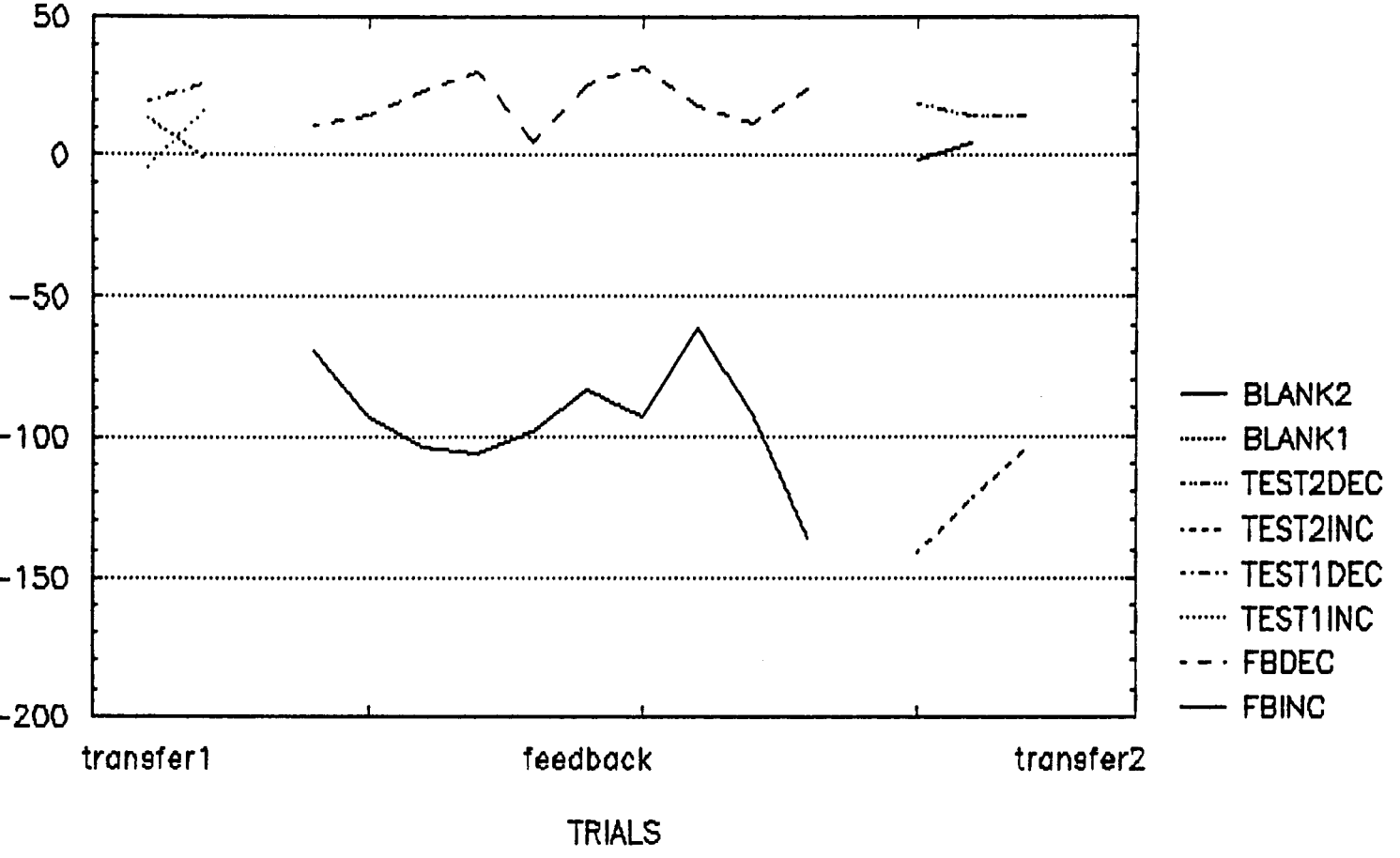


Figure 3b

FEEDBACK ACQUISITION – SESSION 2

Mean Performance for Control Subjects

(n=10)

t (feedback) = −5.4996 (p<.0005)

t (transfer2) = −6.3668 (p<.0001)

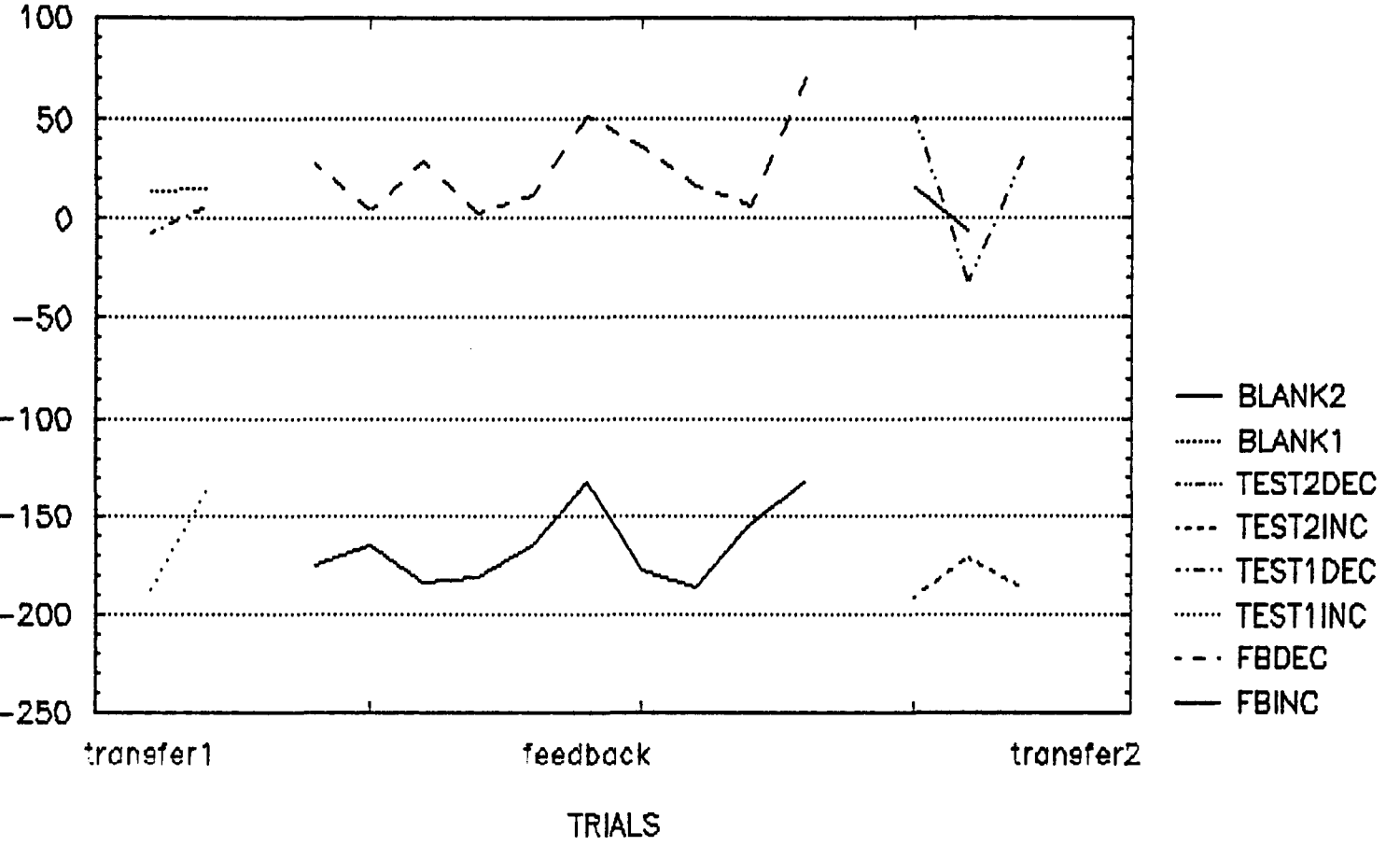
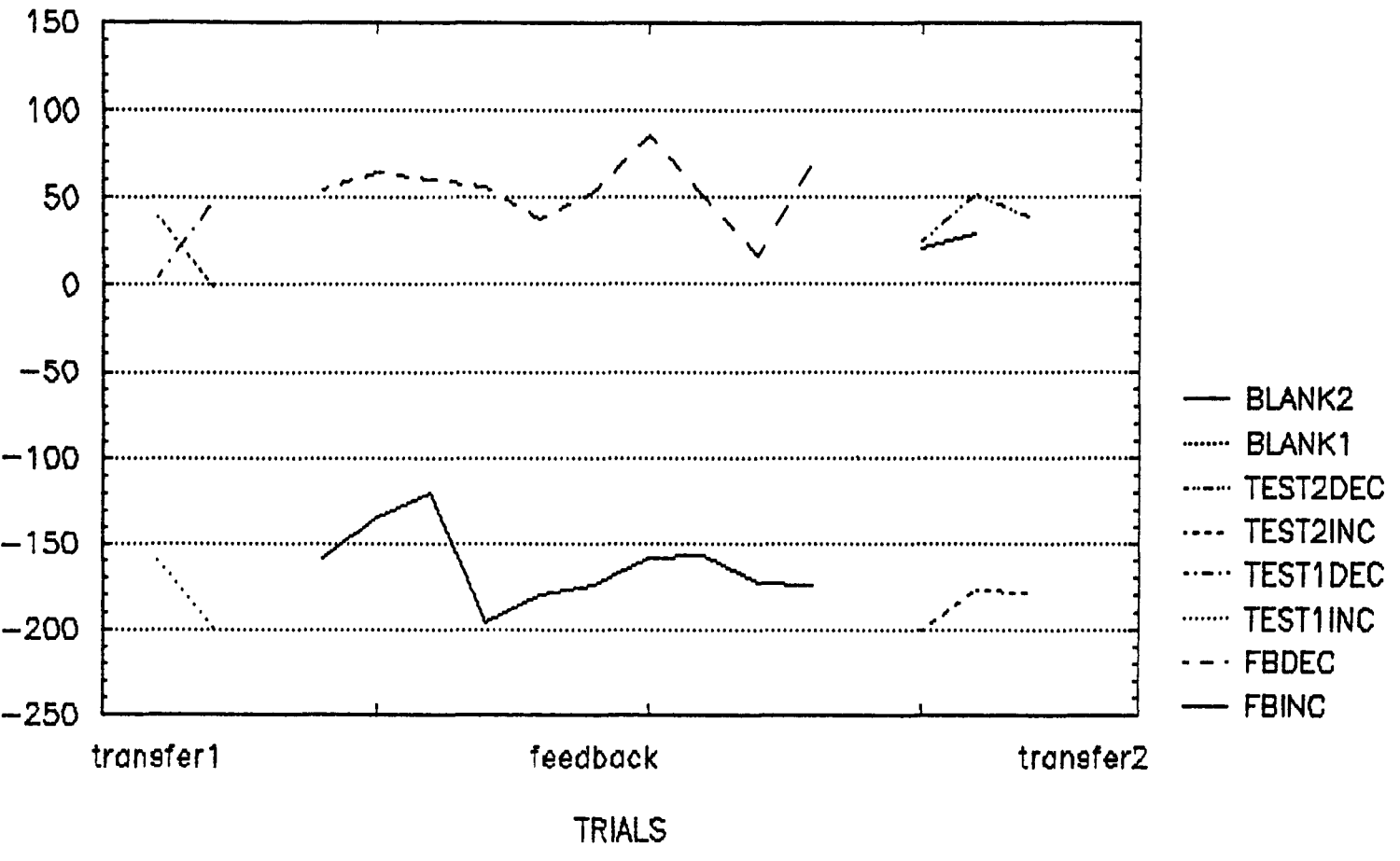


Figure 3c


FEEDBACK ACQUISITION – SESSION 3
Mean Performance for Control Subjects
(n=10)
t (feedback) = −4.1112 (p<.005)
t (transfer2) = −4.9911 (p<.0005)
150
100
50
0
−50
−100
−150
−200
−250
transfer1
feedback
transfer2
TRIALS
BLANK2
BLANK1
TEST2DEC
TEST2INC
TEST1DEC
TEST1INC
FBDEC
FBINC

both groups differentiated between the increase and decrease responses over time, the Anxiety subjects showed slower acquisition of heart rate control when compared to Control subjects. This difference is illustrated in figure 4, which compares the mean changes in IBI for Anxiety and Control subjects during increase and decrease feedback trials over training sessions. Although both groups learned to produce the increase and decrease responses over the course of feedback training, Anxiety subjects never produced heart rate increases or decreases to the magnitude achieved by the Control subjects, even with four extra training sessions.

Statistical Analysis of Feedback Skill:

Feedback skill was statistically measured for each subject by performing a one-tailed dependent measures t-test on the difference between IBI changes during the 10 increase and 10 decrease feedback trials for each session. Significant negative t-values indicated successful feedback differentiation between increase and decrease heart rate responses. Similarly, a one-tailed dependent measures t-test was calculated on the 3 increase and 3 decrease transfer trials at the end of each session. This was in order to test subjects' ability to perform the required responses in the absence of feedback.

Table 2 compares the percentage of Anxiety and Control subjects who significantly differentiated between the A and B responses during feedback trials, over the course of seven and three sessions respectively. As a group, Anxiety subjects took longer to differentiate than Control subjects. While 100% of

Figure 4

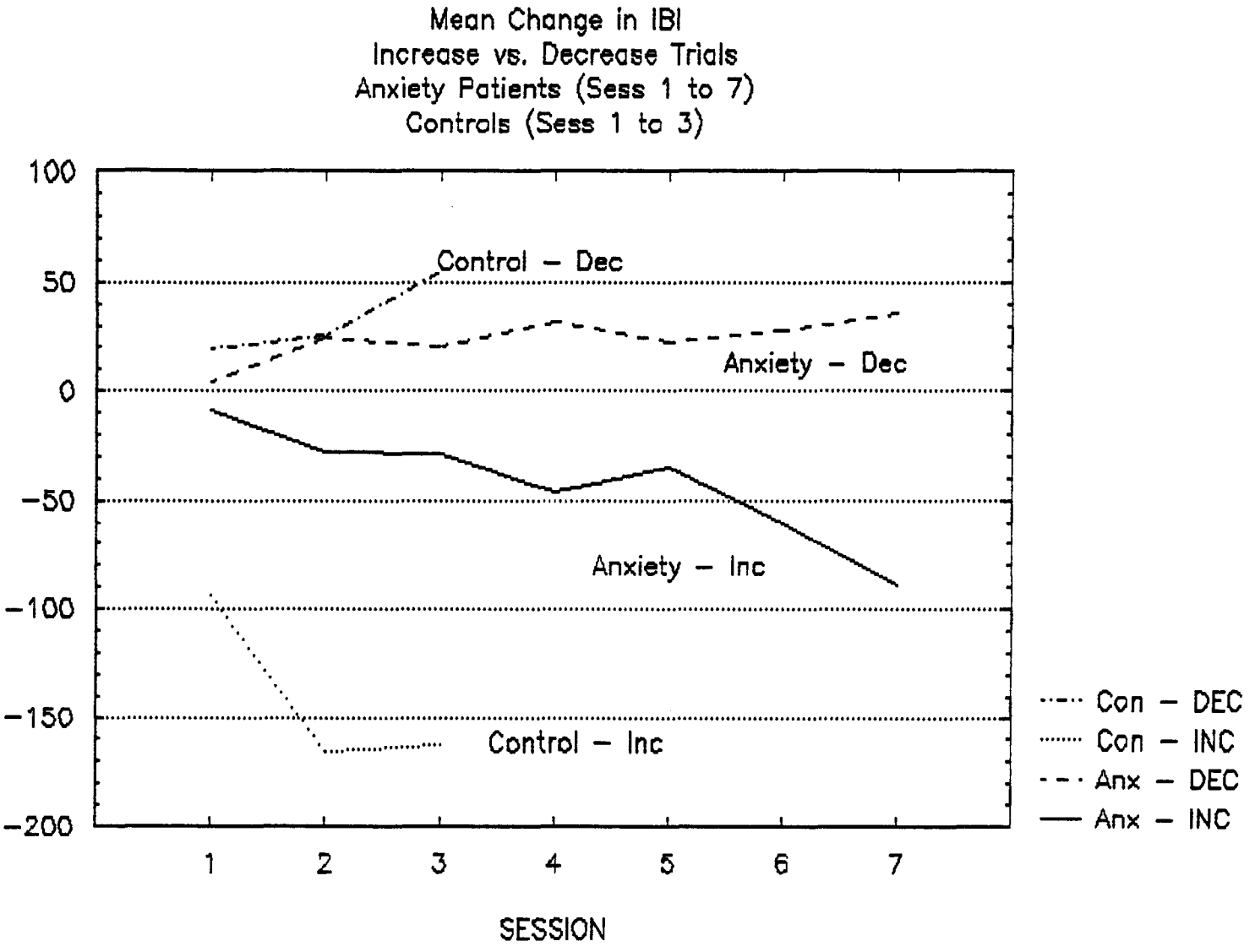

Mean Change in IBI
Increase vs. Decrease Trials
Anxiety Patients (Sess 1 to 7)
Controls (Sess 1 to 3)
100
50
0
−50
−100
−150
−200
Control − Dec
Anxiety − Dec
Anxiety − Inc
Control − Inc
1
2
3
4
5
6
7
SESSION
Con − DEC
Con − INC
Anx − DEC
Anx − INC

Table 2

FEEDBACK PERFORMANCE:
% DIFFERENTIATION AMONG ANXIETY PATIENTS VS. CONTROLS

	SESS1	SESS2	SESS3	SESS4	SESS5	SESS6	SESS7
ANXIETY (n=8)	13% 1/8	63% 5/8	63%	88% 7/8	63%	88%	86% (n=7)
CONTROL (n=10)	70%	90%	100%	---	---	---	---

The above indicates that anxiety subjects took longer as a group to differentiate between the A and B responses during feedback trials, than did the control group, who achieved 100% differentiation on their third feedback session.

Controls differentiated by session 3, their last feedback session, 86% of Anxiety subjects differentiated between the A and B responses by the end of session 7.

Table 3 displays the group t-test values for feedback trials and the second block of transfer trials from sessions 1 to 7. These t-test values represent the mean bidirectional difference in IBI change (Increase trials - Decrease trials) calculated against zero. For the anxiety group, the df = 7 for sessions 1 to 6, while df = 6 for session 7, since one subject did not complete this final session. For the Control group, df = 9 for all sessions shown. The greater the negative t-value, the greater the degree of differentiation between A and B on each given session. As a group, Anxiety patients differentiated on feedback trials during session 2 and on transfer trials during session 3, while the Control subjects differentiated on both feedback and transfer trials during session 1. As well as taking longer to acquire the skill in the presence of feedback, Anxiety patients also took longer to perform this skill during test trials, in the absence of feedback.

In order to statistically compare Anxiety and Control subjects' feedback performance during increase and decrease trials, between-groups t-tests were performed for session 3. These t-tests were calculated by taking the mean change in IBI for the Anxiety group (n=8) against the mean change in IBI for the Control group (n=10) for both trial types. For increase trials, the two-tailed t-value obtained (2.531) was significant at $p < 0.05$, meaning that Control subjects showed significantly greater increases in heart

Table 3

GROUP FEEDBACK PERFORMANCE:
ANXIETY PATIENTS AND CONTROLS

The following tables display the t-test values of the mean bidirectional difference in IBI change (Increase - Decrease) during feedback and transfer2 trials, calculated against zero, for both anxiety subjects and control subjects. The greater the negative t-value, the greater the degree of differentiation between A and B on each given session:

FEEDBACK TRIALS:

	SESS1	SESS2	SESS3	SESS4	SESS5	SESS6	SESS7 (n=7)
ANXIETY (n=8)	-1.73	-3.65 ***	-3.63 ***	-3.71 ***	-4.43 ***	-3.96 ***	-4.25 ***
CONTROL (n=10)	-2.78 *	-5.50 *****	-4.11 ***	---	---	---	---

TRANSFER2 TRIALS:

	SESS1	SESS2	SESS3	SESS4	SESS5	SESS6	SESS7 (n=7)
ANXIETY (n=8)	-0.70	-1.45	-2.38 *	-2.57 *	-2.97 *	-5.46 ****	-4.61 ***
CONTROL (n=10)	-3.07 **	-6.37 *****	-4.99 *****	---	---	---	---

NOTE:
* refers to p<.05 (one-tailed)
** refers to p<.01
*** refers to p<.005
**** refers to p<.001
***** refers to p<.0005

From this table, it is apparent that as a group, the anxiety patients differentiated on feedback trials during session 2 and on transfer trials during session 3, while the control group differentiated on both feedback and transfer trials during session 1.

rate than Anxiety patients. In the case of decrease trials, the calculated t-value (-2.600) was also significant at $p < 0.05$, indicating that Control subjects achieved significantly greater decreases in heart rate when compared to the Anxiety group.

Physiological Response Patterns:

Figures 5a to 5j illustrate the mean physiological response patterns shown by Anxiety and Control subjects for session 3, as measured by the electrophysiological recordings. By this session, both groups of subjects demonstrated a significant degree of differentiation on both feedback and transfer trials. On each figure, "CHANNELS" refer to specific types of physiological activity, including heart rate interbeat interval (IBI), skin conductance as measured on the right palm (SC-R), muscle activity (EMG), gross bodily movement (MVT), amplitude of respiration (R-AMP), intercycle interval or time between inhalations (R-ICI) and area under the respiratory envelope curve (R-VOL). Since these channels differ in units of measurement, t-test values were used to establish a common unit. As changes in IBI, SC-R, EMG, MVT and R-ICI are calculated by subtracting pretrial from trial measurement (zero indicating no change), t-tests for these channels were calculated against zero. In contrast, since changes in R-AMP and R-VOL are expressed as a ratio between trial to pretrial measurement (one indicating no change), t-tests for these channels were calculated against one.

In the case of feedback, transfer trials and blank trials across eight Anxiety subjects (df=7), a two-tailed t-test of 2.365

Figure 5a

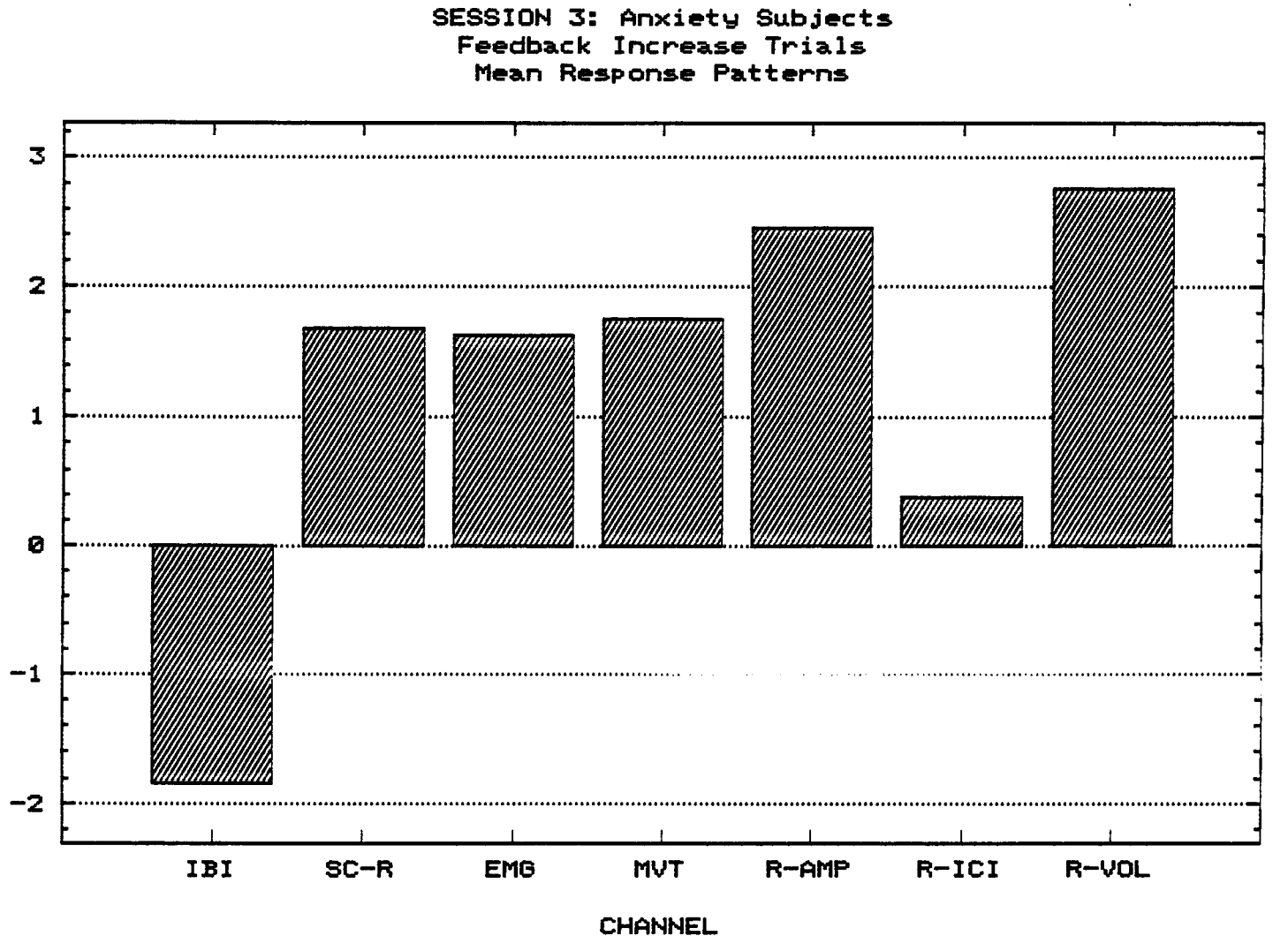

SESSION 3: Anxiety Subjects
Feedback Increase Trials
Mean Response Patterns
3
2
1
0
-1
-2
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5b

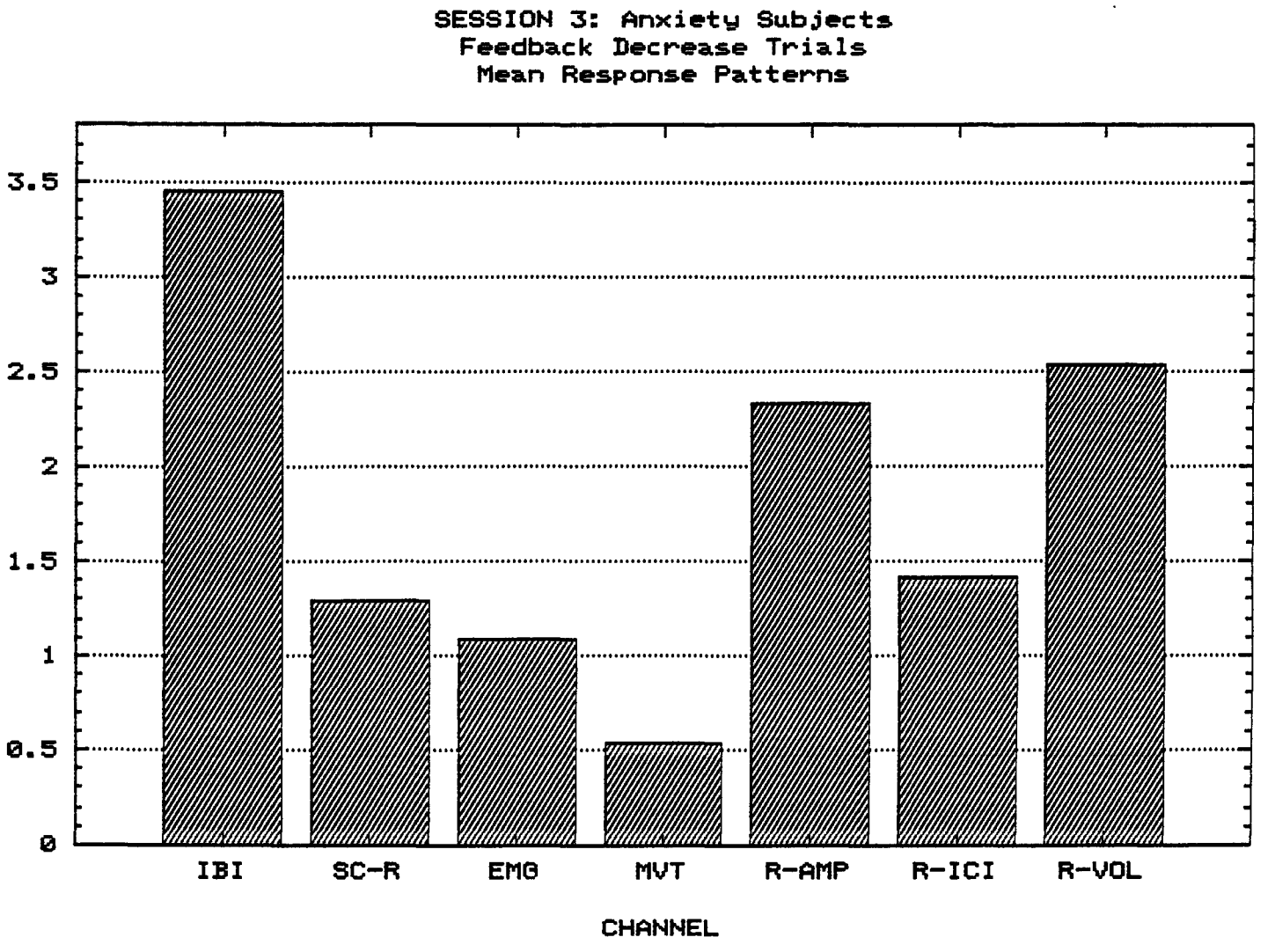

SESSION 3: Anxiety Subjects
Feedback Decrease Trials
Mean Response Patterns
3.5
3
2.5
2
1.5
1
0.5
0
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5c

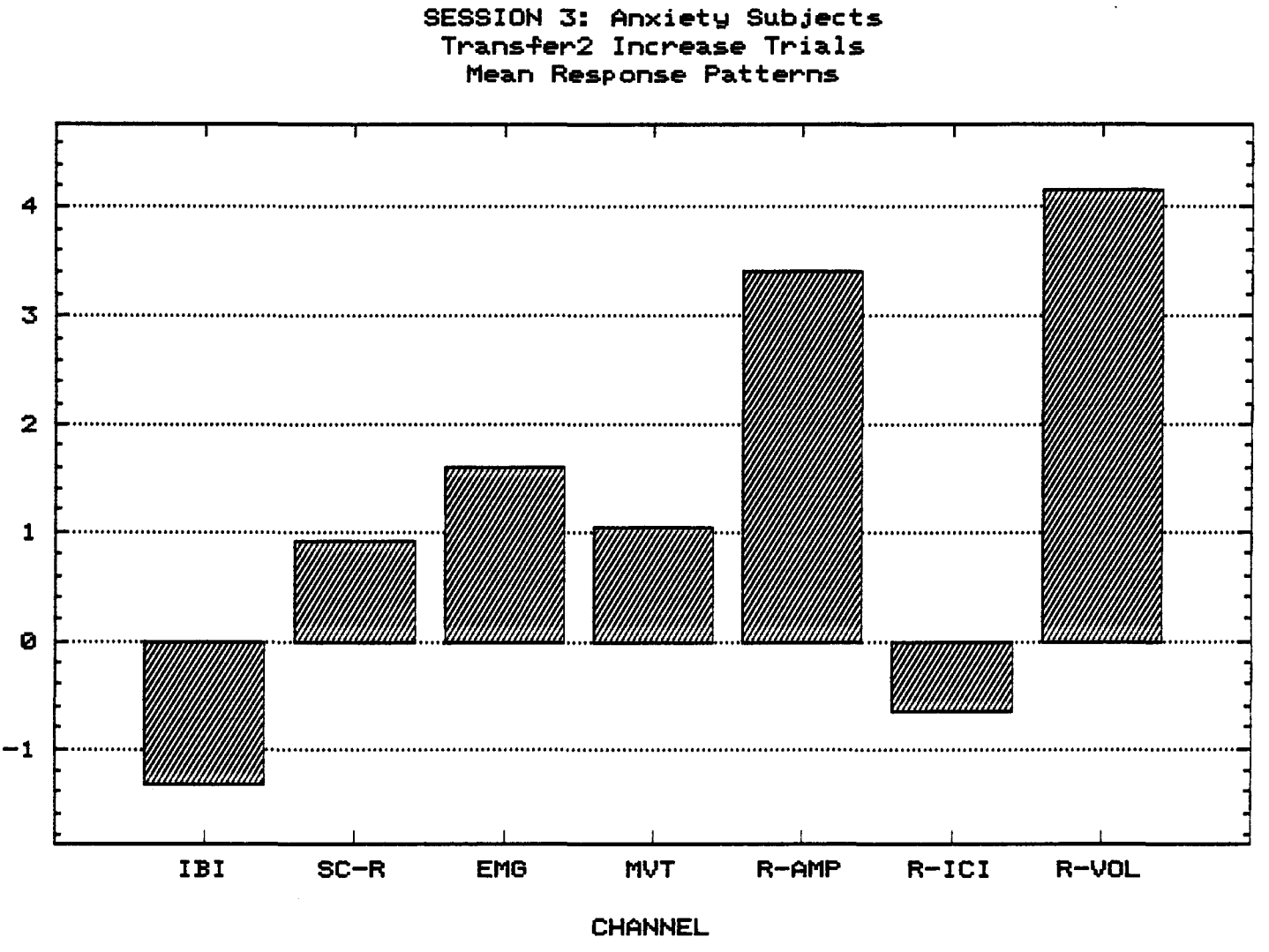

SESSION 3: Anxiety Subjects
Transfer2 Increase Trials
Mean Response Patterns
4
3
2
1
0
-1
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5d

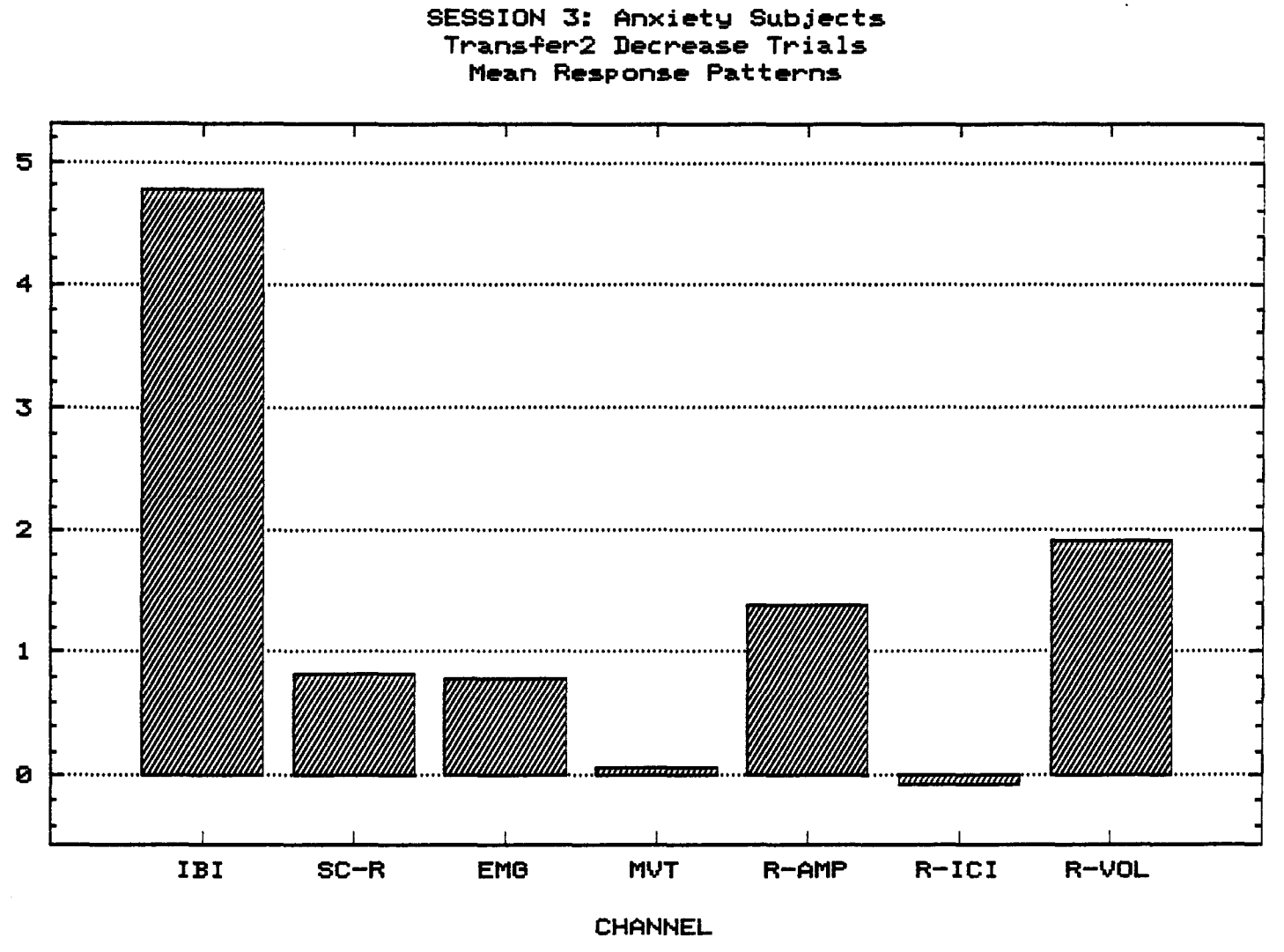

SESSION 3: Anxiety Subjects
Transfer2 Decrease Trials
Mean Response Patterns
5
4
3
2
1
0
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5e

SESSION 3: Control Subjects
Feedback Increase Trials
Mean Response Patterns

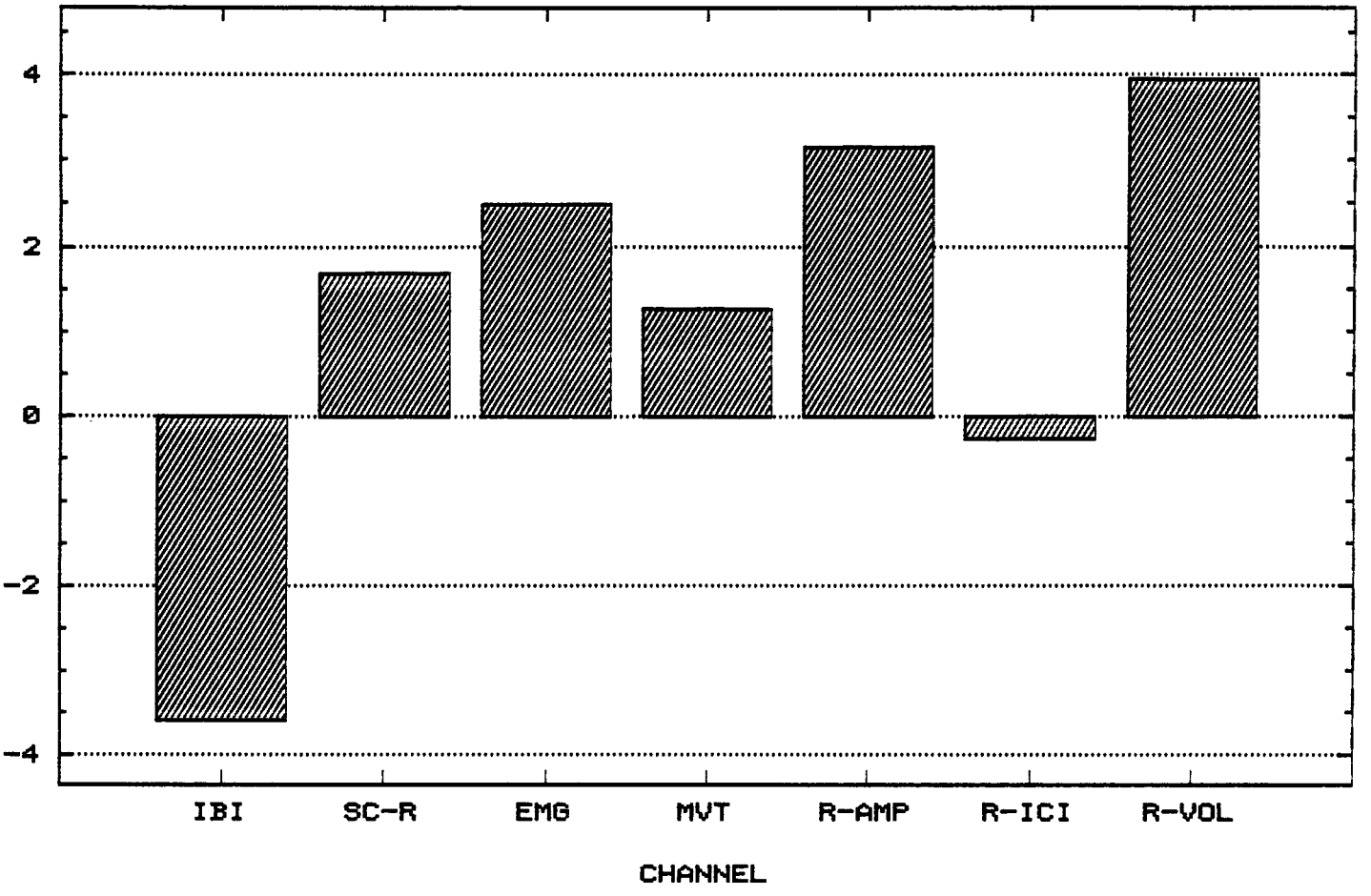


Figure 5f

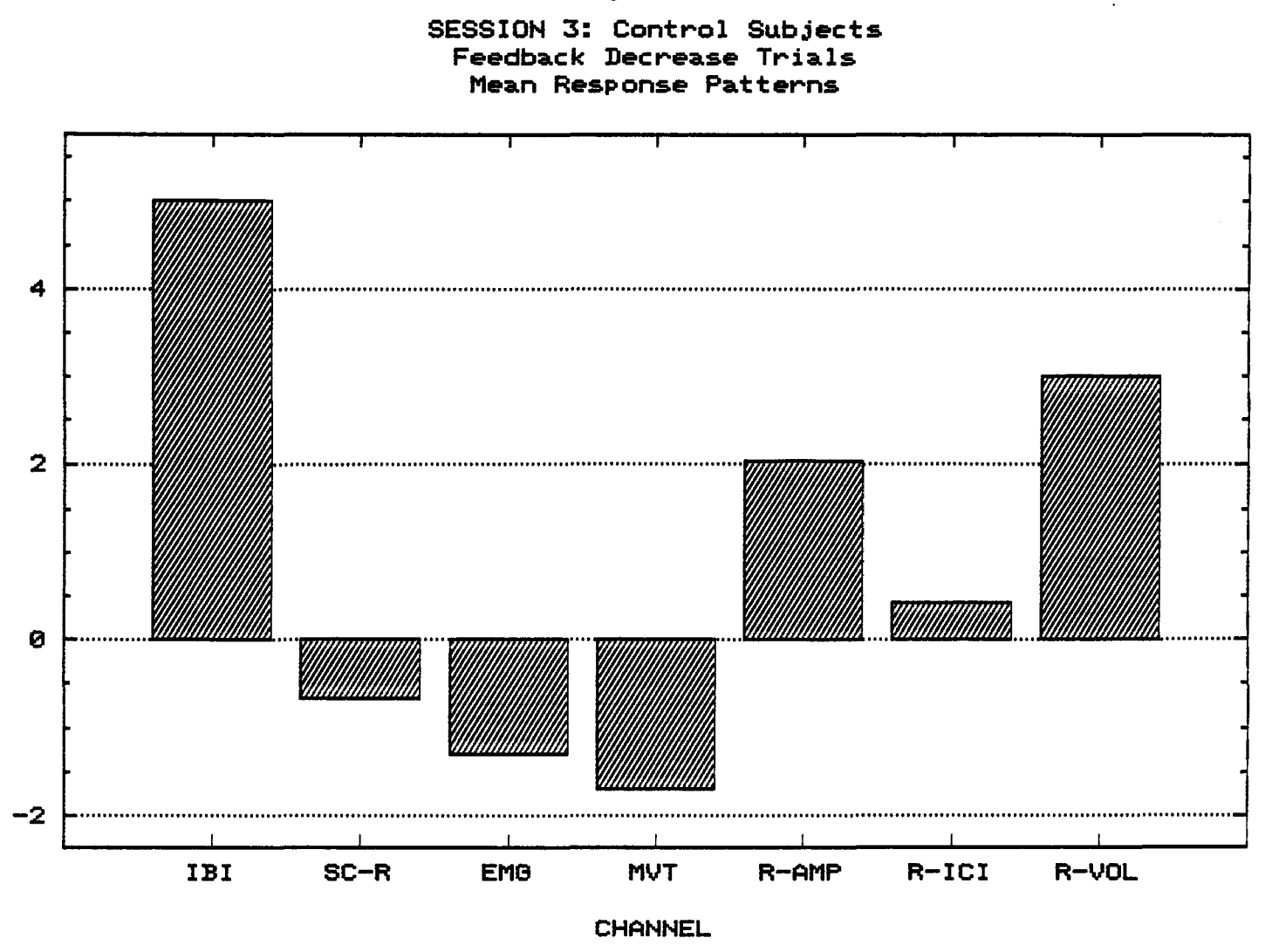

SESSION 3: Control Subjects
Feedback Decrease Trials
Mean Response Patterns
4
2
0
-2
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5g

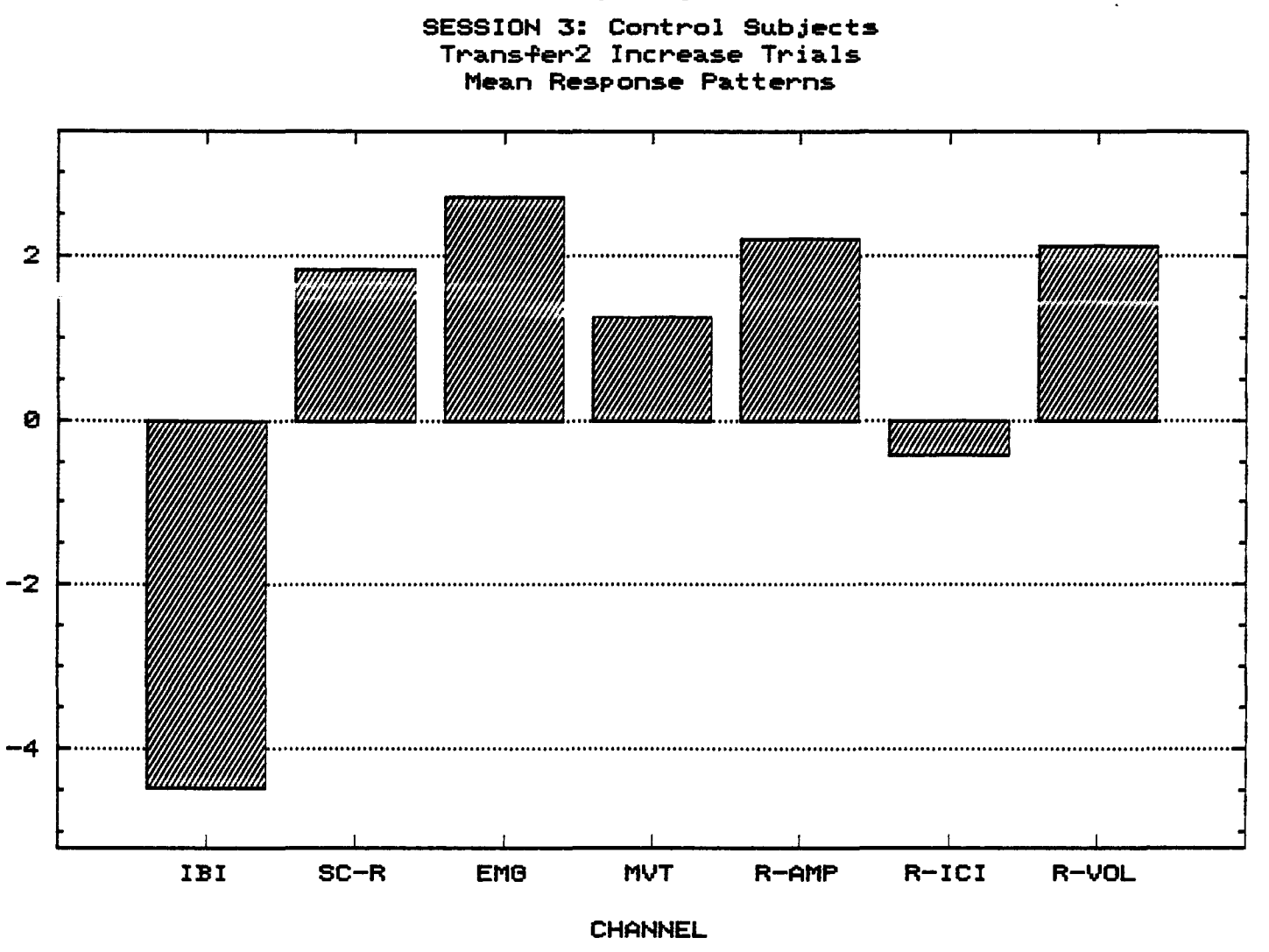

SESSION 3: Control Subjects
Transfer2 Increase Trials
Mean Response Patterns
2
0
-2
-4
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5h

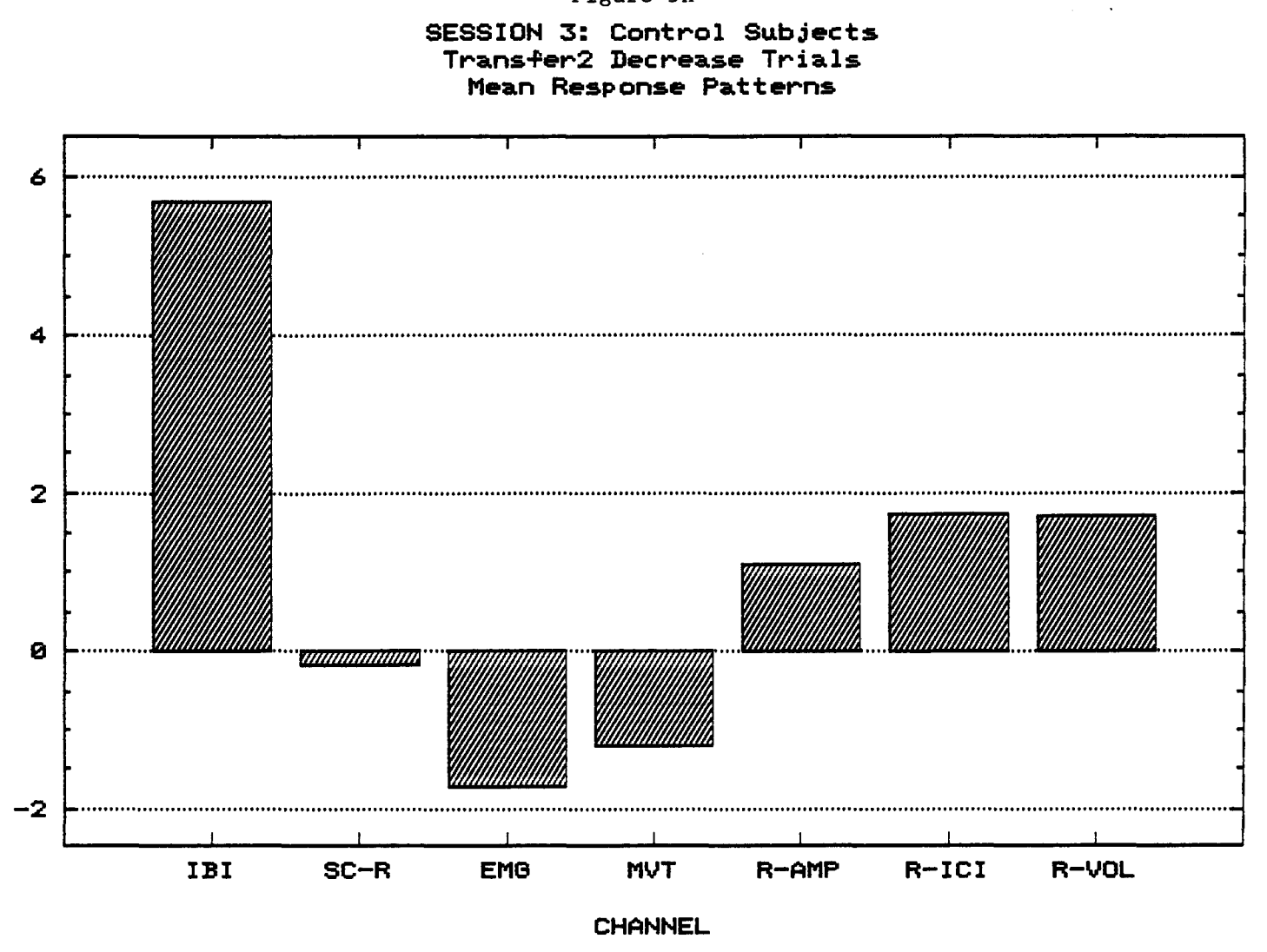

SESSION 3: Control Subjects
Transfer2 Decrease Trials
Mean Response Patterns
6
4
2
0
-2
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5i

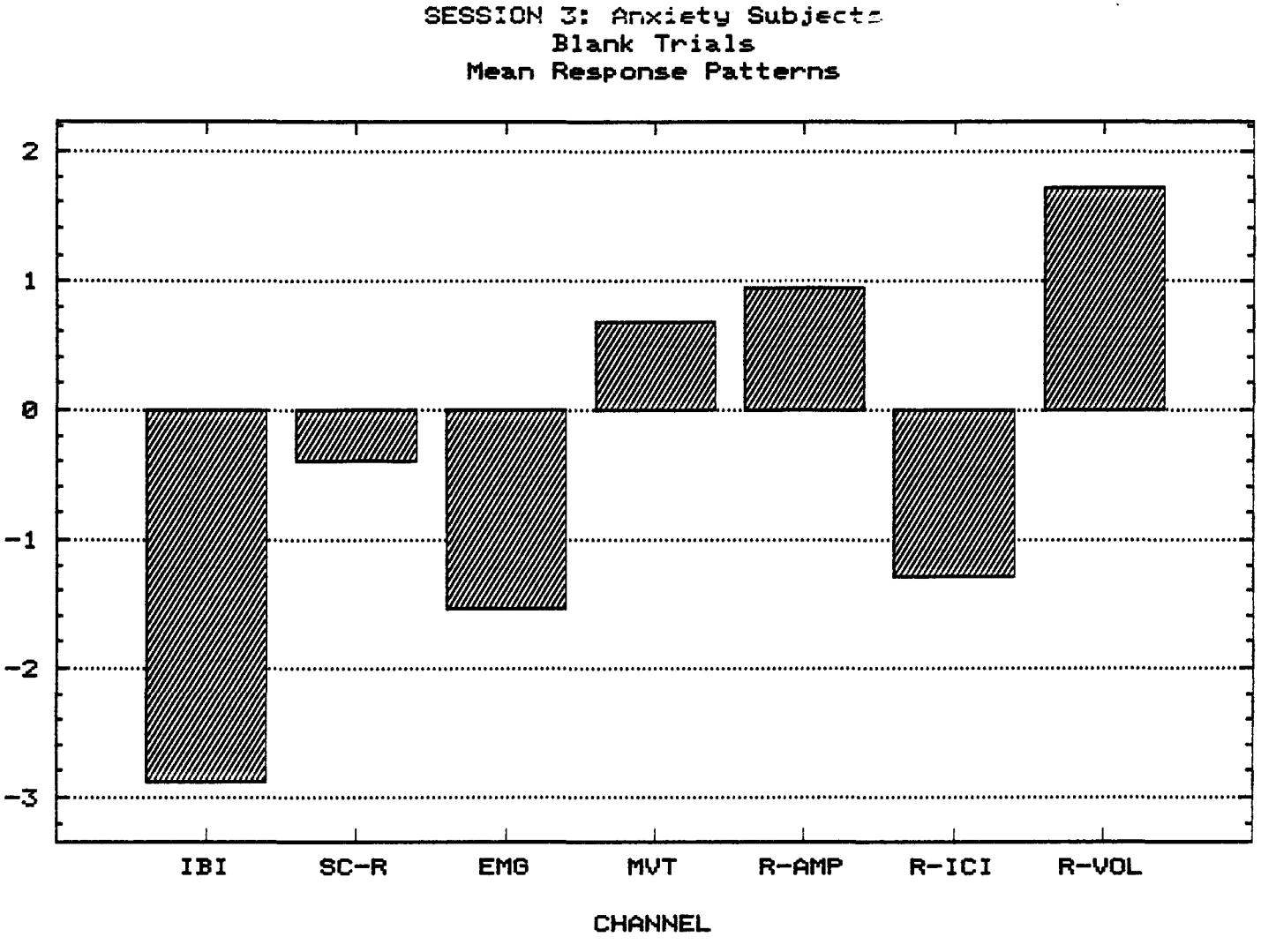
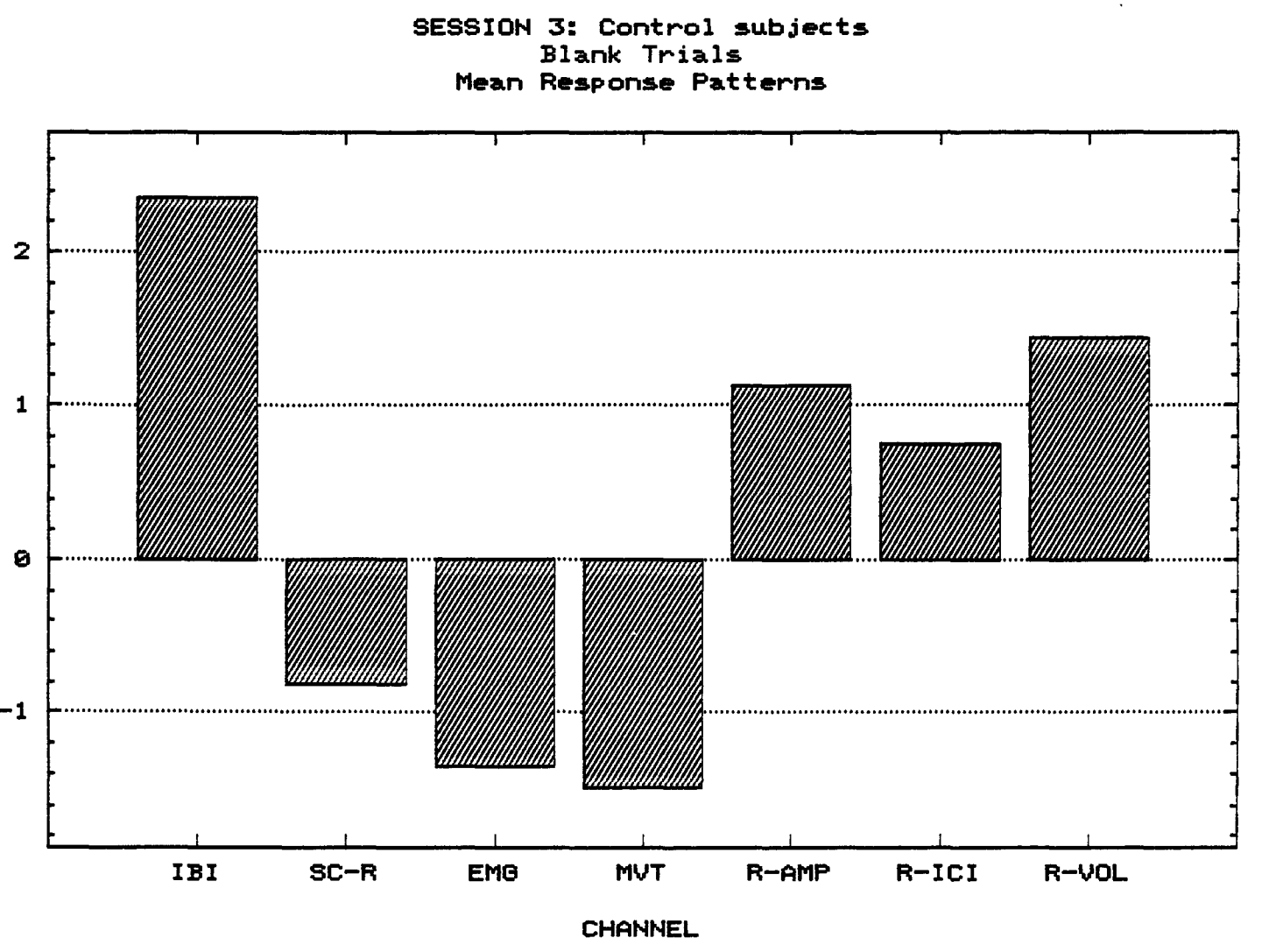

SESSION 3: Anxiety Subjects
Blank Trials
Mean Response Patterns
2
1
0
-1
-2
-3
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

Figure 5j


SESSION 3: Control subjects
Blank Trials
Mean Response Patterns
2
1
0
-1
IBI
SC-R
EMG
MVT
R-AMP
R-ICI
R-VOL
CHANNEL

is significant at $p<.05$. Thus, figure 5a shows that during feedback increase trials, Anxiety subjects significantly increased their amplitude of respiration and area under the respiratory envelope. These subjects also non-significantly decreased their IBI (increased heart rate), and increased their skin conductance, EMG activity and movement. As shown in figure 5c, Anxiety subjects employed the same general pattern of responding during transfer increase trials as they did when provided with feedback. In comparison, Figure 5b indicates that during feedback decrease trials, Anxiety subjects showed significant increases in IBI (heart rate decreases). When compared to increase trials, less movement and a greater tendency to increase the time between respiratory inhalations were also shown during decrease trials. Figure 5d shows that during transfer decrease trials, Anxiety subjects significantly decreased their heart rates from baseline, with less change in responding shown in the other channels.

For feedback, transfer trials and blank trials across ten Control subjects ($df=9$), a two-tailed t-test of 2.262 is significant at $p<.05$. With respect to increase trials, figures 5e and 5g illustrate that Control subjects showed the same pattern of responding as Anxiety subjects, both in the presence and absence of feedback, but with more pronounced increases in heart rate and EMG activity. In the case of decrease feedback and transfer trials, figures 5f and 5h show that Control subjects, like Anxiety patients, significantly increased their IBI (decreased heart rate). As they did during increase trials, these subjects also increased

their amplitude of respiration and area under the respiratory envelope. However, the pattern of respiration was different during decrease trials when compared to increase trials, as subjects also showed a tendency toward increasing the time between respiratory inhalations during decrease trials. In addition to this, the Control group also showed a non-significant tendency to reduce skin conductance activity, EMG activity and gross motor movement during these trials.

When taken together, the above data indicate that Anxiety subjects and particularly Control subjects displayed tendencies to perform responses that are characteristic of panic and anxiety in the case of increase trials (i.e. rapid heart rate, increased muscle tension) and to use responses that are incompatible with anxiety during decrease trials (decreased heart rate, slower breathing, increased amplitude of respiration and respiratory volume, reduced EMG activity). These strategies were typically confirmed in the verbal reports collected after sessions 2 and 5 in Anxiety patients, and after sessions 2 and 3 in the Controls.

Finally, figures 5i and 5j display the mean response patterns shown by the Anxiety and Control groups during blank trials (no visual display on screen). During these trials, Anxiety subjects showed significant increases in heart rate, and non-significant small changes in the other channels measured. In comparison, Controls showed a barely significant decrease in heart rate, as well as other small changes in the remaining channels. It is useful to compare differences in subjects' responding during

transfer2 decrease trials and during blank trials, for the reason that subjects' heart rates may have decreased no more when employing specific strategies, than when sitting and simply waiting for the next trial presentation. If this was the case, there should be no difference between subjects' changes in IBI during transfer2 decrease trials and blank trials. However, in the Anxiety group, subjects showed completely opposite changes in cardiac responding during decrease and blank trials, with significant decreases in the former and increases in the latter. Furthermore, the Controls showed decreases in heart rate during transfer2 decrease trials that were almost three times as great as those shown during blank trials. These differences were significant within both groups.

Baseline IBI differences:

Table 4 displays the mean Pretrial Interbeat Intervals (msec), as well as the equivalent heart rates in beats per minute, for Anxiety patients (sessions 1 to 7) and Control subjects (sessions 1 to 3). These measures were considered to represent each subject's resting heart rate for the beginning of each feedback session. Recall that a high IBI (msec) is equivalent to a low heart rate in beats per minute. One-tailed t-tests were performed comparing this measure for session 1 to all other sessions shown. Table 4 indicates that the average resting heart rate for the Anxiety group remained relatively stable, with no significant increases or decreases across sessions 1 to 7. In contrast, the average resting heart rate for the Control group decreased

Table 4

MEAN PRETRIAL IBIs

The following are tables displaying the mean Pretrial IBIs for Anxiety patients (n=8) and Control subjects (n=10). One-tailed t-tests were performed comparing the Session 1 value to all other sessions shown.

Anxiety Patients:

SESSION	Mean Pretrial IBI (msec)	SIGNIFICANCE of t-test
Session 1	718.10 (83.55 bpm)	
Session 2	709.38 (84.58 bpm)	ns
Session 3	732.87 (81.87 bpm)	ns
Session 4	723.43 (82.94 bpm)	ns
Session 5	709.98 (84.51 bpm)	ns
Session 6	733.03 (81.85 bpm)	ns
Session 7	720.27 (83.30 bpm)	ns (n=7)

Control Subjects:

SESSION	Mean Pretrial IBI (msec)	SIGNIFICANCE of t-test
Session 1	803.20 (74.70 bpm)	
Session 2	871.40 (68.85 bpm)	$p<.005$
Session 3	852.99 (70.34 bpm)	$p=.0736$

significantly between session 1 and 2, then rose to a level non-significantly lower than the value measured in session 1.

Table 5 compares the Anxiety group to the Control group with respect to mean pretrial IBI for sessions 1, 2 and 3. Again, when converted into beats per minute, the Anxiety group had a mean initial resting heart rate of 83.55 bpm at session 1, while Controls had a rate of 74.70 bpm. This difference is significant at $p<.05$, and corroborates earlier reports that anxiety patients have an elevated resting heart rate compared to the normal population. This trend was shown throughout sessions 2 and 3, where the Anxiety group continued to demonstrate a significantly higher resting heart rate (lower interbeat interval) than the Control group. This result is presented graphically in Figure 6.

Clinical Measures

Clinical Profiles:

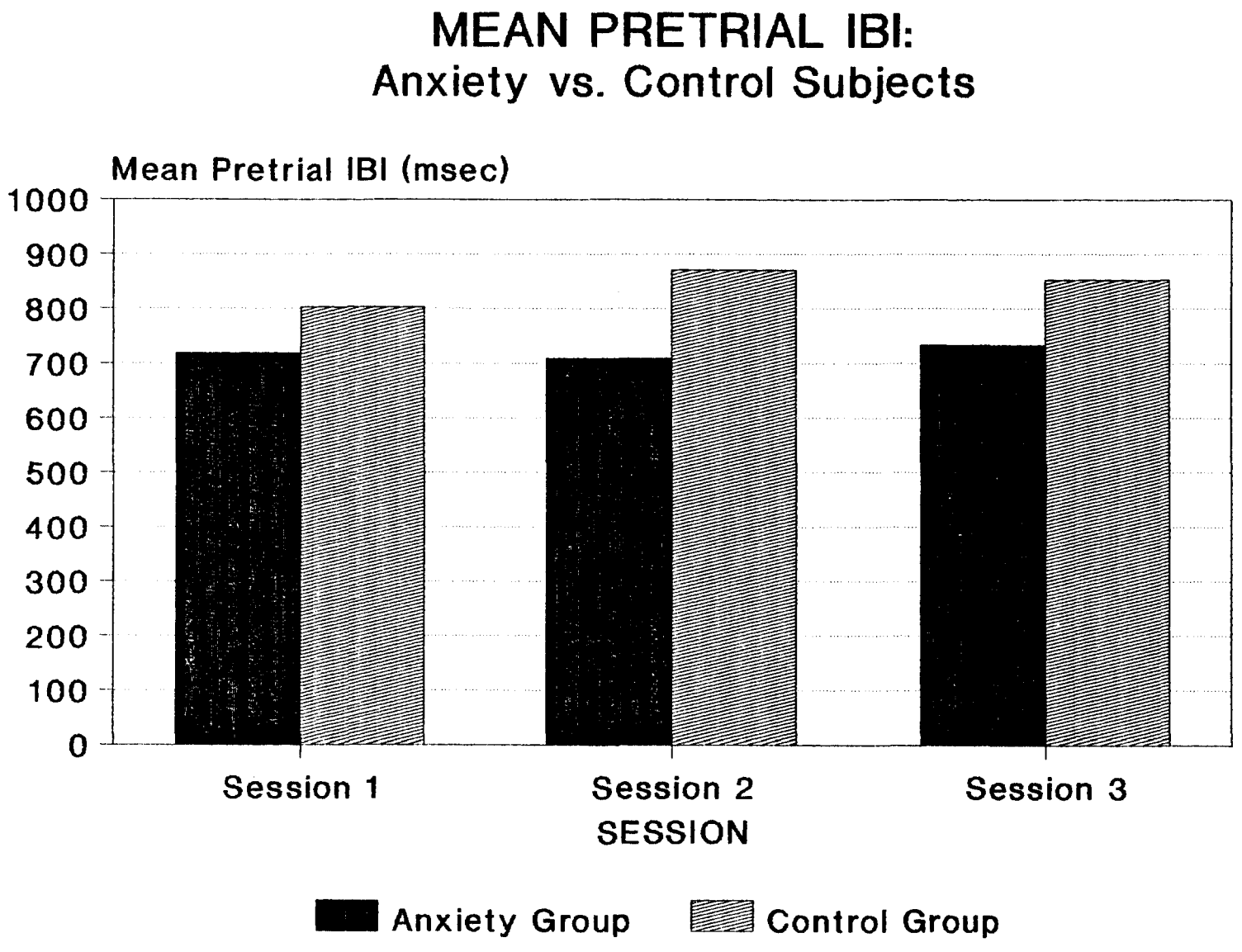
A general clinical profile was determined for each Anxiety and Control subject entering the study. Following each subject's initial interview session, a rating scale was filled out separately by two investigators: Dr. L.E. Roberts and L. Ploom. This scale evaluated each subject's anxiety disorders in 7 categories, including panic, agoraphobia, social phobia, specific phobia, obsessive-compulsive disorder, generalized anxiety disorder and performance anxiety, as determined from the structured anxiety interview (Appendix I). The scale also included a rating for subjects' level of depression. Ratings of 0 indicated the absence of anxiety/depression, 1 indicated a slight problem in a category

Table 5
MEAN PRETRIAL IBI:
Anxiety vs. Control Subjects

The following compares Anxiety patients (n=8) to Control subjects (n=10) with respect to mean pretrial IBI for sessions 1, 2 and 3:

	MEAN PRETRIAL IBI (msec):		
SESSION	ANXIETY	CONTROLS	T-test value
Session 1	718.10	803.20	-1.913 ($p<.05$)
Session 2	709.38	871.40	-3.269 ($p<.005$)
Session 3	732.87	852.99	-2.108 ($p<.05$)

Figure 6


MEAN PRETRIAL IBI:
Anxiety vs. Control Subjects
Mean Pretrial IBI (msec)
1000
900
800
700
600
500
400
300
200
100
0
Session 1
Session 2
Session 3
SESSION
Anxiety Group
Control Group

but not inviting intervention or treatment, and ratings of 2 to 5 represented increasing levels of clinical impairment. Figures 7a and 7b compare the calculated average clinical profiles for the Anxiety and Control subjects respectively, as rated by L. Ploom. On average, the Anxiety subjects displayed clinical levels of panic and generalized anxiety, with subclinical levels of agoraphobia, social phobia, specific phobia, obsessive-compulsive symptoms, performance anxiety and depression. In comparison, the Control group reported only subclinical or absent levels of anxiety and depression.

Anxiety and Panic Diary:

The principal clinical measure in this study was the Anxiety Diary (Appendix III), which consisted of two parts: 1) an Anxiety Report and 2) a Panic diary. Table 6 displays the number of panic attacks per day for the Anxiety subjects as a group, as reported on side 2 of the diary. One-tailed within-subjects t-tests (df=7) were performed comparing the intake measure (interview to feedback session 1) to all other time intervals shown. Here, the trend was a decrease in panic attacks compared to intake, which began to approach significance at the one-month follow-up. The number of attacks per day then increased at the two-month follow-up, as the result of one subject experiencing significant difficulties during that time period. All other subjects remained stable or decreased with respect to daily panic. The results described above are presented graphically in Figure 8.

Figure 9 shows the changes in rated panic intensity for the

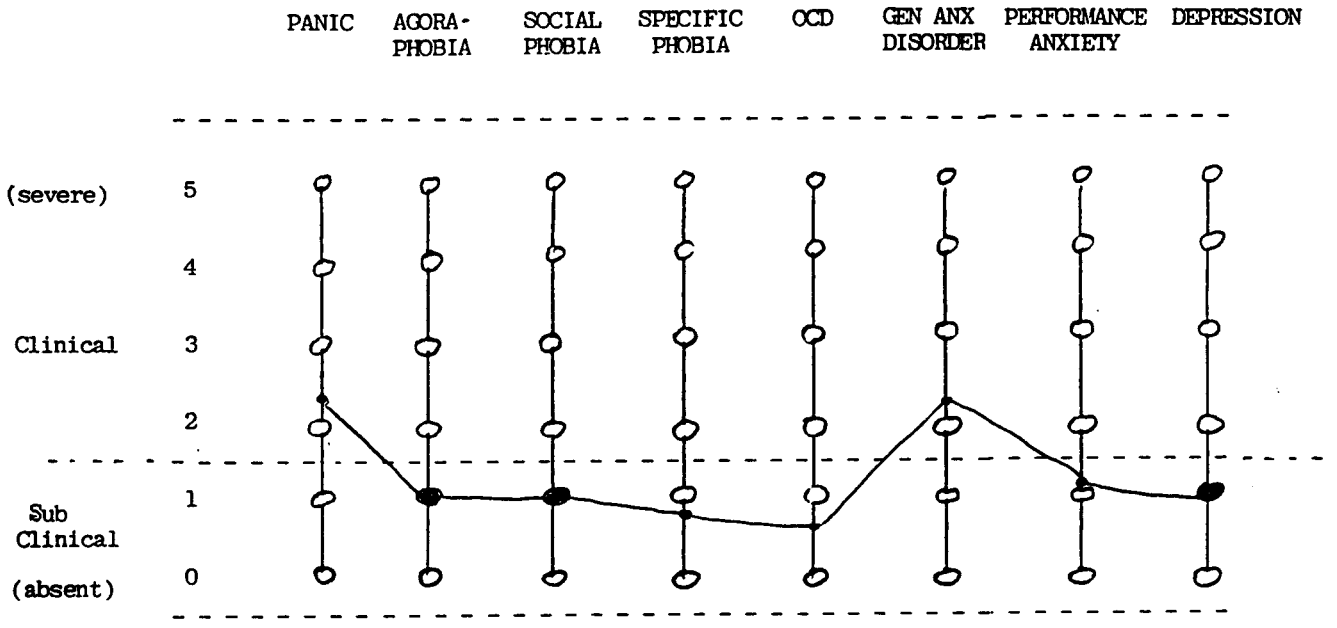
Figure 7a

Subject ANXIETY GROUP

Date _____

Investigator L. Ploom

ANXIETY CATEGORY



Place a mark on each scale
indicating the subject's current condition

Subclinical = not inviting intervention or treatment

Performance anxiety = anxiety associated with a specific task the subject must perform (test anxiety, interviews, seminars, public speaking are examples). These may or may not be present in social phobics who are also uncomfortable about being observed. Note that performance anxieties may occur in the absence of other anxiety problems.

Other anxiety categories are defined by DSM-III-R criteria

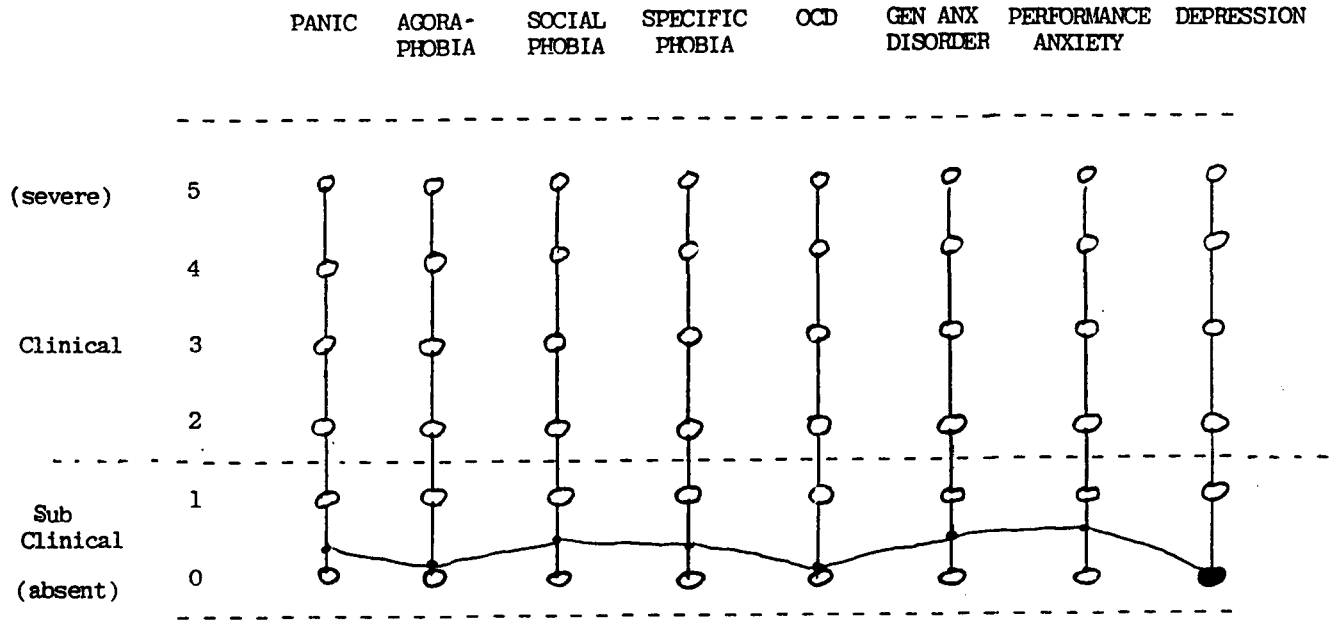
Figure 7b

Subject CONTROL GROUP

Date _____

Investigator L. Ploom

ANXIETY CATEGORY



Place a mark on each scale
indicating the subject's current condition

Subclinical = not inviting intervention or treatment

Performance anxiety = anxiety associated with a specific task the subject must perform (test anxiety, interviews, seminars, public speaking are examples). These may or may not be present in social phobics who are also uncomfortable about being observed. Note that performance anxieties may occur in the absence of other anxiety problems.

Other anxiety categories are defined by DSM-III-R criteria

Table 6

PANIC DIARY RESULTS

1) Control subjects (n=10) reported **no panic attacks** between intake and the one-month follow-up, with the exception of two situational subthreshold attacks by one subject.

2) The following is a table displaying the mean number of panic attacks per day for anxiety patients (n=8). One-tailed t-tests were performed comparing the intake measure (interview to FB1) to all other time intervals shown.

Anxiety Patients:

TIME INTERVAL	# OF ATTACKS/DAY	SIGNIFICANCE of t-test
Intake-FB1	0.8988	
FB1-FB2	1.1213	p=0.3521
FB2-FB3	0.5463	p=0.1963
FB3-FB4	0.7275	p=0.1923
FB4-FB5	0.3125	p=0.0816
FB5-FB6	0.4100	p=0.0617
FB6-FB7	1.0300	p=0.4279

Note that although none of the differences are significant, the trend was toward a decrease in panic attacks compared to the intake value, which appeared to be approaching significance at the one-month follow-up. The number of attacks per day then increased at the two-month follow-up, as the result of one subject experiencing significant difficulties during that time period.

Figure 8

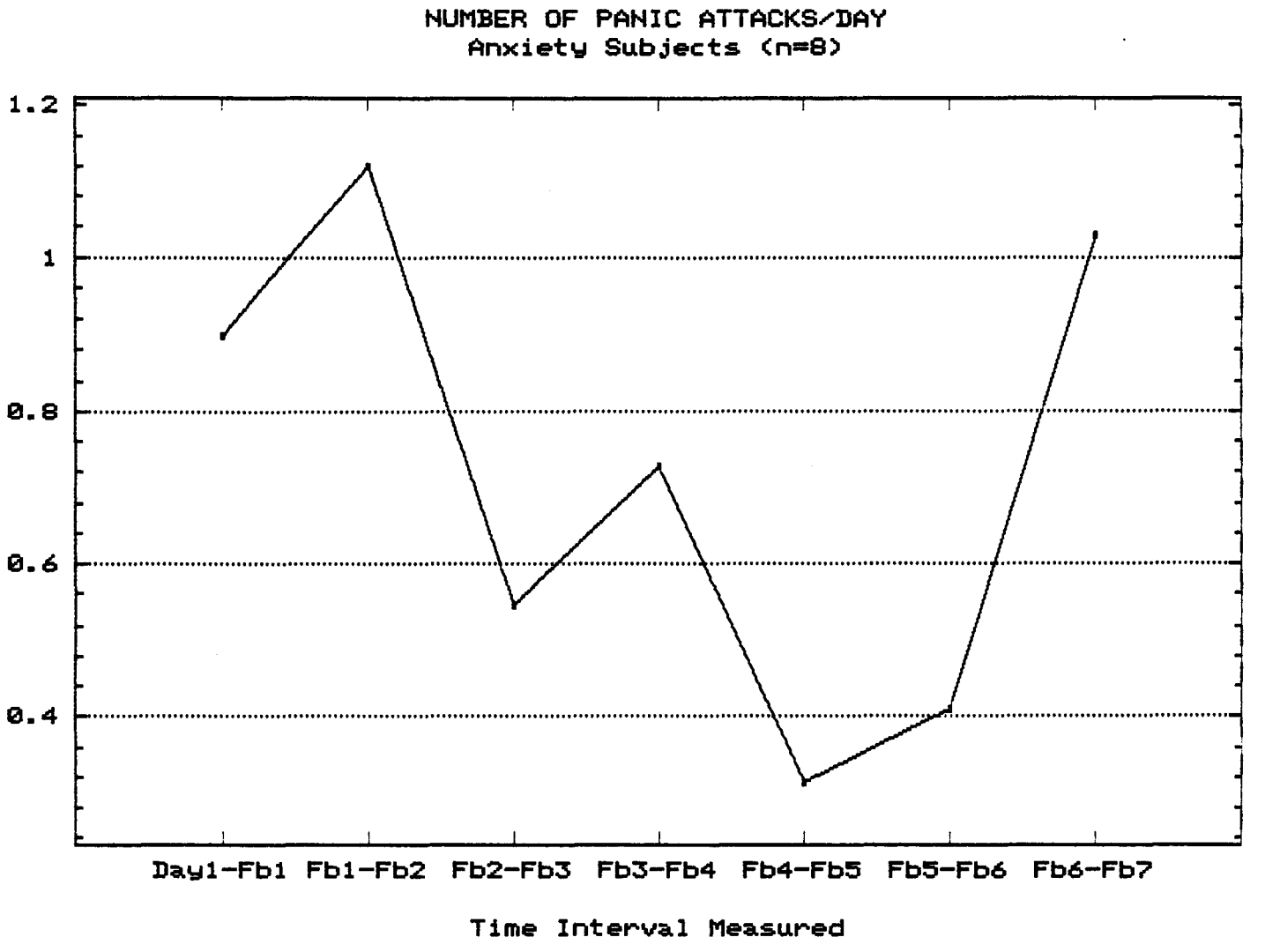
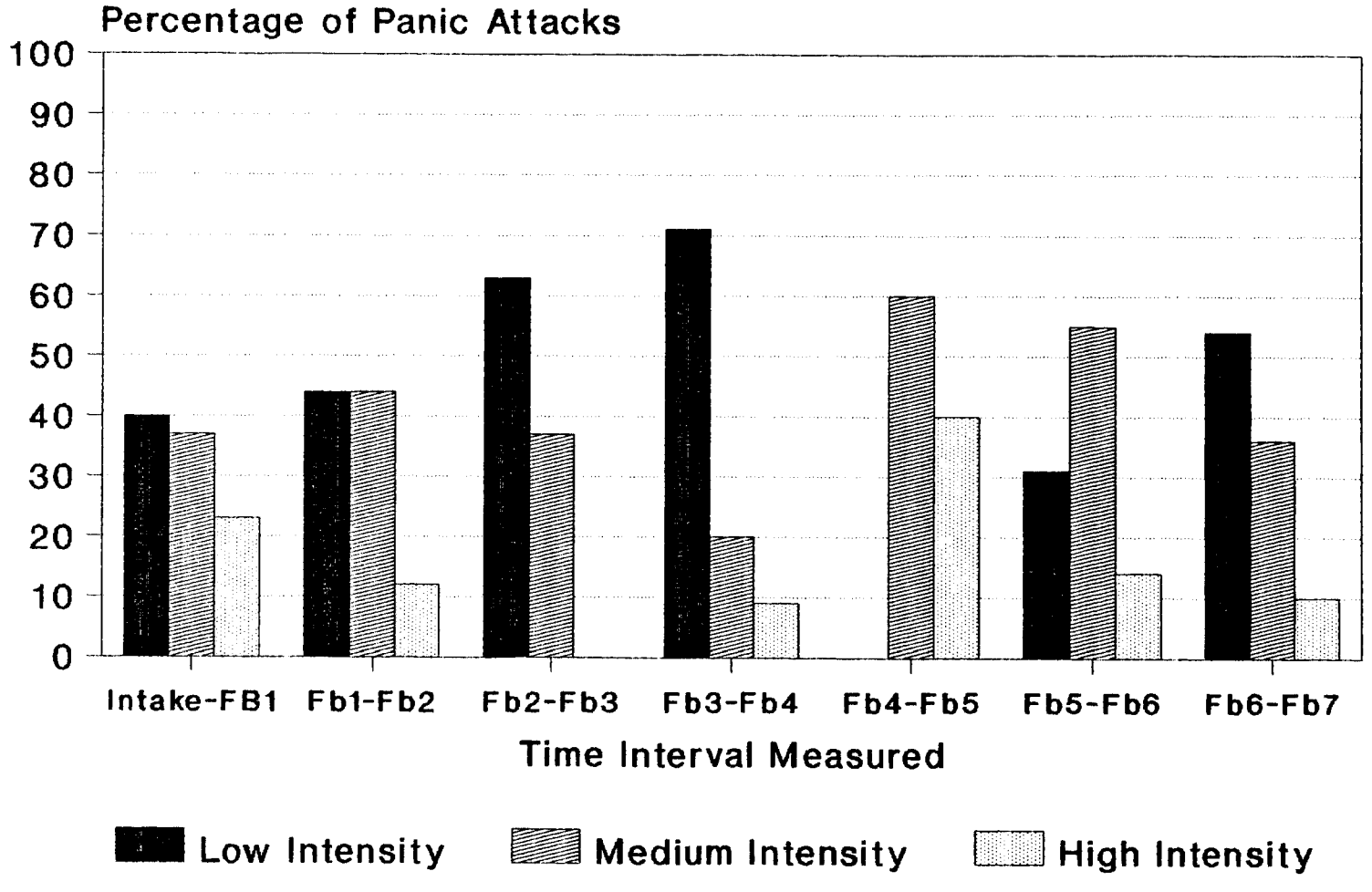

NUMBER OF PANIC ATTACKS/DAY
Anxiety Subjects (n=8)
1.2
1
0.8
0.6
0.4
Day1-Fb1
Fb1-Fb2
Fb2-Fb3
Fb3-Fb4
Fb4-Fb5
Fb5-Fb6
Fb6-Fb7
Time Interval Measured

Figure 9

INTENSITY OF PANIC ATTACKS
Anxiety Patients (n=8)



Anxiety group from intake to the two-month follow-up. This figure suggests a decline in the percentage of attacks rated as highly intense when one compares the intake value to the final measure at the two-month follow-up. Consequently, as the percentage of high intensity attacks declined, a greater percentage attacks were described as having low or medium intensity.

In contrast to the Anxiety patients, Controls reported no panic attacks during the study, with the exception of two situational subthreshold attacks by one subject. Due to this lack of variance in the Control sample, a statistical analysis was not performed on this data, but it is obvious that Controls experienced less panic than Anxiety subjects, with no room for improvement from the baseline measure.

Table 7 contains the average number of anxiety episodes per day for the Anxiety subjects, as determined from side 1 of the diary. Again, there was a decline in the number of times subjects felt anxious each day, and this difference was increasingly significant as feedback training progressed, remaining significant at the one-month follow-up. The number of anxiety episodes per day then increased at the two-month follow-up, again, as the result of one subject experiencing significant difficulties during that time period. As with respect to panic, all other subjects remained stable or decreased with respect to daily anxiety.

Furthermore, table 7 shows the average number of anxiety episodes per day for the Control group. As in the Anxiety group, a decline was noted in the number of times Control subjects felt

Table 7
ANXIETY REPORT RESULTS

The following is a table displaying the mean number of anxiety episodes per day for anxiety patients (n=8) and controls (n=10). One-tailed t-tests were performed comparing the intake measure (interview to FB1) to all other time intervals shown.

Anxiety Patients:

TIME INTERVAL	# OF EPISODES/DAY	SIGNIFICANCE of t-test
Intake-FB1	2.4000	
FB1-FB2	2.3225	p=0.4564
FB2-FB3	1.3100	p=0.0469
FB3-FB4	1.8438	p=0.0756
FB4-FB5	1.3175	p=0.0305
FB5-FB6	1.2763	p=0.0058
FB6-FB7	1.8488	p=0.2613

Control Subjects:

TIME INTERVAL	# OF EPISODES/DAY	SIGNIFICANCE of t-test
Intake-FB1	0.5590	
FB1-FB2	0.5460	p=0.2714
FB2-FB3	0.3640	$p<.05$
FB3-FB6 (one-month)	0.2180	$p<.05$

anxious each day, and this difference was significant at the time interval between feedback session 2 and 3, and remained significant at the one-month follow-up.

A comparison between the Anxiety and Controls groups regarding daily anxiety is shown in Table 8. As determined by a one-tailed between-subjects t-test, Anxiety subjects reported significantly more baseline daily anxiety than did Controls, which is not surprising. Although both groups declined with respect to daily anxiety as treatment progressed, this trend continued to the one-month follow, with Anxiety subjects still reporting significantly more anxiety than controls. This comparison between the Anxiety and Control groups is illustrated graphically in Figure 10.

Psychometric Battery:

With respect to the psychometric test battery, both Anxiety and Control subjects improved significantly on several items, over the course of feedback training. Table 9 contains the mean scores taken at the time periods highlighted in the study protocol (Table 1). For all tests in the battery, high scores indicate a high degree of distress, where low scores represent less distress. For the Anxiety group, one-tailed within-subjects t-tests were calculated between the intake battery scores and scores at feedback sessions 1, 3, 5, 6 (df=7) and 7 (df=6). For the Control group, t-tests (df=9) were calculated between the intake measures and scores at sessions 1, 3 and the one-month clinical follow-up. Compared to the intake measures, Anxiety patients improved significantly on the Body Sensations Questionnaire (BSQ) at sessions 3, 6 and 7, and on

Table 8

ANXIETY REPORT RESULTS

1) The following compares the Controls (n=10) to the Anxiety subjects (n=8) between Intake and the one-month follow-up:

MEAN NUMBER OF ANXIETY EPISODES/DAY:

Time Interval	ANXIETY	CONTROLS	T-test value
Intake-FB1	2.400	0.599	2.511 ($p<.05$)
FB1-FB2	2.323	0.546	1.830 ($p<.05$)
FB2-FB3	1.310	0.364	2.631 ($p<.01$)
One-month follow-up	1.276	0.218	2.502 ($p<.05$)

Figure 10

NUMBER OF ANXIETY EPISODES/DAY
Anxiety Subjects (n=8)
vs.
Control Subjects (n=10)

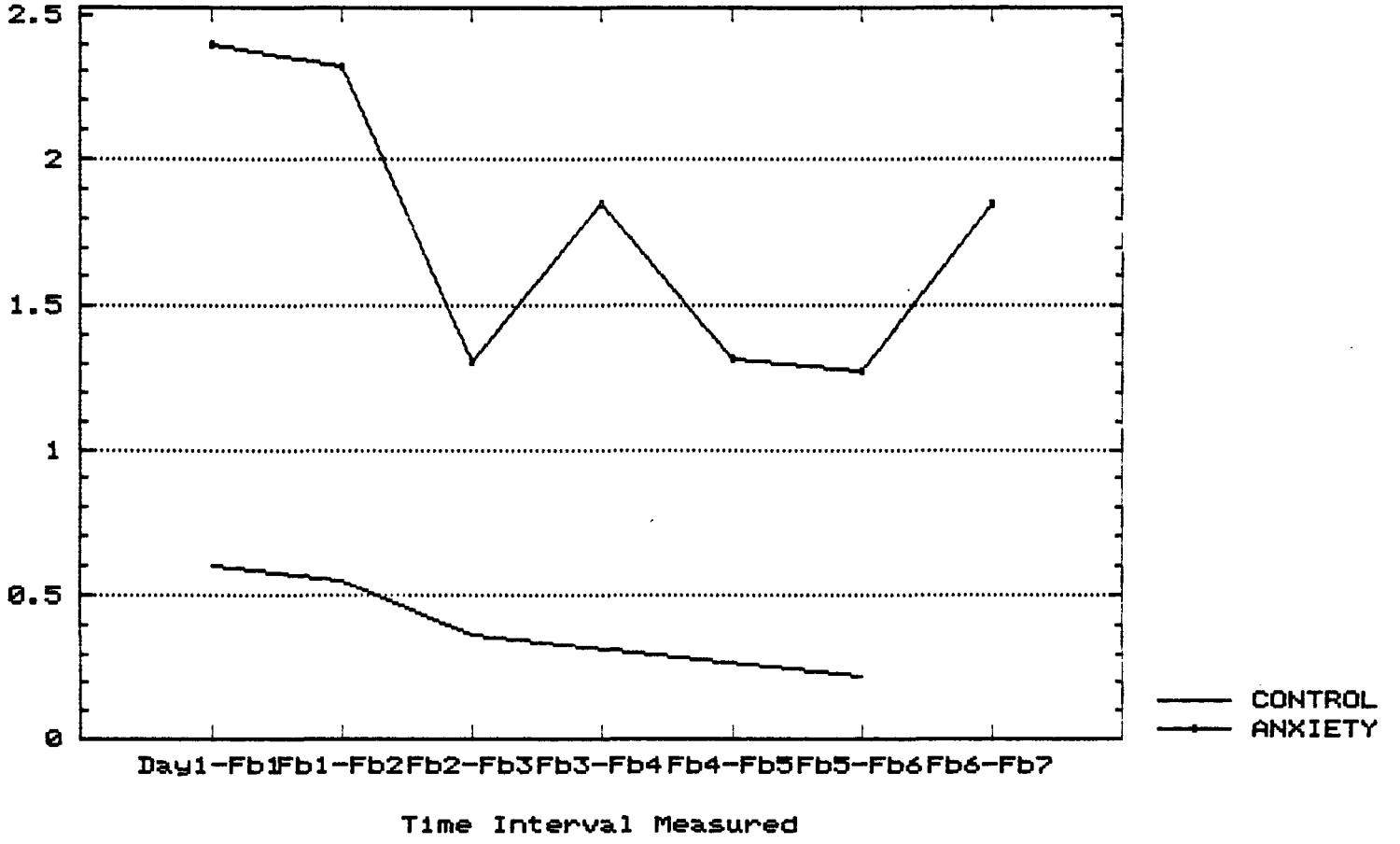


Table 9

SHORT BATTERY RESULTS:
MEAN VALUES ACROSS SESSIONS

Anxiety Patients (n=8):

	Intake	FB1	FB3	FB5	FB6	FB7 (n=7)
STAI-X1	39.75	39.75	35.00	36.75	35.13	36.29
STAI-X2	46.75	44.50	45.25	43.75	42.25	42.29
ACQ	32.50	30.50	30.38	32.13	28.88	30.71
BSQ	39.50	35.88	35.00 *	36.38	32.00 *	32.71 *
BECK	10.25	8.63	7.00 **	7.63 **	8.38	9.71

Control Subjects (n=10):

	Intake	FB1	FB3	FB6 (One month)
STAI-X1	30.50	32.50	29.40	31.10
STAI-X2	32.40	31.20	28.50 *	26.60 ****
ACQ	24.50	20.90 *	19.30 ***	19.60 *
BSQ	28.20	24.80 **	24.90 *	24.50 *
BECK	3.00	2.20	1.30 *	0.80 **

NOTES:

1) The following tests were administered at the beginning of each session:

   a) Spielberger State-Trait Anxiety Inventory (STAI)
      X1 - State anxiety
      X2 - Trait anxiety

   b) Agoraphobic Cognitions Questionnaire (ACQ)
   c) Body Sensations Questionnaire (BSQ)
   d) Beck Depression Inventory (BECK)

2) T-tests were calculated between intake battery scores and scores at FB1, FB3, FB5, FB6 and FB7 (in the case of Controls, at FB1, FB3 and One-month follow-up):

   * refers to scores significantly improved at $p<.05$ (one-tailed)
   ** refers to $p<.01$ (one-tailed)
   *** refers to $p<.005$ (one-tailed)
   **** refers to $p<.001$ (one-tailed)

the Beck Depression Inventory at sessions 3 and 5. For the Beck, this improvement had diminished by the 30-day follow-up (FB6). Control subjects showed a significant decrease in their Agoraphobic Cognitions (ACQ) and Body Sensations Questionnaires (BSQ) from intake to session 1, prior to any feedback training. They also showed a significant decrease in their State-Trait Anxiety Inventory-X2 (trait anxiety), ACQ, BSQ and Beck Depression Inventory scores from intake to session 3 and from intake to the one-month clinical follow-up (FB6).

Significant differences were also found between the Anxiety and Control groups on the psychometric battery measures. Table 10 indicates that the Anxiety group scored significantly higher on all items at intake, session 1 and session 3, with the exception of the STAI-X1 (state anxiety) at session 3. With respect to the one-month follow-up, Anxiety subjects continued to score significantly higher on the STAI-X2 (trait anxiety), the ACQ and the Beck Depression Inventory.

Dose-Response Relations

To evaluate whether clinical improvement in the Anxiety group was related to feedback skill, dose-response relations were examined at three time periods in the study protocol. The first was after two sessions of feedback training, at which time 63% of subjects had differentiated. The second was after the fifth feedback session, when all of the sample had received Anxiety Control Instructions, and the third was after the sixth feedback session. A "dose" of feedback training was measured by the

Table 10

MEAN SHORT BATTERY SCORES:
ANXIETY PATIENTS VS. CONTROLS

	INTAKE		FB SESS1		FB SESS3	
	Anxiety (n=8)	Control (n=10)	Anxiety (n=8)	Control (n=10)	Anxiety (n=8)	Control (n=10)
STAI-X1	39.75	30.50 *	39.75	32.50 *	35.00	29.40
STAI-X2	46.75	32.40 ***	44.50	31.20 **	45.25	28.50 ***
ACQ	32.50	24.50 *	30.50	20.90 *	30.38	19.30 *
BSQ	39.50	28.20 *	35.88	24.80 *	35.00	24.90 *
BECK	10.25	3.00 *	8.63	2.20 *	7.00	1.30 *

	FB SESS6 (1-month)	
	Anxiety (n=8)	Control (n=10)
STAI-X1	35.13	31.10
STAI-X2	42.25	26.60 ***
ACQ	28.88	19.60 *
BSQ	32.00	24.50
BECK	8.38	0.80 *

NOTE: * refers to a significant difference between anxiety patients and controls at $p<.05$ (one-tailed t-test)
** refers to a significant difference of $p<.01$
*** refers to a significant difference of $p<.005$

magnitude of each subject's t-test of differentiation between responses A and B during feedback trials, where negative t's indicated better performance. Clinical improvement was measured by calculating the change in panic attacks per day from baseline to the periods immediately following sessions 2, 5 and 6. Figure 11 illustrates the correlation between subjects' feedback-t and change in panic attacks per day following session 2 (n=8). In this figure, a negative feedback t (better performance) was non-significantly related to a negative change (decline) in panic (r=.4558). This positive relationship was significant for session 5, as shown in Figure 12 (r=.8068). Finally, Figure 13 illustrates the correlation between subjects' feedback t and change in panic attacks per day following session 6 (n=8). In this case, the dose-response relationship had diminished, with r=.0387. However, as mentioned earlier, an increase in panic by one subject at the two-month follow-up dramatically affected the mean number of panic attacks per day for that time period. All other subjects had reported a maintenance or decline in their amount of daily panic since the one-month follow-up. In light of this, a dose-response relationship was examined between subjects' feedback-t at session 6 and change in daily panic following session 6, with the outlier subject removed. Figure 14 shows that by removing that subject from the correlation plot, the dose-response relationship was again positive (r=0.5913), but non-significantly so.

Post-Treatment Evaluation:

At the end of session 7, Anxiety subjects were debriefed on

Figure 11

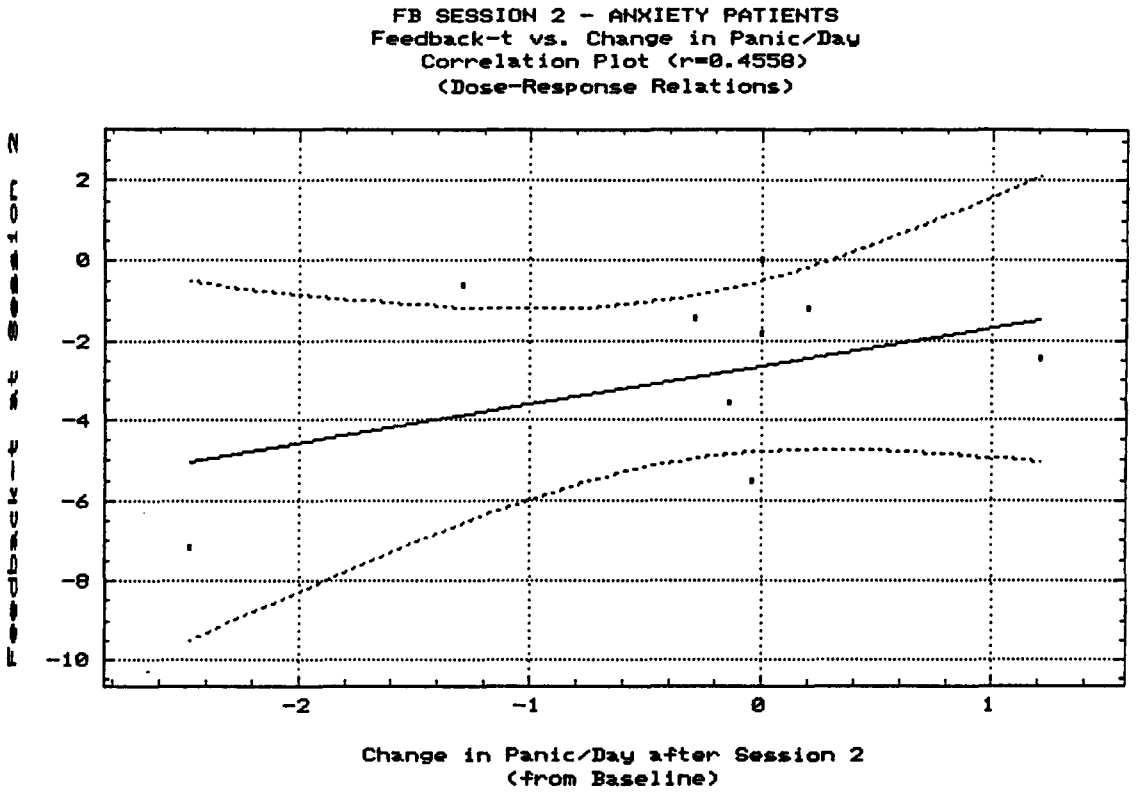


Figure 12

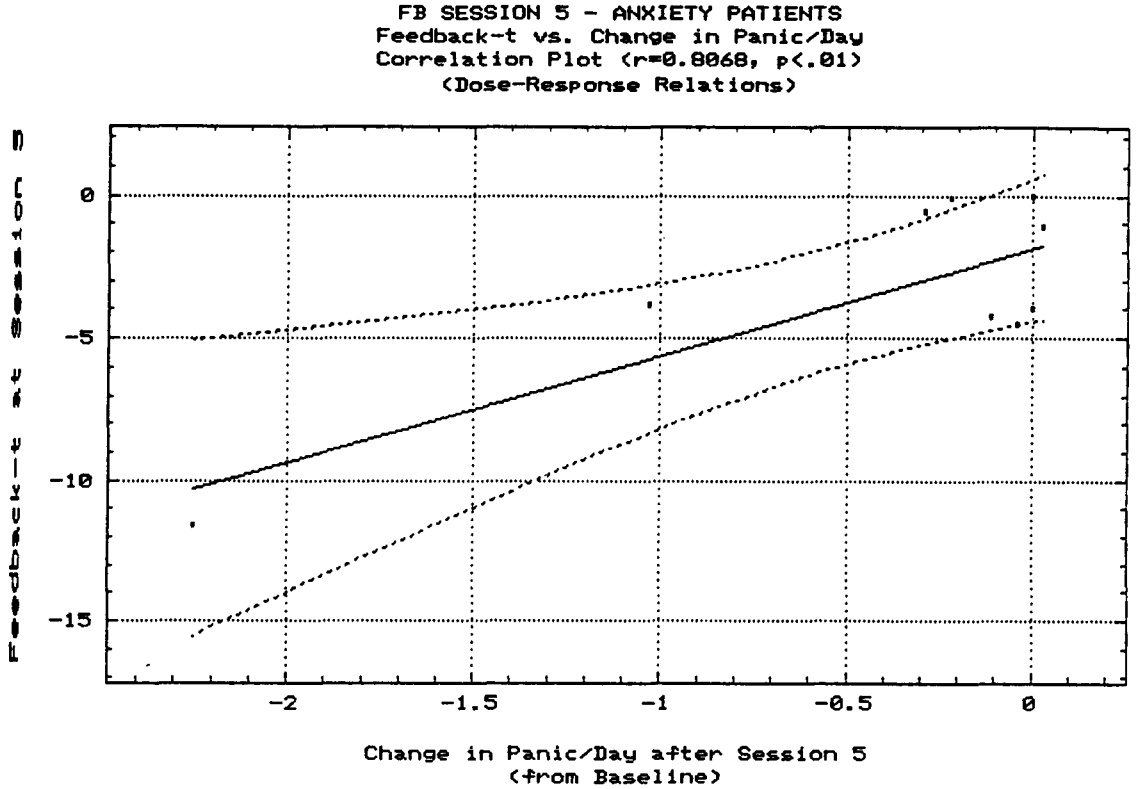
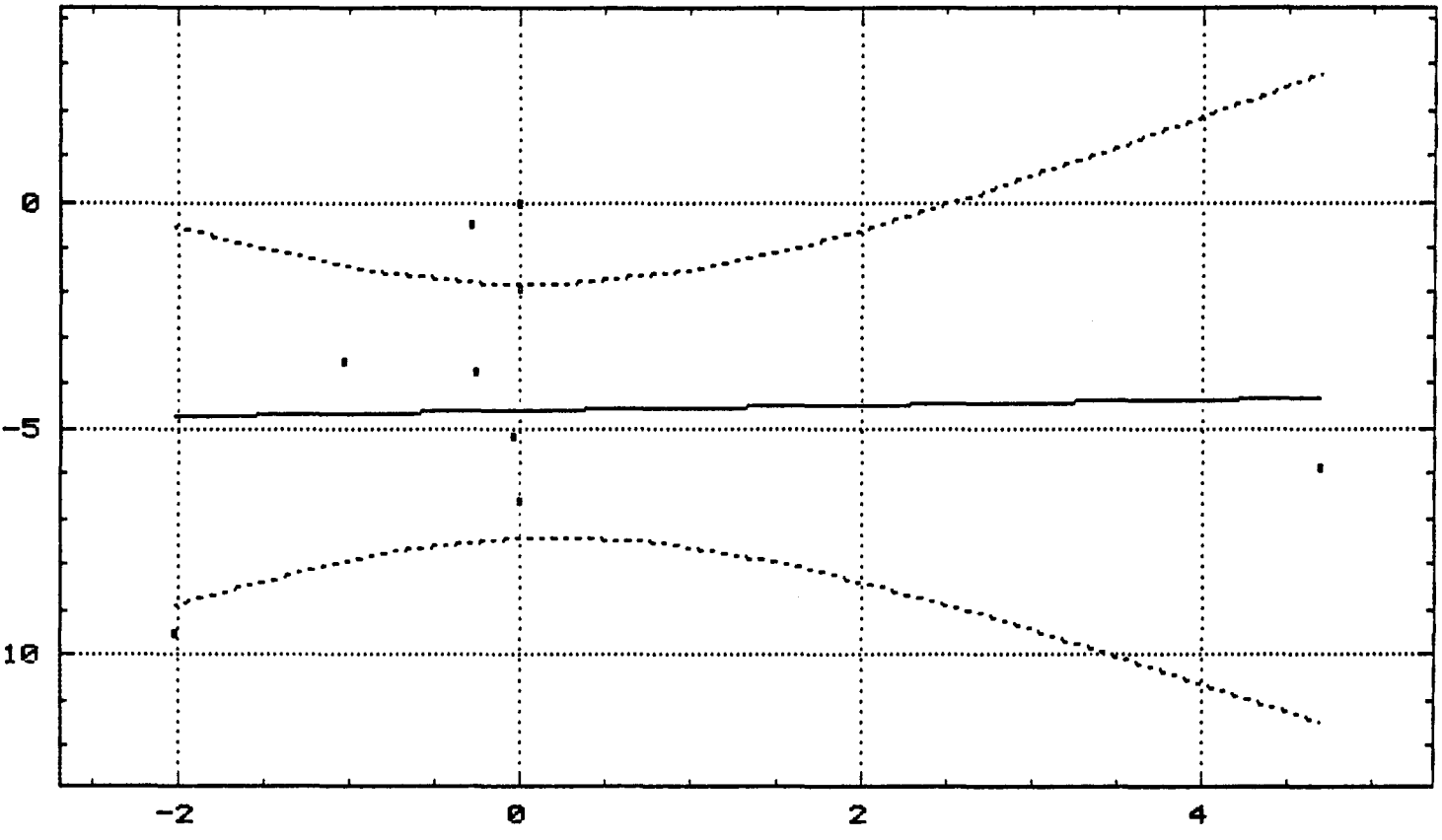


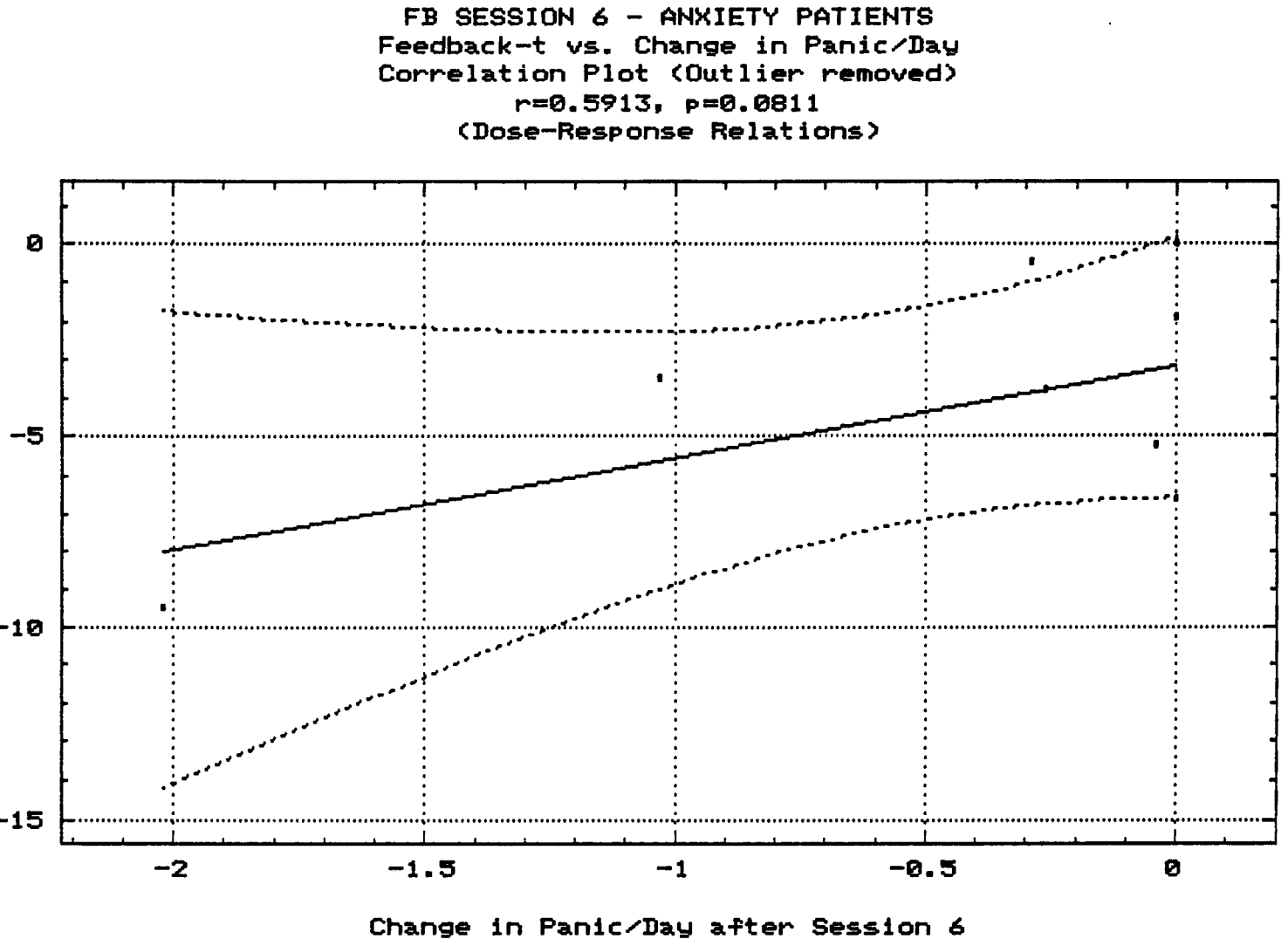
Figure 13

FB SESSION 6 - ANXIETY PATIENTS
Feedback-t vs. Change in Panic/Day
Correlation Plot (r=0.0387)
(Dose-Response Relations)



Change in Panic/Day after Session 6

Figure 14


FB SESSION 6 - ANXIETY PATIENTS
Feedback-t vs. Change in Panic/Day
Correlation Plot (Outlier removed)
r=0.5913, p=0.0811
(Dose-Response Relations)
0
-5
-10
-15
-2
-1.5
-1
-0.5
0
Change in Panic/Day after Session 6

responses A and B, and were then given a brief interview regarding their impressions of the feedback treatment (Appendix XI). In response to question 1, "Did the feedback treatment help you with your anxiety problem?", 6 out of 8 subjects replied "yes", 1 answered "no", and 1 was unsure as to whether the treatment had helped them. On question 2, regarding which symptoms were most positively affected by the treatment, subjects cited a number of bodily sensations, including tension, palpitations, chest pain and shortness of breath. In response to question 3, which asked whether their anxiety symptoms had become less intense or frequent, 3 out of 8 answered that they had become less intense, and 4 out of 8 subjects responded that their symptoms had become less frequent. Finally, all subjects reported that they would continue to use the decrease response to deal with anxiety (question 4), and all 8 said that they would recommend feedback treatment to others suffering from anxiety disorders (question 7).

DISCUSSION

Summary of Study:

The present study investigated the efficacy of heart rate feedback training in the treatment of panic disorder. Anxiety patients participated in 7 feedback sessions, in which they were instrumentally trained to produce increases and decreases in heart rate in order to move the letters A and B toward a target area on a computer screen. For half of the subjects, A represented increases in heart rate, and B decreases in heart rate. This relationship was reversed for the other half. Throughout the study, psychometric tests (STAI, ACQ, BSQ, Beck Depression Inventory) were completed, and a daily anxiety diary was filled out by all subjects. When they could successfully differentiate between responses A and B in the presence and absence of feedback (as determined by t-tests), or when they had completed five sessions (whichever came first), subjects were instructed to use the decrease response to control anxiety and panic, and to avoid the increase response.

Two groups of subjects were compared in the study, the Anxiety patient group and a Non-anxious Control group. The non-anxious Control group, consisting of 10 subjects, was utilized to provide comparisons with the Anxiety group in the areas of feedback skill, physiological measures, baseline anxiety, and change in anxiety levels with the development of feedback skill.

Summary of Main Findings:

As a result of feedback training, Anxiety patients learned to

produce increases and decreases in heart rate in the presence of visual feedback by the end of two training sessions. By the end of three training sessions, they were also able to perform these responses in the absence of feedback.

As well as acquiring feedback skill, Anxiety patients also improved on several clinical measures over the course of feedback training. With respect to panic, a decline was noted in the number of self-reported daily attacks, which began to reach significance at the one month follow-up. This decline was statistically significant regarding self-reported daily anxiety episodes. Unfortunately, due to the influence of one subject experiencing situational anxiety, the average number of panic attacks and anxiety episodes increased at the two-month follow-up. It should be noted, however, that the remainder of the anxiety group decreased or remained stable with respect to panic attacks and daily anxiety at the two-month follow-up. On the psychometric battery measures, Anxiety subjects improved significantly over the course of training on the Body Sensations questionnaire. This improvement remained significant to the two-month follow-up. This result suggests that feedback training established control over physiological responses that are related to anxiety, which may have reduced patients' fear of normal bodily fluctuations (which is measured in that questionnaire).

Most importantly, to evaluate whether clinical improvement in the Anxiety group was related specifically to feedback skill as opposed to non-specific treatment factors, dose-response relations

were examined at three time periods in the study protocol. The first was after two feedback sessions, at which time just over half of subjects had differentiated on responses A and B. The second was after five sessions, when all subjects had received anxiety control instructions, and the third was after session 6, at a two-month follow-up. Briefly, a dose was defined as a subject's degree of differentiation between increases and decreases in heart rate, as measured by a t-test. Clinical improvement was measured as the change in panic attacks per day after sessions 2, 5 and 6, compared to baseline.

A positive, though non-significant correlation was found between Anxiety subjects' degree of feedback skill and decline in panic after session 2. This positive relationship was statistically significant for session 5, when all subjects had received anxiety control instructions and had monitored their frequency of panic attacks for one month following this session. Subjects who had acquired the most feedback skill experienced the greatest decline in daily panic attacks. After session 6, this relationship had diminished, due to a situational increase in panic by one subject who was normally a feedback differentiator. With this outlier removed, the dose-response relationship was again positive, but non-significant.

This result may be interpreted in a number of ways. It is possible that feedback skill may be anxiolytic in the short-term, with a lesser degree of long-term success. It may also be the case that a greater number of initial treatment sessions, or several

long-term refresher sessions may have led to a stronger dose-response relationship at the two-month follow-up. Finally, it should be noted that the subject number was small to begin with, and that by eliminating the outlier at the two-month follow-up, the sample size declined even further, making it more difficult to produce a significant result at $p<.05$. Future studies with a greater number of subjects would be required to test the strength of the dose-response relationship at a two-month follow-up.

Feedback Skill: Anxiety vs. Control subjects:

Regarding feedback skill, a comparison was made between the Anxiety and Control groups with respect to rate of acquisition and response strategies. Judging from past studies (Cournoyer, 1986), it was predicted that both groups would acquire feedback skill over the course of the treatment protocol, but that non-anxious controls would acquire feedback skill faster than anxiety patients. This prediction was, in fact, confirmed. Both Anxiety and Control subjects acquired feedback skill, and were able to perform this skill in the absence of visual feedback. However, the rates at which the two groups acquired this skill was different. Recall that Anxiety subjects became feedback differentiators by the end of their second feedback session, and transfer differentiators by the end of their third session. On the other hand, the Control group succeeded at performing the A and B responses by the end of their first feedback session, both in the presence and absence of feedback.

There are a number of possible explanations for this finding.

First, it may be that since Controls experience less anxiety in their daily lives, they are more comfortable and efficient in new learning situations. As a result, they are able to learn the feedback skill faster than Anxiety patients. It is also possible that because cardiovascular arousal is the most common symptom in panic disorder, Anxiety patients may have a more difficult time gaining control over cardiovascular responses in a learning situation than do normal subjects. According to cognitive models of panic (Barlow, 1990; Charney et. al., 1990), these patients perceive themselves as having little control over their normal bodily fluctuations and often misinterpret them as signs of danger. Since responses A and B are physiological in nature, it is conceivable that anxiety patients are less confident in being capable of controlling such responses in a learning situation and thus take longer to do so.

With respect to response strategies, it was shown that by session 3, both groups of subjects performed physiological responses that are characteristic of panic and anxiety in the case of increase trials (i.e. rapid heart rate, increased muscle tension, increased respiratory amplitude and volume without slowed rate of respiration), and used responses that are incompatible with anxiety during decrease trials (i.e. decreased heart rate, slowed breathing with increased respiratory amplitude and volume, reduced muscle tension). As Control subjects showed better response control by that session, their employment of these strategies was more pronounced than in the Anxiety group.

In the area of feedback, it was also investigated whether subjects produced significant decreases in their heart rates during decrease trials through the use of an active response strategy, or whether this decrease could also have occurred simply through the passage of time, with subjects sitting passively and waiting for the trial to finish. This was important to determine, since the decrease response was thought to be the patient's "weapon" during times of panic and anxiety. This question was addressed by comparing Anxiety and Control subjects' heart rate responses during decrease test trials and during blank trials. If increases in interbeat interval (decreases in heart rate) during decrease trials were, in fact, no greater than when subjects sat and did nothing, then they should not differ significantly from increases in IBI during blank trials, where no stimulus was presented on the screen. The result of this comparison was such that Anxiety subjects actually increased their heart rates during blank trials, and that Control subjects decreased their heart rates, but significantly less than the amount shown during decrease trials. Therefore, it is likely that subjects used active strategies in producing the decreases measured during decrease trials.

Baseline IBIs: Anxiety vs. Controls:

Another comparison between the Anxiety and Control groups involved physiological recordings taken during the feedback training sessions. Specifically, it was thought that Anxiety patients would have a higher initial resting heart when compared to Controls. Furthermore, it was tested whether feedback training

would have an effect on the resting heart rates of both groups. In terms of baseline measures, the Anxiety group was found to have a higher resting heart rate than Controls, corroborating earlier reports that anxiety patients have an elevated resting heart rate compared to the normal population. This was also true during sessions 2 and 3.

Regarding the effect of feedback training on subjects' resting heart rate, no significant increase or decrease was found in the Anxiety group from sessions 1 to 7. In comparison, the average resting heart rate for the Control group decreased significantly between sessions 1 and 2. This suggests that Control subjects may have been more relaxed during their second session, knowing what to expect after having experienced session 1. On the other hand, Anxiety patients may take considerably longer to relax in a new learning situation. Furthermore, their resting heart rates may be more resistant to change, and feedback training might be more useful in helping patients develop a coping mechanism rather than serving as a means of lowering an elevated physiological baseline.

Clinical Comparisons:

In terms of clinical measures, it was predicted that anxiety patients would show elevated levels of anxiety at baseline when compared to controls, as determined from the psychometric test battery and daily anxiety diary. This was true with respect to number of panic attacks, anxiety episodes and all of the psychometric battery items, including measurements of state and trait anxiety, agoraphobic cognitions, fear of bodily symptoms and

depression. Anxiety patients were significantly elevated in all of the above areas, when compared to the non-anxious Controls.

This finding has several implications. First, it suggests that the Anxiety group used in the study was, in fact, clinically different from the normal population with respect to daily panic, anxiety, agoraphobia and cognitions regarding somatic symptoms. They also endorsed greater levels of depressive ideation. Aside from the self-report measures discussed above, a clinical interview by two separate investigators suggested that the Anxiety group was clinically elevated when compared to controls, with respect to panic symptoms, agoraphobia, generalized anxiety and depression.

A second issue concerns the validation of the daily anxiety diary and psychometric battery. Since the two groups compared in the study were significantly different on these measures, it supports the idea that these tools are truly measuring what they are supposed to. In the case of the State-Trait Anxiety Inventory, Agoraphobic Cognitions Questionnaire, Body Sensations Questionnaire and Beck Depression Inventory, this study adds support to numerous studies that have already provided clinical validation for these measures. Regarding the daily anxiety dairy, which was constructed by the investigators solely for the purposes of this study, it provides encouraging evidence that this diary may be useful in clinical settings, to help patients monitor their daily levels of anxiety, since it accurately separates anxiety patients from non-anxious controls at a significant level.

In terms of daily panic attacks, it was not possible or

necessary to perform statistical analyses on the Control group regarding changes in daily panic, since it was virtually non-existent to begin with. However, since a small amount of initial daily anxiety was found among the Controls, it was possible to compare this value to that measured during various periods throughout the study protocol. A significant decline was noted in the number of times Control subjects felt anxious each day, and this difference became significant between sessions 2 and 3, and remained significant at the one-month follow-up. This suggests that feedback treatment may be therapeutic in the reduction of anxiety, even among the general clinically non-anxious population. By learning a physiological response that is incompatible with anxiety, it is possible that non-anxious individuals may find this technique useful in the management of everyday stress.

On the psychometric battery measures, Control subjects showed a significant decrease in their Agoraphobic Cognitions and Body Sensations Questionnaires from intake to session 1, prior to any feedback training. This result is interesting, and may be interpreted as suggesting that with repeated administration, subjects may simply have a tendency to choose lower numbers (indicating less anxiety), perhaps due to the structure of the questionnaire. This suggests that improvements on battery measures should be viewed with caution, but further study would be required to test this hypothesis. Control subjects also showed significant improvements on the State-Trait Anxiety Inventory (Trait anxiety), ACQ, BSQ and Beck Depression Inventory from intake to both session

3 and the one-month follow-up. Again, this result suggests that feedback training may be useful in helping non-anxious individual cope with everyday life stresses.

It was also predicted that initial differences in anxiety between the Anxiety and Control groups would lessen as treatment progressed. Since control subjects were initially less anxious than Anxiety patients, they would have less room to improve. Since anxiety subjects' levels of anxiety declined as treatment progressed, then the difference between the levels of anxiety in the two groups was predicted to decrease. However, on the self-report diary of daily anxiety episodes, the initially significant difference between the two groups remained to the one-month follow-up, with Anxiety subjects still reporting more anxiety than Controls. On the psychometric test battery, Anxiety patients continued to score significantly higher on the State-Trait Anxiety Inventory (Trait anxiety), Agoraphobic Cognitions Questionnaire and Beck Depression Inventory. It is possible that a greater number of treatments would be required to bring Anxiety patients' levels of anxiety and depression to that of the general population. It is interesting, however, that the significant difference between the two groups disappeared on the Body Sensations Questionnaire at the one-month follow-up. Again, since feedback treatment targets and focuses on a physiological symptom of anxiety, perhaps it is most helpful in reducing patients' fears of bodily sensations, bringing it to a level non-significantly different from normal controls. Perhaps a greater number of treatments would eventually lead

patients to reduce agoraphobic cognitions and levels of depression to a level that approximates the general non-anxious population.

The Dose-Response Relationship: Alternative Explanations:

The fact that a significant dose-response relationship was found at the one-month follow-up is important, since there are a variety of factors within the overall treatment package that may have influenced the degree of clinical improvement measured in the Anxiety subjects. For example, subjects may have benefitted from the interview/education session, simply by learning that anxiety is a normal bodily reaction to stress. Furthermore, interaction with the experimenter during feedback sessions, daily monitoring of anxiety through a diary, and the knowledge of receiving treatment for anxiety may have all contributed to producing clinical improvement. However, the positive dose-response relationship suggested that more than these non-specific factors were involved, since clinical improvement (decline in panic attacks) was related to subjects' degree of acquired feedback skill. Conversely, it also showed that failure to learn the feedback skill was related to an unchanged level of daily panic. This result suggests that in producing clinical improvement, learning the feedback skill may have been an important component in the treatment package, as opposed to the non-specific factors described above. Again, further studies would be required to test whether this relationship would truly hold at a two-month follow-up.

However, there are several reasons why successful feedback differentiation would lead to clinical improvement, and only

further study would help to eliminate the following possibilities. First, it may be that the feedback skill is truly anxiolytic, and that actively learning to produce decreases in heart rate led to a decline in panic symptoms. This result would be consistent with the hypothesis outlined in the introduction of this paper, which states that decreases in heart rate are incompatible with anxiety and panic.

A second possibility is that since subjects received positive visual feedback about their internal bodily responses, they gained confidence in their skills through their perception of success during feedback sessions. By increasing their level of self-confidence and knowing that they had acquired a "weapon" against anxiety, subjects may have subsequently experienced a decline in panic symptoms. To test this hypothesis, one could devise an experiment with two groups, one experiencing false negative feedback and the other experiencing false positive feedback regarding their physiological responses. If a decline in panic symptoms was noted in the latter group and not in the former, then this hypothesis would be supported. Unfortunately, this experiment would be difficult to perform from an ethical standpoint.

A third possible explanation for a positive dose-response relationship is that successful feedback differentiators may simply be better at organizing their daily lives, and are better performers in new learning situations. These individuals may respond favourably to any type of treatment, regardless of its nature, and are better able to apply it to their daily lives. This

hypothesis that the benefits of feedback training are not linked specifically to anxiety symptoms, or even clinical disorder requires further examination. Overall, it is clear that further study is required to establish the source of a positive dose-response relationship in the feedback treatment of panic disorder, and a number of alternative hypotheses likely exist, even aside from those outlined above.

Subjects' Impressions of Treatment:

Finally, it was found that Anxiety patients' own impressions of the feedback treatment were generally favourable. 75% of subjects found the treatment helpful, and listed the symptoms most positively affected as being tension, palpitations, chest pain and shortness of breath. Half of the subjects reported that they felt their symptoms had become less frequent, and all subjects said that they would continue to use the decrease response to deal with anxiety, and would recommend it to others suffering from anxiety.

Limitations:

Although the results of this study are encouraging, a number of methodological limitations exist. Therefore, the findings outlined above should be considered strictly preliminary in nature. To begin, the most obvious limitation in this study was the small sample size. The originally intended number of twenty anxiety patients would be the minimum that one would use before drawing any serious conclusions. Unfortunately, a lack of suitable patients from the Anxiety Disorders Clinics prevented a sample size of that magnitude. This difficulty also prevented a wait-list comparison,

which was also originally intended in the study. This is a component lacking in previous research, and warrants attention in future investigations.

Another limitation in this study was the deviation from the original inclusion/exclusion criteria, again, due to the lack of available anxiety patients. For this reason, a large percentage of the patients used in this study were only mildly symptomatic with respect to panic, and one had a diagnosis of obsessive-compulsive disorder. In order to truly determine the efficacy of feedback training in the treatment of panic disorder, one would have to use a larger sample of patients, all meeting the original inclusion/exclusion criteria of panic disorder, which would ensure adequate room for clinical improvement through the course of treatment. By using patients that are adequately symptomatic, a stronger dose-response relationship might also be determined.

Another deviation from the original subject criteria was that of psychoactive medications. It was originally intended that subjects included in the study be free of such medications, thus eliminating the chance of this possible confound. True, subjects were required to keep all medications constant throughout the course of the study. However, the fact that many of the subjects were taking anxiolytic medications introduced a further floor effect with respect to symptomatology, with medicated subjects already experiencing a minimum of panic symptoms at baseline.

Other limitations in this study involved the comparison between Anxiety subjects and Non-anxious Controls. First, although

efforts were made to roughly match subjects with respect to age, there were unequal numbers males and females in each group. A properly controlled study would match subjects closely with respect to age, sex and education level. On average, Anxiety subjects were a decade older than Controls, with a greater proportion of females in the former group. Second, the Control group consisted of faculty members, graduate students and alumni of the Psychology department at McMaster University, whereas the Anxiety group was comprised of a variety of educational/vocational backgrounds. This suggests that the Control group, on average, had attained a higher level of education than the Anxiety group. This disparity may, in part, have contributed to the faster rate of feedback learning found in the Control group when compared to the Anxiety patients. Rather than learning faster because of less anxiety in new learning situations, it may be that the Controls have gained more experience in problem solving situations due to their higher level of education. Third, due to practical reasons, Control subjects participated in only three feedback sessions prior to their one month clinical follow-up, whereas Anxiety patients participated in five sessions. However, the two groups were directly compared with respect to clinical measures at the one-month follow-up. In order to be a truly valid comparison, both groups should have had an equal number of feedback sessions.

Despite these limitations, the results of this study are encouraging. Anxiety patients acquired feedback skill and were able to perform this skill in the absence of visual feedback

through the course of training. As in the preliminary study by Cournoyer (1986), they also experienced a decline in anxiety and panic, and a dose-response relationship was determined between feedback skill and clinical improvement. Furthermore, it was noted that this skill could even prove beneficial for non-anxious Controls, who also experienced a decline in daily anxiety throughout the treatment protocol.

Further well-controlled studies will be required to confirm these findings, and to determine the source of the dose-response relationship. In conclusion, if feedback training is consistently found to be successful in alleviating the symptoms of panic disorder patients, it may eventually serve as a recognized effective alternative or complement to pharmacological treatment. The success of feedback training as a behavioural treatment for panic disorder might also encourage further evaluation of feedback as a possible therapy for other subcategories of anxiety disorder, including generalized anxiety disorder and obsessive-compulsive disorder.

APPENDIX I

Name _____
Date _____
Interviewer _____

Procedure for Day 1
(Revised 4/8/93)

A. Information Sheet

The subject has received an information sheet prior to their arrival at the laboratory (copy attached).

B. Introduction to Laboratory

1. Subject completes the short battery (Ploom). Then subject is seen by Roberts and Ploom together for the following introduction.

2. The following account is given verbally. What we do is we attach recording devices to the surface of your skin (no needles), so that we can measure several internal responses. We then display these responses on a television screen so that you can see them. The training procedure is a little like a video game. We will use the video display to teach you to control two responses that relate to anxiety. For convenience call one the A response and the other the B response. The display looks like this (give example).

   We can't tell you exactly how to control these responses; for each person they can be a little different. What you should do is try various things and find something that works, using feedback as a guide to success. Will get further instructions in first feedback session.

   Two sessions a week for first 3 weeks, then another session one and two months later. Diary every day; some psychological tests. Each visit lasts about 2 hours. Feedback control in normal limits, no risks found for such training. Risk of infectious disease less than medical examination or dental visit.

3. Reasons why control may help:

   (a) responses will reduce anxiety;
   (b) avoid vicious circle effect;
   (c) feedback skill a weapon that may give control over situations where anxiety felt.

4. Today we first need a consent form. Then want to learn a little about the kind of anxiety you experience. Finally, will explain diary we want to you to complete throughout the study.

C. Consent (filenames consent.adc or consent.cou)
D. Anxiety Interview (see below)
E. Anxiety Information Sheet (filename Educate.2)
F. Diary (filename diary)

C. Anxiety Interview

BIOGRAPHICAL:

Age

Occupation

Marital status

OVERALL: Describe your anxiety problem in your own words:

(Now want to ask some more specific questions)

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

A. Panic Behavior

1. Have you ever had an attack of panic, when you suddenly felt intensely anxious or uncomfortable? (unpredicted and not caused by being observed by others)

   ? 1 2 3 (clear yes) IF NO GO TO #12

2. Tell me about them. Do they occur in certain situations (or are the unexpected)?

3. Have you ever had four attacks like this in a month? (how many?)

4. During your last bad attack, Were you:

short of breath (have trouble catching your breath)?	?	1	2	3
Heart race, pound, or skip?	?	1	2	3
tremble or shake?	?	1	2	3
sweat?	?	1	2	3
feel as if you were choking?	?	1	2	3
did things seem unreal, did you feel detached?	?	1	2	3
tingling or numbness?	?	1	2	3
hot flashes or chills?	?	1	2	3
chest pain or pressure?	?	1	2	3
afriad you might die?	?	1	2	3
afraid of losing control?	?	1	2	3

5. How long does it take for these attacks to reach their peak? (is it less than 10 minutes?

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

---

6. How much coffee, tea, or cola fo you drink each day?

7. Are your attacks related to:

   physical illness?

   relaxation?

   fasting (going without meals)?

   medication or drug use?

8. Have there been situations or places that you have avoided because you were afraid of having a panic attack? Describe:

   ? 1 2 3 (clear yes)

9. In the past month, how many panic attacks have you had?

Number of symptoms (see above)	1-3	4-6	>6
number of attacks	_____	_____	_____

10. So are panic attacks a problem for you currently?

    ? 1 2 3 (clear yes)

11. How old were you when you had your first attack?

    DESCRIBE CIRCUMSTANCES:

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

B. Anxieties and fears

12-14 agoraphobia
15-19 social
20-24 specific

12. Are you (or have you recently been) afraid of going out of the house alone, being in crowds, standing in line, or riding on buses or trains?

? 1 2 3 (clear yes) IF NO GO TO #15

13. Tell me about the problem:

Currently a problem? ? 1 2 3 (clear yes)

How often do you go out of house alone?

Do you need a companion? ? 1 2 3 (clear yes)

14. How old were you when this problem developed, and how long has it been present?

15. Are there things that you feel uncomfortable doing in front of other people, like eating, writing, or speaking?

? 1 2 3 (clear yes) IF NO, GO TO #20

comment:

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

---

16. Do you think you are more uncomfortable than most people in these situations?

? 1 2 3 (clear yes)

17. Do you think your fear is greater than it should have been (unrealistic)?

? 1 2 3 (clear yes)

18. Does this fear or discomfort interfere with your life?

? 1 2 3 (clear yes)

19. How old were you when this problem first occurred?

Is it a problem now (last month)?

? 1 2 3 (clear yes)

20. Are there specific things that you have been frightened about, such as certain animals or insects, flying, heights, seeing blood?

(Note: exclusive of fear of panic attacks or social situations)

? 1 2 3 (clear yes) IF NO, GO TO #25

Describe:

21. Does this fear interfere with your life:

? 1 2 3 (clear yes)

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

---

22. Do you go out of your way to avoid these situations or objects?

? 1 2 3 (clear yes)

23. Do you think your fear is stronger than it should have been?

? 1 2 3 (clear yes)

24. Are these fears a problem now (last month)

? 1 2 3 (clear yes)

C. Obsessional behavior

25. Are you bothered by thoughts that don't make any sense, that keep coming back into your head despite your best effort to eliminate them? (for example, intrusive, senseless, thoughts; thoughts about germs or dirt)

(do not include fears of having panic attacks or anxious ruminations about realistic danger)

? 1 2 3 (clear yes) (IF NO GO TO #27)

26. When you had these thoughts, did you try to get them out of your head?

? 1 2 3 (clear yes)

27. Was there anything you had to to do over and over again and could resist doing, like washing yourself over and over, or checking something several times to be sure you had done it right?

? 1 2 3 (clear yes) IF NO, GO TO #30

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

How many times did you have to repeat?

How much time did you spend each day?

Do you think this compulsion makes sense?

28. How old were you when this problem developed?

DESCRIBE CIRCUMSTANCES

29. Is it a problem now (last month)?

? 1 2 3 (clear yes)

D. Generalized Anxiety

30. In the last 6 months, have you been particularly anxious or nervous?

? 1 2 3 (clear yes)

31. Do you worry a lot about terrible things that might happen?

(About two or more life circumstances, for no good reason examples: illness of friend, finances, academic, social performance; bothered more days than not)

? 1 2 3 (clear yes)

? = insufficent information
1 = absent
2 = subthreshold, borderline, ambiguous
3 = clearly present

---

32. When you have been nervous,

Do you tremble, twitch, or feel shaky?	?	1	2	3
muscles feel tense or ache?	?	1	2	3
physically restless, can't sit still?	?	1	2	3
tire easily?	?	1	2	3
short of breath?	?	1	2	3
heart pound or race?	?	1	2	3
sweat alot?	?	1	2	3
mouth dry?	?	1	2	3
dizzy, light-headed?	?	1	2	3
stomach upset, diarrhea?	?	1	2	3
flushes or chills?	?	1	2	3
urinate more than usual?	?	1	2	3
trouble swallowing?	?	1	2	3
keyed up and on edge?	?	1	2	3
sudden noise make jump?	?	1	2	3
trouble concentrating?	?	1	2	3
can't fall asleep?	?	1	2	3
irritable?	?	1	2	3

33. When did the anxiety begin?

34. Is it a problem now (last month)?

? 1 2 3 (clear yes)

? = insufficent information
1 = problem absent
2 = subthreshold, borderline, ambiguous
3 = problem present

E. General

		okay			
1.	eating okay?	?	1	2	3 (pblm)
2.	sleep okay?	?	1	2	3 (pblm)
3.	digestion okay?	?	1	2	3 (pblm)
4.	social life?	?	1	2	3 (pblm)
5.	family life?	?	1	2	3 (pblm)
6.	school work?	?	1	2	3 (pblm)
7.	employment?	?	1	2	3 (pblm)

F. Medication

	Benzodiazepines	Anxiolytic (dose mg/day)
Short-acting	Midazolam (Versed)	+ parenteral
	Triazolam (Halcion)	+ 0.25
Intermediate	Alprazolam (Xanax)	+ 0.5
	Bromazepam (Lectopam)	++ 3.0
	Halazepam (Paxipam)	++ 40.0
	Lorazepam (Ativan)	+++ 1.0
	Oxazepam (Serax)	++ 15.0
	Temazepam (Restoril)	+ 10.0
Long-acting	Chlordiazepoxide (Librium)	++ 25.0
	Clonazepam (Rivotril, Klonopin)	+ 0.25
	Clorazepate (Tranxene)	++ 10.0
	Diazepam (Valium)	+++ 5.0
	Estazolam (ProSom)	+ 1.0
	Flurazepam (Dalmane)	+ 15.0
	Ketazolam (Loftran)	++ 7.5
	Nitrazepam (Mogadon)	+ 2.5
	Prazepam (Centrax)	++ 10.0
	Quazepam (Doral)	+ 7.5

	therapeutic range (mg/day)
TRICYCLIC	
Amitriptyline (Elavil)	75 - 300
Clomipramine (Anafranil)	75 - 300
Desipramine (Norpramin)	75 - 300
Doxepin (Sinequan, Triadapin)	75 - 300
Imipramine (Tofranil)	75 - 300
Nortriptyline (Aventyl, Pamelor)	40 - 200
Protriptyline (Triptil, Vivactil)	20 - 60
Trimipramine (Surmontil)	75 - 300
DIBENZOXAZEPINE	
Amoxapine (Asendin)	100 - 600
TETRACYCLIC	
Maprotiline (Ludiomil)	100 - 225
TRIAZOLOPYRIDINE	
Trazodone (Desyrel)	150 - 600
MONOCYCLIC	
Bupropion (Wellbutrin) [a]	225 - 450
Fluvoxamine (Luvox) [e]	50 - 300
BICYCLIC	
Fluoxetine (Prozac)	10 - 20 [b]
MAOI	
Isocarboxazid (Marplan)	30 - 50
Phenelzine (Nardil)	45 - 90
Tranylcypromine (Parnate)	20 - 60

APPENDIX II

CONSENT FORM FOR FEEDBACK TREATMENT STUDY

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A. Description of Feedback Treatment Study

The Anxiety Disorders Clinics at McMaster University and St. Joseph's Hospital, in collaboration with the University Department of Psychology at McMaster, are studying a new treatment for the control of anxiety. The treatment uses biofeedback to teach anxiety sufferers how to identify and control bodily symptoms of anxiety. Knowledge of how to recognize and control these symptoms is expected to reduce anxiety and give patients more control over their lives.

Biofeedback (or more simply, "feedback" training) is a procedure that can help you control responses that are not usually thought of as being controlled voluntarily. What we do is attach recording devices to the surface of your skin, so that we can measure several bodily processes (no needles). We will then display these bodily processes on a television screen so that you can see them (this is where the word "feedback" comes from). The training procedure is a little like a video game. Your task is to use the video display to learn how to recognize and control certain internal bodily responses. It is difficult for us to describe exactly what these responses are, because for every person they can be a little different. In your case we will give you feedback for responses that we think are going to help control anxiety and panic.

.../2

B. Risks and Benefits

There are no established medical or psychological risks associated with feedback training. Although the feedback method that we will use has not been tested on patients with anxiety disorders, it has been has been used extensively in subjects who do not have anxiety disorders. No complications or unpleasant side effects have been reported by these subjects, and the response control established by the procedure is within normal limits.

In order to carry out feedback training, it will be necessary to attach physiological recording devices to the surface of the skin and scalp using special adhesive tape. The skin beneath these devices will be rubbed gently with an abrasive gel. You could experience some redness after the devices are removed, but if present it should clear within a day or two after the feedback session. The risk of infectious disease is less than that associated with a standard medical examination or dental visit (disposable gloves and sanitized recording devices are used). The feedback training session is not painful or psychologically threatening (most patients find the experience interesting).

The main benefit of the study is that you are likely to learn a skill that will significantly reduce your anxiety.

C. Requirements

You should understand that if you agree to participate, you will be required to do the following:

(1) attend all scheduled visits to the Feedback Laboratory and Anxiety Disorders Clinic;
(2) keep your medications constant for the duration of the study;
(3) complete psychological tests and a psychiatric assessment during some of your visits to the Anxiety Disorders Clinic;
(3) complete a daily diary describing panic or anxiety experienced during the day and the circumstances related to such experiences;
(4) sign a consent form.

If you agree to participate, feedback treatments will commence within one week in most cases (sometimes more depending on the study schedule). Once the feedback treatments have begun, they will be given twice weekly for a total of five treatments. When these five treatments are finished, two follow-up treatments will be scheduled at one-month intervals. Overall, a total of 8 visits to the Feedback Laboratory and Anxiety Disorders Clinic will be required, over a period of about 3 months. Each of these 8 visits will last 2 hours, sometimes less.

We assure you that your clinical records will be treated confidentially and used for statistical analysis only. Should the findings of the study be published, you will not be identified by name.

.../3

We may ask you to withdraw from the study if you do not follow the required procedures, or if your doctor or the investigators feel that you are getting worse. We acknowledge that you are volunteering to participate and that you may quit at any time if you so decide. If you decide not to participate, or to quit, you will not be penalized or surrender any benefits which you had before entering the study. If you quit, we will require that you notify your study physician. In any of these cases other treatment methods will be made available to you. You will not have to pay for any of the examinations, feedback sessions, or materials required for the study (neither will you be paid for participating).

If you agree to participate in this treatment study, please read the "Statement of Consent" given below and sign your name where indicated. If you have questions, feel free to contact Dr. L.E. Roberts of the McMaster University Department of Psychology, or Dr. M. Van Ameringen or Dr. C. Mancini of the McMaster Psychiatry Department. Their telephone numbers are given at the top of page 1. Drs. Roberts, Van Ameringen, and Mancini are directors of the project.

D. Statement of Consent

I have read the description of the feedback treatment study which is given on pages 1-3 above. I agree to take part in the study and to accept the requirements stated for participation. I understand the risks described on page 2 and accept them without qualification. I am between the ages of 18 and 64 years and give my consent freely.

| --- | --- | --- |
| Name of Subject (please print) | Signature | Date |

| --- | --- | --- |
| Investigator (please print) | Signature | Date |

Reviewed and received by:

| --- | --- | --- |
| Name (please print) | Signature | Date |

(Original copy to Investigator and a copy to the patient)

Name: _____ Dates: _____

ANXIETY REPORT

Please tell us how many times you noticed you were anxious, and rate the intensity of anxiety you felt.

DAYS	# OF TIMES ANXIOUS	INTENSITY OF ANXIETY:		
		LOW	MEDIUM	HIGH

Note: If the above report includes some panic attacks, please describe these attacks on the reverse side. If you did not have any panic attacks, record a zero in the appropriate box.

MEDICATION RECORD

Please indicate the type and amount of medication taken each day.

DAYS	TYPE OF MEDICATION	AMOUNT TAKEN (i.e. # of pills)

DIARY INSTRUCTIONS

During the biofeedback study we will ask that you fill out a daily diary consisting of (1) an anxiety report, (2) a panic diary, and (3) a medication record. The procedure is very simple. These instructions describe what you should do.

On side 1 of the diary you will find the daily anxiety report. This chart asks that you (a) tell us how many times you noticed that you were anxious during the day, and (b) rate the intensity of the anxiety you experienced. To rate the intensity of anxiety, place a check mark at the appropriate level of intensity indicated on the chart, for every episode of anxiety you reported. The number of check marks for each day should equal the number of episodes you experienced.

Now, in some cases the anxiety you experienced during the day might come in the form of panic attacks. If so, turn to the panic diary on side 2 of the sheet and report the number of attacks you experienced. Then, indicate whether the attacks were spontaneous or situational. By spontaneous, we mean that the panic attack came from "nowhere" and was not related to any anxiety provoking situation. Situational means that the panic attack occurred during a specific situation, place, or activity that made you anxious. If the panic attack was situational, please describe the situation in a few words in the last column of the diary. We also want you to rate the intensity of each spontaneous or situational panic attack. To do this, place a check mark at the appropriate level of intensity for every panic attack you experienced. The number of check marks for each day should equal the number panic attacks experienced on that day. Intensity depends on the number of symptoms you felt. One to 3 symptoms is a mild attack, 4-6 symptoms an attack of medium intensity, and more than 6 symptoms a panic attack of high intensity.

Finally, return to side 1 of your diary where a medication record is requested. If you are taking medication for the control of anxiety, please report the drug and amount taken each day.

We have attached a sample diary to illustrate in more detail how to record your data. Of course, the data in the example are fictitious and are shown for purposes of illustration only. When you complete your diary, it is your experience that you should describe.

EXAMPLE

Name: John Smith Dates: January 1-7, 1993

ANXIETY REPORT

Please tell us how many times you noticed you were anxious, and rate the intensity of anxiety you felt.

DAYS	# OF TIMES ANXIOUS	INTENSITY OF ANXIETY:		
		LOW	MEDIUM	HIGH
Mon, Jan. 1	3	✓✓	✓	
Tues, Jan. 2	5	✓✓	✓✓	✓
Wed, Jan. 3	0			
Thurs, Jan. 4	1			✓
Fri, Jan. 5	6		✓✓✓	✓✓✓
Sat, Jan. 6	4		✓✓✓✓	
Sun, Jan. 7	2	✓	✓	

Note: If the above report includes some panic attacks, please describe these attacks on the reverse side. If you did not have any panic attacks, record a zero in the appropriate box.

MEDICATION RECORD

Please indicate the type and amount of medication taken each day.

DAYS	TYPE OF MEDICATION	AMOUNT TAKEN (i.e. # of pills)
Mon, Jan. 1	Prozac	3 (10 mg each)
Tues, Jan 2	Prozac	3 (10 mg each)
Wed, Jan 3	Prozac	3 (10 mg each)
Thurs, Jan. 4	None	
Fri, Jan. 5	Prozac	3 (10 mg each)
Sat, Jan. 6	Prozac	3 (10 mg each)
Sun, Jan. 7	Prozac	3 (10 mg each)

APPENDIX 4b

PANIC DIARY

Name: John Smith Date: January 1-7, 1993

First, please tell us how many panic attacks you had each day. Then, indicate how many of these attacks were spontaneous or situational. Finally, rate the intensity of each panic attack.

DAYS	HOW MANY PANIC ATTACKS TODAY?	OF THESE ATTACKS, HOW MANY WERE SPONTANEOUS OR SITUATIONAL?	INTENSITY OF EACH ATTACK: (SYMPTOMS) (1-3) LOW	(4-7) MED	(8+) HIGH	DESCRIBE PANIC SIT'N
Mon Jan 1	0	SPONTANEOUS 0				
		SITUATIONAL 0				
Tues Jan 2	2	SPONTANEOUS 1		✓		During a meeting
		SITUATIONAL 1			✓	
Wed Jan 3	0	SPONTANEOUS 0				
		SITUATIONAL 0				
Thurs Jan 4	1	SPONTANEOUS 0				School cafeteria
		SITUATIONAL 1			✓	
Fri Jan 5	2	SPONTANEOUS 2	✓	✓		
		SITUATIONAL 0				
Sat Jan 6	3	SPONTANEOUS 1	✓			1 at a shopping mall
		SITUATIONAL 2			✓✓	1 at Doctor's office
Sun Jan 7	0	SPONTANEOUS 0				
		SITUATIONAL 0				

PANIC SYMPTOMS:

1. Shortness of breath
2. Choking or smothering sensations
3. Palpitations of accelerated heart rate
4. Chest or pain discomfort
5. Sweating
6. Faintness
7. Dizziness, lightheadedness or unsteady feelings
8. Nausea or abdominal distress
9. Depersonalization or derealization
10. Tingling sensation
11. Hot flushes or chills
12. Trembling or shaking
13. Fear of dying
14. Fear of going crazy or doing something uncontrolled

APPENDIX V
SELF-EVALUATION QUESTIONNAIRE
STAI FORM X-1

Developed by C.D. Spielberger, R.L. Gorsuch & R. Lushene

Name _____ DATE _____

Directions: A number of statements which people have used to describe themselves are given below. Reach each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

		NOT AT ALL	SOMEWHAT SO	MODERATELY SO	VERY MUCH	
1.	I feel calm	1	2	3	4	____
2.	I feel secure	1	2	3	4	____
3.	I am tense	1	2	3	4	____
4.	I am regretful	1	2	3	4	____
5.	I feel at ease	1	2	3	4	____
6.	I feel upset	1	2	3	4	____
7.	I am presently worrying over possible misfortunes	1	2	3	4	____
8.	I feel rested	1	2	3	4	____
9.	I feel anxious	1	2	3	4	____
10.	I feel comfortable	1	2	3	4	____
11.	I feel self-confident	1	2	3	4	____
12.	I feel nervous	1	2	3	4	____
13.	I am jittery	1	2	3	4	____
14.	I feel "high strung"	1	2	3	4	____
15.	I am relaxed	1	2	3	4	____
16.	I feel content	1	2	3	4	____
17.	I am worried	1	2	3	4	____
18.	I feel over-excited	1	2	3	4	____
19.	I feel joyful	1	2	3	4	____
20.	I feel pleasant	1	2	3	4	____

Code No: _____ Date: _____

Agoraphobic Cognitions Questionnaire

Below are some thoughts or ideas that may pass through your mind when you are nervous or frightened. Please indicate how often each thought occurs when you are nervous. Rate from 1-5 using the scale below.

1. Thought never occurs.
2. Thought rarely occurs.
3. Thought occurs during half of the times I am nervous.
4. Thought usually occurs.
5. Thought always occurs when I am nervous.

____ I am going to throw up.

____ I am going to pass out.

____ I must have a brain tumor.

____ I will have a heart attack.

____ I will choke to death.

____ I am going to act foolish.

____ I am going blind.

____ I will not be able to control myself.

____ I will hurt someone.

____ I am going to have a stroke.

____ I am going to go crazy.

____ I am going to scream.

____ I am going to babble or talk funny.

____ I will be paralyzed by fear.

____ Other ideas not listed (Please describe and rate them)

Code No.:_____ Date:_____

Body Sensations Questionnaire

Below is a list of specific body sensations that may occur when you are nervous or in a feared situation. Please mark down how afraid you are of these feelings. Use a five point scale from not worried to extremely frightened. Please rate all items.

1. Not frightened or worried by this sensation.
2. Somewhat frightened by this sensation.
3. Moderately frightened by this sensation.
4. Very frightened by this sensation.
5. Extremely frightened by this sensation.

____ 1. Heart palpitations
____ 2. Pressure or a heavy feeling in chest
____ 3. Numbness in arms or legs
____ 4. Tingling in the fingertips
____ 5. Numbness in another part of your body
____ 6. Feeling short of breath
____ 7. Dizziness
____ 8. Blurred or distorted vision
____ 9. Nausea
____ 10. Having "butterflies" in your stomach
____ 11. Feeling a knot in your stomach
____ 12. Having a lump in your throat
____ 13. Wobbly or rubber legs
____ 14. Sweating
____ 15. A dry throat
____ 16. Feeling disoriented and confused
____ 17. Feeling disconnected from your body: Only partly present
____ 18. Other _____

Please describe. _____

_____

_____

ST. JOSEPH'S HOSPITAL
HAMILTON ONTARIO

4 PSYCHIATRY

BECK INVENTORY

NAME _____ DATE _____ TREATMENT DAY _____

INSTRUCTIONS:

Read through the items in the first group (labelled A) slowly and carefully. Then go back, read each item a second time, and finally, circle the number next to the item which most closely describes the way you feel at the present time. Proceed with each group of items in the same way until you have circled one item in each group.

A.	0	I do not feel sad
	1	I feel blue or sad
	2a	I am blue or sad all the time & I can't snap out of it
	2b	I am so sad or unhappy that it is very painful
	3	I am so sad or unhappy that I can't stand it
B.	0	I am not particularly pessimistic or discouraged about the future
	1	I feel discouraged about the future
	2a	I feel I have nothing to look forward to
	2b	I feel that I won't ever get over my troubles
	3	I feel that the future is hopeless & that things cannot improve
C.	0	I do not feel like a failure
	1	I feel I have failed more than the average person
	2a	I feel I have accomplished very little that is worthwhile or that means anything
	2b	As I look back on my life, all I can see is a lot of failures
	3	I feel I am a complete failure as a person
D.	0	I am not particularly dissatisfied
	1a	I feel bored most of the time
	1b	I don't enjoy things the way I used to
	2	I don't get satisfaction out of anything anymore
	3	I am dissatisfied with everything
E.	0	I don't feel particularly guilty
	1	I feel bad or unworthy a good part of the time
	2a	I feel quite guilty
	2b	I feel bad or unworthy practically all the time now
	3	I feel as though I am very bad or worthless

PD 1252-3/81

F.	0	I don't feel I am being punished
	1	I have a feeling that something bad may happen to me
	2	I feel I am being punished or will be punished
	3a	I feel I deserve to be punished
	3b	I want to be punished
G.	0	I don't feel disappointed in myself
	1a	I am disappointed in myself
	1b	I don't like myself
	2	I am disgusted with myself
	3	I hate myself
H.	0	I don't feel I am worse than anybody else
	1	I am very critical of myself for my weaknesses or mistakes
	2	I blame myself for my faults
	3	I blame myself for everything bad that happens
I.	0	I don't have any thought of harming myself
	1	I have thoughts of harming myself, but I would not carry them out
	2a	I feel I would be better off dead
	2b	I feel my family would be better off if I were dead
	3a	I have definite plans about committing suicide
	3b	I would kill myself if I could
J.	0	I don't cry any more than usual
	1	I cry more now than I used to
	2	I cry all the time now. I can't stop it.
	3	I used to be able to cry, but now I can't cry at all even though I want to
K.	0	I am no more irritated now than I ever am.
	1	I get annoyed or irritated more easily than I used to
	2	I feel irritated all the time
	3	I don't get irritated at all at the things that used to irritate me
L.	0	I have not lost interest in other people
	1	I am less interested in other people now than I used to be
	2	I have lost most of my interest in other people and have little feeling for them
	3	I have lost all my interest in other people and don't care about them at all
M	0	I make decisions about as well as ever
	1	I try to put off making decisions
	2	I have great difficulty in making decisions
	3	I can't make any decisions at all anymore

N.	0	I don't feel I look any worse than I used to
	1	I am worried that I am looking old or unattractive
	2	I feel that there are permanent changes in my appearance and they make me look unattractive
	3	I feel that I am ugly or repulsive looking
O.	0	I can work about as well as before
	1a	It takes extra effort to get starting at doing something
	1b	I don't work as well as I used to
	2	I have to push myself very hard to do anything
	3	I can't do any work at all
P.	0	I can sleep as well as usual
	1	I wake up more tired in the morning than I used to
	2	I wake up 1-2 hours earlier than usual and find it hard to get back to sleep
	3	I wake up early every day and can't get more than 5 hours' sleep
Q.	0	I don't get any more tired than usual
	1	I get tired more easily than I used to
	2	I get tired from doing anything
	3	I get too tired to do anything
R.	0	My appetite is no worse than usual
	1	My appetite is not as good as it used to be
	2	My appetite is much worse now
	3	I have no appetite at all anymore
S.	0	I haven't lost much weight, if any, lately
	1	I have lost more than 5 pounds
	2	I have lost more than 10 pounds
	3	I have lost more than 15 pounds
T.	0	I am no more concerned about my health than usual
	1	I am concerned about aches and pains <u>or</u> upset stomach <u>or</u> constipation <u>or</u> unpleasant feelings in my body
	2	I am so concerned with how I feel or what I feel that it's hard to think of much else
	3	I am completely absorbed in what I feel
U.	0	I have not noticed any recent change in my interest in sex
	1	I am less interested in sex than I used to be
	2	I am much less interested in sex now
	3	I have lost interest in sex completely

Information About Anxiety Reactions

The purpose of this short hand-out is to give you some information about anxiety responses. You probably already know a fair amount about anxiety from your personal experience. Even so, the following information might be useful and new in some respects. The information will also help you complete a short diary that we will ask you to fill out each day of the study.

It is natural to experience anxiety from time to time. The brain produces anxiety when we are confronted with uncertainty or perceived threat, because the anxiety reaction can sometimes improve performance. For example, when we are anxious, blood flow increases to the muscles and brain which can increase the strength and speed of our response to dangerous situations. We know a fair amount about the brain mechanisms that produce anxiety (a structure called the amygdala is very important). These brain mechanisms evolved early in the history of our species when physical danger was common and vigorous action (for example, running or fighting) was called for. Although physical danger may be less common in the modern age, other life challenges are able to trigger the anxiety system. The anxiety system can also be sensitized by past experiences which make the system more responsive.

So, anxiety is part of our normal make-up. However, some people experience anxiety so often and so strongly that they seek help. The anxiety they experience is not just a twinge or occasional apprehension. Rather, the anxiety is sufficiently intense and/or frequent that their ability to cope is impaired. In some cases anxiety can be caused by a medical disorder, but this is rare among anxiety sufferers. More often anxiety is caused by specific problems such as family disputes, financial worries, or challenges at school or work. We will describe anxiety that is triggered by a specific problem or situation as "situational" anxiety. When you ask a person who is experiencing situational anxiety why they are anxious, they can tell you what they are anxious about.

However, anxiety can also occur spontaneously and unexpectedly, without apparent cause. Anxiety of this type is called "spontaneous" anxiety. Here the person cannot describe what has made them anxious; they "just are". The sufferer may feel anxious all the time, or their anxiety may wax and wane unpredictably over the day or week. The person who experiences spontaneous anxiety might also feel anxious about specific situations. In other words, their anxiety can be a mixture of the two types (situational and spontaneous).

Sometimes the anxiety response (situational or spontaneous) is so strong that we describe it as a "panic attack". This type of anxiety is accompanied by strong feelings of dread or loss of control, and physical symptoms such as flushing or sweating, pounding heart, dizziness, chest pain, and so on. The diary that we will give you to record your anxiety responses includes a list of physical symptoms that are experienced during panic attacks. Like the milder forms of anxiety, panic attacks may occur spontaneously and unexpectedly (spontaneous panic) or during specific situations (situational panic).

It is helpful to realize that anxiety is a cognitive as well as physical experience. Anxiety sufferers may feel that they are losing control and worry excessively about life problems, physical illness, job security, personal worthwhileness, and so on. Thoughts about these topics tend to perseverate and magnify any problem that is truly present. If the physical symptoms of anxiety such as shortness of breath or pounding heart are

experienced (which is frequently the case), the anxiety reaction is intensified. Some physical responses during anxiety (for example, excessive breathing) can elicit additional physiological changes all by themselves. The physical experience may be then misperceived by the anxiety sufferer as a medical illness. When this happens, the anxiety feeds on itself, making the situation worse (a vicious cycle effect).

It helps to recognize that disturbing thoughts and physical symptoms are part of the anxiety response. Because the experience of anxiety can itself intensify the problem (sometimes causing panic), it is important to recognize the symptoms of anxiety, and to learn how to control them. This is what we are going to do with the feedback training procedure.

Our feedback procedure is a type of "biofeedback" training that can help you control responses that are not usually thought of as being controlled voluntarily. What we do is attach recording devices to the surface of your skin, so that we can measure several bodily processes (no needles). We will then display these bodily processes on a television screen so that you can see them (this is where the word "feedback" comes from). The training procedure is a little like a video game. Your task is to use the video display to learn how to recognize and control your internal bodily responses. It is difficult for us to describe exactly what these responses are, because for every person they can be a little different. In your case we will give you feedback for responses that are likely to help you control physical sensations and feelings associated with anxiety and panic.

There are several reasons why learning how to control the symptoms of anxiety should help you. First, you will come to recognize these symptoms and sensations as anxiety and nothing worse. Second, if you dampen the physical symptoms of anxiety with your fedback skill, you can decrease anxiety and perhaps even eliminate it altogether. This is important, because anxiety will be less likely to feed on itself. Finally, you won't be helpless in the face of anxiety. The experience of anxiety should be a signal to exercise your feedback skill. Life is full of challenges, so your skill might not conquer every anxiety response. But your skill is a weapon that can make things better and restore a sense of control to the situation.

APPENDIX VII

Questionnaire

Name: Date:
Telephone:
Occupation: Handedness:
Sex: Height:
Age: Weight:

1. Have you smoked or consumed coffee or an alcoholic beverage in the last hour? If so, how long ago?

2. Are you presently taking any medications (e.g. antibiotics, antihistamines, psychoactive drugs)? If so, give name of drug.

3. Do you have any breathing problems (e.g. bronchitis, asthma)? If so, describe.

4. Do you have any skin conditions (eczema, blistering, rashes)? If so, describe.

5. Do you have (or have you had) any heart or circulation problems (high blood pressure, angina, heart attack)? If so, describe.

6. Is there a history of heart problems in your immediate family? (parents, brothers, or sisters)?

7. BLOOD PRESSURE (1) _____/_____ (2) _____/_____

8. Are you diabetic? yes no Epileptic? yes no

9. Do you have any current health problems? If so, describe.

10. Touch finger to nose

11. Are you a smoker? yes no

12. Do you have any previous biofeedback experience? If so, describe.

Investigator _____

APPENDIX VIII

NAME_____ Date_____

1. Describe what you did on A trials to make the letter A move toward the target area:

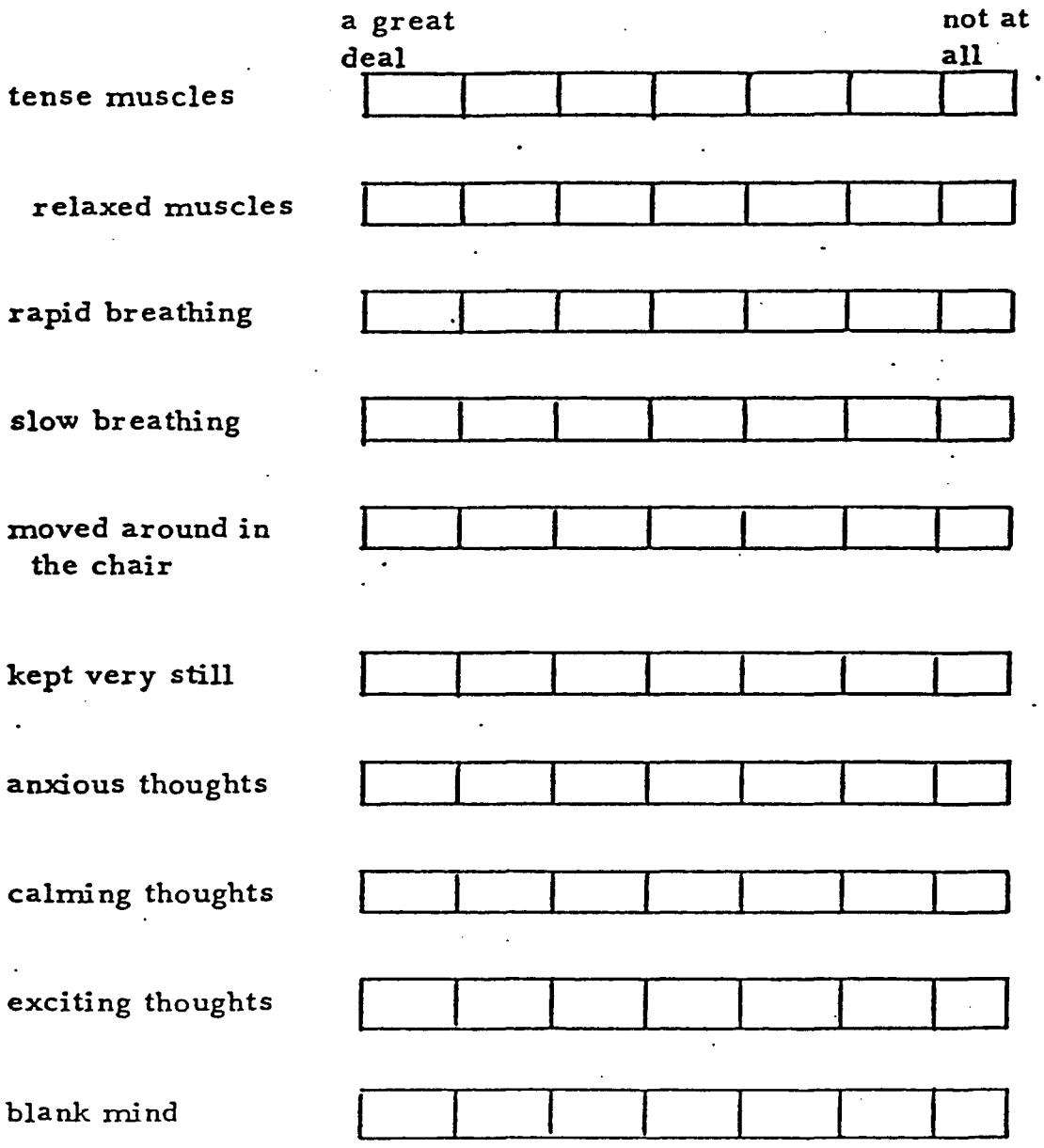
2. Were there activities that made the letter A go the wrong way? If so, please describe these activities:

NAME_____ Date_____

3. Describe what you did on B trials to make the letter B move toward the target area:

4. Were there activities that made the letter B go the wrong way? If so, please describe these activities:

We would like to have you describe what you did on A and B using the scales given below. On each scale place an "A" in the box that best describes what you did on A trials, and, on the same scale place a "B" in the box that best describes what you did on B trials. You may place these letters in the same or different boxes on each scale, as you see fit. Please place an "A" and a "B" on every scale, even if you find this difficult.



Please rate the degree of success you experienced in moving the dash in the direction of the letter A on A-Trials, and the letter B on B-Trials. As before, you may place the letters "A" and "B" in the same box or in different boxes, as you see fit.

I was very successful

I was not successful at all

Name:

Date:

ANXIETY CONTROL INSTRUCTIONS

_____:

Now that you have experienced feedback for Response A and Response B, you can use these responses to help control your anxiety.

When you experience anxiety, you should perform Response _____ to reduce your symptoms. You should also avoid activities associated with Response _____, because these activities are likely to increase your symptoms.

APPENDIX XI

SESSION 7: RETENTION TEST 2

Debrief Subject:

- Anxiety is a physical experience, particularly cardiovascular
- Because of this, we trained you to produce INCREASES and DECREASES in heart rate (tell subject what response A and response B were)
- Heart rate correlates with breathing, muscle activity, sweat activity, and thoughts
- INCREASE response related to anxiety and DECREASE response related to relaxation
- By gaining control over both A and B, people can gain more control over their anxiety and use the decrease response as a weapon
- What helps to produce the INCREASE and DECREASE responses is different for everyone (i.e. different bodily responses work for different people), therefore we didn't tell you what A and B were until now

Questions:

1) Did the feedback treatment help you with your anxiety problem?

   YES NO

2) For which part of your anxiety problem was the treatment most helpful (i.e. which symptoms)?

3) Describe how the treatment helped your anxiety:
   (ask whether symptoms were less intense/frequent)

4) Will you continue to use response ____ to deal with anxiety?

   YES NO

5) What part of the treatment package did you find most helpful? Least helpful?

   Most:

   Least:

6) Would you change anything about the procedure?

7) Would you recommend feedback treatment to others with anxiety?

REFERENCES

Alexander, A.B. (1975). An experimental test of assumptions relating to the use of electromyographic biofeedback as a general relaxation training technique. Psychophysiology, 12, 656-662.

Anastasiades, P., Clark, D.M., Salkovskis, P.M. & Middleton, H. (1990). Psychophysiological responses in panic and stress. Journal of Psychophysiology, 4, 331-338.

Barlow, D.H. (1984). Panic and generalized anxiety disorders: nature and treatment. Behaviour Therapy, 15, 431-449.

Barlow, D.H. (1990). Long-Term outcome for patients with panic disorder treated with cognitive-behavioural therapy. Journal of Clinical Psychiatry, 51(12,suppl.A), 17-23.

Canter, A., Kondo, C. & Knott, J. (1975). A Comparison of EMG feedback and progressive muscle relaxation training in anxiety neurosis. British Journal of Psychiatry, 127, 470-477.

Cheatle, M.D. & Weiss, T. (1982). Biofeedback in heart rate control and in the treatment of cardiac arrhythmias. In T. White & B. Tursky (Eds.), Clinical Biofeedback: Efficacy and Mechanisms (164-194). New York: Guilford Press.

Clark, D.M. (1986). A cognitive approach to panic. Behav. Res. Ther., 24(4), 461-470.

Cournoyer, J. (1986). Effects of heart rate biofeedback training on the clinical symptoms of anxiety disorder patients. Unpublished B.A. thesis, McMaster University, Hamilton, Ontario.

Craske, M.G., Brown, T.A. & Barlow, D.H. (1991). Behavioural treatment of panic disorder: A two-year follow-up. Behaviour Therapy, 22, 289-304.

Ehlers, A., Margraf, J., Roth, W.T. & Taylor, C. (1988). Anxiety induced by false heart rate feedback in patients with panic disorder. Behavioural Research and Therapy, 26(1), 1-11.

Fahrion, S.L & Norris, P.A. (1990). Self regulation of Anxiety. Bulletin of the Menninger Clinic, 54(2), 217-231.

Gatchel, R.J. & Proctor, J.D. (1976). Effectiveness of voluntary heart rate control in reducing speech anxiety. Journal of Consulting and Clinical Psychology, 44, 381-389.

Gelder, M.G. (1986). Panic attacks: New approaches to an old problem. British Journal of Psychiatry, 149, 346-352.

Gilbert, C. (1986). Skin conductance feedback and panic attacks. Biofeedback and self-regulation, 11(3), 251-254.

Hiebert, B.A. & Fitzsimmons, G. (1981). A comparison of EMG feedback and alternative anxiety treatment programs. Biofeedback and Self-Regulation, 6(4), 501-516.

Hoehn-Saric, R., McLeod, D.R & Zimmerli, W.D. (1991). Psychophysiological response patterns in panic disorder. Acta Scandinavica, 83, 4-11.

Hrachovinova, T., Bohdanecky, Z., Indra, M., Mates, J. (1989) Some relations between successfulness of biological feedback and psychological variables. Activas Nervosa Superior, 31(3), 220-221.

Hibbert, G.A. (1984). Hyperventilation as a cause of panic attacks. British Medical Journal, 288, 263-264.

Hughes, D.E. & Roberts, L.E. (1985). Evidence of a role for response plans and self-monitoring in biofeedback. Psychophysiology, 22, 427-439.

Katon, W.J. (1990). Chest pain, cardiac disease, and panic disorder. Journal of Clinical Psychiatry, 51(5,suppl), 27-30.

Klein, D.G. (1964). Delineation of two-drug responsive anxiety syndromes. Psychopharmacologica, 5, 397-408.

Lavallee, Y., Lamontagne, Y., Annable, L. & Fontaine, F. (1982) Characteristics of chronically anxious patients who respond to EMG feedback training. Journal of Clinical Psychiatry, 43, 229-230.

Leboeuf, A. & Lodge, J. (1980). A comparison of frontalis EMG feedback training and progressive muscle relaxation in the treatment of chronic anxiety. British Journal of Psychiatry, 137, 279-284.

Lelliott, P. & Bass, C. (1990). Symptom specificity in patients with panic. British Journal of Psychiatry, 157, 593-597.

Ley, R. (1985). Agoraphobia, the panic attack and the hyperventilation syndrome. Behav. Res. Ther., 23(1), 79-81.

Ley, R. (1991). The efficacy of breathing retraining and the centrality of hyperventilation in panic disorder: a reinterpretation of experimental findings. Behav. Res. Ther., 29(3), 301-304.

Maddock, R.J. & Carter, C.S. (1991). Hyperventilation-induced panic attacks in panic disorder with agoraphobia. Biological Psychiatry, 29(9), 843-854.

Margraf, J., Ehlers, A. & Roth, W.T. (1986). Biological models of panic disorder and agoraphobia - a review. Behav. Res. Ther., 24(5), 553-567.

Mateos, J.L.A., Perez, C.B., Carrasco, J.S. & Olivares, D. (1989). Atypical chest pain and panic disorder. Psychother. Psychosom., 52, 92-95.

McKinney, M.E. & Gatchel, R.J. (1982). The comparative effectiveness of heart rate biofeedback, speech skills training, and a combination of both in treating public-speaking anxiety. Biofeedback and Self-Regulation, 7(1), 71-87.

Pauli, P., Marquardt, C., Hartl, L. & Nutzinger, D.O. (1991). Anxiety induced by cardiac perceptions in patients with panic attacks: a field study. Behav. Res. Ther., 29(2), 137-145.

Raskin, M., Bali, L.R. & Peeke, H.V. (1980). Muscle Biofeedback and Transcendental meditation: A controlled evaluation of efficacy in the treatment of chronic anxiety. Archives of General Psychiatry, 37, 93-97.

Raskin, M., Peeke, H.V., Dickman, W. & Pinsker, H. (1982). Panic and Generalized anxiety disorders. Archives of General Psychiatry, 39, 687-689.

Roberts, A.H. (1985). Biofeedback. American Psychologist, 40, 938-941.

Roberts, L.E., Williams, R., Marlin, R., Farrell, T. & Imiolo, D. (1984). Awareness of the response after feedback training for changes in heart rate and sudomotor laterality. Journal of Experimental Psychology, 113, 225-255.

Roberts, L.E. (1990). Feedback studies of instrumental learning. Society for Psychophysiological Research, Boston, MA.

Roy-Byrne, P.P. (1992). Integrated treatment of panic disorder. American Journal of Medicine, 92(1A), S.

Rupert, P.A. & Holmes, D.S. (1978). Effects of multiple sessions of true and placebo heart rate biofeedback training on the heart rates and anxiety levels of anxious patients during and following treatment. Psychophysiology, 15, 582-589.

Salkovskis, P.M., Clark, D.M. & Hackmann, A. (1991). Treatment of panic attacks using cognitive therapy without exposure or breathing retraining. Behav. Res. Ther., 29(2), 161-166.

Sharpley, C.F. (1989). Biofeedback training versus simple instructions to reduce heart rate reactivity to a Psychological stressor. Journal of Behavioural Medicine, 12(5), 435-447.

Shear, M.K., Fyer, A.J., Ball, G. & Josephson, S. (1991). Vulnerability to sodium lactate in panic disorder patients given cognitive-behavioural therapy. American Journal of Psychiatry, 148, 795-797.

Sheehan, D.V. (1982). Current views on the treatment of panic and phobic disorders. Drug Therapy, 12, 179-193.

Suinn, R.M. (1990). Anxiety Management training: A behaviour therapy, New York: Plenum press.

Svebak, S., Cameron, A. & Levander, S. (1990). Clonazepam and imipramine in the treatment of panic attacks: A double-blind comparison of efficacy and side effects. Journal of Clinical Psychiatry, 51(5,suppl), 14-17.

Telch, M.J. (1988). Combined pharmacological and psychological treatments for panic sufferers. In S. Rachman and J. Maser (Eds.), Panic: Psychological perspectives (167-187). Hillsdale, NJ: Erlbaum.

Thompson, J., Haber, J. & Tearnan, B. (1981). Generalization of frontalis electromyographic feedback to adjacent muscle groups: A critical review. Psychosomatic Medicine, 43, 19-24.

Townsend, R., House, J. & Addario, D. (1975). A comparison of biofeedback-mediated relaxation and group therapy in the treatment of chronic anxiety. American Journal of Psychiatry, 132, 537-548.

Vaitl, B., Ebert-Hampel, B. & Kuhmann, W. (1988). Cardiac feedback training in patients with cardiophobia, In T. Elbert, W. Langosch, A. Steptoe, & D. Vaitl (Eds.), Behavioural Medicine in Cardiovascular Disorders (307-323). New York: Wiley.

Weinman, M.L., Semchuk, K.M., Gaebe, G. & Mathew, R.J. (1983) The Effect of stressful life events on EMG biofeedback and relaxation training in the treatment of anxiety. Biofeedback and Self-Regulation, 8(2), 191-205.

Weissman, M.M. (1990). The hidden patient: Unrecognized panic disorder. Journal of Clinical Psychiatry, 51(11,suppl), 5-8.

White, L. & Tursky, B. (1982). Clinical Biofeedback: Efficacy and mechanisms. New York: Guilford.

Williams, R.J. & Roberts, L.E. (1988). Relation of learned heart rate control to self-report in different task environments. Psychophysiology, 25, 354-365.